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Piankatank River Shoreline Situation Report

Marcia Berman
Virginia Institute of Marine Science

Harry Berquist
Virginia Institute of Marine Science

Tamia Rudnicky
Virginia Institute of Marine Science

Julie Glover
Virginia Institute of Marine Science

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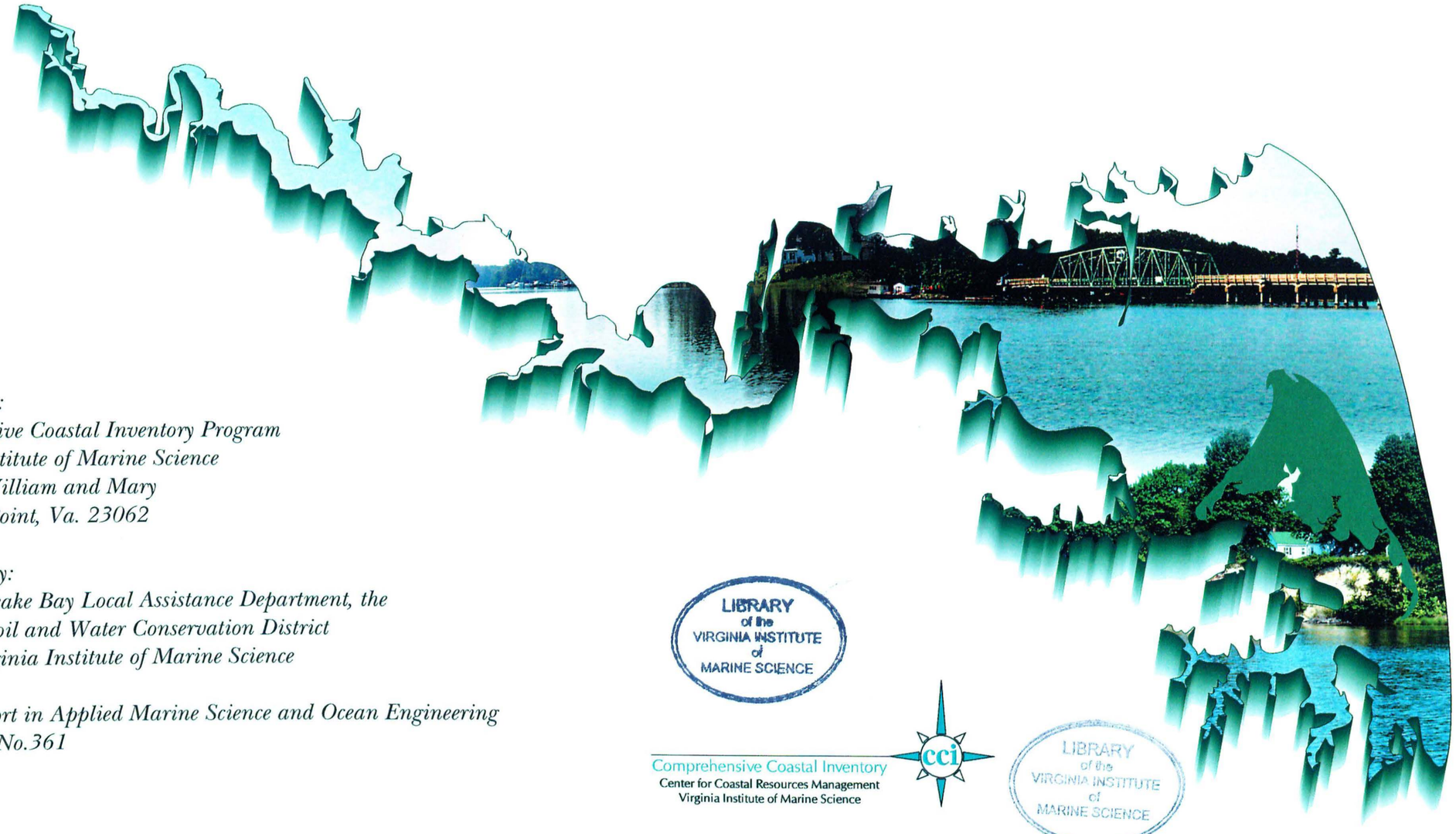

Prepared By:
Comprehensive Coastal Inventory Program
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, Va. 23062

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Prepared By:
Marcia Berman
Harry Berquist
Tamia Rudnicky
Julie Glover
Sharon Dewing
Daniel Schatt
Kevin Skunda
Mike Campana

Project Supervisors:
Marcia Berman - Director, Comprehensive Coastal Inventory Program
Carl Hershner - Director, Center for Coastal Resources Management

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CHAPTER 1 - Introduction

1.1 Background

In the 1970s, the Virginia Institute of Marine Science (VIMS) received a grant through the National Science Foundation's Research Applied to National Needs Program to develop a series of reports which would describe the condition of tidal shorelines in the Commonwealth of Virginia. These reports became known as the Shoreline Situation Reports. They were published on a county by county basis with additional resources provided by the National Oceanic and Atmospheric Administration's Office of Coastal Zone Management (Hobbs et.al., 1979).

The Shoreline Situation Reports quickly became a common desktop reference for nearly all shoreline managers, regulators, and planners within the Tidewater region. They provided useful information to address the common management questions and dilemmas of the time. Despite their age, these reports remain a desk top reference for many today.

The CCI Program is committed to developing a revised series of Shoreline Situation Reports which are aimed at addressing the management questions of today. While an upcoming county series is planned, this "watershed" based inventory was developed as a model to support the future series.

1.2 Description of the Watershed

The Piankatank River Watershed includes more than 44,300 acres of the Middle Peninsula of Virginia, and flows through the counties of Middlesex, Mathews, and Gloucester. The headwaters of the river, known as the Dragon Run, flow through the county of Essex (Figure 1).

The Piankatank River discharges directly into the Chesapeake Bay near Gwynn Island. Estimates report that currently 43% of the watershed is forested, 27% is residential, 19% is agricultural, and 11% are other land uses. Approximately 40 percent of the land area is classified as highly erodible soil, which poses a potential threat to Bay water quality and nutrient reduction goals.

1.3 Purpose and Goals

This shoreline inventory has been developed as a tool for assessing conditions along the tidal shoreline of the river, and tributaries in the Piankatank River Watershed. Recent conditions are reported for three zones within the immediate riparian river area: riparian land use, bank and buffers, and the shoreline. A series of maps and tabular data are published to illustrate and quantify results of an extensive survey in the watershed. This survey extends from the mouth of the Dragon Run to the mouth of the Piankatank River, at the confluence with the Chesapeake Bay. Coverage extends slightly south and east, including regions surrounding Gwynn Island in Mathews County (Figure 1).

1.4 Report Organization

This report is divided into several sections. Chapter 2 describes methods used to develop this inventory, along with conditions and attributes considered in the survey. Chapter 3 identifies potential applications for the data, with a focus on current management issues. From existing literature and the current survey, Chapter 4 reports the general state of the watershed, and integrates a series of maps which illustrate current conditions.

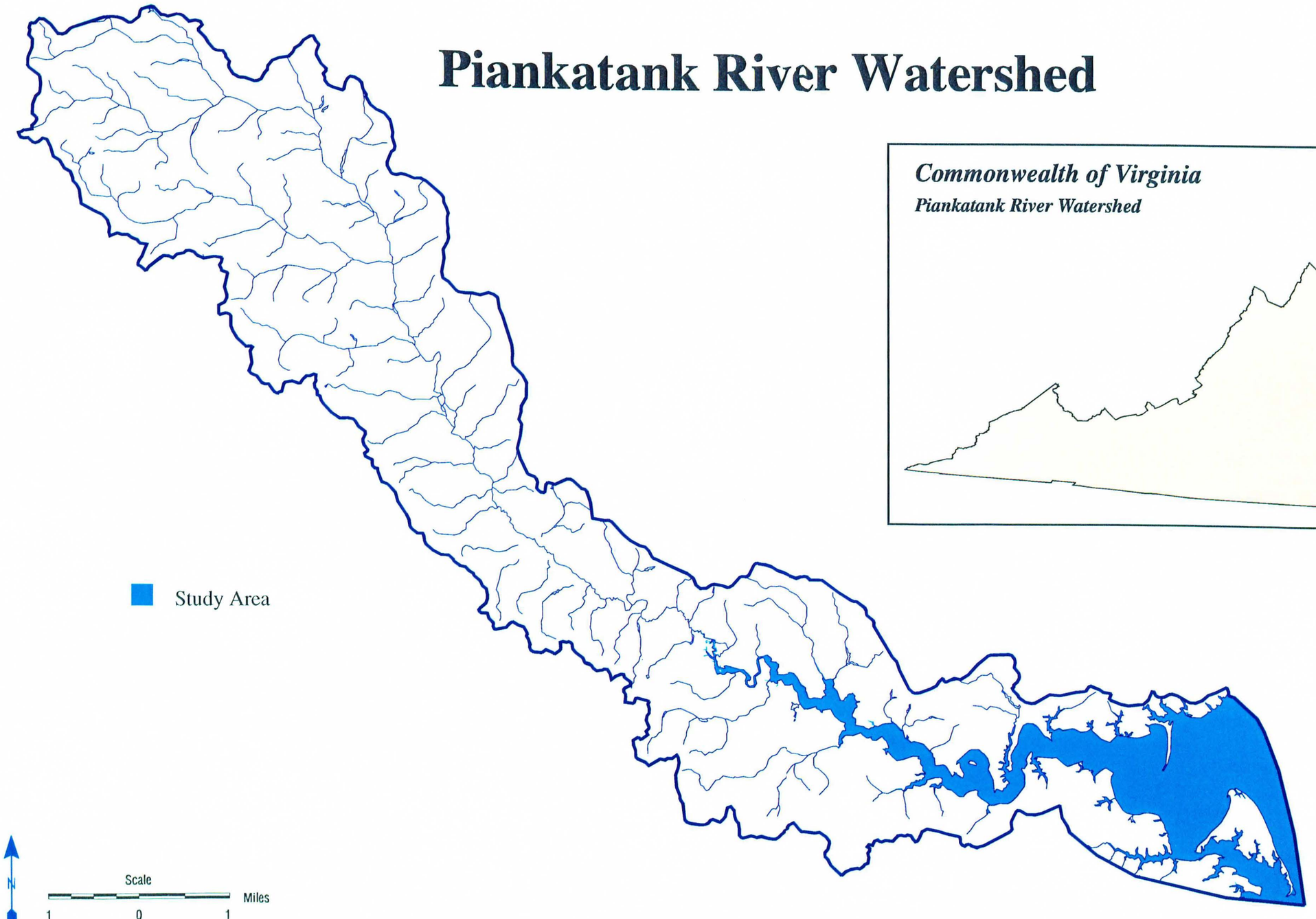
1.5 Acknowledgments

This report has been funded through a grant with the Chesapeake Bay Local Assistance Department (CBLAD), and in cooperation with the Tidewater Soil and Water Conservation District (TSWCD). The Comprehensive Coastal Inventory Program (CCI) wishes to thank Scott Kudlas and Margie Reynolds of CBLAD, and Buddy Bland of the TSWCD. Leslie Bowie, formerly of the Tidewater Resource Conservation and Development Area, made a significant contribution in the early stages of this project.

This work was completed entirely with staff support and management from the Virginia Institute of Marine Science's Comprehensive Coastal Inventory Program (CCI). A host of individuals are acknowledged. In alphabetical order they are Marcia Berman (Program Director), Harry Berquist, Sharon Dewing, Carl Hershner (Director, Center for Coastal Resources Management), Julie Glover, Tamia Rudnicky, and Dan Schatt. CCI staff was assisted by graduate students Kevin Skunda, and Mike Campana. In addition, the project directors would like to extend appreciation to the VIMS Vessel Center, and the Publication Center for their support.

Ferry Creek entrance

Piankatank River Watershed



Comprehensive Coastal Inventory
Center for Coastal Resources Management
Virginia Institute of Marine Science

Figure 1. Piankatank River study area

CHAPTER 2 - The Shoreline Assessment: Approach and Considerations

2.1 Introduction

The Comprehensive Coastal Inventory Program (CCI) has developed a set of protocols for describing shoreline conditions along Virginia's tidal shoreline. The assessment approach uses state of the art Global Positioning Systems (GPS), and Geographic Information Systems (GIS) to collect, analyze, and display shoreline conditions. These protocols and techniques have been developed over several years, incorporating suggestions and data needs conveyed by state agency and local government professionals.

Three separate activities embody the development of a Shoreline Situation Report: data collection, data processing and analysis, and map generation. Data collection follows a three tiered shoreline assessment approach described below.

2.2 Three Tiered Shoreline Assessment

The data inventory developed for the Shoreline Situation Reports is based on a three-tiered shoreline assessment approach. This assessment characterizes conditions in the shorezone, which extends from a narrow portion of the riparian zone seaward to the shoreline. This assessment approach was developed to use observations which could be made from a moving boat. To that end, the survey is a collection of descriptive measurements which characterize conditions. GPS units log location of observed conditions observed from a boat. No other field measurements are performed.

The three tiered shoreline assessment approach divides the shorezone into three regions: 1) the immediate riparian zone, evaluated for land use; 2) the bank, evaluated for height, stability and natural protection; and 3) the shoreline, describing the presence of shoreline structures for shore protection and recreational purposes. Each tier is described in detail below.

2.2a Riparian Land Use - Land use adjacent to the bank is classified into one of eight categories (Table 1). The categories provide a simple assessment of land use, and give rise to land management practices which could be anticipated. GPS is used to measure the linear extent along shore where the practice is observed. The width of this zone is not measured. Riparian forest buffers are considered the primary land use if the buffer width equals or exceeds 30 feet. This width is calculated from digital imagery as part of the quality control in data processing.

2.2b Bank Condition - The bank extends off the fastland, and serves as an interface between the upland and the shore. It is a source of sediment and nutrient fluxes from the fastland, and bears many of the upland soil characteristics which determine water quality in receiving waters. Bank stability is important for several reasons. The bank protects the upland from wave energy during storm activity. The faster the bank erodes, the sooner the upland will be at risk. Bank erosion can contribute high sediment loads to the receiving waters. Stability of the bank depends on several factors: height, slope, sediment composition, vegetative cover, and the presence of buffers to absorb energy impact to the bank itself.

The bank assessments in this inventory address three major bank characteristics: bank height, bank stability, and the presence of stable or unstable natural buffers at the toe of the bank (Table 2). Conditions are recorded continuously using GPS as the boat moves along the shoreline. The GPS log reflects any changes in conditions observed.

Bank height is described as a range, measured from the toe of the bank to the top. Bank stability characterizes the condition of the bank face. Banks which are undercut, have exposed root systems, down vegetation, or exhibit slumping of material qualify as "high erosion". At the toe of the bank, natural marsh vegetation and/or beach material may be present. These features offer protection to the bank and enhance water quality. Their presence is noted in the field, and a general assessment (stable/unstable) describes whether they are experiencing any erosion.

Sediment composition and bank slope cannot be surveyed from a boat, and are not included. Bank cover was added as a feature to be surveyed subsequent to data collection for this inventory. Other Shoreline Situation Reports will include bank cover as a descriptive attribute.

Table 1. Tier One - Riparian Land Use Classes

Forest	stands greater than 18 feet / width greater than 30 feet
Scrub-shrub	stands less than 18 feet
Grass	includes grass fields, pasture land, and crop land
Residential	includes single or multi family dwellings
Commercial	includes industrial, small business, recreational facilities
Bare	lot cleared to bare soil
Timbered	clear-cuts
Unknown	land use undetectable from the vessel

Table 2. Tier 2 - Bank Conditions

Bank Attribute	Range	Description
bank height	0-5 ft	from the toe to the edge of the fastland
	5-10 ft	from the toe to the edge of the fastland
	> 10 ft	from the toe to the edge of the fastland
bank stability	low erosion	minimal erosion on bank face or toe
	high erosion	includes slumping, scarps, exposed roots
marsh buffer	no	no marsh vegetation along the bank toe
	yes	fringe or pocket marsh present at bank toe
marsh stability (if present)	stable	no obvious signs of erosion
	unstable	marsh edge is eroding or vegetation loss
beach buffer	no	no sand beach present
	yes	sand beach present
beach stability (if present)	stable	accreting beach
	unstable	eroding beach

2.2c Shoreline Features - Features added to the shoreline by property owners are recorded as a combination of points or lines. These features include defense structures, which are constructed to protect shorelines from erosion; offense structures, designed to accumulate sand in longshore transport; and recreational structures, built to enhance recreational use of the water. The locations of these features along the shore are surveyed with a GPS unit. Linear features are surveyed without stopping the boat. Structures such as docks, and boat ramps are point features, and a static ten-second GPS observation is collected at the site. Table 3 summarizes shoreline features surveyed. Linear features are denoted with an "L" and point features are denoted by a "P." The glossary at the end of this report describes these features, and their functional utility along a shore.

Table 3. Tier 3 - Shoreline Features

Feature	Feature Type	Comments
Control Structures		
riprap	L	
bulkhead	L	
breakwaters	L	first and last of a series is surveyed
groinfield	L	first and last of a series is surveyed
miscellaneous	L	can include tires, rubble, tubes, etc.
Recreational Structures		
piers	P	includes private and public
boat ramp	P	includes private and public
boat house	P	all covered structures, assumes a pier
marina	L	includes piers, bulkheads, wharfs

2.3 Data Collection/Survey Techniques

Data collection is performed in the field, from a small, shoal draft vessel, navigating at slow speeds parallel to the shoreline. To the extent possible, surveys take place on a rising tide, allowing the boat to be as close to shore as possible. The field crew consists of a boat operator, and two data surveyors. The boat operator navigates the boat to follow the shoreline geometry. One surveyor collects information pertinent to land use and bank condition. The second surveyor logs information relevant to shoreline structures.

Data is logged using the handheld Trimble GeoExplorer GPS unit. GeoExplorers are accurate to within 4 inches of true position with extended observations, and differential correction. Both static and kinematic data collection is performed. Kinematic data collection is a collection technique where data is collected continuously along a pathway (in this case along the shoreline). The GPS units are programmed to collect information at a rate sufficient to compute a position anywhere along the course. The shoreline survey collects kinematic data at a rate of one observation every five seconds. The land use, bank condition, and linear shoreline structures are collected using this technique.

Static surveys are used to pin-point fixed locations which occur at very short intervals. The boat actually stops to collect these data, and the boat operator must hold the boat against the tidal current, and surface wind waves. Static surveys collect 10 observations recorded at a rate of one observation per second at the fixed station. This technique is used to survey point features like piers, boat ramps, and boat houses.

The GPS units are preprogramed with the complete suite of shoreline features described in section 2.2. These features are stored in a "data dictionary" prepared specifically for this project. As features are observed in the field, the GPS unit tags each geographic coordinate pair with the attribute's code. The survey, therefore, is a complete set of geographically referenced shoreline features.

GPS base stations established by the United States Coast Guard collect GPS data simultaneously. For sites within 124 miles (~200km) of the VIMS laboratory, VIMS' Trimble base station operates there 24 hours a day, and data from this station can be used for differential correction.

2.4 Data Processing

Data processing occurs in two parts. Part one processes the raw GPS field data, and converts the data to GIS coverages. Part two corrects the GIS coverages to reflect true shoreline geometry.

2.4a GPS Processing - Differential correction improves the accuracy of GPS data by correcting for erroneous errors introduced by "selective availability", a process in which the government scrambles satellite signals to degrade positional data. Differential correction is the first step to processing GPS data. Trimble's Pathfinder Office GPS software is used. The software reviews simultaneously the GPS data logged in the field and the base station data, and corrects the position of the field data based on the known location of the base station, the satellites, and the satellite geometry.

Although the Trimble Geo-Explorers are capable of decimeter accuracy (~ 4 inches), the relatively short occupation of sites in the field reduces the accuracy to 5 meters (~16 feet). In many cases the accuracy achieved is better, but the overall limits established by the CCI program are set at 5 meters. This means that features are mapped to within 5 meters (~16 feet) (or better) of their true position on the earth's surface.

An editing function is used to clean the GPS data. Cleaning corrects for breaks in the data which occur when satellite lock is lost during data collection. Editing also eliminates erroneous data collected when the boat circles off track, and the GPS unit is not switched to "pause" mode.

The final step in GPS processing converts the files to three separate ArcInfo GIS coverages. The three coverages are: a land use and bank condition coverage, a shoreline structure coverage (lines only), and a shoreline structure coverage (points only).

2.4b GIS Processing - GIS processing uses ESRI's ArcInfo® GIS software, and ERDAS' Imagine® software. Several data sets are integrated to develop the final inventory products. First, the shoreline situation data are derived from the GPS field data, and the three coverages discussed above. These attributes are summarized in Tables 1, 2, and 3. Second, the basemap coverage is derived from a digitized record of the high water shoreline illustrated on 7.5 minute USGS topographic maps for the study area. Since it is available for the entire Tidewater area, this shoreline has been selected as the baseline shoreline for development of all Shoreline Situation Reports. The digital coverage was developed by the CCI program in the early 1990s using the most recent topographic maps available. These maps range from the late 1960s to the early 1980s. As USGS updates these maps, revisions to the digital basemap series can be made. Finally, the third data set integrated is digital color infra-red imagery derived either from products developed by the National Aerial Photography Program (NAPP), or from Digital Ortho Quarter Quadrangles (DOQQs). Both products are circulated by the USGS. DOQQs are fully rectified digital imagery representing one quarter of a USGS quadrangle. They were released in 1997, and use imagery flown in1994. NAPP imagery are scanned photography which were rectified by CCI using GPS and ground-control surveys. These imagery were also flown in 1994. The imagery are used as background during data processing and maps production. They are an important quality control tool for verifying the location of certain landscape attributes, and provide users with additional information about the coastal landscape.

GIS processing includes two separate parts. Part one checks the relative accuracy of the shoreline coverage. Since this coverage was developed from topographic maps dating back to the 1960s, significant changes in the shoreline orientation may have occurred. While this process does not attempt to recompute a shoreline position relative to a vertical tidal datum, it adjusts the horizontal geographic position to reflect the present shoreline geometry. Using ERDAS' Imagine software, the 1994 imagery is displayed onscreen behind the digitized shoreline coverage. The operator looks for areas where the digitized shoreline departs greatly from the land water interface illustrated in the background image. The digitized shoreline coverage is then corrected using Imagine's onscreen digitizing techniques to align more closely with the land water interface displayed. This revised shoreline coverage is used in all subsequent inventory steps and products.

Step two corrects the coverages generated from the field data to the shoreline record. These coverages, having been processed through GPS software, are geographically coincident with the path of the boat, from where observations are made. They are, therefore, located somewhere in the waterway. Step two transfers these data back to the corrected shoreline record so the data more precisely reflects the location being described along the shore.

The majority of data processing takes place in step two, which uses all three data sets simultaneously. The corrected shoreline record, and the processed GPS field data are displayed onscreen in ArcInfo together. The imagery is used in the background for reference. The corrected shoreline is the base coverage. The remaining processing re-codes the base shoreline coverage for the shoreline attributes mapped along the boat track. Each time the boat track data indicates a change in attribute type or condition, the digital shoreline arc is split, and coded for the attribute using ArcInfo techniques.

This step endures a rigorous sequence of checks to insure the positional translation is as accurate as possible. Each field coverage; land use, bank condition, and shoreline condition, is processed separately. The final products are three new coded shoreline coverages. Each coverage has been checked twice onscreen by different GIS personnel. A final review is done on hardcopy printouts.

2.4c. Maps and Tables - Large format, color maps are generated to illustrate the attributes surveyed along the shore. A three-part map series illustrates the three tiers individually. Plate A describes the riparian land use as color coded bars along the shore. A legend keys the color to the type of land use.

Plate B depicts the condition of the bank and any natural buffers present. A combination of color and pattern symbology gives rise to a vast amount of bank and buffer information. Erosional conditions are illustrated in red for both bank and buffer. Stable or low erosion conditions are illustrated in green. Bank height varies with the thickness of the line; where the thickest lines designate the highest banks (> 10 feet). Open circles just seaward of the line indicate a natural fringe marsh along the base of the bank. Solid circles indicate a sand beach buffer at the base of the bank. It is possible to have both. The length of the symbology along the shore reflects the length alongshore that the features persist. The symbology changes as conditions change.

Plate C combines recreational and shoreline protection structures in a composition called Shoreline Features. Linear features, described previously, are mapped using color coded bar symbols which follow the orientation of the shoreline. Point features use a combination of colors and symbols to plot the positions on the map.

Digital imagery is used as a backdrop, upon which the shoreline data is superimposed. The imagery illustrated here was collected in 1994. The color infra red image is used as a backdrop to Plate A. A gray scale version of this same image is used for Plates B and C.

For publication purposes the watershed is divided into a series of plates set at a scale of 1:12,000. The number of plates was determined by the geographic size and shape of the river. An index is provided which illustrates the orientation of plates to each other. The three map compositions (A,B, and C) described above are presented for each plate. The Piankatank River was divided into twelve plates (plate 1a, 1b, 1c, etc.), for a total of 36 map compositions.

Tables 4 and 5 quantify the features mapped in a watershed. These are generated using frequency analysis techniques in ArcInfo. The tables use two different accounting units for measuring shoreline frequency.

Table 4 bases its calculations on the river reaches which were delineated in the 1970s by VIMS' coastal geologists to represent short, process similar stretches of shoreline. They provide a unit of measure for comparative purposes over time. The reach boundaries are illustrated in Figure 2. Table 4, quantifies present conditions (1998) on a reach by reach basis. There are 97 reaches in the Piankatank, encompassing 145 miles of shoreline. Table 4 reports the linear attribute data as a percent of the total reach length, and point data as the number of features per reach. Reach data divides the waterway by the three localities in the system.

Table 5, which precedes the map compositions, quantifies the features on a plate by plate basis. For linear features, values are reported in actual miles surveyed. The number of point features surveyed are also listed on a plate by plate basis. The total miles of shoreline surveyed for each plate is reported. The total river miles surveyed, 131.90 miles, can not be reached by adding the shoreline miles for each plate since there is plate overlap. Therefore, a total value for each feature is also reported in Table 5. Total miles surveyed for Tables 4 and 5 differ slightly because some sections of surveyed shoreline fall outside the historic river reach boundaries.

Trimble's Geo Explorer GPS unit is used to collect data in the field

Piankatank River- River Reaches

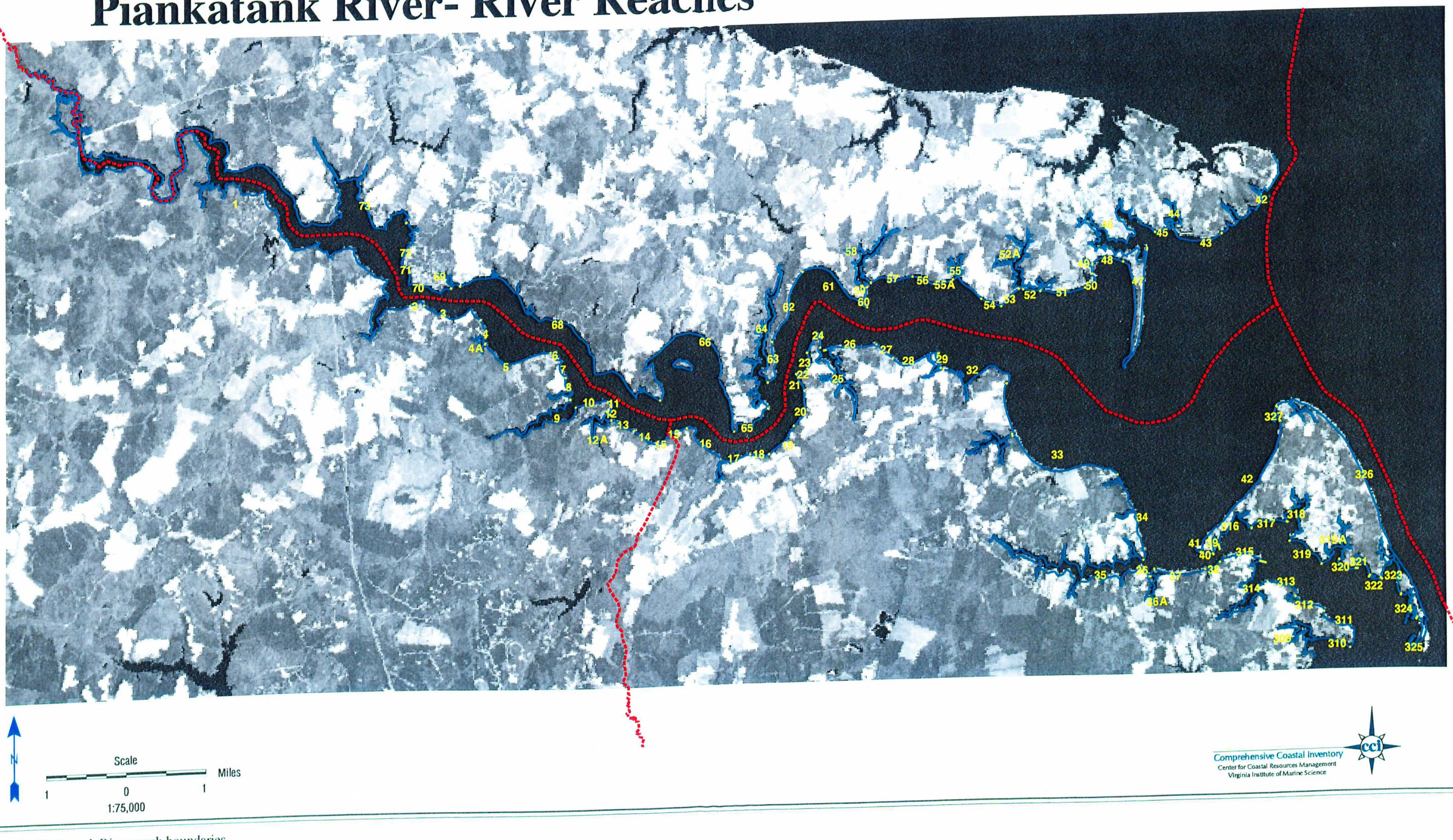


Figure 2. Piankatank River reach boundaries

Table 4. Piankatank River Shoreline Attributes – River Reach Data

REACH NUMBER	REACH LENGTH SURVEYED (miles)	RIPARIAN LAND USE (% of reach length surveyed)						SHORELINE FEATURES									BANK (bank height and erosion status (%))						BUFFER CONDITION			
																	0-5 ft		5-10 ft		>10 ft		BEACH PRESENT (% of reach length)		MARSH PRESENT (% of reach length)	
		forest	scrub-shrub	grass	residential	commercial	bare	No. docks	No. boathouses	No. ramps	No. groinfields	No. marinas	No. bkwtr*	No. jetties	% bulkhead	% riprap	low	high	low	high	low	high	Eroding	Stable	Eroding	Stable
Gloucester																										
1	11.30	78	2	0	17	3	0	74	4	6	0	0	1	0	8	5	61	1	27	1	9	1	1	8	0	84
2	0.22	27	61	0	12	0	0	2	0	1	0	0	0	0	22	10	40	0	13	0	47	0	0	29	0	40
3	1.00	21	11	5	63	0	0	16	0	0	0	0	0	0	3	19	46	5	34	4	11	0	10	12	13	65
4	0.23	0	1	2	97	0	0	6	0	0	0	0	0	0	26	0	100	0	0	0	0	0	0	7	0	73
4a	0.81	39	23	3	35	0	0	5	0	0	0	0	0	0	0	0	40	8	41	3	8	0	0	3	0	30
5	0.97	56	5	0	39	0	0	14	2	2	2	0	0	0	20	14	18	0	0	2	32	47	0	48	4	18
6	0.18	0	84	0	16	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100
7	0.38	12	0	0	88	0	0	5	0	0	0	0	0	0	11	20	74	0	26	0	0	0	0	26	0	100
8	1.05	45	28	0	27	0	0	5	0	1	0	0	0	0	3	2	77	7	15	0	0	0	0	2	0	37
9	1.68	38	0	3	59	0	0	14	5	0	0	0	0	0	2	8	45	0	23	3	29	0	0	0	0	70
10	0.42	12	0	0	88	0	0	9	1	0	1	0	0	0	41	44	82	0	6	0	12	0	0	15	0	21
11	0.10	0	0	0	100	0	0	1	0	1	0	0	0	0	0	0	100	0	0	0	0	0	0	11	0	89
12	0.10	0	21	0	79	0	0	1	0	0	0	0	0	0	46	0	100	0	0	0	0	0	0	44	0	56
12a	1.32	24	4	0	71	0	0	13	3	2	0	0	0	0	1	6	56	0	11	0	33	0	0	4	0	62
13	0.34	53	0	0	47	0	0	4	0	0	0	0	0	0	0	9	56	0	0	15	22	7	0	31	0	37
14	0.35	56	0	0	44	0	0	3	1	0	0	0	0	0	5	0	44	15	9	0	31	1	15	39	0	45
15	0.20	33	0	0	67	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0	67	0	0	0	0	100
Gloucester Total	20.65	57	6	1	34	2	0	172	16	13	3	0	1	0	8	7	57	2	22	2	14	3	1	11	1	70
Mathews																										
15	0.25	80	0	0	20	0	0	0	1	0	0	0	0	0	0	0	39	0	35	0	20	6	6	59	0	93
16	0.69	93	1	0	6	0	0	1	0	0	0	0	0	0	19	2	29	0	0	0	43	28	14	20	0	11
17	0.42	71	7	0	22	0	0	2	0	0	1	0	0	0	0	5	12	0	0	0	88	0	0	40	0	40
18	0.25	16	0	0	84	0	0	6	0	0	0	0	0	0	0	0	84	0	0	0	16	0	0	52	0	33
19	0.49	50	0	0	50	0	0	2	0	0	0	0	0	0	0	18	6	0	0	0	94	0	0	24	0	36
20	0.50	9	0	0	91	0	0	6	0	0	0	0	0	0	1	0	0	0	30	0	42	28	0	0	0	10
21	0.24	58	3	0	39	0	0	1	1	0	0	0	0	0	0	44	3	0	0	0	97	0	0	0	0	3
22	0.18	0	13	0	87	0	0	2	1	0	0	0	0	0	43	18	29	0	26	0	45	0	0	0	0	39
23	0.22	0	0	0	100	0	0	3	0	0	0	0	0	0	0	50	100	0	0	0	0	0	0	0	0	27
24	0.50	18	31	0	51	0	0	2	0	0	0	0	0	0	0	43	100	0	0	0	0	0	0	17	0	31
25	3.90	16	9	0	74	1	0	53	4	1	0	2	0	0	5	10	25	1	49	0	25	0	0	2	4	13
26	0.72	18	24	0	58	0	0	3	0	0	0	0	0	0	9	49	27	0	47	0	19	8	4	14	0	27
27	0.28	23	0	0	77	0	0	2	0	0	0	0	0	0	11	70	7	0	0	15	77	0	7	0	0	7
28	0.67	31	0	0	67	0	0	6	1	0	0	0	0	0	0	40	23	0	14	0	54	9	0	0	0	0
29	0.22	0	68	0	32	0	0	1	0	0	0	0	0	0	18	0	100	0	0	0	0	0	0	0	0	68
32	1.42	33	0	0	67	0	0	9	2	0	0	0	0	0	20	34	29	0	58	5	8	0	0	0	0	29
33	2.24	26	0	7	66	0	0	7	0	0	0	0	0	2	20	37	33	0	62	5	0	0	8	26	3	0
34	1.21	26	4	18	52	0	0	6	0	2	1	0	0	0	23	41	79	9	0	12	0	0	9	39	0	15
35	8.31	14	0	2	83	.5	0	129	10	7	0	1	0	0	6	12	94	0	5	1	0	0	0	1	0	69
36	0.20	0	0	0	100	0	0	1	0	0	0	0	0	0	0	24	100	0	0	0	0	0	0	28	0	100
36a	1.24	41	0	8	51	0	0	10	0	0	0	0	2	0	0	0.1	100	0	0	0	0	0	0	0	0	100
37	0.67	3	0	0	97	0	0	4	0	0	1	0	5	0	0	9	100	0	0	0	0	0	0	39	0	51
38	0.43	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100

Table 4. Piankatank River Shoreline Attributes – River Reach Data (con't)

REACH NUMBER	REACH LENGTH SURVEYED (miles)	RIPARIAN LAND USE (% of reach length surveyed)						SHORELINE FEATURES									BANK (bank height and erosion status (%))						BUFFER CONDITION			
																	0-5 ft		5-10 ft		>10 ft		BEACH PRESENT (% of reach length)		MARSH PRESENT (% of reach length)	
		forest	scrub-shrub	grass	residential	commercial	bare	No. docks	No. boathouses	No. ramps	No. groinfields	No. marinas	No. bkwtr*	No. jetties	% bulkhead	% riprap	low	high	low	high	low	high	Eroding	Stable	Eroding	Stable
Mathews (con't)																										
39	0.41	0	32	0	22	46	0	9	1	1	0	1	0	0	3	18	100	0	0	0	0	0	0	0	0	47
40	0.17	0	0	0	0	100	0	0	0	0	0	1	0	0	0	0	100	0	0	0	0	0	0	0	0	0
41	0.35	0	67	0	0	33	0	0	0	0	1	1	0	0	2	23	100	0	0	0	0	0	0	72	0	15
42	1.79	3	2	30	65	0	0	12	0	0	5	0	1	0	26	58	44	0	56	0	0	0	0	18	0	11
309	2.40	19	26	0	47	8	0	22	6	1	0	1	0	0	3	5	100	0	0	0	0	0	0	0	0	73
310	0.50	0	100	0	0	0	0	3	0	0	0	0	0	0	0	10	100	0	0	0	0	0	0	44	0	100
311	0.79	8	52	0	40	0	0	4	0	0	0	0	0	0	0	41	86	14	0	0	0	0	14	23	32	42
312	0.79	57	0	0	43	0	0	5	0	1	0	0	0	0	0	36	56	44	0	0	0	0	0	13	0	59
313	0.48	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	48	0	0	0	0	24	32	3	32
314	3.13	41	1	0	52	6	0	28	3	4	0	0	0	0	8	5	92	8	0	0	0	0	0	5	4	75
315	0.77	0	21	0	39	40	0	8	1	1	0	0	0	0	15	32	100	0	0	0	0	0	0	3	0	71
316	1.21	0	19	1	55	25	0	18	2	1	0	2	0	0	9	32	100	0	0	0	0	0	0	0	0	51
317	0.53	7	4	0	73	16	0	5	0	0	0	1	0	0	2	54	100	0	0	0	0	0	0	23	0	43
318	2.09	11	29	0	56	4	0	17	0	0	0	2	0	0	2	21	100	0	0	0	0	0	0	0	5	65
319	0.56	0	0	0	100	0	0	3	0	0	1	0	0	0	19	49	80	0	20	0	0	0	0	32	0	0
319a	2.57	6	5	10	79	0	0	19	3	0	0	0	0	0	8	16	100	0	0	0	0	0	0	0	0	56
320	0.33	0	0	0	100	0	0	1	0	0	0	0	0	0	0	72	100	0	0	0	0	0	0	0	0	38
321	0.70	0	10	0	90	0	0	3	0	0	0	0	0	0	0	14	100	0	0	0	0	0	0	0	0	44
322	0.38	0	97	0	3	0	0	1	0	0	0	0	0	0	0	12	100	0	0	0	0	0	0	25	0	75
323	1.59	0	27	0	54	19	0	11	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	100	0	0
324	1.01	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	100	0	0
325	1.45	0	7	0	0	0	92	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	93	7	0	0
326	4.87	4	15	0	73	68	0.2	39	0	0	6	0	0	0	10	20	99	0	1	0	0	0	15	40	0	0
327	0.20	0	0	0	100	0	0	4	0	0	2	0	0	0	8	92	0	0	100	0	0	0	0	55	0	0
Mathews Total	54.32	17	12	3	61	5	2	468	36	19	18	12	4	2	7	19	77	2	12	1	7	1	5	16	1	39
Middlesex																										
43	1.19	14	16	4	66	0	0	23	0	0	2	0	0	0	7	25	69	31	0	0	0	0	31	0	0	11
44	1.37	17	19	6	58	0	0	13	0	1	0	0	0	0	35	2	52	5	31	12	0	0	1	0	7	28
45	0.18	1	0	0	99	0	0	1	0	0	1	0	0	0	18	62	1	0	99	0	0	0	27	0	0	0
46	5.11	11	9	4	67	8	0	89	7	5	0	6	0	0	15	16	31	8	32	21	6	1	3	0	10	31
47	3.01	2	5	0	93	0	0	30	1	1	1	0	0	0	24	43	17	0	69	2	12	0	11	20	0	.5
48	0.42	0	0	0	84	16	0	6	0	0	0	0	0	0	17	0	16	0	84	0	0	0	0	84	0	84
49	0.38	0	0	0	6	94	0	0	0	0	0	0	0	0	4	0	100	0	0	0	0	0	0	6	0	0
50	0.27	0	0	0	100	0	0	7	0	0	0	0	0	0	24	48	100	0	0	0	0	0	0	29	0	12
51	0.58	0	0	0	89	11	0	22	3	0	0	0	0	0	43	53	23	0	29	0	48	0	0	9	0	4
52	1.12	0	0	0	80	20	0	10	4	0	0	0	0	0	8	0	100	0	0	0	0	0	0	15	0	84
52a	3.96	35	1	0	64	0	0	45	9	1	0	0	0	1	1	5	37	0	27	0	34	2	0	.4	0	38
53	0.31	23	32	0	45	0	0	0	0	0	0	0	0	1	47	21	55	0	42	2	0	0	0	23	0	55
54	0.28	0	0	0	100	0	0	1	0	0	0	0	0	0	15	53	41	0	41	18	0	0	0	41	0	41
55	1.77	42	8	0	49	0	0	10	2	0	0	0	0	0	3	27	29	0	44	2	16	9	0	7	0	28
55a	0.25	9	10	0	81	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	91	0	54	0	9

Table 4. Piankatank River Shoreline Attributes – River Reach Data (con't)

REACH NUMBER	REACH LENGTH SURVEYED (miles)	RIPARIAN LAND USE (% of reach length surveyed)						SHORELINE FEATURES									BANK (bank height and erosion status (%))						BUFFER CONDITION			
																	0-5 ft		5-10 ft		>10 ft		BEACH PRESENT (% of reach length)		MARSH PRESENT (% of reach length)	
		forest	scrub-shrub	grass	residential	commercial	bare	No. docks	No. boathouses	No. ramps	No. groinfields	No. marinas	No. bkwtr*	No. jetties	% bulkhead	% riprap	low	high	low	high	low	high	Eroding	Stable	Eroding	Stable
Middlesex (con't)																										
56	0.30	34	0	0	66	0	0	4	0	0	0	0	0	0	10	15	61	0	0	0	0	39	0	0	0	46
57	0.57	58	0	0	42	0	0	3	0	0	0	0	0	0	8	0	89	0	0	0	0	11	0	41	0	78
58	3.49	55	0	0	45	0	0	23	1	1	0	1	0	0	1	7	19	0	32	3	40	5	0	0	0	33
59	0.26	38	0	0	62	0	0	0	3	0	0	0	0	0	0	8	77	0	20	3	0	0	0	10	0	84
60	0.28	0	0	0	100	0	0	0	0	0	0	0	0	0	11	81	9	0	91	0	0	0	0	9	0	0
61	1.05	27	0	0	73	0	0	10	4	0	0	0	0	0	24	0	13	0	38	0	49	0	0	16	0	10
62	0.99	35	0	0	65	0	0	14	0	0	0	0	0	0	27	0	0	0	2	0	91	7	0	33	0	0
63	0.59	44	0	0	56	0	0	7	1	0	0	0	0	0	9	0	20	0	39	0	41	0	0	34	0	53
64	6.32	57	4	2	37	0	0	46	1	0	0	2	0	0	.2	1	19	0	30	1	47	3	0	0	1	13
65	0.69	0	26	0	74	0	0	9	0	1	0	0	0	0	21	10	100	0	0	0	0	0	0	0	11	39
66	2.97	57	3	0	40	0	0	20	5	1	2	0	0	0	16	9	27	0	26	0	37	10	0	0	0	42
68	3.68	54	1	1	39	5	0	26	7	2	3	0	0	0	8	15	37	2	21	6	30	4	0	.4	0	39
69	0.27	19	74	0	7	0	0	6	0	0	0	0	0	0	15	4	81	0	19	0	0	0	0	0	0	100
70	0.75	0	0	0	100	0	0	18	6	3	0	0	0	0	35	32	100	0	0	0	0	0	0	0	0	39
71	0.12	0	0	0	100	0	0	7	1	0	0	0	0	0	86	14	100	0	0	0	0	0	0	0	0	58
72	0.95	0	47	0	53	0	0	25	3	2	2	0	0	0	25	27	82	0	0	0	18	0	0	0	0	84
73	10.71	68	16	0	16	0	0	30	7	5	1	0	0	0	6	.3	31	1	41	1	18	8	0	0	0	76
144	2.59	26	5	0	69	0	0	52	0	2	2	0	0	0	7	47	97	3	0	0	0	0	18	1	1	29
Middlesex Total	56.78	39	8	1	50	2	0	577	67	25	14	9	0	2	10	13	38	2	30	3	23	4	2	5	1	39
Piankatank Total	131.75	33	9	2	52	3	1	1217	119	57	35	22	4	4	9	14	57	2	21	2	15	3	3	10	1	44

* bkwtr = breakwater

Table 5. Piankatank River Shoreline Attributes – Plate Summary

PLATE NUMBER	TOTAL MILES Surveyed	RIPARIAN LAND USE (miles)						SHORELINE FEATURES									BANK (bank height and erosion status – miles of shore)						BUFFER CONDITION			
																	0-5 ft		5-10 ft		>10 ft		BEACH PRESENT (miles)		MARSH PRESENT (miles)	
		forest	scrub-shrub	grass	residential	commercial	bare	No. docks	No. boathouses	No. ramps	No. groinfields	No. marinas	No. bkwtr*	No. jetties	miles of bulkhead	miles of riprap	low	high	low	high	low	high	Eroding	Stable	Eroding	Stable
1	11.90	10.04	0.07	0	1.79	0	0	57	11	7	1	0	0	0	0.47	0.41	6.05	0.08	4.59	0.08	1.01	0.11	0	0.07	0	9.87
2	12.40	6.18	2.39	0	3.50	0.33	0	132	13	10	2	0	1	0	1.87	0.63	5.89	0.10	3.00	0.22	2.30	0.90	0.15	1.03	0	9.12
3	9.94	4.01	1.11	0.21	4.44	0.17	0	110	10	7	5	0	0	0	0.90	1.27	4.89	0.26	2.22	0.38	1.65	0.55	0.10	0.81	0.17	4.92
4	14.47	6.63	0.66	0.13	7.05	0	0	109	20	6	4	2	0	0	1.20	1.19	5.61	0.12	2.60	0.12	5.20	0.83	0.16	1.27	0.13	5.39
5	18.71	6.70	1.25	0.13	10.58	0.05	0	169	16	2	1	4	0	0	1.29	1.91	5.38	0.03	5.90	0.14	6.81	0.46	0.05	1.28	0.30	3.90
6	12.98	4.58	0.45	0	7.82	0.13	0	78	19	1	0	1	0	2	1.01	2.24	4.72	0	3.73	0.34	3.31	0.89	0.05	1.10	0	4.51
7	12.12	1.61	0.58	0	9.00	0.93	0	144	22	4	1	5	0	2	1.65	2.53	4.79	0.04	4.70	0.43	2.06	0.10	0.49	1.46	0.09	3.85
8	12.15	1.63	1.13	0.33	8.60	0.46	0	198	7	9	6	6	0	0	2.10	2.99	5.99	0.91	3.59	1.25	0.32	0.07	1.34	0.45	0.64	3.17
9	3.63	0.97	0.05	0.33	2.28	0	0	17	0	1	0	0	0	2	0.78	1.57	1.45	0.11	1.88	0.19	0	0	0.30	0.61	0.06	0.18
10	10.91	1.64	0.10	0.44	8.67	0.06	0	148	10	6	3	2	2	0	0.62	1.39	10.28	0	0.42	0.21	0	0	0	0.91	0	7.38
11	15.79	1.93	1.44	0.70	10.26	1.46	0	143	8	7	12	8	1	0	1.71	3.59	14.12	0.30	1.35	0	0	0	0	2.67	0.20	6.30
12	18.41	2.17	5.07	0.26	8.32	1.24	1.35	83	8	2	5	4	0	0	0.59	3.08	17.46	0.66	0.11	0	0	0	2.40	4.98	0.36	6.73
River Total	131.90	42.97	12.49	2.09	68.91	4.09	1.35	1217	119	57	33	22	4	4	11.46	19.00	75.68	2.47	28.12	2.78	19.30	3.54	4.73	13.83	1.63	57.57

* bkwtr = breakwater

Chapter 3. Applications for Management

3.1 Introduction

There are a number of different management applications for which the Shoreline Situation Reports (SSRs) support. This section discusses four of them which are currently high profile issues within the Commonwealth or Chesapeake Bay watershed. The SSRs are data reports, and do not necessarily provide interpretation beyond the characteristics of the nearshore landscape. However, the ability to interpret and integrate these data into other programs is key to gleaming the full benefits of the product. This chapter offers some examples for how the data within the SSRs can be integrated and synthesized to support current state management programs.

3.2 Shoreline Management

The first uses for SSRs were to prepare decision makers to bring about well informed decisions regarding shoreline management. This need continues today, and perhaps with more urgency. In many areas, undisturbed shoreline miles are almost nonexistent. Development continues to encroach on remaining pristine reaches, and threatens the natural ecosystems which have prevailed. At the same time, the value of waterfront property has escalated, and the exigency to protect shorelines through stabilization has increased. Generally speaking, this has been an accepted management practice. However, protection of tidal shorelines does not occur without incidence.

Management decisions must consider the current state of the shoreline, and understand what actions and processes have occurred to bring the shoreline to its current state. This includes evaluating existing management practices, assessing shore stability in an area, and determining future uses of the shore. The SSRs provide data to perform these evaluations.

Plate A defines the land use adjacent to the shoreline. To the extent that land use directs the type of management practices found, these maps can predict shoreline strategies which may be expected in the future. Residential areas are prone to shoreline alterations. Commercial areas my require structures along the shore for their daily operations. Others frequently seek structural alternatives to address shoreline stability problems. Forested riparian zones, and large tracts of grass or agricultural areas are frequently unmanaged even if chronic erosion problems persist.

Stability at the shore is described in Plate B. The bank is characterized by its height, its state of erosion, and the presence or absence of natural buffers at the bank toe. Upland adjacent to high, stable banks with a stable natural buffer at the base are less prone to flooding or erosion problems resulting from storm activity. Upland adjacent to banks of lesser height (< 5feet) are at greater risk of flooding, but if the banks are stable with marshes or beaches present, erosion may not be a significant concern. Survey data reveals a strong correlation between banks of high erosion, and the absence of natural buffers. Conversely, the association between stable banks and the presence of marsh or beach is also well established. This suggests that natural buffers such as beaches and fringe marshes play an important role in bank protection. This is illustrated on the maps. Banks without natural buffers, yet classified as low erosion, are often structurally controlled with rip rap or bulkheads.

Plate C delineates structures installed along the shoreline. These include erosion control structures, and structures to enhance recreational use of the waterway. This map is particularly useful for evaluating requests from property owners seeking structural methods for controlling shoreline erosion problems. Shoreline managers can evaluate the current situation of the surrounding shore including: impacts of earlier structural decisions, proximity to structures on neighboring parcels, and the vicinity to undisturbed lots. Alternative methods such as vegetative control may be evaluated by assessing the energy or fetch environment from the images. Use this plate in combination with Plate B to evaluate the condition of the bank proposed for protection.

A close examination of shore conditions may suggest whether certain structural choices have been effective. Success of groin field and breakwater systems is confirmed when sediment accretion is observed. Low erosion conditions surveyed along segments with bulkheads and riprap indicate structures have controlled the erosion problem. The width of the shorezone, estimated from the background image, also speaks to the success of structures as a method of controlling erosion. A very narrow shorezone implies that as bulkheads or riprap have secured the erosion problem at the bank, they have also deflated the supply of sediment available to nourish a healthy beach. This conflict remains unresolved in most management cases.

Shoreline managers are encouraged to use all three plates together when developing management strategies or making regulatory decisions. Each plate provides important information independent of the others, but collectively the plates become a more valuable management tool.

3.3 Non-Point Source Targeting

The identification of potential problem areas for non-point source pollution is a focal point of water quality improvement efforts throughout the Commonwealth. The three tiered approach provides a collection of data which, when combined, can allow for an assessment of potential non-point source pollution problems in a waterway.

Grass land, which includes cultivated and pasture lands, has the highest potential for nutrient runoff. These areas are also prone to high sediment loads since the adjacent banks are seldom restored when erosion problems persists. Residential, bare, and commercial land uses rank second because of the types of practices which prevail, and the large impervious surface areas.

The highest potential for non-point source pollution combines these land uses with "high" bank erosion conditions and no marsh buffer protection. The potential for non-point source pollution moderates as the condition of the bank changes from "high" bank erosion to "low" bank erosion, or with the presence or absence of stable marsh vegetation to function as a nutrient sink for runoff. Where defense structures occur in conjunction with "low" bank erosion, the structures are effectively controlling erosion at this time, and the potential for non-point source pollution is reduced. If the following characteristics are delineated: low bank erosion, stable marsh buffer, riprap or bulkhead; the potential for non-point source pollution from any land use class can be lowered.

At the other end of the spectrum, forested and scrub-shrub sites do not contribute significant amounts of non-point source pollution to the receiving waterway. Forest buffers, in particular, are noted for their ability to uptake

nutrients running off the upland. Forested areas with stable or defended banks, a stable fringe marsh, and a beach would have the lowest potential as a source of non-point pollution. Scrub-shrub with similar bank and buffer characteristics would also be very low.

A quick search for potential non-point source sites would begin on Plate A. Identify the "grass" areas. Locate these areas on Plate B, and find those which have eroding banks (in red) without any marsh protection. The hot spots are these sites where the banks are highest (thick red line), so the potential sediment volume introduced to the water is greatest. Finally check plate C to determine if any artificial stabilization to protect the bank has occurred. If these areas are without stabilizing structures, they indicate the hottest spots for the introduction of non-point source pollution.

3.4 Designating Areas of Concern (AOC) for Best Management Practice (BMP) Sites

Sediment load and nutrient management programs at the shore are largely based on installation of Best Management Practices (BMPs). Among other things, these practices include fencing to remove livestock from the water, installing erosion control structures, and bank re-vegetation programs. Installation of BMPs is costly. Cost share programs provide relief for property owners, but funds are scarce in comparison to the capacious number of waterway miles needing attention. Targeting Areas of Concern (AOC) can prioritize spending programs, and direct funds where most needed.

Data collected for the SSR can assist with targeting efforts for designating AOCs. AOCs can be areas where riparian buffers are fragmented, and could be restored. Use Plate A to identify forested upland. Breaks in the continuity of the riparian forest can be easily observed in the line segments, and background image. Land use between the breaks relates to potential opportunity for restoring the buffer where fragmentation has occurred. Agricultural tracts which breach forest buffers are more logical targets for restoration than developed residential or commercial stretches. Agricultural areas, therefore, offer the highest opportunity for conversion. Priority sites for riparian forest restoration should target forested tracts breached by "grass" land (green-yellow-green line pattern).

Plate B can be used to identify sites for BMPs. Look for where "red" (i.e. eroding) bank conditions persist. The thickness of the line tells something about the bank height. The fetch, or the distance of exposure across the water, can offer some insight into the type of BMP which might be most appropriate. Re-vegetation may be difficult to establish at the toe of a bank with high exposure to wave conditions. Plate C should be checked for existing shoreline erosion structures in place.

3.5 Targeting for Total Maximum Daily Load (TMDL) Modeling

As the TMDL program in Virginia evolves, the importance of shoreline erosion in the lower tidal tributaries will become evident. Total maximum daily loads are defined as a threshold value for a pollutant, which when exceeded, impedes the quality of water for specific uses (e.g. swimming, fishing). Among the pollutants to be considered are: fecal coliform, pathogens, nitrogen, phosphorous, and sediment load.

State agencies will develop models to address each of these parameters. In upper watersheds, nutrient and fecal coliform parameters will be critical where high agricultural land use practices prevail. Sediment loads will eventually be considered throughout the watershed. In the lower watersheds, loads from shoreline erosion must be addressed for a complete sediment source budget. Erosion from shorelines has been associated with high sediment loads in receiving waters (Hardaway et.al., 1992), and the potential for increased nutrient loads (Ibison et.al., 1990). Virginia's TMDL program is still developing. Impaired stream segments are being used to initially identify where model development should focus. For Virginia, this streamlining has done little to reduce the scope of this daunting task, since much of the lower major tributaries are considered impaired. Additional targeting will be necessary to prioritize model development.

Targeting to prioritize TMDL can be assisted by maps which delineate areas of high erosion, and potential high sediment loads. Plate B in this inventory delineates banks of high erosion. Waterways with extensive footage of eroding shorelines should be targeted. The volume of sediment entering a system is also a function of bank height. Actual volumes of sediment eroded can be estimated by using bank height, and the linear extent that the condition persists along the shore. Bank height is an attribute defined in Plate B by the width of the line. Eroding banks (in red) with heights in excess of 10 feet (thickest line) would be target areas for high sediment loads. Plate A can be used in combination with Plate B to determine the dominant land use practice, and assess whether nutrient enrichment through sediment erosion is also a concern. This would be the case along agriculturally dominated waterbodies. Tables 4 and 5 quantify the linear extent of high, eroding banks on a reach by reach, or plate by plate basis, respectively.

Chapter 4. The Shoreline Situation

This section describes conditions for the Piankatank River shoreline extending from the headwaters at the mouth of the Dragon Run, to the river's mouth, southeast, where it meets the Chesapeake. The river includes the shorelines of Mathews and Gloucester County on the south shore, and Middlesex County on the north shore. The river is described on a plate by plate basis. Conditions are reported for subsegments or river reaches in Table 4, where appropriate, and in Table 5, on a plate by plate basis. The reaches have been a unit for describing historic shoreline conditions in an earlier report by Byrne and Anderson, 1978.

Embayed marsh at the limit of the survey area

Plate 1

Location: Meggs Bay to approximately 1 mile east of Carvers Creek
Reaches: Gloucester County Reach 1 (partial); Middlesex County Reach 73 (partial)
Total shoreline miles: 14.12
Shoreline miles surveyed: 11.90
Survey Date(s): 9/17/98; 9/24/98

Description: The landscape in Plate 1 varies between wide embayed marshes at the headwater of the Piankatank River known as Meggs Bay and Dragon Swamp, to clustered areas of residential development. Nearly twelve miles of shoreline were surveyed. The remaining 2.2 miles was non-navigable water. Plate 1 is oriented with north at the top of the map. Subsequent plates may be rotated for publication purposes.

Land Use: The upland along this portion of the river between Dragon Swamp and Carvers Creek is dominated by forested land use. Eighty-four percent of the upland along the shoreline miles is forested. Residential areas are intermittent. Less than two miles, or 15% of the total shore surveyed is residential. This development is concentrated in two areas. The housing density in both these areas has increased since the 1970s. New development outside these sections has not been evident. With forested land use dominating the riparian area, and several large agricultural tracts observed beyond, the character of this plate can be described as rural.

Bank Condition: Banks in this portion of the river range from less than 5 feet in height, to more than ten feet. Field observations record the condition of the bank as stable. A few short stretches are noted in red where bank erosion is evident. Erosion of the bank in these noted areas is primarily due to runoff or undercutting at the bank toe. Hazards from flooding in this area of the Piankatank was qualified as being low to noncritical in earlier Shoreline Situation Reports (Anderson et.al., 1976; Whitcomb et.al., 1975).

Shore Condition: The shoreline is dominated by wide, embayed marshes along the undeveloped, wooded shoreline stretches. Fringe marshes are found nearly everywhere else. Erosion of the shore and wetland area is low, which is expected in this low fetch environment. As a result, shoreline stability, in general, is relatively good. Historic erosion rates indicate nearly no change, with highest rates averaging around 1 foot per year. Shoreline stabilization structures are minimal here. Less than one mile of shoreline, cumulatively, is stabilized. Dock density in the private residential areas is relatively high. There are several boathouses, and private boat ramps also concentrated in the residential areas.

Residential district at Coach Point known as Piankatank Shores

Plate 2

Location: East of Carvers Creek to Blands Wharf
Reaches: Gloucester County Reach(s) 1 (partial), and 2; Middlesex County Reach(s) 70-72, and 73(partial)
Total shoreline miles: 12.80 miles
Shoreline miles surveyed: 12.40 miles
Survey Date(s): 9/17/98; 9/24/98

Description: Plate 2 extends from just east of Carvers Creek on the south shore to Blands Wharf. It includes shoreline in both Gloucester and Middlesex Counties. Two relatively wide bays are located in Middlesex County, increasing the river width in the north-south direction to almost one mile. The landscape combines forested, agricultural, and residential land uses. Riparian forests front the agricultural tracks, and are considered the primary use in these river segments. Nearly all 12.8 miles of measured shoreline on the plate has been surveyed. Plate 2 was rotated west 45 degrees for publication purposes, and the top of the map is NE.

Freeport in Gloucester County on the Piankatank River in Gloucester County

Land Use: Fifty percent of the land use mapped on Plate 2 is forested. This includes the forest buffers bordering the agricultural tracts illustrated on the map. Scrub-shrub dominates just under 20% of the shore. Most of the scrub-shrub serves as a buffer between forested uplands, and fringe marshes. There are three relatively large residential developments here. The largest is the Middlesex County development known as Piankatank Shores. A second, smaller development is located just upriver from Piankatank Shores in Middlesex. On the Gloucester side of the river, a concentrated residential area is located at Anderson Point.

Bank Condition: More than half the banks in this river section exceed five feet in height. Approximately 3.2 miles of shoreline surveyed have banks in excess of 10 feet. This is prevalent along the north shore of the river in the bay contiguous to My Lady's Swamp. Most of the banks have fringe marsh at the base, which offers protection from erosion. This could account for the overall stability of the banks surveyed. With the exception of My Lady's Swamp, only short, isolated bank sections are eroding. Most of these isolated areas do not have marsh vegetation as a buffer. Bank erosion in several sections has created a thin sandy beach area in front of the bank. The flood hazard along this river segment was noted as critical only in the residential area of Piankatank Shores. The south shore of the river has no significant flood risks identified (Anderson et.al., 1976; Whitcomb et.al., 1975).

Shore Condition: Fringe marshes persist along most of the small embayments, and at the headwater of creeks. These marshes offer protection to the bank and fastland. Sediment supply is limited in this environment, and therefore there are almost no beaches. Only 1.2 miles of beach was surveyed. Historic records which compare shoreline position over time offer little data for this area. A small section of shore just upriver from the Piankatank Shores development was reported to be accreting at a rate of 0.8 ft/yr, calculated over an 85 year time period. On the Gloucester side of the river, Reach 2 (Figure 2), located just down river from the mouth of Harpers Creek, has a measured erosion rate of 0.7 ft/yr, also calculated over a period of 85 years. The residential areas have been largely armored with shoreline protection structures. Riprap and bulkhead line nearly 100 percent of the shoreline along these river segments. As illustrated in the image, dock density is very high in the developments. One hundred and thirty-two docks were in place at the time the survey was conducted. Thirteen additional piers with boathouses were surveyed. Ten boat ramps are present. One, located at the southeast plate edge (right), is a public launch site.

Ferry Creek in Gloucester County

Plate 3

Location: Blands Wharf to east of Ferry Creek entrance
Reaches: Gloucester County Reach(s) 2-10 (partial); Middlesex County Reach(s) 68(partial), and 69
Total shoreline miles: 11.93 miles
Shoreline miles surveyed: 9.94 miles
Survey Date(s): 9/12/98

Description: Plate 3 extends from Blands Wharf down river, past the entrance of Ferry Creek. The landscape is dominated by forested and agricultural practices, the shore has thin fringe marshes in isolated areas, and a few beaches are present along the shore. The main stem of the river trends NW to SE. This is a fetch restricted area due to the sinuosity of the river down stream. Eighty-three percent, or roughly 10 miles of the shoreline was surveyed for this inventory, including Ferry Creek. Approximately two miles could not be accessed by boat due to shoal water. Plate 3 has been rotated, and the top of the map is north 25 degrees east.

Wreck along Piankatank Shores in Middlesex County

Land Use: Forest cover and residential areas make up 85% of the land use within Plate 3. Most of the notable agricultural tracts in the upland are buffered by residential or forest cover, and are not immediately adjacent to the shore. Residential land use is spread throughout the plate. The pattern of development over the past twenty years has not significantly changed. From earlier records (Anderson et.al., 1976; Whitcomb et.al., 1975), increases in residential housing are most notable west of Cooper Point in Gloucester County, and upriver from Creek Point in Middlesex County.

Bank Condition: Banks along this portion of the Piankatank range from less than five feet to more than ten. High bluffs occur along the Gloucester side upriver from Cooper Point. The majority of banks are stable, with erosion most prevalent along these high bluffs. Here, erosion is clearly providing the sediment source for the longest stretch of beach surveyed in this segment of the river. In other areas, there are short segments where erosion is observed. A few of these have very narrow beaches at their base. In other areas, the sediment supply and current conditions prohibit any sand accumulation. Most of the eroding sections are absent a natural marsh buffer for protection. This is most obvious within Ferry Creek, where the only unstable stretch of bank (noted in red) is associated with no marsh protection. Erosion here is most likely at the bank toe. No significant flood hazards are reported for this area, although there are places where the elevation of the adjacent upland is less than five feet.

Shore Condition: Anderson et.al. (1976), and Whitcomb et.al.(1975) recognized moderate erosion at headlands in Gloucester, and no erosion in Middlesex County, respectively. A small section of shore in Middlesex was reported to be accreting just upriver from Coach Point. From Byrne and Anderson(1978), the Gloucester County portion of this plate had measured historic erosion rates which varied between 0.9-1.3 ft/yr at selected sites. The only measured historic rates available for the Middlesex County shore were reported in the same report for the small lagoon known as Woodstock Lagoon (Reach 69) located just east of the Pianatank Shore development. Erosion rates reported here averaged 0.7ft/yr over 85 years. Only 2.17 miles of the surveyed shoreline has riprap or bulkheads. There were 110 piers recorded, and ten pier/boathouse structures. Seven boat ramps were surveyed. None are open to the public for trailerable vessels.

Eroding bluffs at Holland Point

Plate 4

Location: East Ferry Creek entrance to Glebe Neck (Wilton Creek)
Reaches: Gloucester County Reach(s) 10 (partial) - 15; Mathews County Reach(s) 16 - 19; Middlesex County Reach(s): 62 (partial) - 69 (partial)
Total shoreline miles: 15.98 miles
Shoreline miles surveyed: 14.47 miles
Survey Date(s): 9/12/98

Description: Plate 4 extends from the mouth of Ferry Creek to approximately 0.4 mile east of the Route 3 bridge. It includes shoreline in Gloucester, Mathews, and Middlesex Counties. The river here trends NW/SE, with a NW fetch of approximately 2.5 miles. The large bay formed by the two headlands, Doctor Point and Wilton Point, in Middlesex County, characterize this segment of the river. The measurable shoreline equates to almost 16 miles. Approximately 14.5 miles were surveyed as part of this inventory. The orientation of Plate 4 has north approaching the top of the map (shift of 3 degrees west).

Land Use: Land use/land cover on this plate is divided mainly between residential uses (49%), and forest cover (46%). Agricultural grass areas are evident in the image, yet most of these have forest or scrub shrub-buffers in the riparian zone. The western shore of Wilton Point is where housing densities are greatest. Although slight, this is also the only notable sign of growth since the earlier report in 1975 (Whitcomb et.al.,1975). Concentrations have also increased since 1975 in Wilton Creek.

Bank Condition: Bank height ranges from less than five feet to greater than ten feet. The highest areas are along the south shore in Mathews County, and the large embayment around Berkeley Island on the north shore. Stability of the bank varies, and a total of 1.1 miles of bank was classified as high erosion. The remaining 13.4 miles exhibit no obvious signs of instability. There is no erosion pattern evident along the banks, except that nearly all eroding bank sections are without the presence of either a beach or marsh buffer. Holland Point is the only exception, where the eroding bluff is probably responsible for the presence of the beach material indicated. From earlier reports (Anderson et.al.,1976; Whitcomb et.al.,1975; and Hobbs et.al., 1975) the flood hazard in this area is low, and much of the upland is well above flood levels.

Shore Condition: Historic erosion rates identify the following sections as having the highest rates of erosion; Holland Point east to the Pond (Mathews Reach 16) at 1.5 ft/yr, and Doctor Point east to Wilton Point (Middlesex Reaches 65-66) at 1.15 ft/yr. Accretion just east of the mouth of Ferry Creek has also been recorded (+1.1 ft/yr) (Byrne and Anderson,1978). Shoreline protection has been installed along the western shore of Wilton Point, and includes 0.74 mile of bulkhead and riprap, and two groin fields. Structures have also been installed along isolated sections, as indicated on the map. There are 109 piers, and twenty boathouses with attached piers. Two community dock facilities are present inside Wilton Creek. These are illustrated as "marinas" on the map. There are six boat ramps indicated. All of these appear to be restricted to private use.

Eroding banks in Wilton Creek

Plate 5

Location: Route 3 Bridge (Twigg Bridge) to east of Horse Point
Reaches: Mathews County Reach(s) 8 - 27; Middlesex County Reach(s) 57 (partial) - 66 (partial)
Total shoreline miles: 18.72 miles
Shoreline miles surveyed: 18.72 miles
Survey Date(s): 9/3/98

Description: Plate 5 includes nearly 19 miles of shoreline in Mathews and Middlesex Counties. The shoreline of Wilton Creek in Middlesex County, and Cobbs Creek in Mathews County are considered in that total. Water depth allowed the entire shore to be surveyed in this section of the river. Some overlap exists between Plate 5 and Plate 4. For values reported in Table 5, the quantitative assessment for segments which fall on two plates are counted twice. This area of the Piankatank River represents a typical waterfront community. Residential districts spread several miles along the shore. The river is oriented NS here, and the fetch is approximately 2.4 miles in this direction. This portion of the river does not receive high energy waves directly from the Chesapeake Bay. Plate 5 was rotated 75 degrees to the east for publication purposes, and west is toward the top of the map.

Fringe marsh along Cobbs Creek in Mathews County

Land Use: More than half the shoreline surveyed is residential (56%), which extends over 10.5 miles of shoreline. The majority of forest land in the plate is located in Wilton Creek, where forest cover comprises about half of the land use classified in the creek. Forest cover is dispersed throughout other areas as well. The remaining 1.4 miles of shore is classified as scrub-shrub, with the exception of a small commercial operation inside of Cobbs Creek. This operation has a number of boat slips (see Plate 4c), but it is unknown whether it is a recreational marina, or a commercial facility for working waterman.

Bank Condition: The banks along the shore here are fairly high. More than 7.0 miles of banks are higher than10 feet, and more than 6 miles are between 5 and 10 feet high. Long stretches of stable condition persist, with short, intermittent sections of bank erosion. Fringe marsh is most common around headlands, spits, and small embayments.

Shore Condition: With a relatively low erosion problem, shoreline protection has not occurred at great length in this area of the Piankatank. There are some sections of bulkheading and riprap, but little compared to other areas with fewer shoreline miles. Historic rates are consistent with others already reported. (0.5-1.3 ft/yr). These are reported for selected reaches which were quantified using historic charts (Byrne and Anderson,1978). There are 169 docks identified, and 16 dock/boathouse combinations. The density of docks is highest in Cobbs Creek. There are four clusters of boat slips (designated as "marinas"). Only one was identified to be a commercial operation, suggesting the others may be residential or community facilities supporting a waterfront or waterview community.

Eroding banks outside Cores Creek in Middlesex County

Plate 6

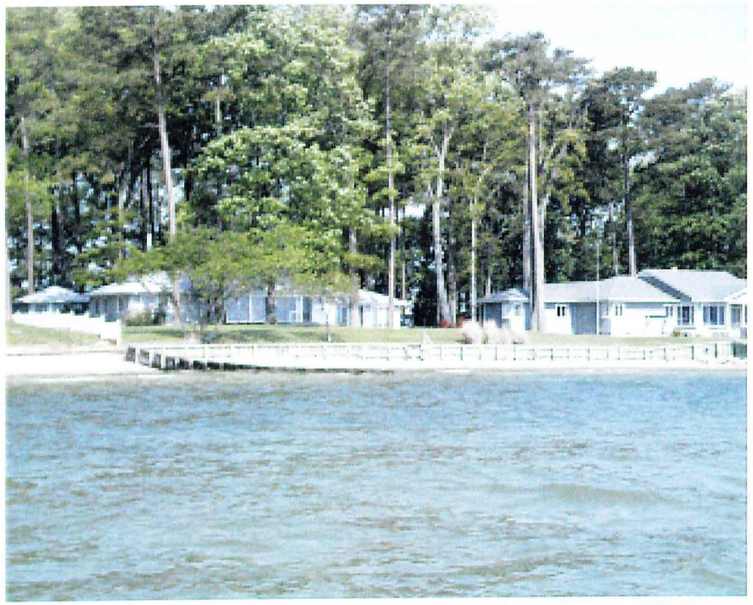
Location: West of Horse Point to 0.2 mile east of entrance to Moore Creek
Reaches: Mathews County Reach(s) 26 (partial) - 32 (partial); Middlesex County Reach(s) 52 - 61 (partial)
Total shoreline miles: 15.62 miles
Shoreline miles surveyed: 12.98 miles
Survey Date(s): 9/2/98; 9/3/98

Description: As we approach the mouth of the Piankatank River, the river widens, and exposure to wave activity generated in the Chesapeake Bay increases. The peninsula known as Stove Point, near the river mouth, still shelters a portion of the river here from long fetches across the Chesapeake Bay. The river trends nearly EW here. There are 15.62 miles of shoreline in Plate 6. Almost 13 miles were surveyed by boat. Plate 6 was rotated 25 degrees west. There is some overlap between Plate 5 and Plate 6. Values reported in Table 5 consider each plate separately, and features illustrated on both plates are counted twice.

Landuse: Sixty percent of the landuse in this area of the river is residential with heaviest development at Horse Point (outside of Healy Creek), and between Pond Point and Roane Point in Mathews County. While residential development is evident at the shore between Cores Creek and Bland Point in Middlesex County, it is obvious that agricultural practices are ongoing just upland of the riparian zone. Like other plates already described, forest cover follows as the second largest land cover in the region (35%). One commercial operation is partially mapped at the NE edge of the plate. This establishment is completely described in Plate 7.

Bank Condition: As we move toward the mouth of the Piankatank River, bank height decreases, and there are more banks within the 0-5 and 5-10 feet range. Low erosion was reported along 4.7 miles of banks with heights less than five feet. High erosion was noted along a total of 1.23 miles of shoreline surveyed. As expected, most of this instability occurs on the north shore between Healy Creek and Bland Point. This section receives wave energy from the SW across a 4.5 mile fetch. Sand beaches are frequently associated with the eroding banks, particularly those greater than 10 feet in height. Fringe marshes are present as vegetative buffers at selected sites.

Shore Condition: Accretion dominates historically in Middlesex County east and west of Bland Point. Accretion rates between 1.5 and 2.3 ft/yr were recorded. While shoreline change rates are not noted everywhere, Byrne and Anderson (1978) reported rates for Reach 56 and 59 of 0.7ft/yr (Figure 2), and 1.2 ft/yr for Reach 60 (Figure 2), which includes the peninsula at the entrance to Healy Creek. Riprap and bulkheads protect these eroding sections now. The highest erosion rates reported are on the Mathews side of the river along Reach 32 (Figure 2), east of Roane Point. Historic erosion rates here were calculated to be 2.4 ft/yr based on 90 years of change. Erosion rates for Roane Point were estimated at 0.8 ft/yr. Shoreline protection structures have been built at intermittent sites along this stretch of Mathews shoreline. There are 78 docks within Plate 6, and 19 additional piers constructed with boathouses. A small community dock facility inside Healy Creeks has a boat ramp, but this access is most likely restricted to residence of the area.



Stove Point, Middlesex County

Plate 7

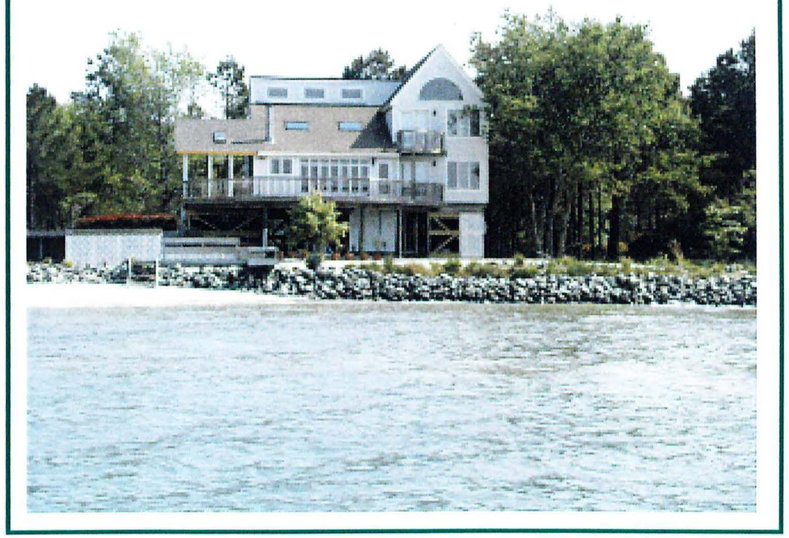
Location: 0.28 mile west of Bland Point to Stove Point
Reaches: Middlesex County Reach(s) 46 partial- 54
Total shoreline miles: 12.12 miles
Shoreline miles surveyed: 12.12 miles
Survey Date(s): 9/2/98; 9/3/98

Description: Plate 7 includes shoreline along the north shore of the Piankatank in Middlesex County. Just over 12 miles of shoreline were surveyed in early September, 1998. Coverage begins just west of Bland Point and continues to Stove Point, including the shoreline of Moore Creek, Fishing Bay, and the south shore of Jackson Creek. There is slight overlap between Plate 6. The east side of Stove Point, which is oriented NS, receives direct wave action from the Chesapeake Bay. This shoreline, therefore is very dynamic. Fetch is greatest here from the east. Inside Stove Point, the shoreline trends EW and fetches are limited, with the longest fetch approaching 4.6 miles from the SE. Flooding is moderate from Stove Point to Fishing Bay. Upriver, the risk of flooding is reduced. Plate 7 was rotated for publication purposes 10 degrees to the west.

Land Use: Plate 7 is dominated by residential land use along the shore. Concentrations are steady east of Moore Creek through the west side of Stove Point neck. Forest cover prevails only in Moore Creek, accounting for 35% of the shoreline miles surveyed there (Table5). There are four commercial establishments indicated. Three of these are marina facilities. Several large agricultural tracts are evident in the adjacent upland. The riparian area is buffered with some other land use at least 30 feet thick.

Bank Condition: Bank height in this area ranges from less than five feet to more than 10 feet. Roughly one third of the banks surveyed were between 5 and 10 feet high. Erosion is low along nearly all reaches, except at select areas of Jackson Creek, and the Bay side of Stove Point. The eastern shore along Stove Point is protected by riprap and bulkheads. A sandy beach here exhibits signs of erosion and accretion at different points. The beach, assisted by a long groinfield (Plate 7c) is wide enough, and persistent enough to offer erosion protection to the bank. Shoals are obvious along the eastern and southern nearshores.

Shore Condition: Historic erosion rates are available only at selected reaches within the plate. Approximately 40 acres of land loss was reported for Reach 47 (Figure 2), Stove Point Neck between 1856 and 1942 (Byrne and Anderson, 1978). No shoreline recession rates are given on an annual basis. The base shoreline used to illustrate the shoreline features in this report was surveyed in 1964. The imagery, from 1994 suggests that the tip of Stove Point Neck has been receding since that time. It is unknown whether this loss is continual, or the result of a major storm event. Property owners here have installed riprap at the "Point", and a combination of riprap and bulkheads protect the bank along the eastern shore. An extensive system of groins is also in place on the eastern shore of the neck. Shoreline protection between Moore Creek and Fishing Bay is prominent. Dock density is very high on Plate 7, and there are more than 144 docks surveyed. Twenty-two additional piers with boathouses were surveyed. There are four ramps indicated. None of these are listed as public launch sites by the Department of Game and Inland Fisheries. Public access should not be assumed.



Jackson Creek

Plate 8

Location: Jackson Creek to Stingray Point
Reaches: Middlesex County Reach(s) 42 - 48 (partial)
Total shoreline miles: 12.15 miles
Shoreline miles surveyed: 12.15 miles
Survey Date(s): 5/5/99

Description: Plate 8 extends from the north shore entrance of the Piankatank River to Jackson Creek. The northern end of Stove Point Neck, and a small amount of shoreline within Fishing Bay is also included. The entire shoreline of Jackson Creek is surveyed. Plate 8 has very long fetches from the east and southeast directions. The eastern shore of Stove Point neck, and the mouth of Jackson Creek includes a shallow nearshore characterized by mobile shoals which are active during high energy wave events. The channel into Jackson Creek is very narrow for this reason. The land mass, including Stingray Point,

offers protection from northeast storms. Plate 8 has been rotated 45 degrees to the east. There is overlap with Plate 7 at the left edge, or southwest end of the plate.

Headwaters of Jackson Creek

Land Use: Land use within Plate 8 is dominated by residential use with 8.60 miles of the 12.15 miles surveyed designated as residential. Forest cover is present at intermittent sites, and accounts for just over 1.6 miles of the surveyed shoreline. Forest cover is notable in the upland area surrounding the low density residential districts west of Stingray Point. There are five commercial areas. All of these are surveyed as marina/dock facilities of some type.

Bank Condition: Nearly six miles of the banks surveyed were classified at less than 5 feet in height, and exhibiting minimum erosion. Approximately 3.6 miles of banks were between 5 and 10 feet in height, and also stable. Banks classified as high erosion accounted for less than 20%. As illustrated in Plate 8b, these areas are mainly in the creeks. Fringe marshes offer protection along the bank in several areas, but marshes are not well established, and themselves, show signs of erosion. Much of the erosion noted is concentrated at small headlands. Marsh erosion and bank instability at these sites may be due to boat wake activity in this area where boat traffic is likely to be high. Jackson Creek is heavily developed, and an increase in runoff resulting from development may also be responsible for erosion along the bank. Beaches offer protection to many of the low lying areas between Stingray Point and the mouth of Jackson Creek.

Shore Condition: No historic erosion rates are reported for this area. Accretion was measured for Reach 43 southwest of Stingray Point (Byrne and Anderson, 1978). The beaches surveyed here may have persisted through time. The extensive stretch of groin fields has perhaps aided in this accumulation recently. Sediment accumulation on the updrift side of the groins are apparent in the imagery. It is also apparent that the small tributaries mark a shift or nodal point in net longshore drift. The groinfield closest to Stingray Point appears to have accumulation on the upriver side of the groins, while the groinfields closer to Jackson Creek have accumulation on the downriver side of the groins. In all cases, the groins appear to be effective in trapping longshore sediment suggesting that a source of sediment is available in the system. This, despite the fact that there is extensive bank protection in the vicinity. The remaining shoreline includes more than 5 miles of bulkhead and riprap protection. Almost 200 private piers have been constructed. There are 9 private boat ramps. There are no public launch sites in the vicinity.

Recreational beach in Godfrey Bay, Mathews County

Plate 9

Location: Iron Point to 0.5 mile south Burton Point
Reaches: Mathews County Reach(s) 32(partial) - 34 (partial)
Total shoreline miles: 7.72 miles
Shoreline miles surveyed: 3.63 miles
Survey Date(s): 9/3/98

Description: Plate 9, located entirely within Mathews County, is dominated by the wide bay known as Godfrey Bay which lies between Iron Point, and Burton Point headlands. Iron Point is the site of one of several oyster reef demonstration projects in the Piankatank River. This structure is clearly marked in the river. Shoreline miles surveyed include only primary shoreline of the Piankatank River. Access to the small unnamed tributaries was restricted by water depth. Fetch distance is greater than 20 miles from the northeast across the Chesapeake Bay. From the north and east, distances are close to 2.5 miles. For illustration purposes, Plate 9 was rotated 10 degrees to the west.

Iron Point Oyster Reef Restoration Site

Land Use: Plate 9 is dominated by residential, and forested land cover. Residential use backs 2.28 miles of the total shoreline surveyed. Forest cover accounts for just under 1 mile of surveyed shore. There is 0.33 mile of grass cover noted. These areas appear to be agricultural tracts which have been cultivated at some time.

Bank Condition: Banks in this area are generally within the 5-10 foot range. Erosion of the bank is slight along most of this river stretch, despite the exposure. A sandy beach exists along much of the bay, offering protection to the banks. These beaches are wide enough for recreational purposes. Marshes are not very persistent here. Exposure may prohibit vegetation from establishing in this area.

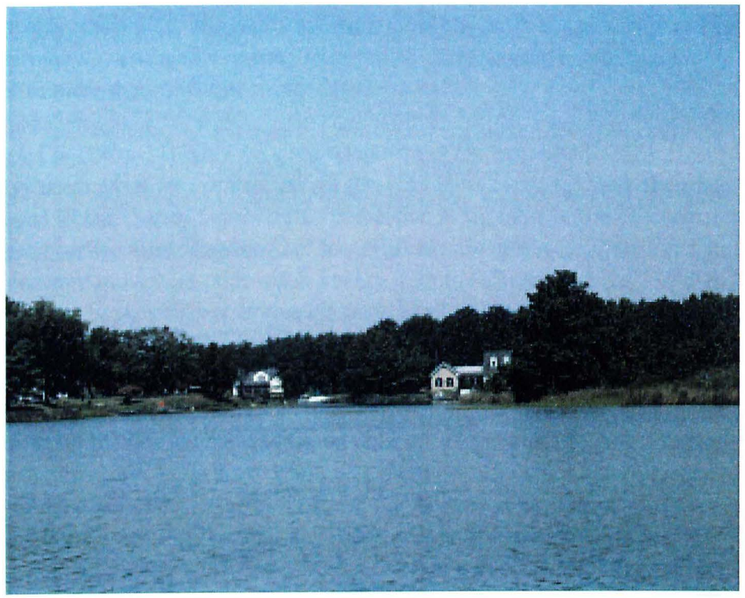
Shore Condition: The headlands of Iron Point and Burton Point have been defended with riprap and bulkheads. Structures have been installed at various other points along the shore. Most of the shoreline in Plate 9 is within Reach 33 (Figure 2). From Byrne and Anderson (1978), historic erosion rates along this reach equal 2.2 ft/yr. A comparison between Plates 9b and 9c indicate that beaches are absent in most areas where riprap and bulkheads have been installed. The longest stretch of beach is associated with a section where no shore protection structures have been constructed. There are relatively few piers in the area. Only 17 were surveyed. One boat ramp, south of Burton Point was observed. This appears to be a private access.

Entrance to Queens Creek

Plate 10

Location: 0.5 mile south of Burton Point to Winder Creek, including Queens Creek
Reaches: Mathews County Reach(s) 34 (partial) -37
Total shoreline miles: 11.56 miles
Shoreline miles surveyed: 10.91 miles
Survey Date(s): 10/13/98

Description: Plate 10 includes Hills Bay and Queens Creek in Mathews County. Hills Bay is exposed to long fetches from the northeast across the Chesapeake Bay. Queens Creek, oriented east-west, is a limited fetch environment. The upper reaches of Queens Creek could not be surveyed due to low water. Plate 10 is oriented nearly north south, with a two degree shift to the west. There is slight overlap at the northern edge of the plate with Plate 9. Attributes and features which overlap are reported for both plates.

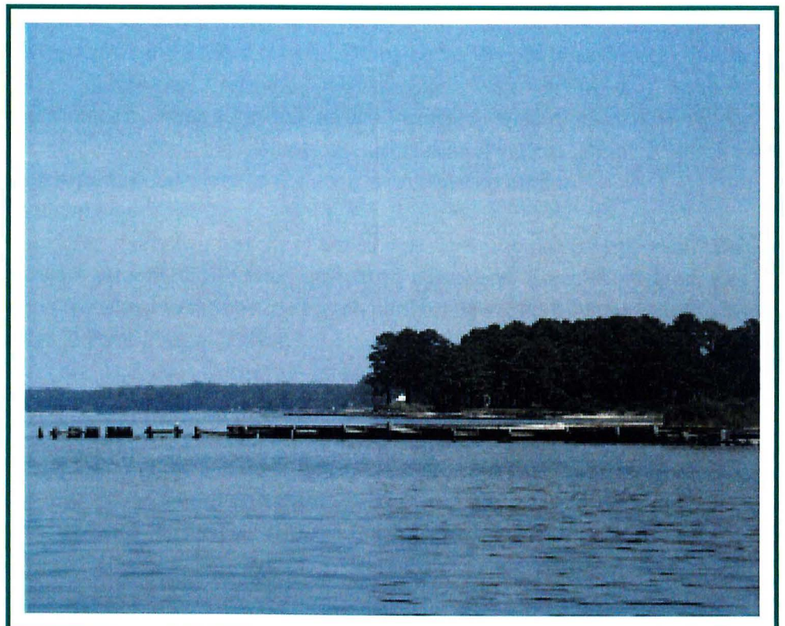


Queens Creek shoreline

Land Use: Land use here is primarily residential development. Residential areas were measured along 8.67 miles of shoreline, accounting for 79% of the land use. Numerous agricultural areas back the primary residential uses immediately adjacent to the shore. There are few well established forested buffers along these stretches.

Bank Condition: Queens Creek, and the banks along Hills Bay, are relatively low lying. Just over 10 miles of the area surveyed was determined to be less than five feet in height. No banks greater than 10 feet were mapped. Erosion of the banks was only found at the north entrance to Queens Creek. This eroding neck has nourished a small sandy beach. Stable fringe marshes offer protection along most of the shoreline and banks in Queens Creek.

Shore Condition: Historic erosion rates indicate erosion between the entrance of Queens Creek along the Hills Bay shoreline to approach 3.7 ft/yr. No rates are available for Queens Creek. Erosion south of Queens Creek to Winder Creek (Reach 36) is reported to be 1.3ft/yr (Byrne and Anderson, 1978). Portions of Hills Bay shoreline have been defended with riprap and bulkheads. Two short groinfields are present on the bay shoreline, and two breakwaters installed at the entrance to Winder Creek. There are few defense structures within Queens Creek. One hundred and forty-eight private docks, and 10 boat houses were surveyed. A small commercial marina is located in Queens Creek. At this time it is unknown if there are public launch sites within Queens Creek. Four ramps were, however, noted.



Beach at Islander Hotel on Gwynn Island

Plate 11

Location: ~ 0.30 mile east of Winder Creek, with Gwynn Island, Lane Creek, and Edward Creek.

Reaches: Mathews County Reach(s): 37 (partial) - 42, 313 (partial) -319 (partial), 326 (partial)-327.

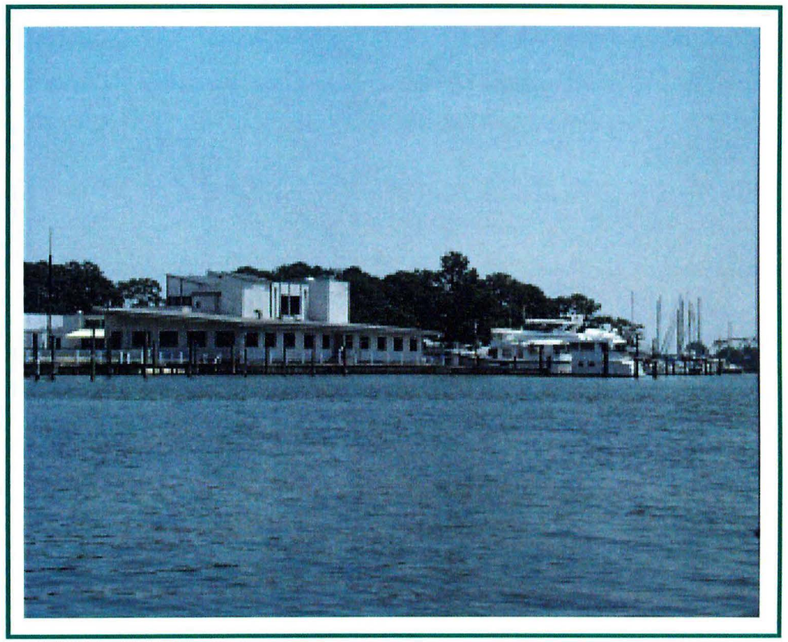
Total shoreline miles: 15.79 miles

Shoreline miles surveyed: 15.79 miles

Survey Date(s): 10/5/98, 10/12/98

Description: Gywnn Island is the dominant land mass in Plate 11, as well as the waterway known as Milford Haven. Both are very common to local people of Mathews County. The United State Coast Guard operates a facility on the mainland at the south side of the bridge going to the island. Exposure to northeast storms in Plate 11 is greatest along the Chesapeake Bay shore of Gwynn Island. Fetch from the north and northwest equal approximately 0.6 mile in either direction. The island offers protection to the mainland contiguous to the waterbody known as Milford Haven. Plate 11 includes approximately 0.28 mile of overlap with Plate 10 just east of Winder Creek. The plate has been rotated 42 degrees to the east.

Land Use: Plate 11 is dominated by residential land use which extends along most of the Chesapeake and Hills Bay shorelines. There is 1.46 miles of commercially developed shoreline which is concentrated in six major areas. Four of these are designated as marinas. At least one other is a business with water-related interests. Inland, Gwynn Island is a combination of rural residential



Islander Hotel and marina

housing, small agricultural areas, and concentrated forest stands. Lanes Creek is primarily residential. The southeast entrance of the creek has a number of large agricultural tracts with a riparian forest buffer ranging from approximately 75 feet to more than 250 feet thick.

Bank Condition: This is a very low-lying area of the watershed. Bank elevations everywhere are 5 feet or less, except for 1.35 miles along the west shore of Gwynn Island. Sandy beaches offer protection along most of the exposed areas. These beaches, while classified as "low erosion", are understood to be in a state of constant movement under wave energy from the Chesapeake Bay. Undercutting of the bank is evident at small isolated areas in Lanes Creek, and along the southwest shore of Milford Haven.

Shore Condition: High historic erosion rates of 7.1 ft/yr are reported for Reach 326 along the Bay shoreline of Gwynn Island. These rates measure recession of the shoreline over 90 years of change. Cherry Point (Reach 327) at the north tip of the island is accreting at a rate of 1.3 ft/yr. The western shore of Gwynn Island has erosion rates up to 2.1 ft/yr recorded. Erosion within Lanes Creek was estimated to be 1.4 ft/yr. Shore protection is in place along the western shore of the island. Several groin fields have been constructed in combination with existing riprap and bulkheads. Nearly one third of the shoreline in Plate 11 has been defended. One hundred and forty-three docks are in place, along with eight boathouses. There are seven boat ramps. A public launch is located on the southeast side of the bridge on Gwynn Island.

Plate 12

Location: southeastern portion of Gwynn Island, Milford Haven, and the entrance to Stutts Creek
Reaches: Mathews County Reach(s) 317 - 326 (partial)
Total shoreline miles: 18.41 miles
Shoreline miles surveyed: 18.41 miles
Survey Date(s): 10/5/98, 10/12/98

Description: Plate 12 actually extends outside of the true entrance to the Piankatank River Watershed, and was included here to complete the coverage of Gwynn Island and Milford Haven. The eastern shores of this area are dynamic in nature, with fetches stretching across the Chesapeake from the east, northeast, and southeast. Plate 12 includes a considerable amount of overlap with Plate 11, especially along the Milford Haven shoreline of Gwynn Island. Plate 12 has been rotated 67 degrees to the west for publication purposes.

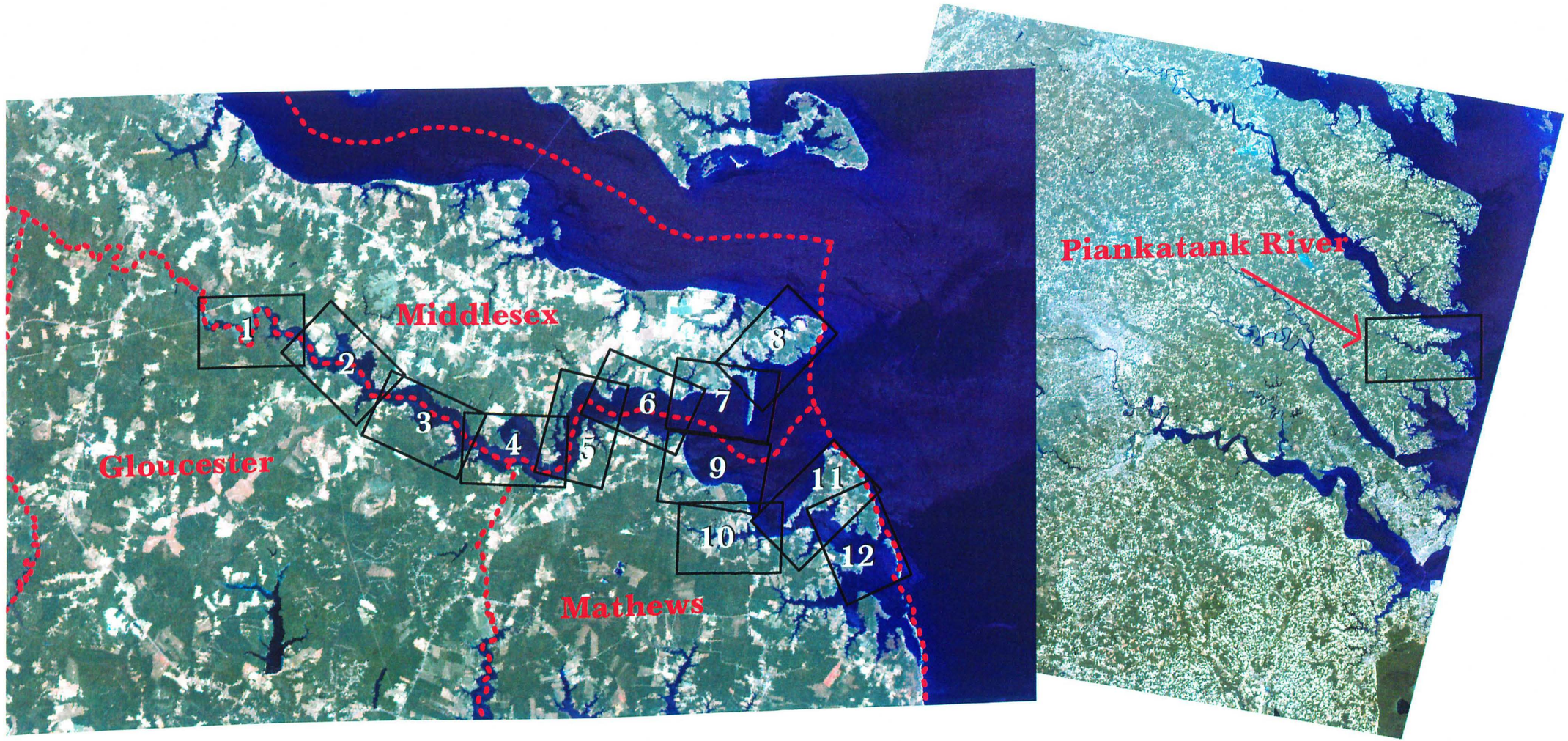
Land Use: Forty-five percent of the land use in this region is residential. Many plats are associated with small agricultural operations. Scrub-shrub dominates along the island formed by the breach north of Sandy Point. Scrub also dominates at Point Breeze. Forest cover lines less than 2.20 miles of shoreline, and there are six commercial establishments.

Bank Condition: This is an area with low elevation, with no banks exceeding 5 feet. Erosion of the banks are minimum considering the degree of exposure in this area. Beaches offer extensive protection to wave energy, as do the fringe marshes inside the creek, and the major waterway.

Shore Condition: Of the 18.41 miles of shoreline surveyed, only 3.67 miles is protected with structures. This does not include approximately 0.40 miles of groinfields which have been installed. The longest of these is located along the eastern shore of Gwynn Island. Accretion on the north side of the groins suggest an adequate supply of sediment updrift, and effective placement of the groins. Historic erosion rates inside Milford Haven do not exceed 1.5 ft/yr, and are just over 7.0 ft/yr on the eastern shore of Gwynn Island from Cherry Point to Sandy Point (Byrne and Anderson, 1978). Construction of piers is greatest inside Milford Haven, and the surrounding creeks. There are 83 surveyed, and an additional 8 boathouses. The two ramps surveyed are privately owned.

Collecting data with Trimble's Geo Explorer GPS unit

Piankatank River
Plate Index



N

Scale

5 0 Miles

1 : 175000

Landsat Thematic Mapper Scene: TM1534_07_14_97

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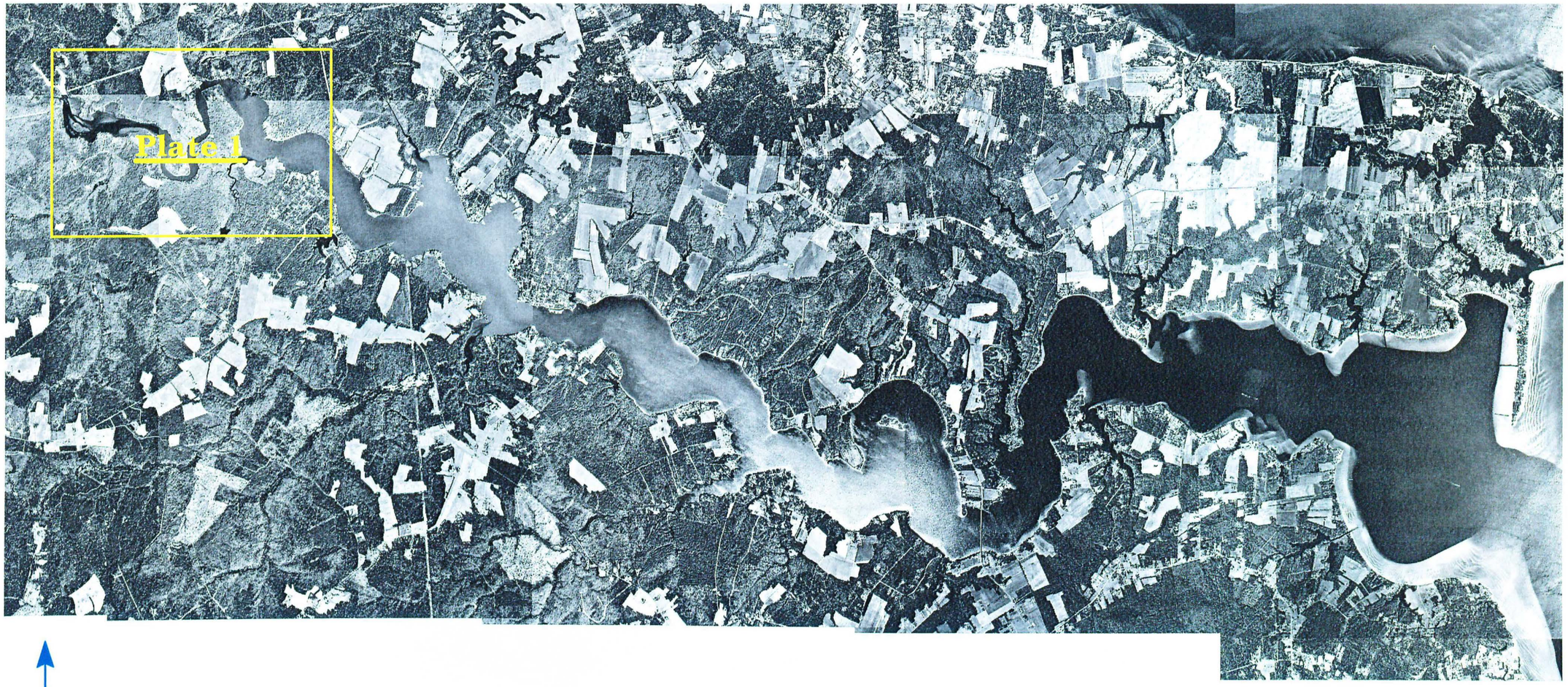
Location Map
Piankatank River
Plate 1



N

Scale

1 0 1 Miles

1 : 65000

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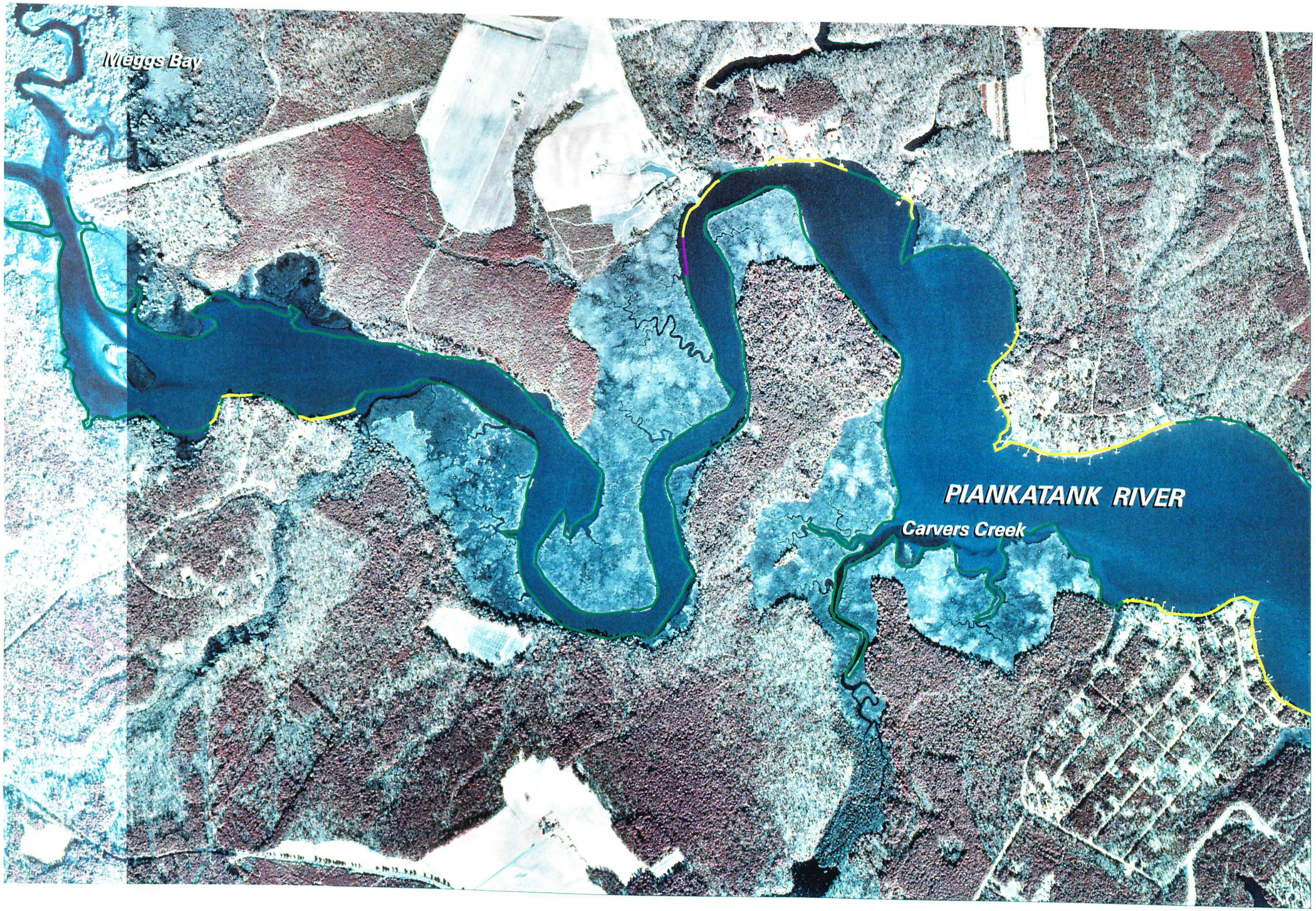

PIANKATANK RIVER
PLATE 1a

Riparian Land Use

Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

N

Scale

1,000 0 1,000 Fe

1:12,000

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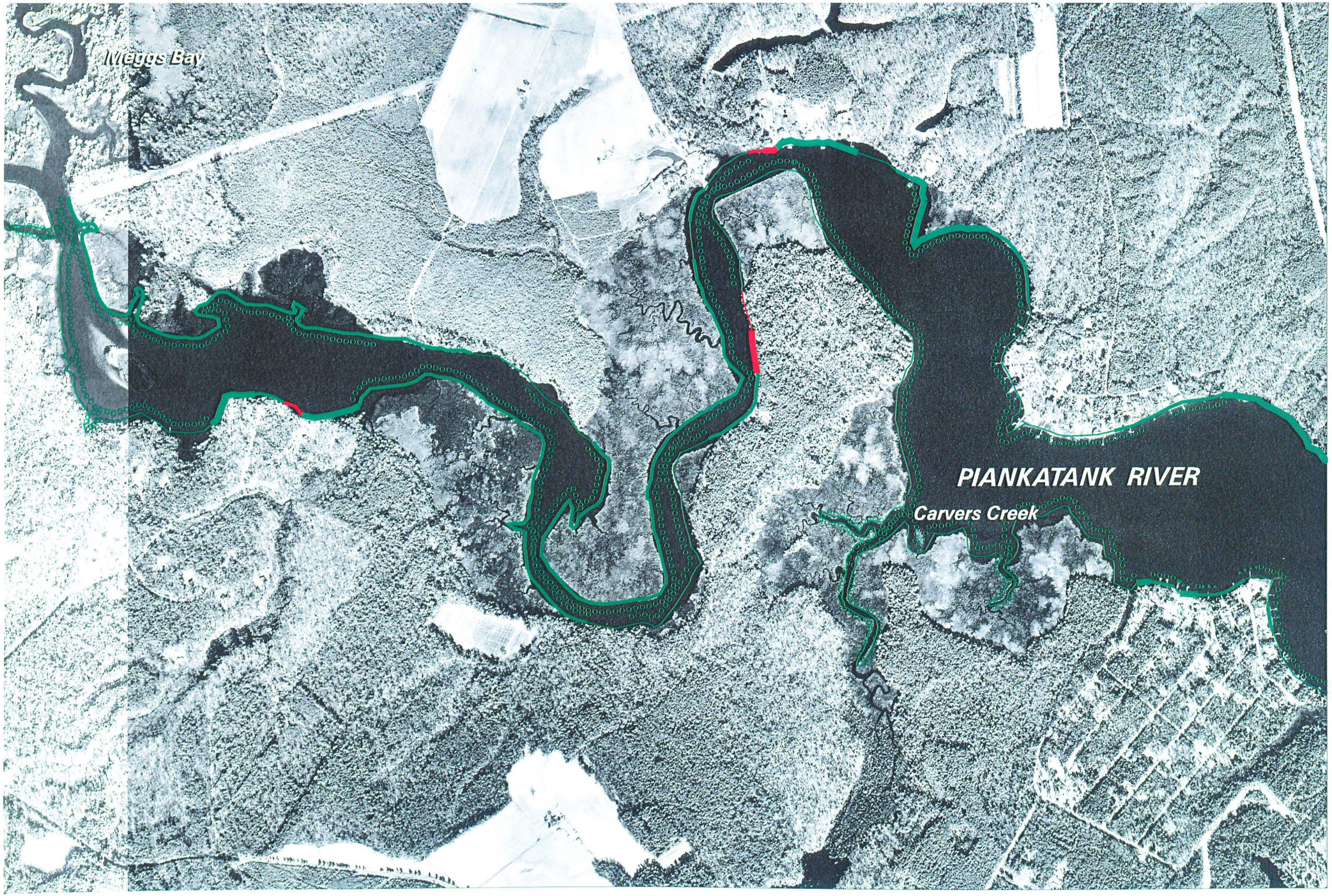
PIANKATANK RIVER
PLATE 1b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

N

Scale

1,000 0 1,000 Feet

1:12,000

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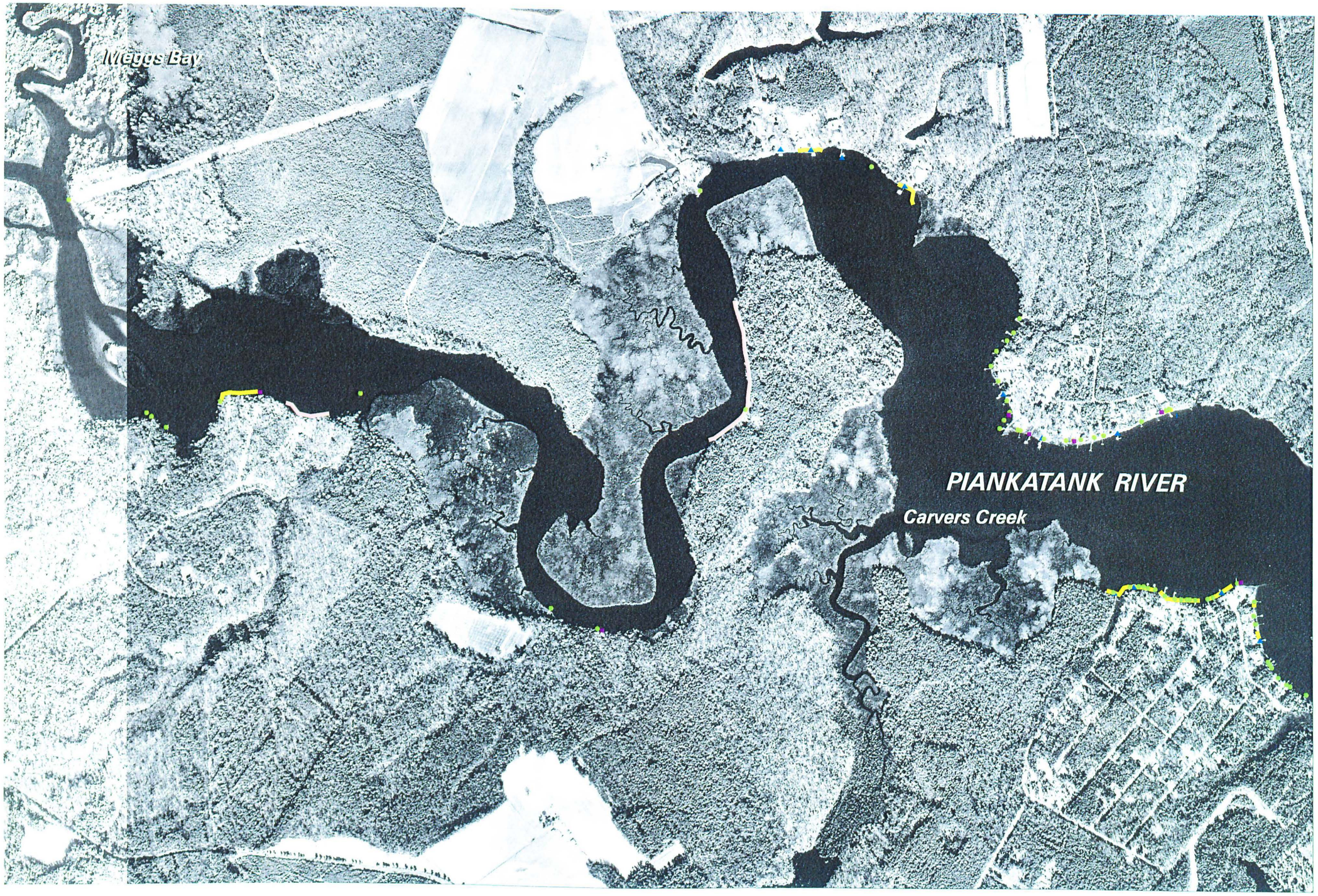

PIANKATANK RIVER
PLATE 1c

Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- boathouse
- pier/wharf
- boat ramp

N

Scale

1,000 0 1,000 Feet

1:12,000

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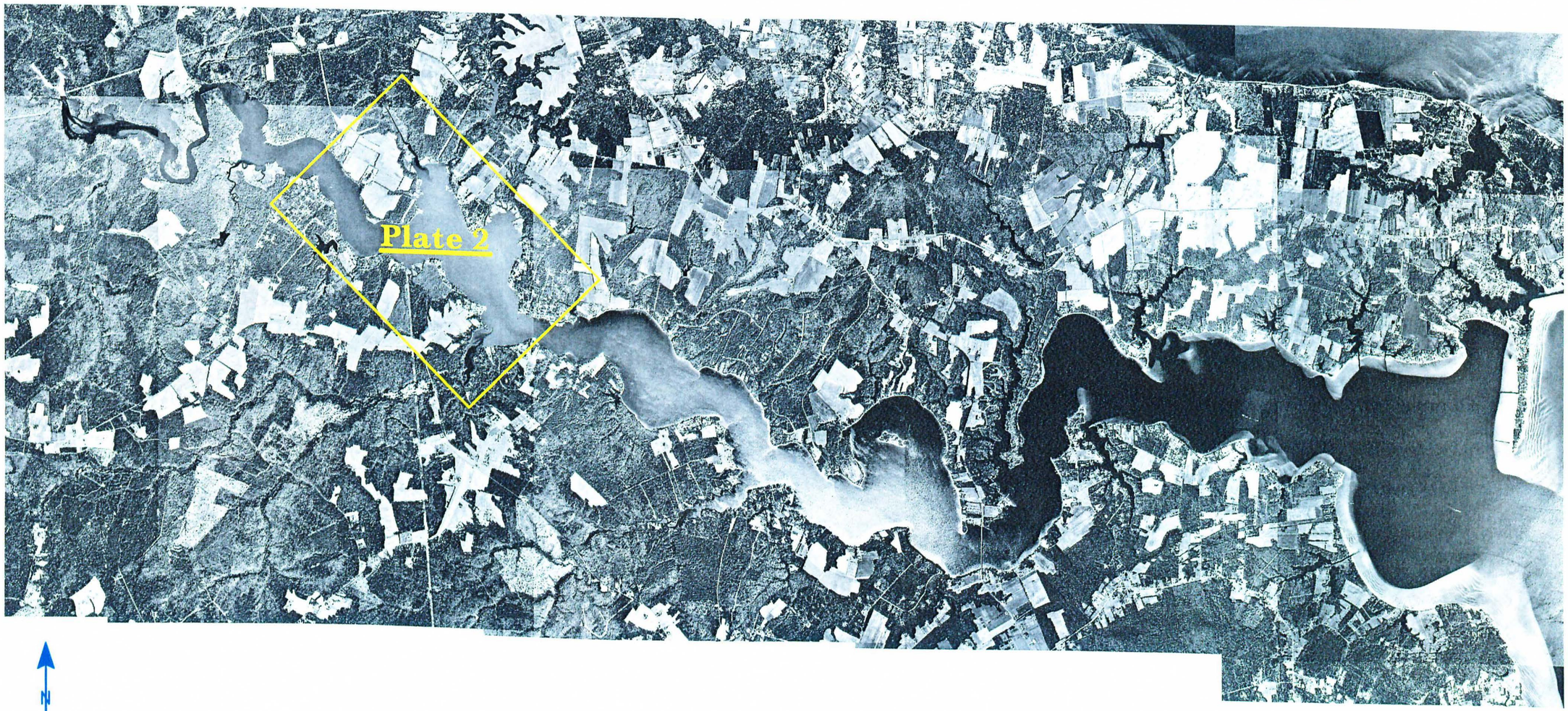
Location Map
Piankatank River
Plate 2



N

Scale

1 0 1 Miles

1 : 65000

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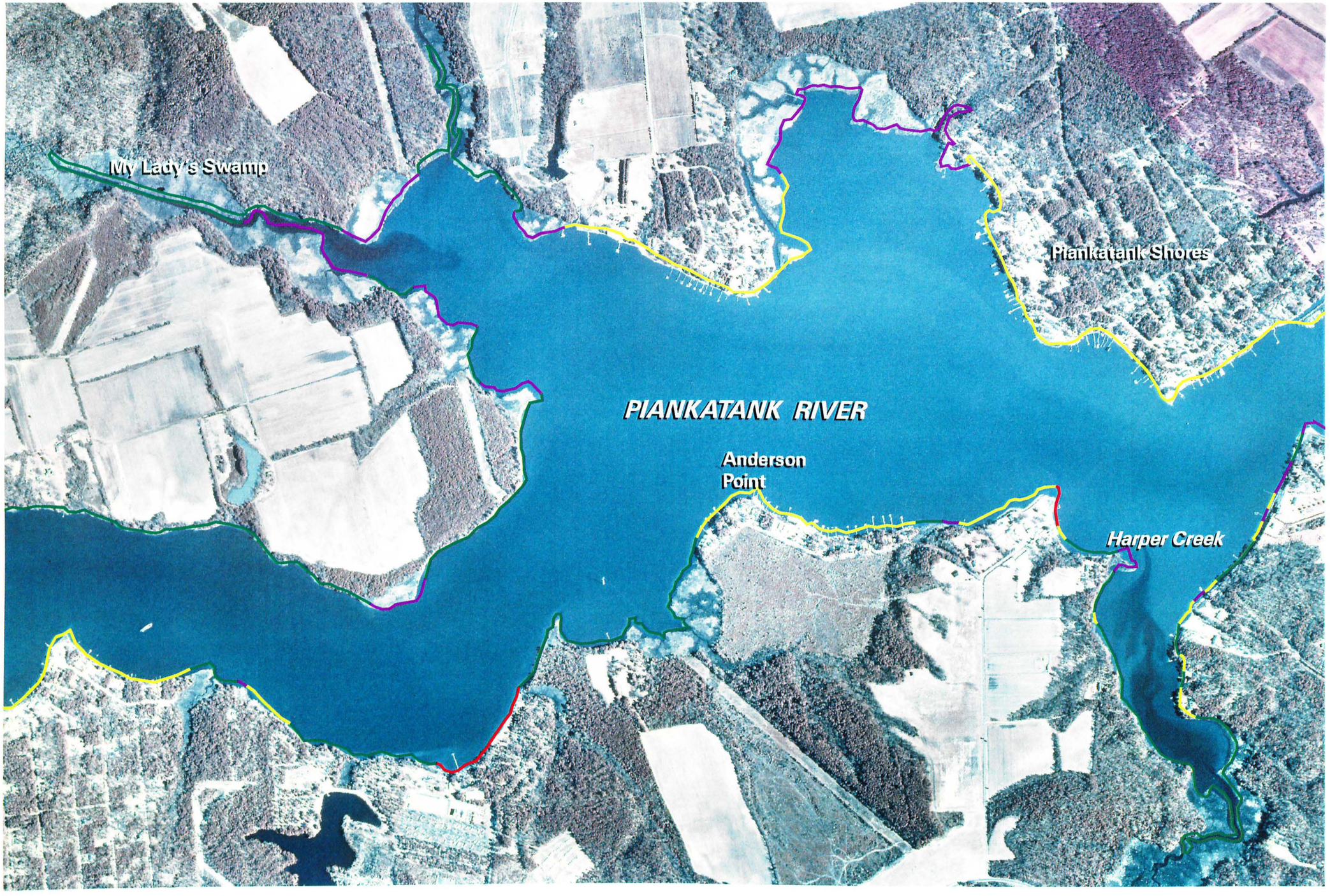
PIANKATANK RIVER
PLATE 2a

Riparian Land Use



Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

Scale

1,000 0 1,000 Feet

1:12,000

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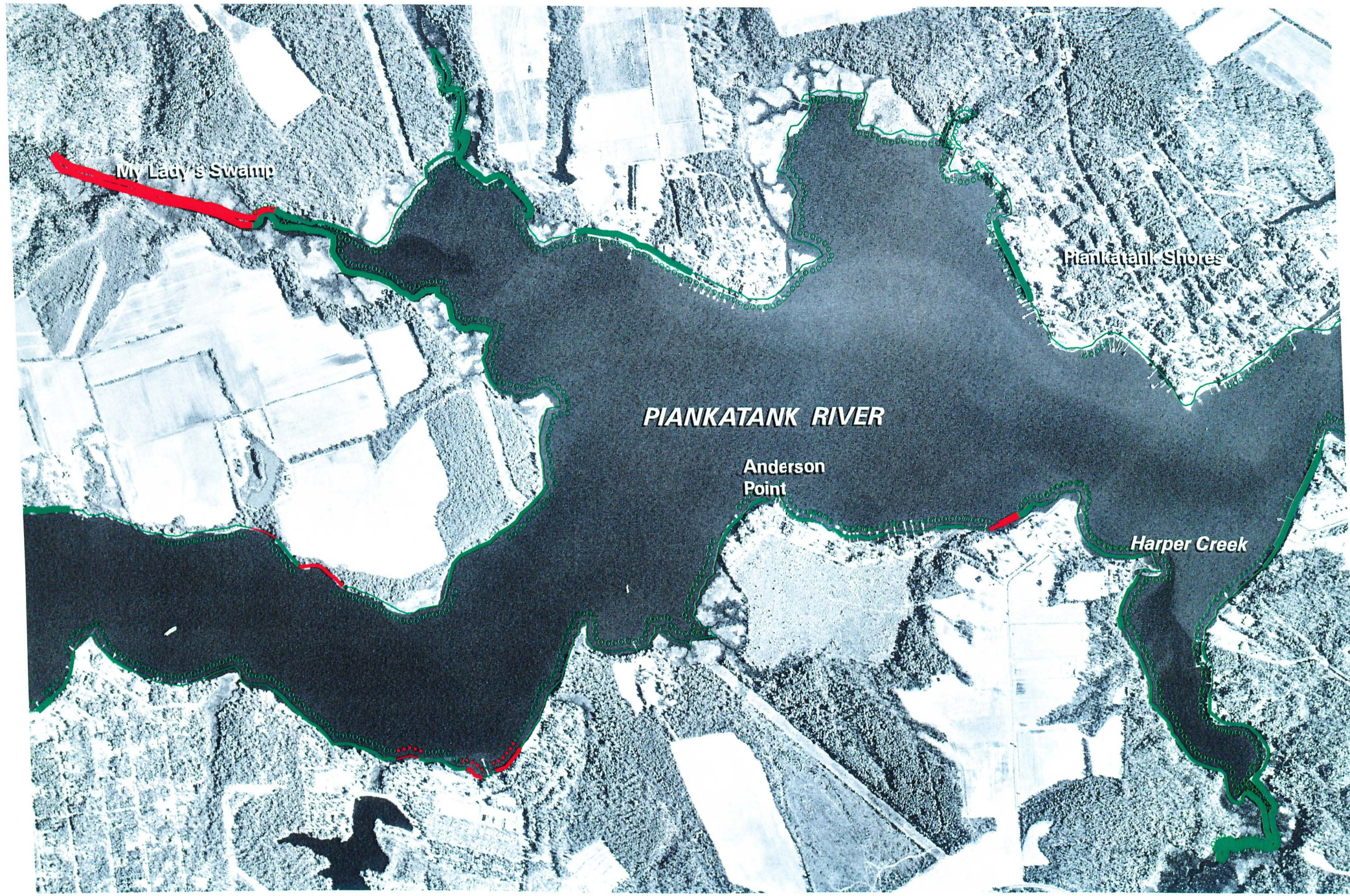
PIANKATANK RIVER
PLATE 2b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

Scale

1,000 0 1,000 Fee

1:12,000

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PIANKATANK RIVER
PLATE 2c

Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- boathouse
- pier/wharf
- boat ramp

Scale

1,000 0 1,000 Feet

1:12,000

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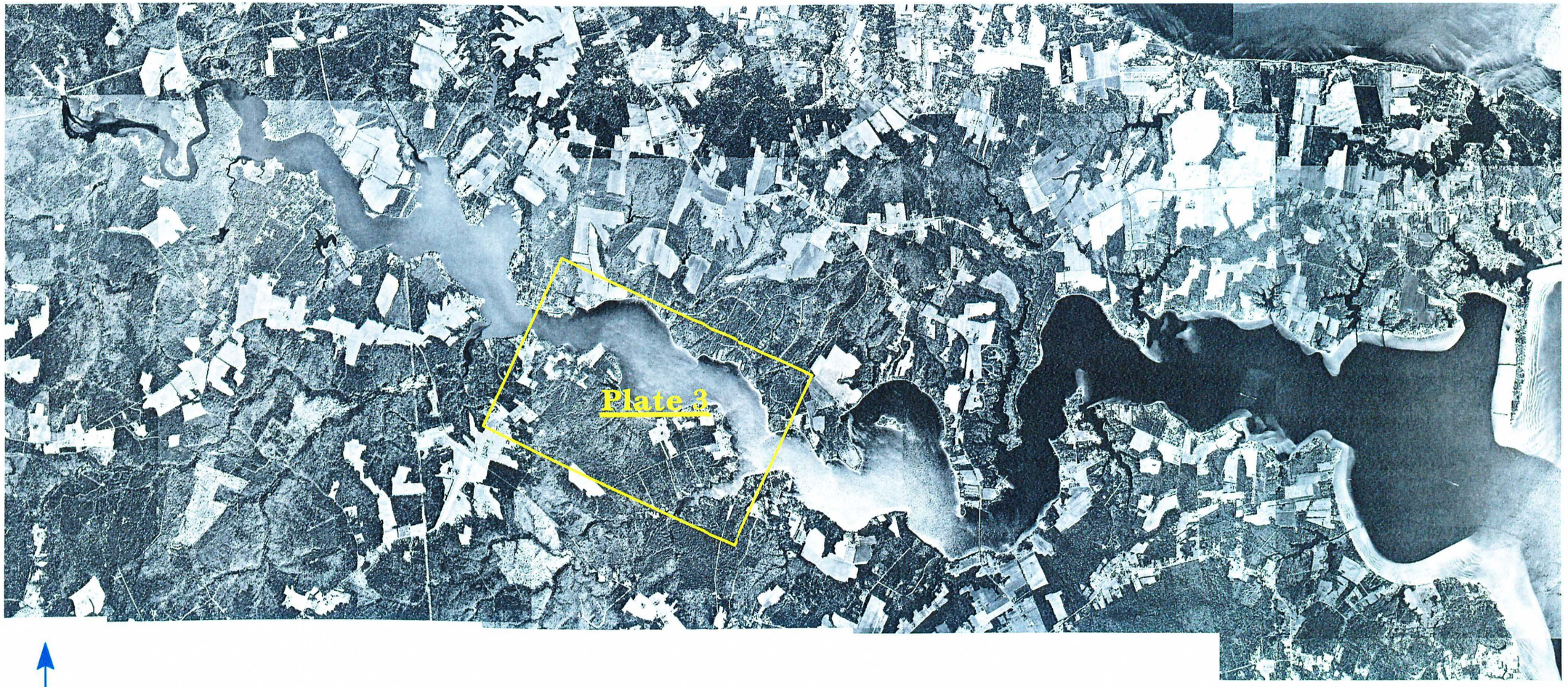
Location Map
Piankatank River
Plate 3



N

Scale

1 0 1 Miles

1 : 65000

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PIANKATANK RIVER
PLATE 3a

Riparian Land Use

Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

Scale

1,000 0 1,000 Feet

1:12,000

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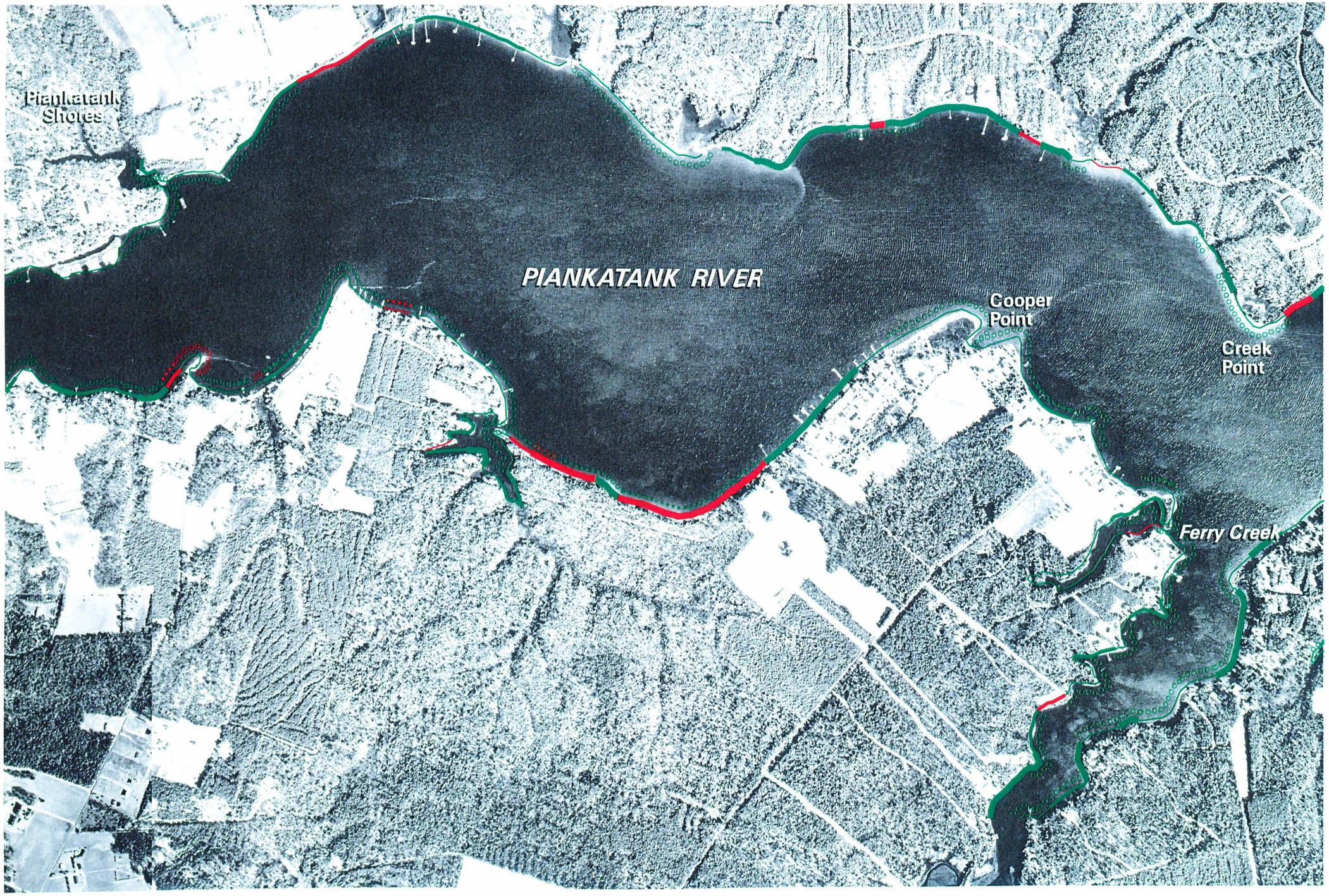
PIANKATANK RIVER
PLATE 3b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

Scale

1,000 0 1,000 Feet

1:12,000

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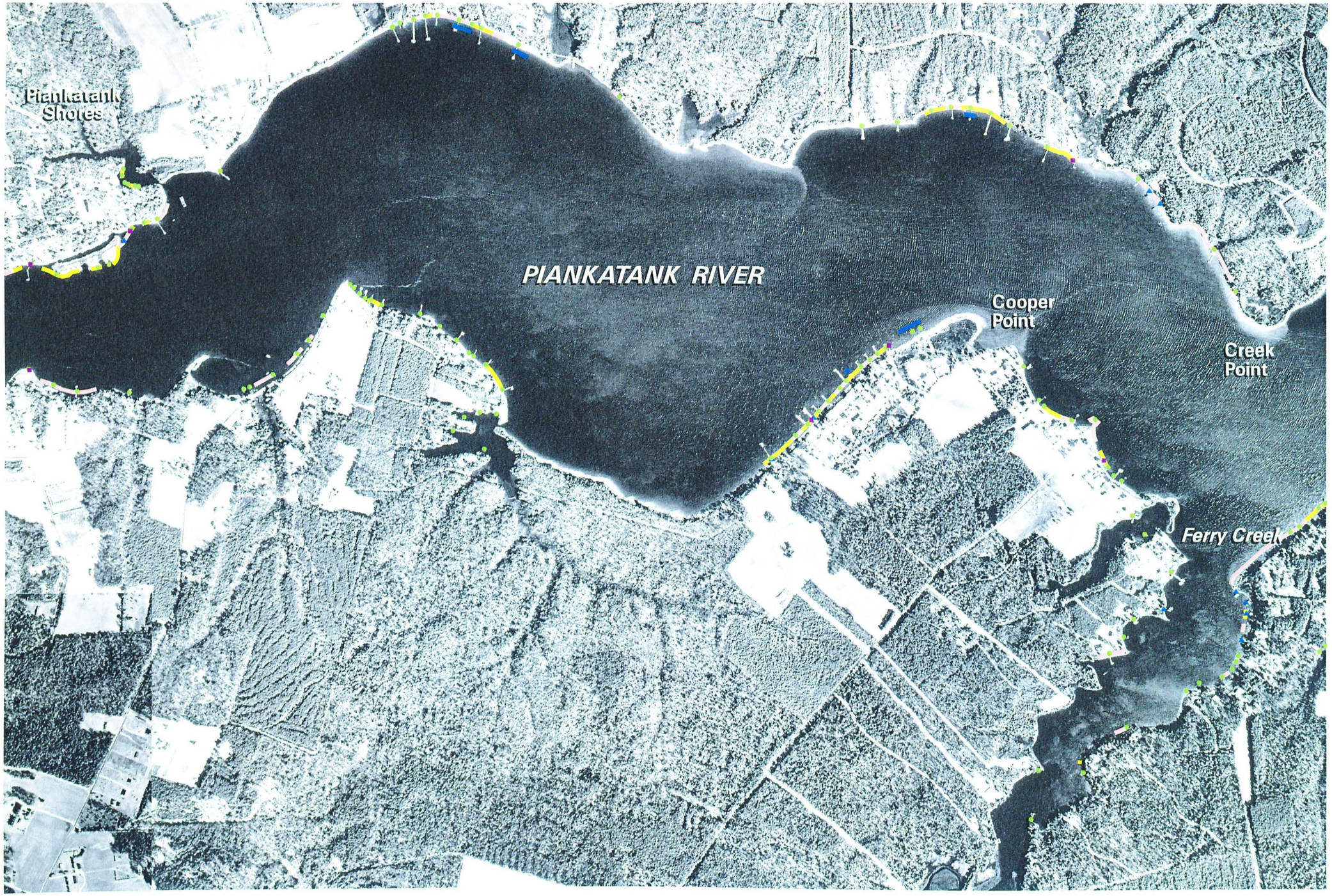
PIANKATANK RIVER
PLATE 3c

Shoreline Features



Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- boathouse
- pier/wharf
- boat ramp

Scale

1,000 0 1,000 Feet

1:12,000

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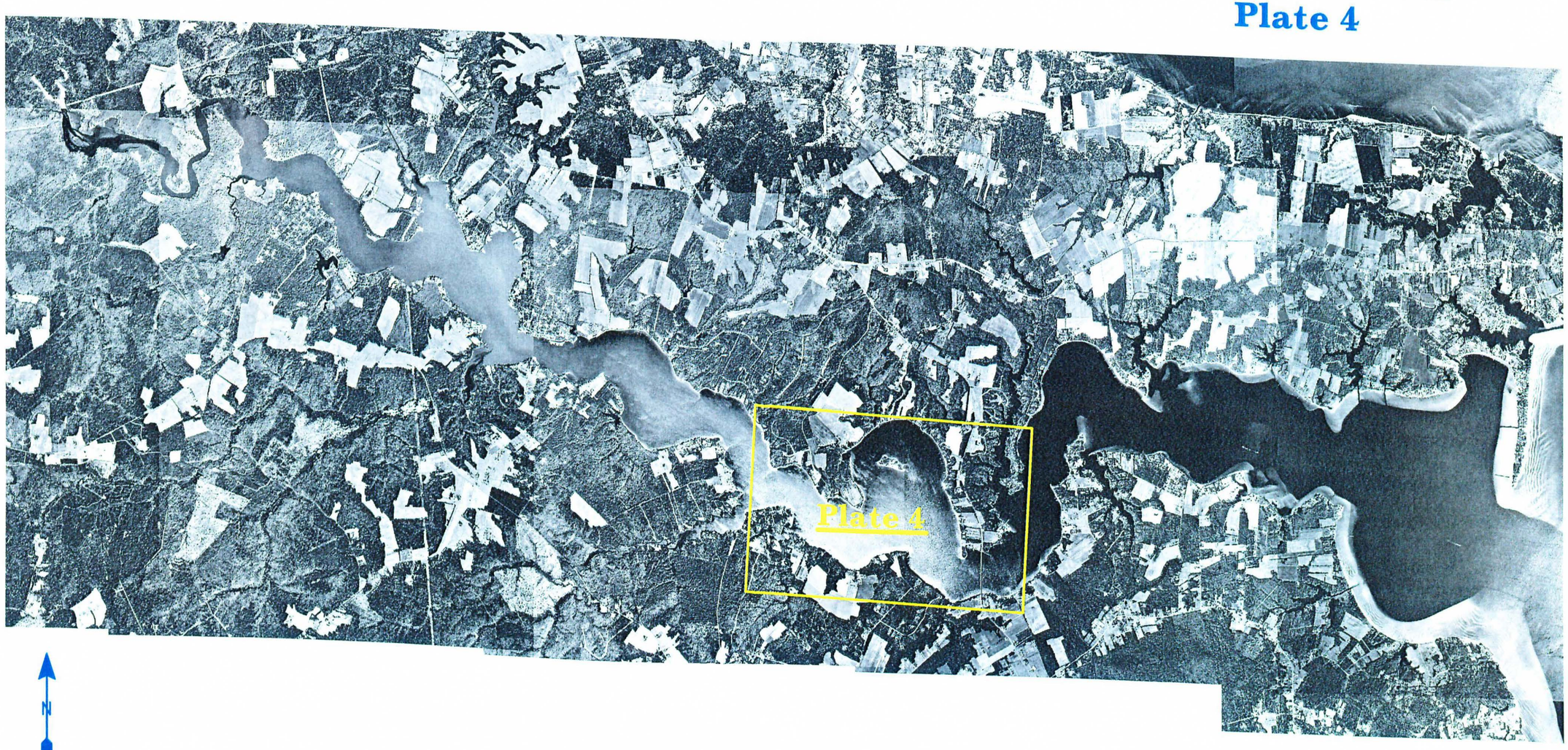
Location Map
Piankatank River
Plate 4



N

Scale

1 0 1 Miles

1 : 65000

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PIANKATANK RIVER
PLATE 4a

Riparian Land Use

Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

N

Scale

1,000 0 1,000

1:12,000

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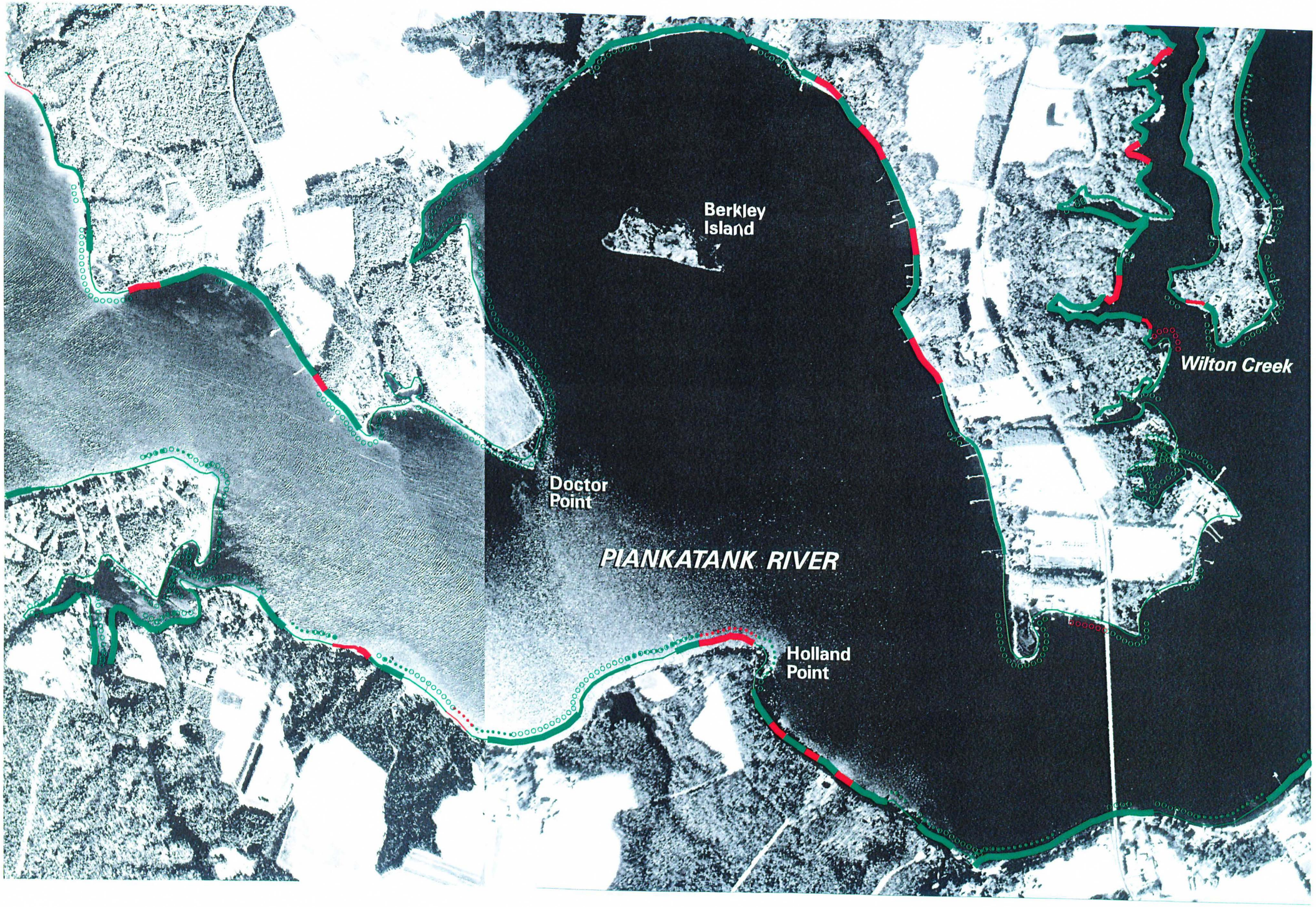
PIANKATANK RIVER
PLATE 4b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

N

Scale

1,000 0 1,000 Fe

1:12,000

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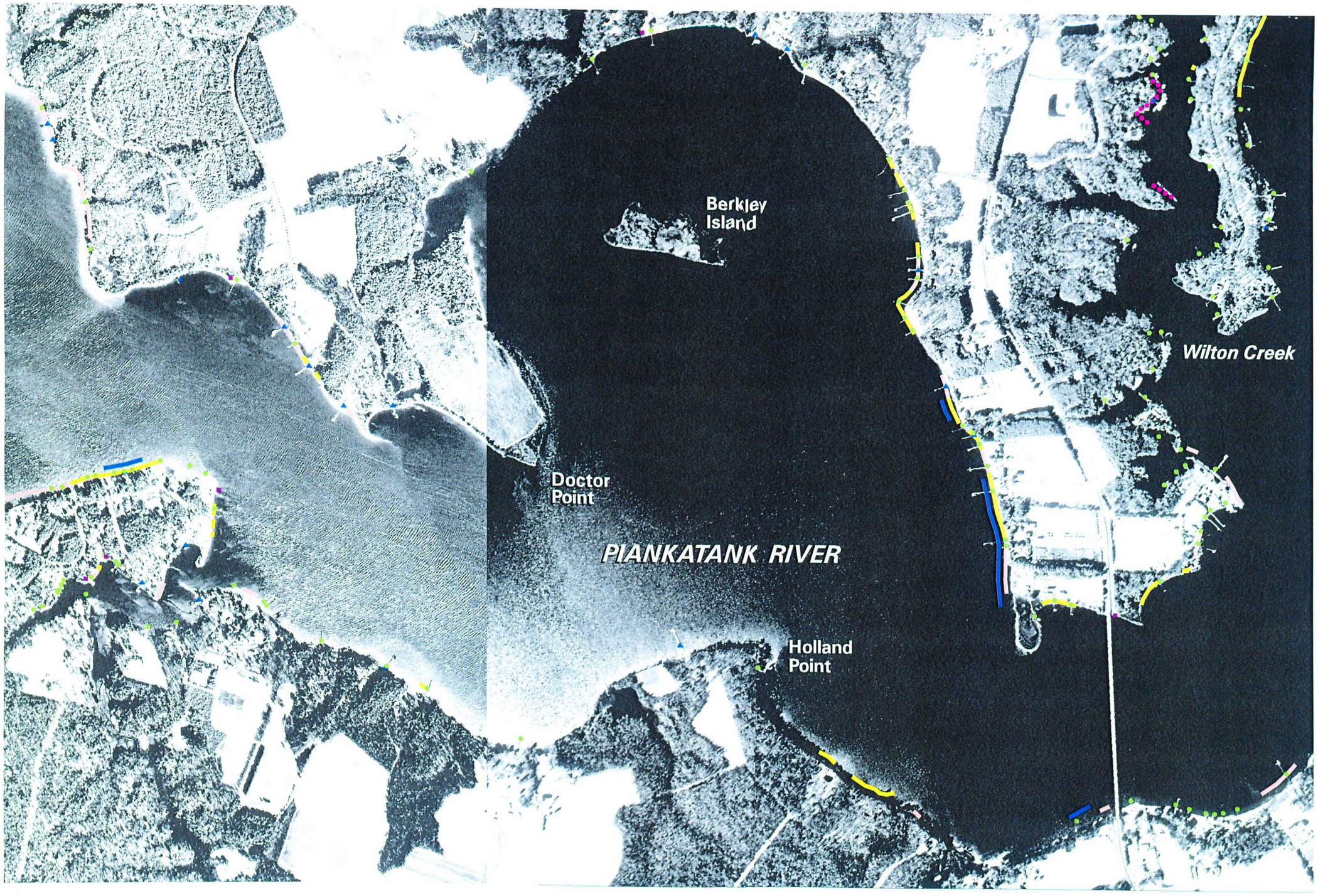
PIANKATANK RIVER
PLATE 4c



Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- boathouse
- pier/wharf
- boat ramp

N

Scale

1,000 0 1,000 Feet

1:12,000

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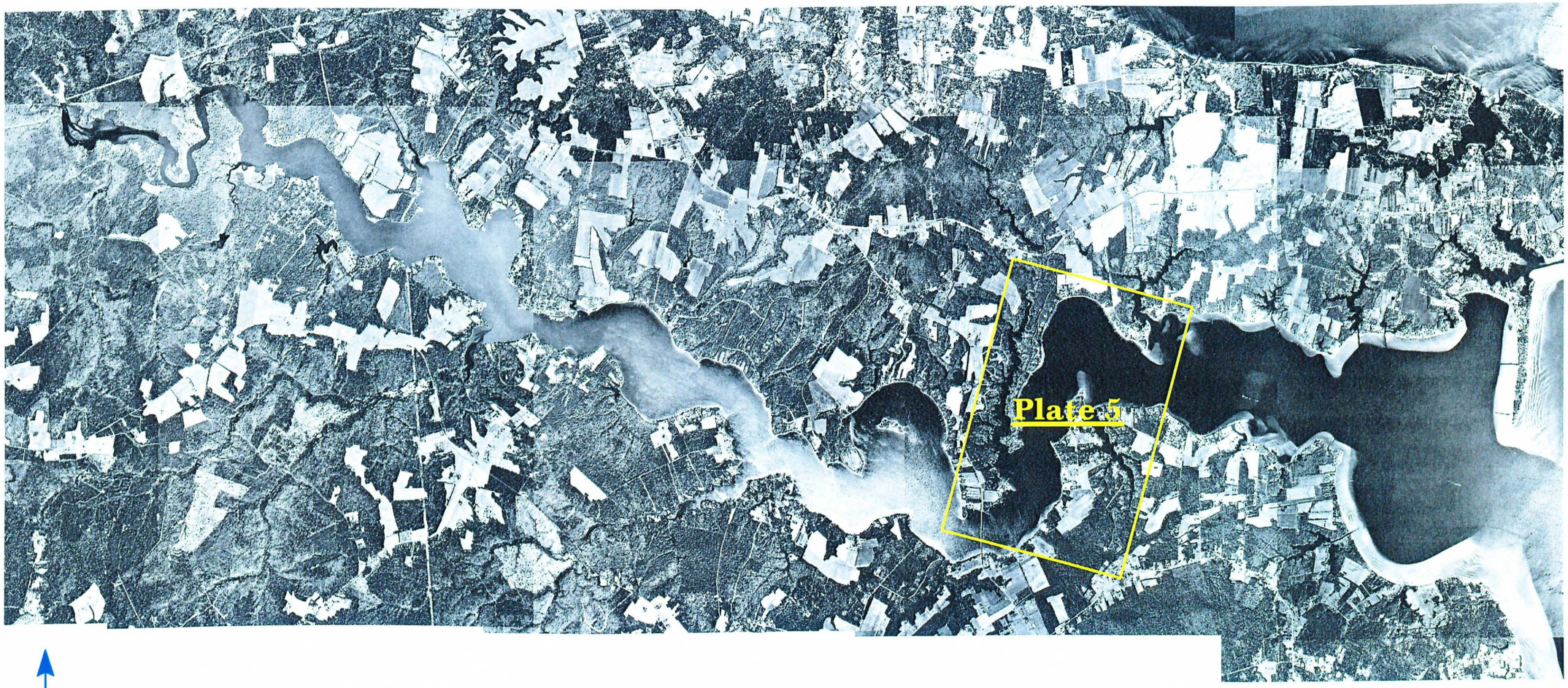
Location Map
Piankatank River
Plate 5



N

Scale

1 0 1

Miles

1 : 65000

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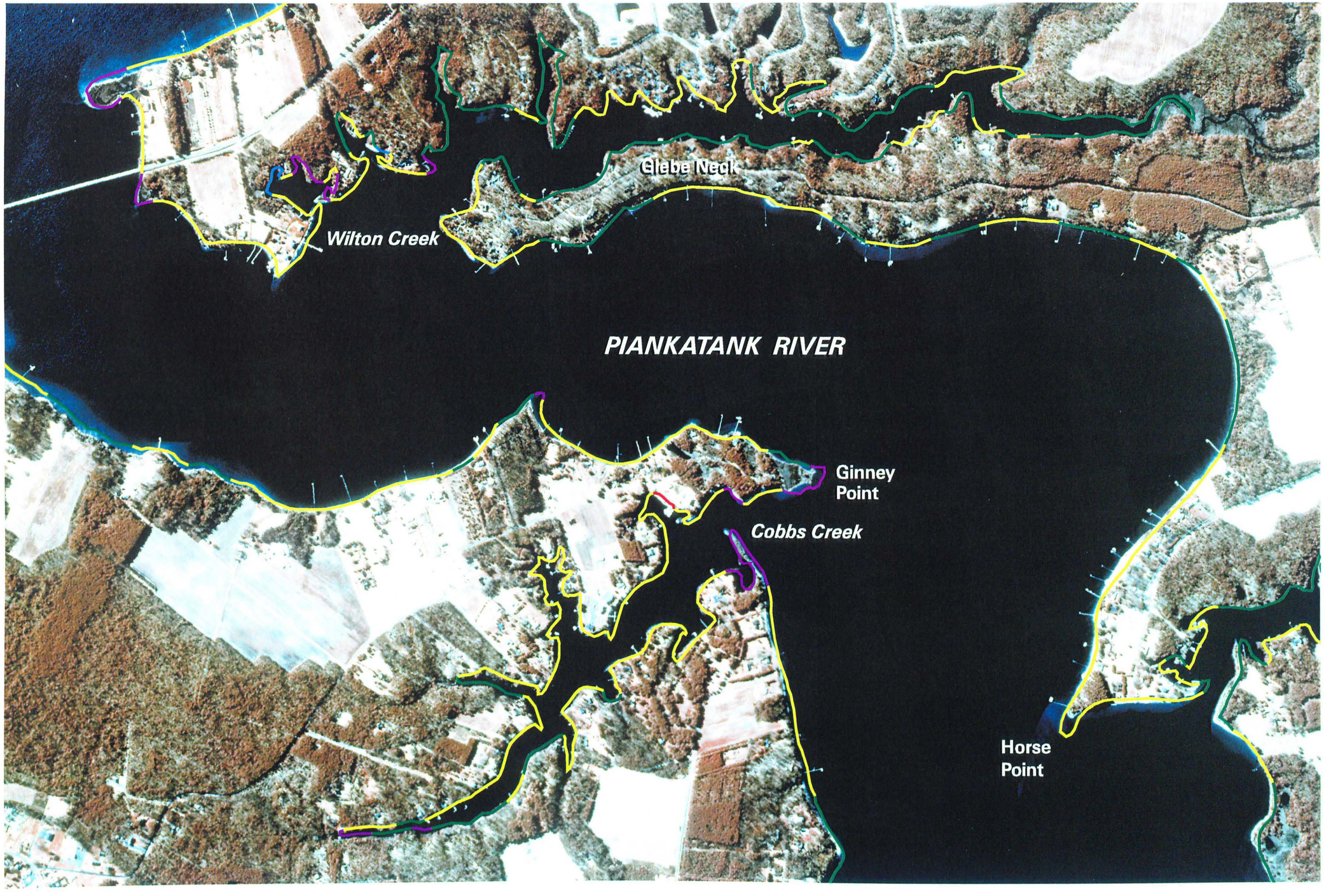
PIANKATANK RIVER
PLATE 5a

Riparian Land Use



Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

Scale

1,000 0 1,000 Feet

1:12,000

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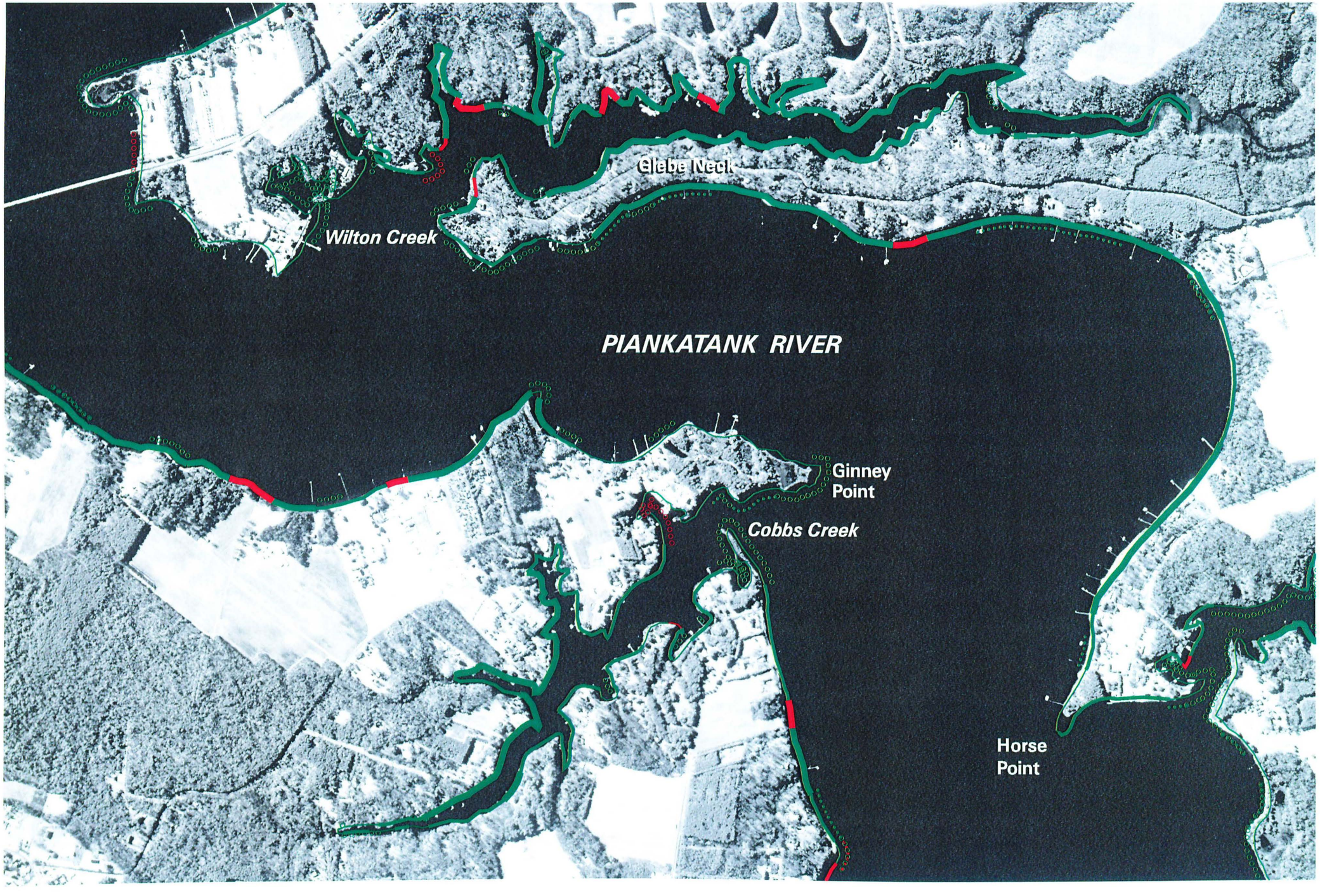
PIANKATANK RIVER
PLATE 5b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

N

Scale

1,000 0 1,000 Feet

1:12,000

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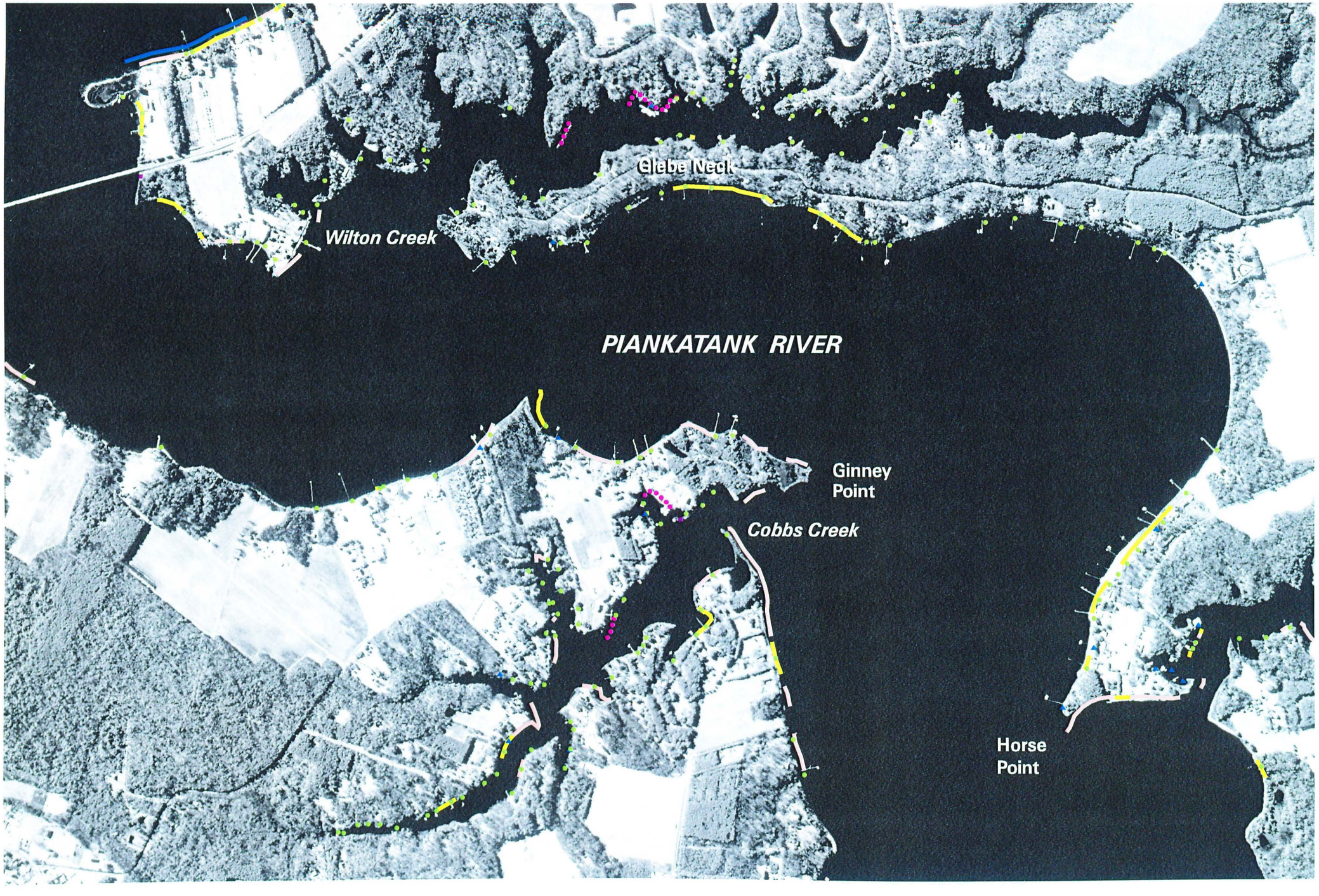
PIANKATANK RIVER
PLATE 5c



Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- boathouse
- pier/wharf
- boat ramp

Scale

1,000 0 1,000 Feet

1:12,000

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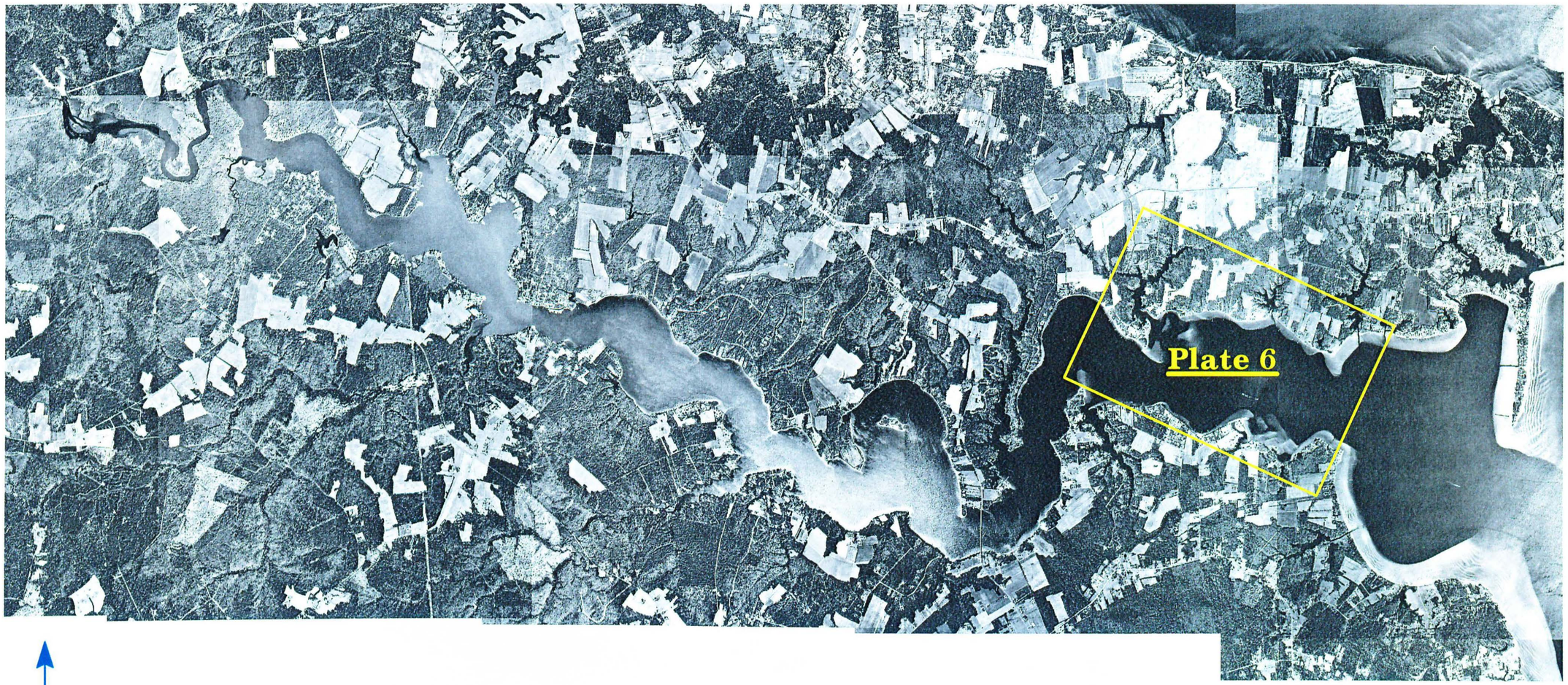
Location Map
Piankatank River
Plate 6



N

Scale

1 0 1 Miles

1 : 65000

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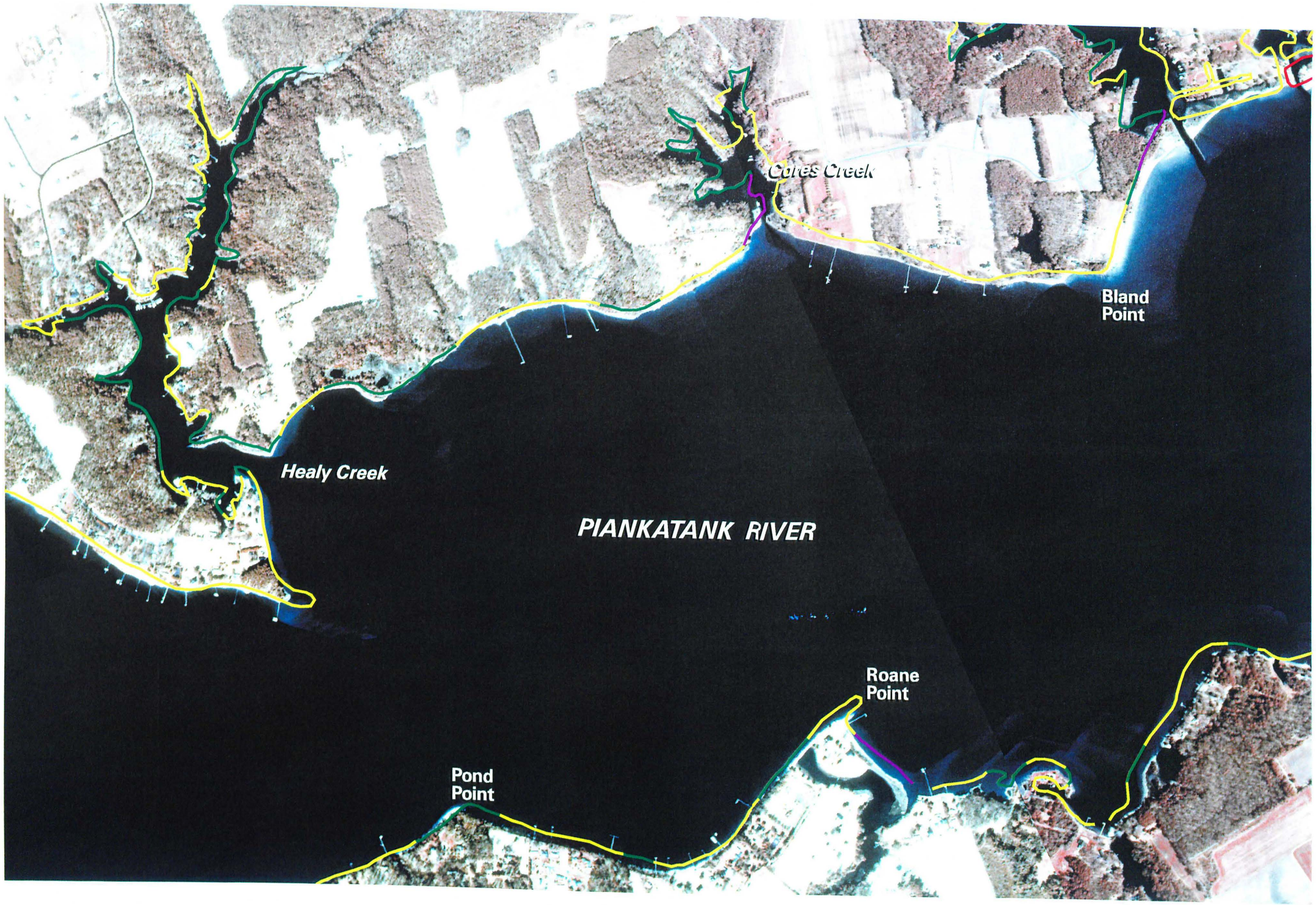
PIANKATANK RIVER
PLATE 6a

Riparian Land Use



Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

Scale

1,000 0 1,000 Fe

1:12,000

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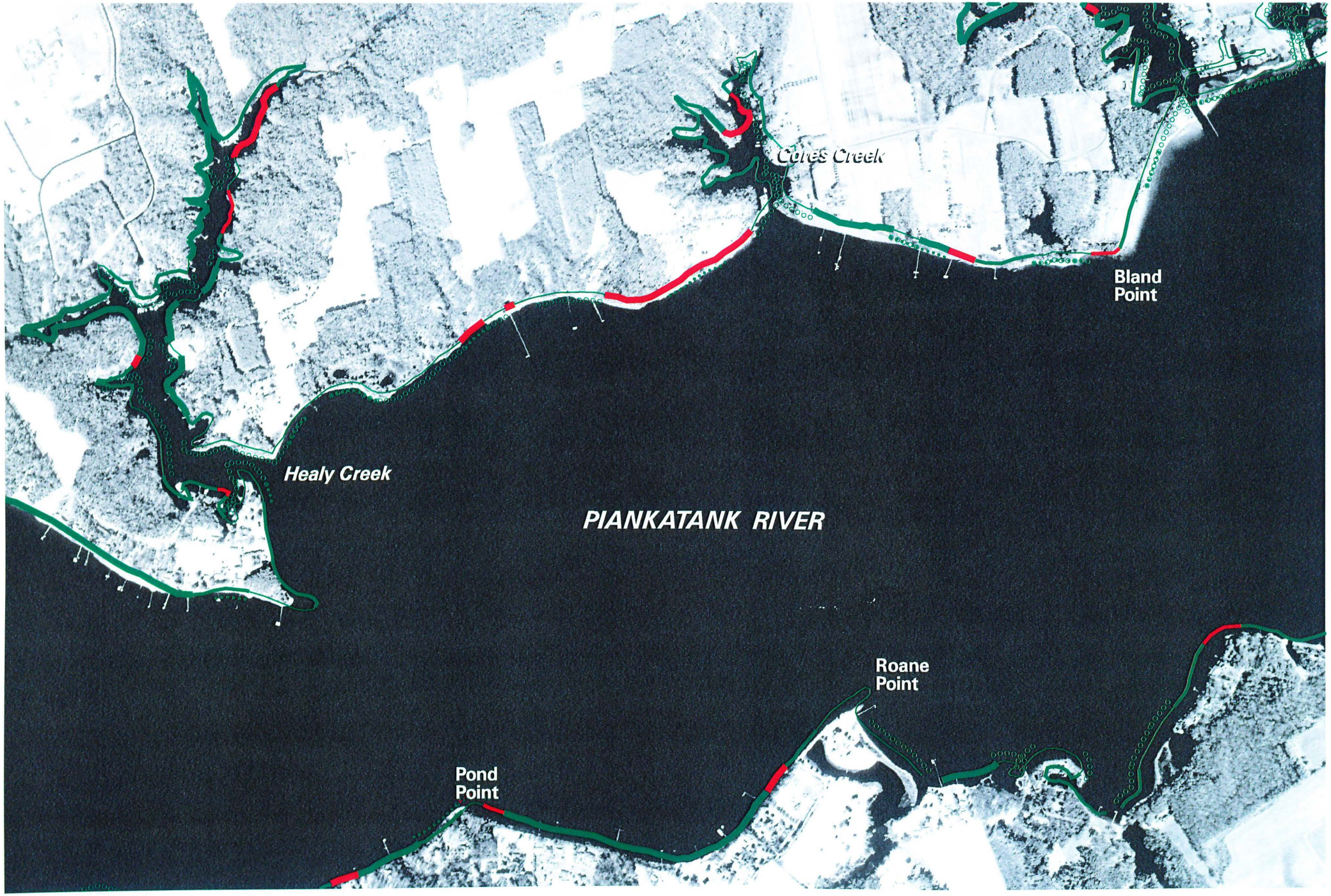
PIANKATANK RIVER
PLATE 6b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

Scale

1,000 0 1,000 Feet

1:12,000

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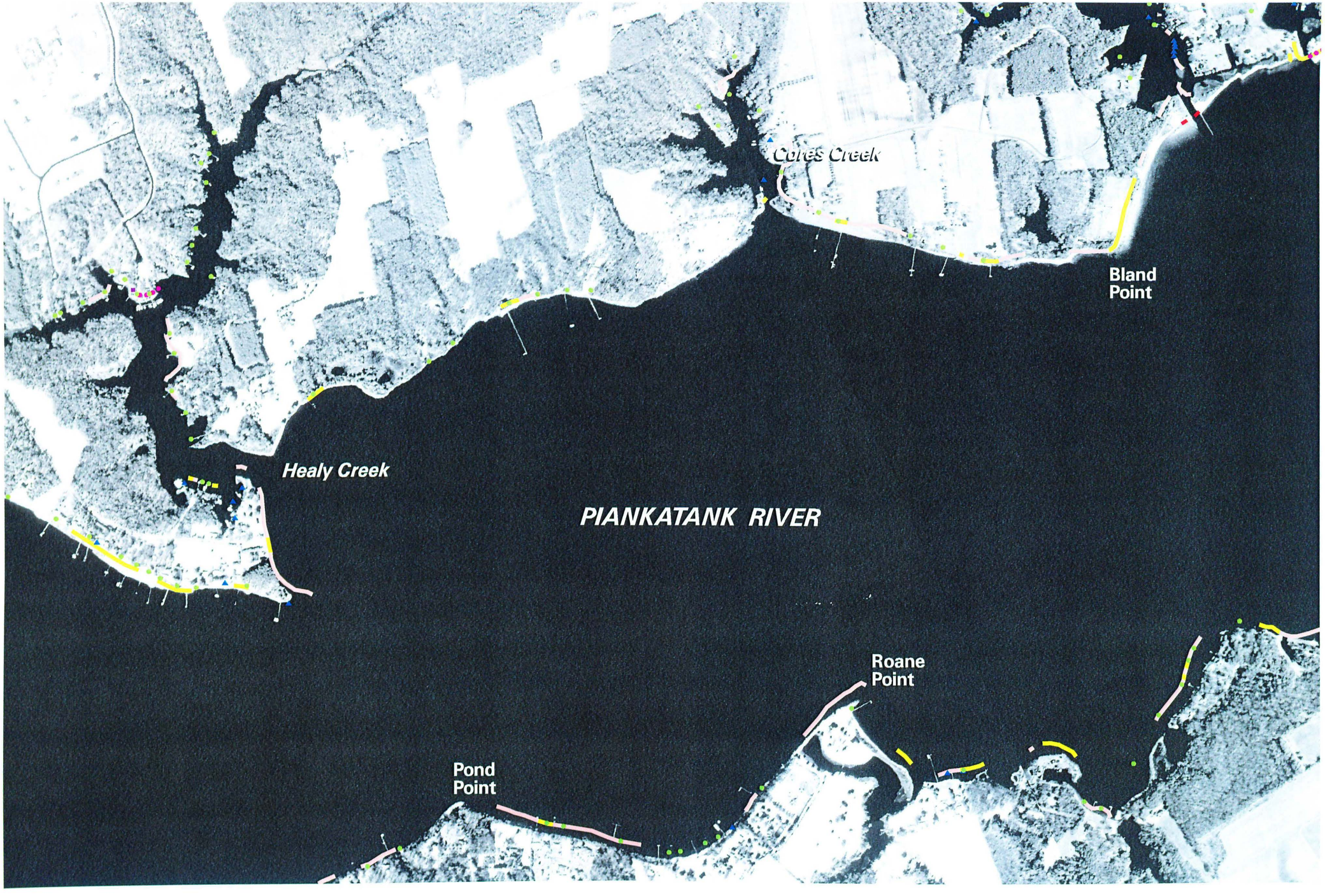
PIANKATANK RIVER
PLATE 6c



Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- jetty
- boathouse
- pier/wharf
- boat ramp

Scale

1,000 0 1,000 Feet

1:12,000

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Location Map
Piankatank River
Plate 7

N

Scale

1 0 1 Miles

1 : 65000

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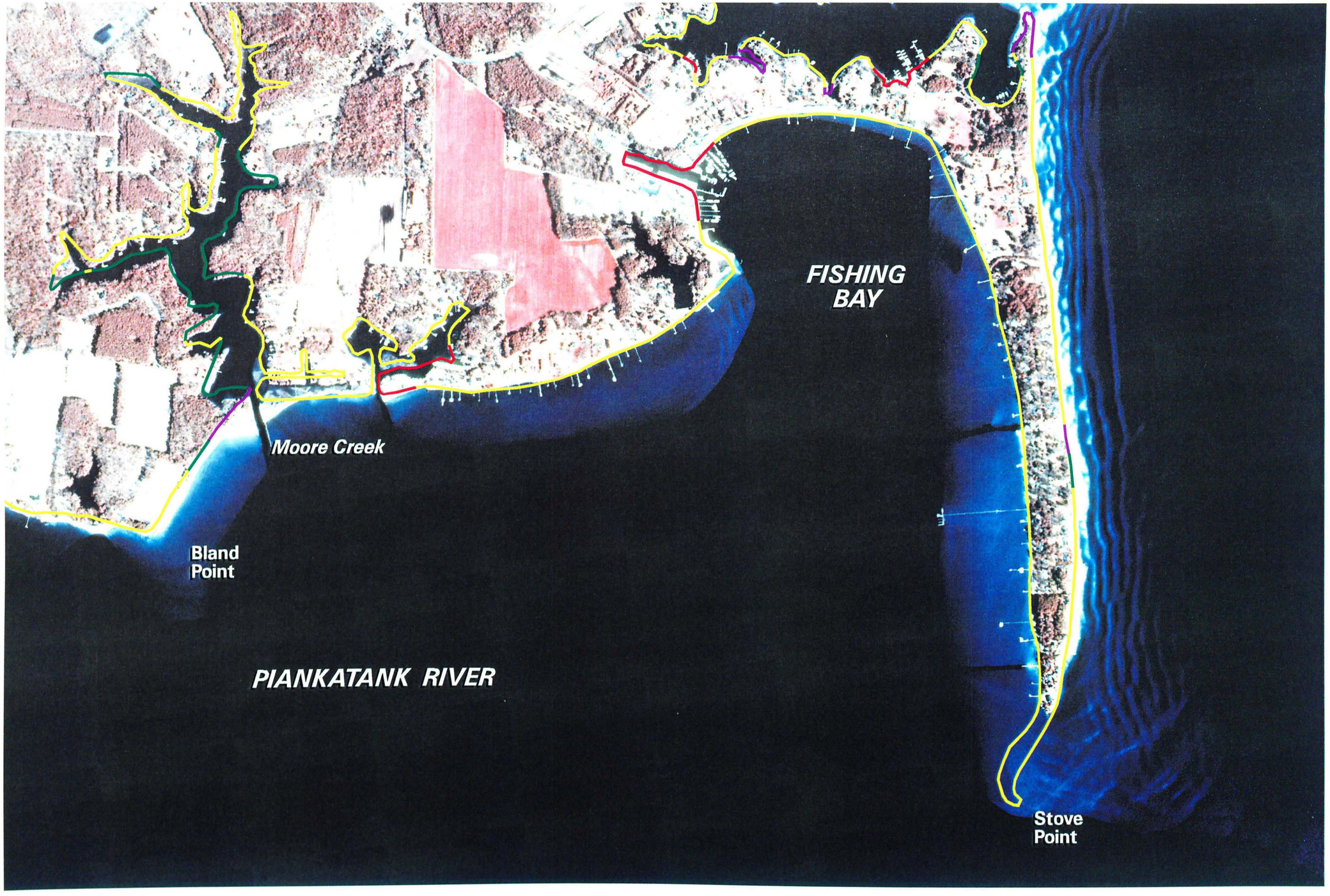
PIANKATANK RIVER
PLATE 7a

Riparian Land Use



Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

N

Scale

1,000 0 1,000 Feet

1:12,000

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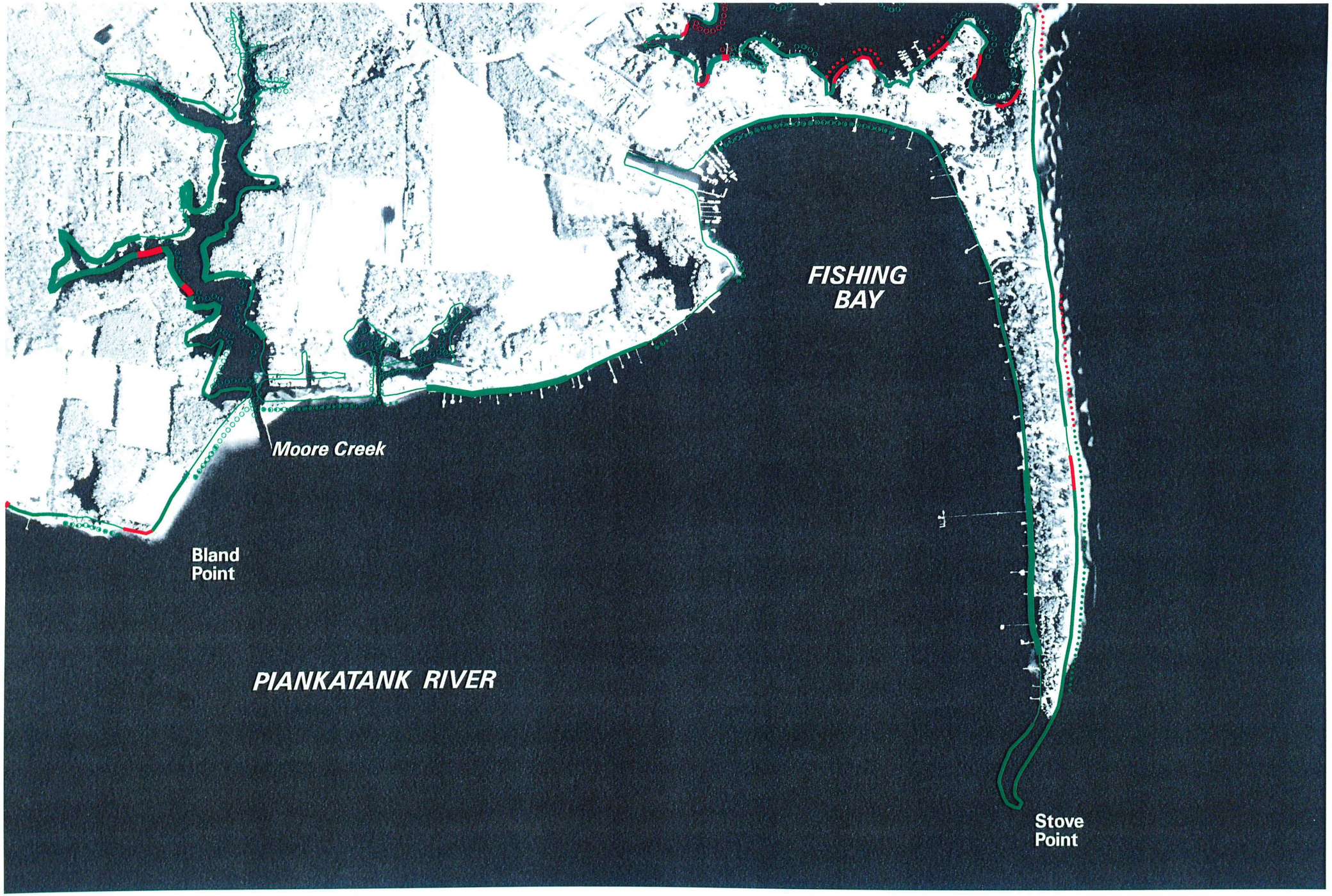
Virginia Institute of Marine Science

PIANKATANK RIVER
PLATE 7b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

N

Scale

1,000 0 1,000 Feet

1:12,000

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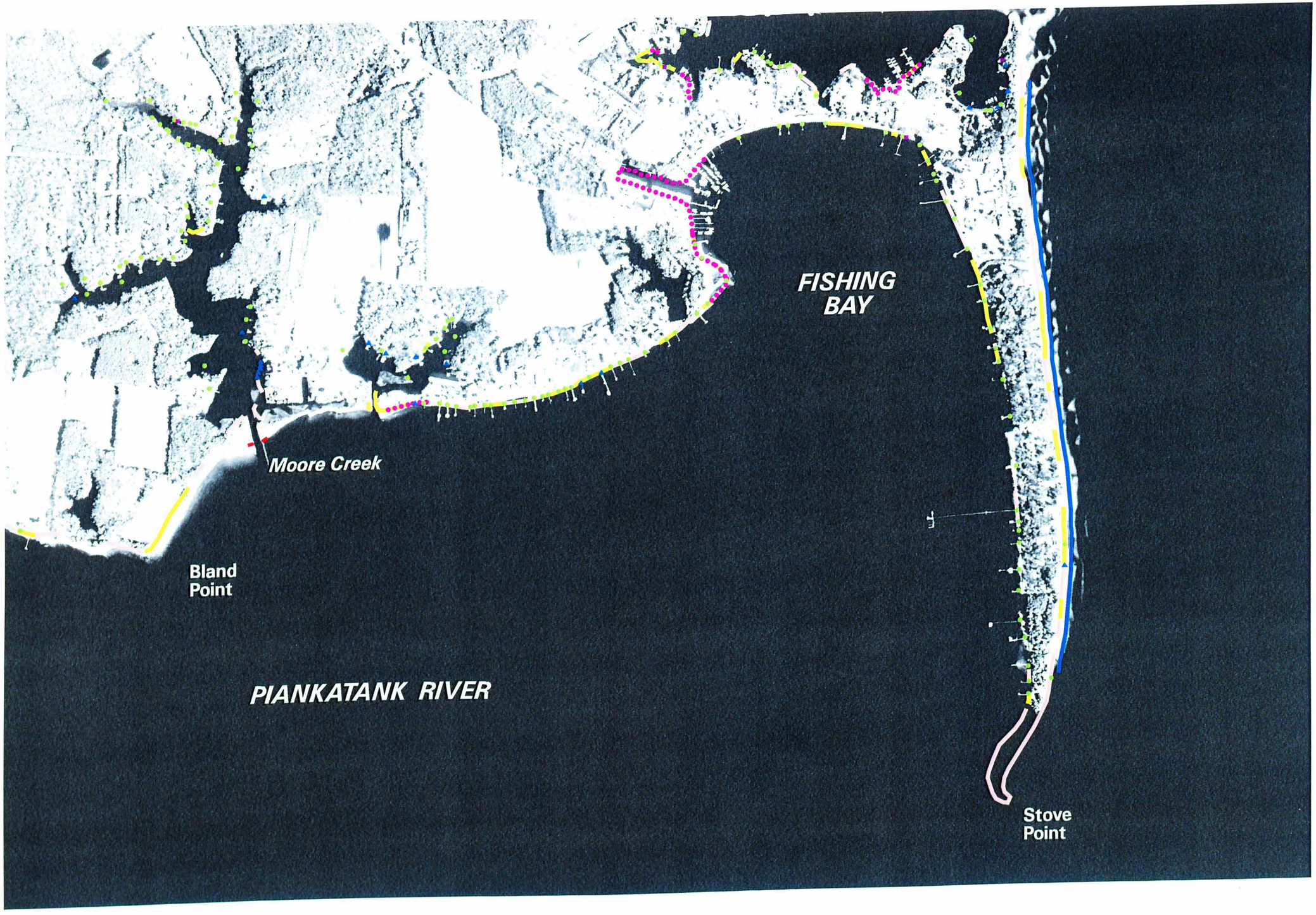
PIANKATANK RIVER
PLATE 7c



Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- jetty
- boathouse
- pier/wharf
- boat ramp

N

Scale

1,000 0 1,000 Feet

1:12,000

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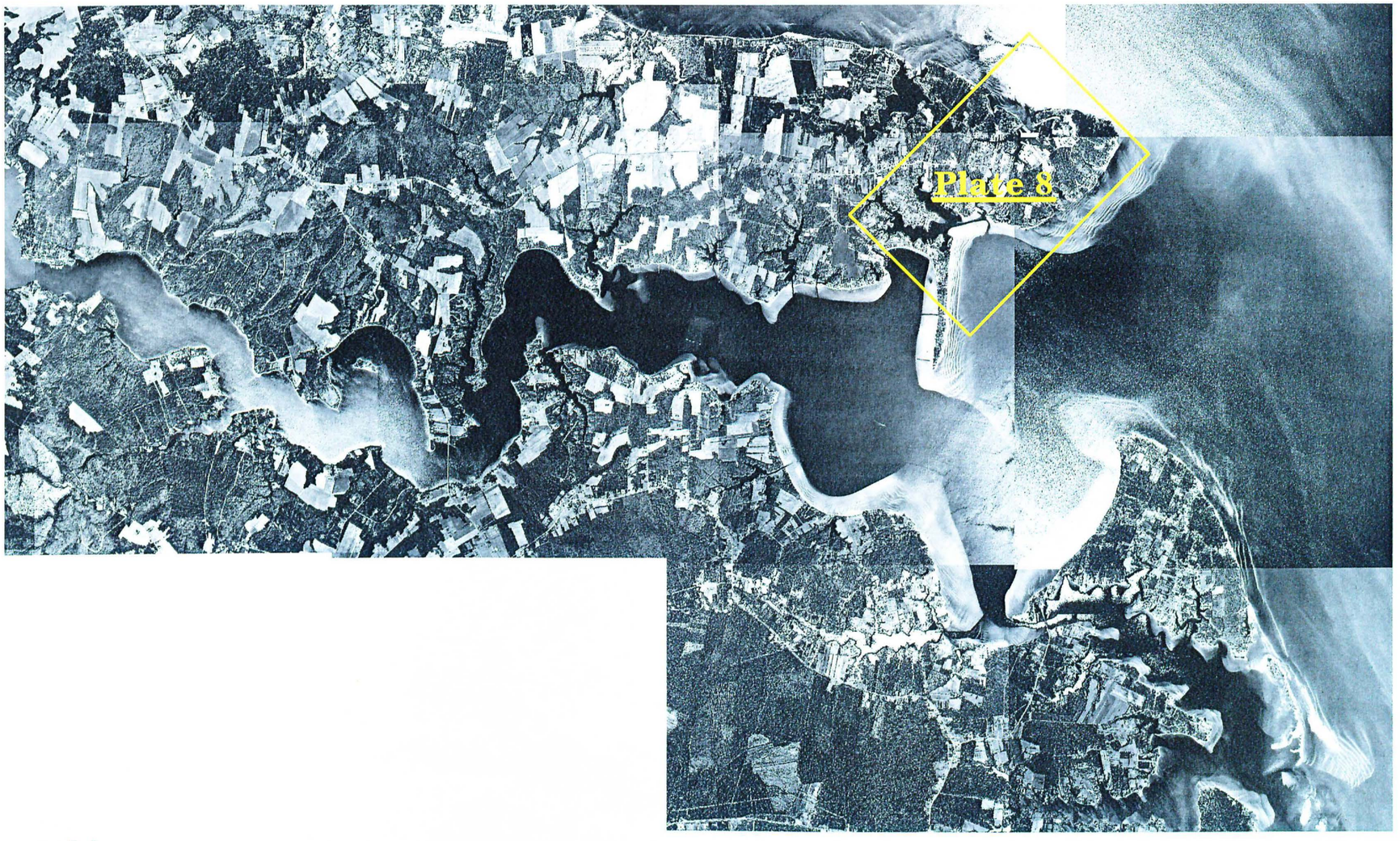
Location Map
Piankatank River
Plate 8



N

Scale

1 0 1

Miles

1 : 65000

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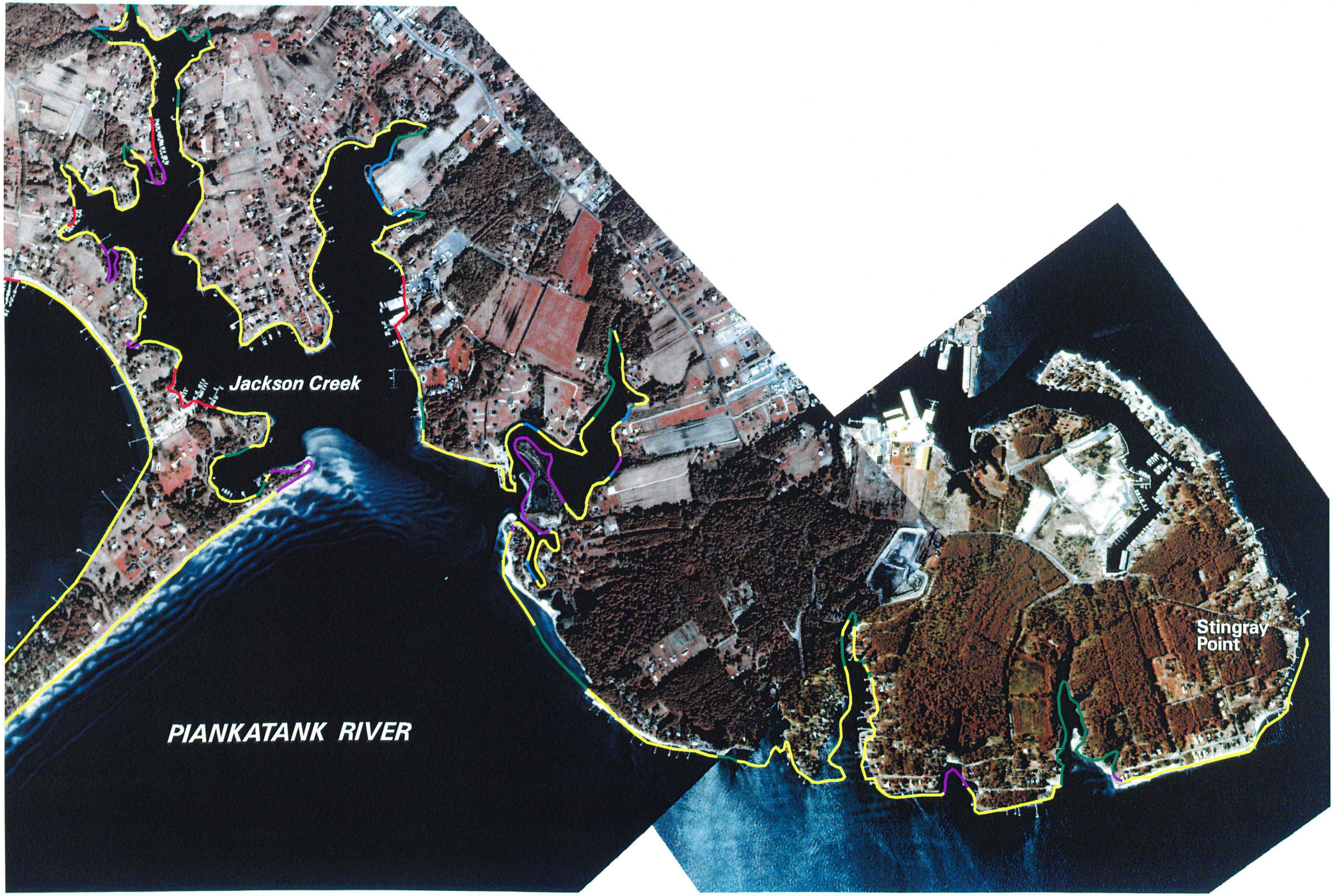
PIANKATANK RIVER

PLATE 8a

Riparian Land Use



Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

Scale

1,000 0 1,000 Feet

1:12,000

Comprehensive Coastal Inventory
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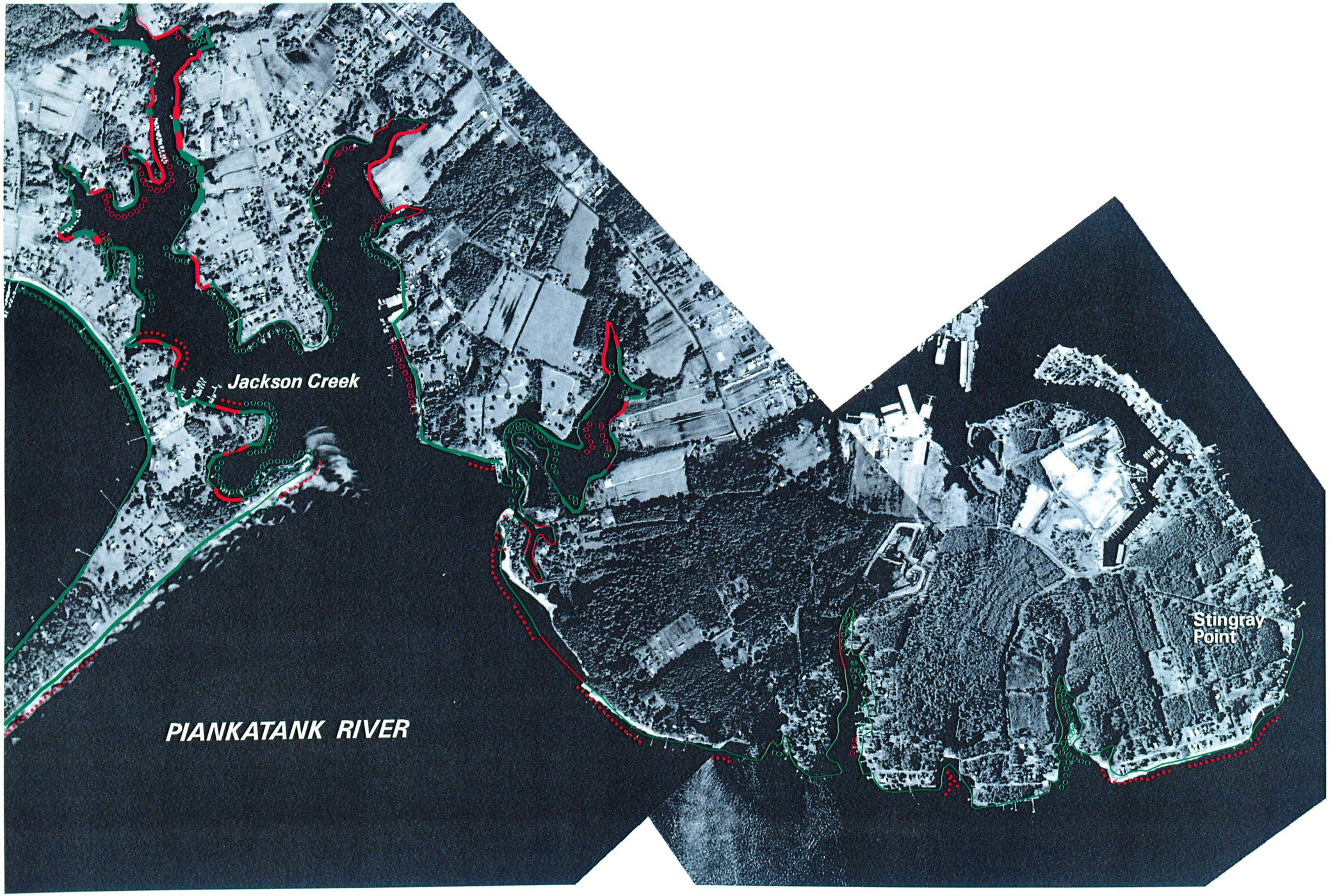
Virginia Institute of Marine Science

PIANKATANK RIVER

PLATE 8b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

Scale

1,000 0 1,000 Feet

1:12,000

Comprehensive Coastal Inventory
Center for Coastal Resources Management
Virginia Institute of Marine Science

PIANKATANK RIVER
PLATE 8c

Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- jetty
- boathouse
- pier/wharf
- boat ramp

Jackson Creek

PIANKATANK RIVER

Stingray Point

Scale

1,000 0 1,000 Feet

1:12,000

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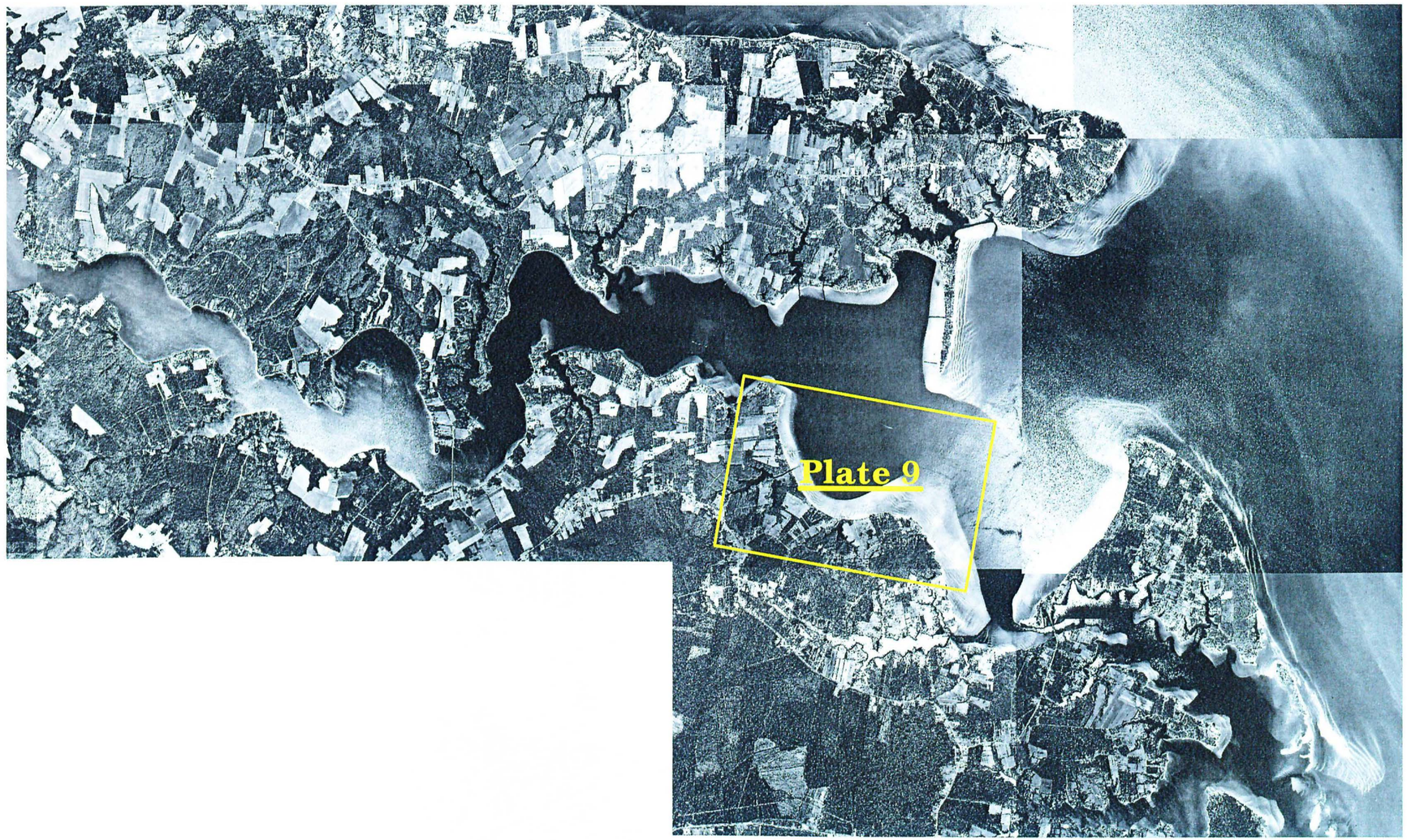
Location Map
Piankatank River
Plate 9



N

Scale

1 0 1 Miles

1 : 65000

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Center for Coastal Resources Management
Virginia Institute of Marine Science

PIANKATANK RIVER

PLATE 9a

Riparian Land Use

Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

N

Scale

1,000 0 1,000 Feet

1:12,000

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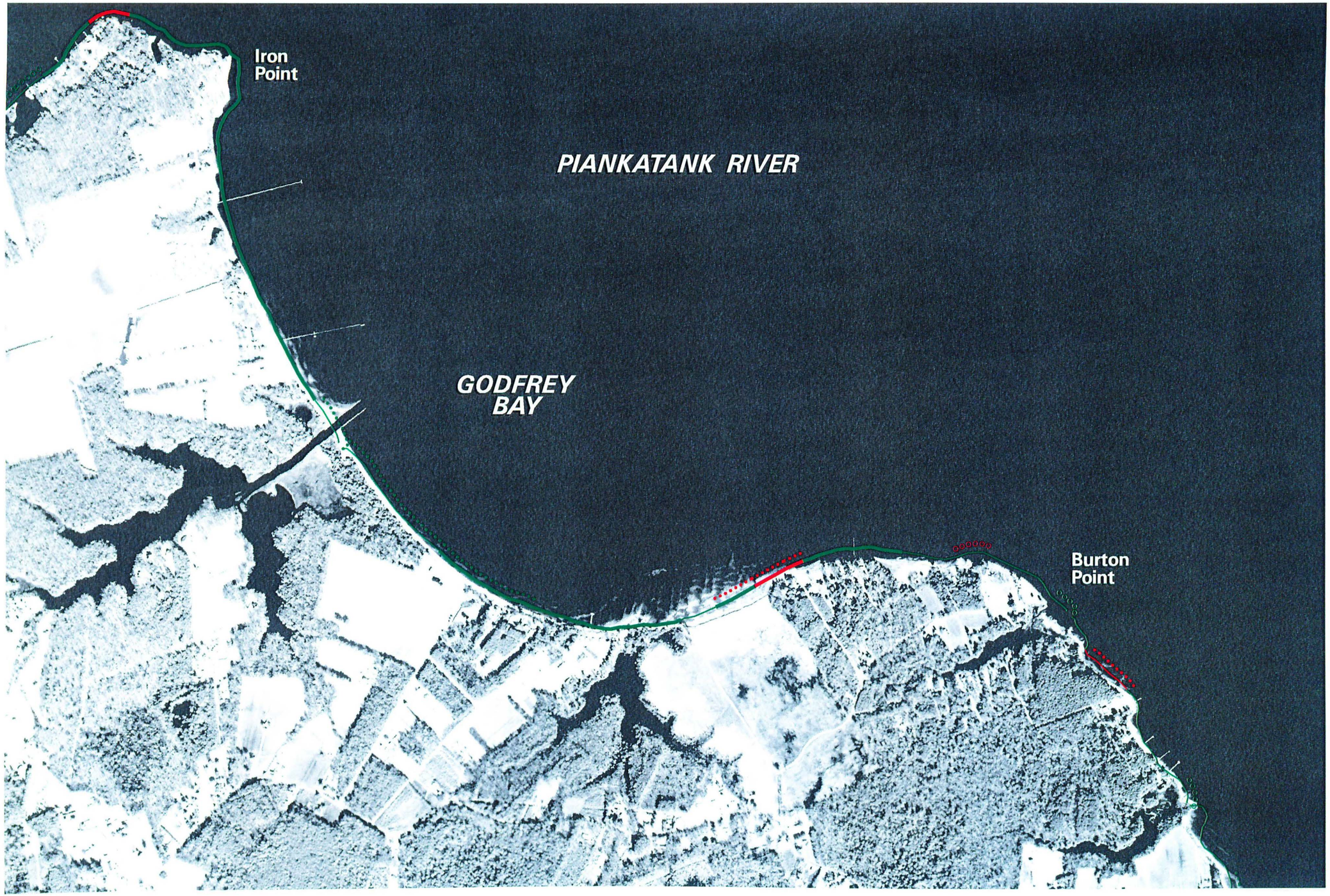
PIANKATANK RIVER

PLATE 9b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

N

Scale

1,000 0 1,000 Feet

1:12,000

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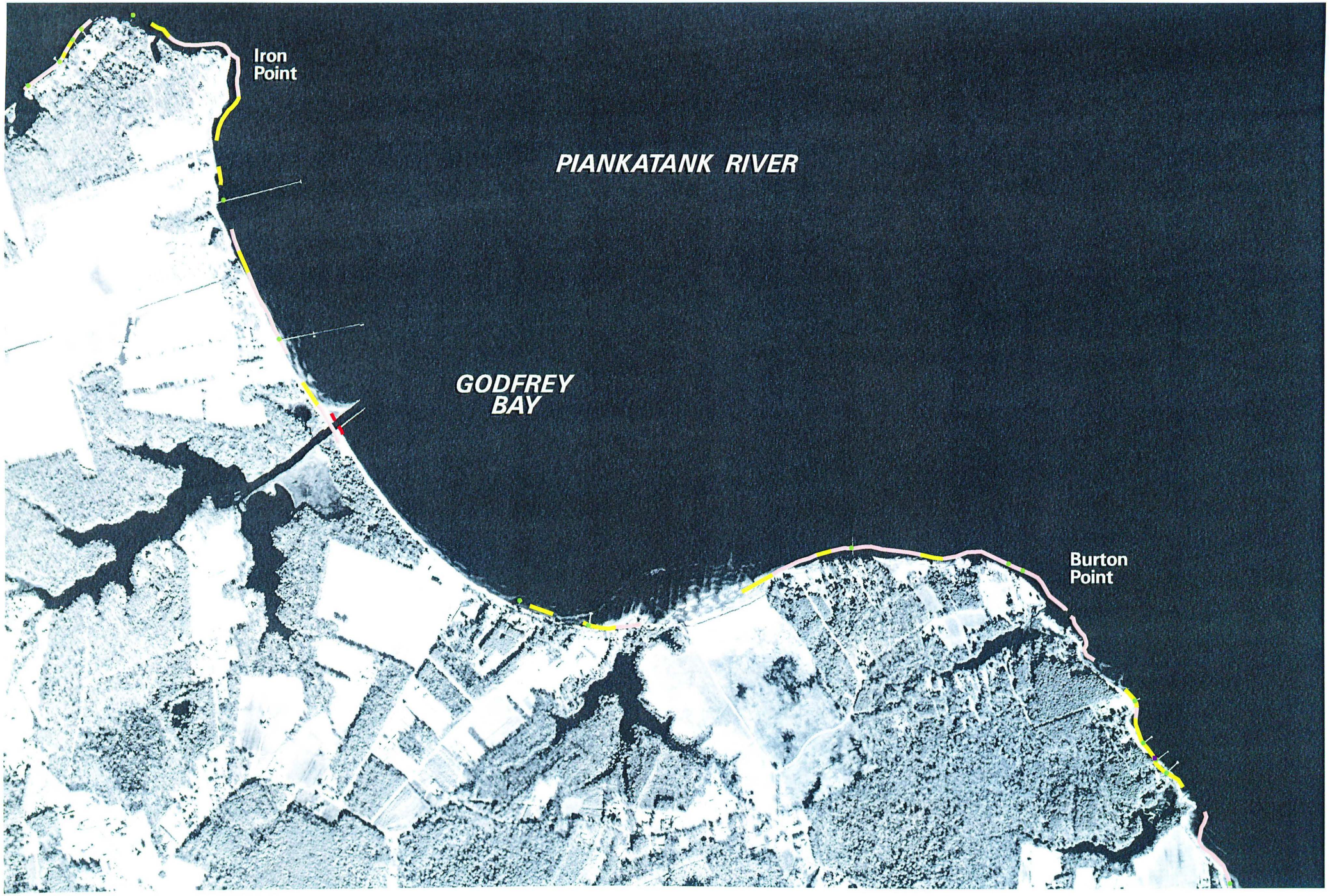
PIANKATANK RIVER
PLATE 9c

Shoreline Features



Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- jetty
- boathouse
- pier/wharf
- boat ramp

Scale

1,000 0 1,000 Feet

1:12,000

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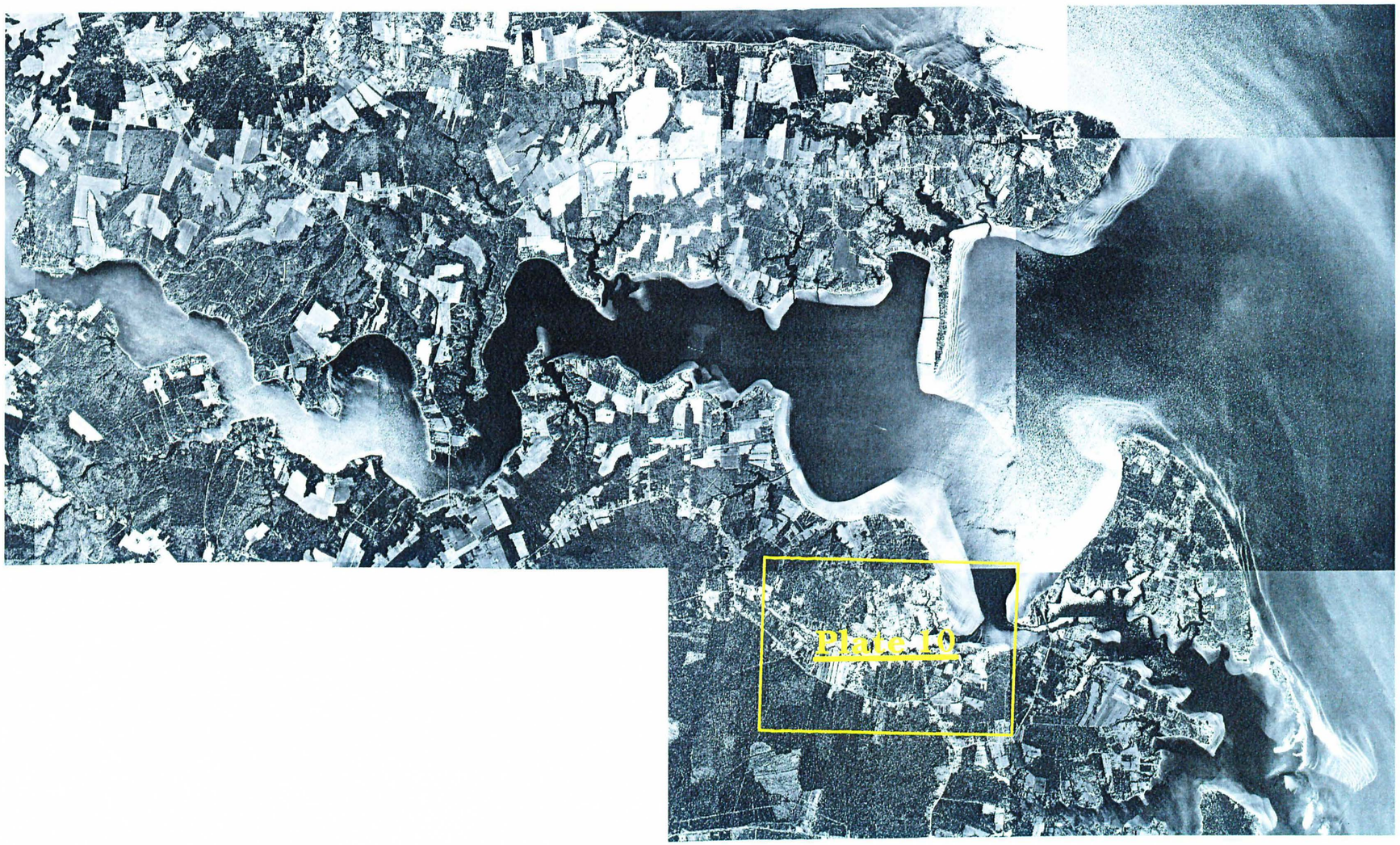
Location Map
Piankatank River
Plate 10



N

Scale

1 0 1 Miles

1 : 65000

Comprehensive Coastal Inventory
Center for Coastal Resources Management
Virginia Institute of Marine Science

cci

PIANKATANK RIVER
PLATE 10a

Riparian Land Use

Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

N

Scale

1,000 0 1,000 Feet

1:12,000

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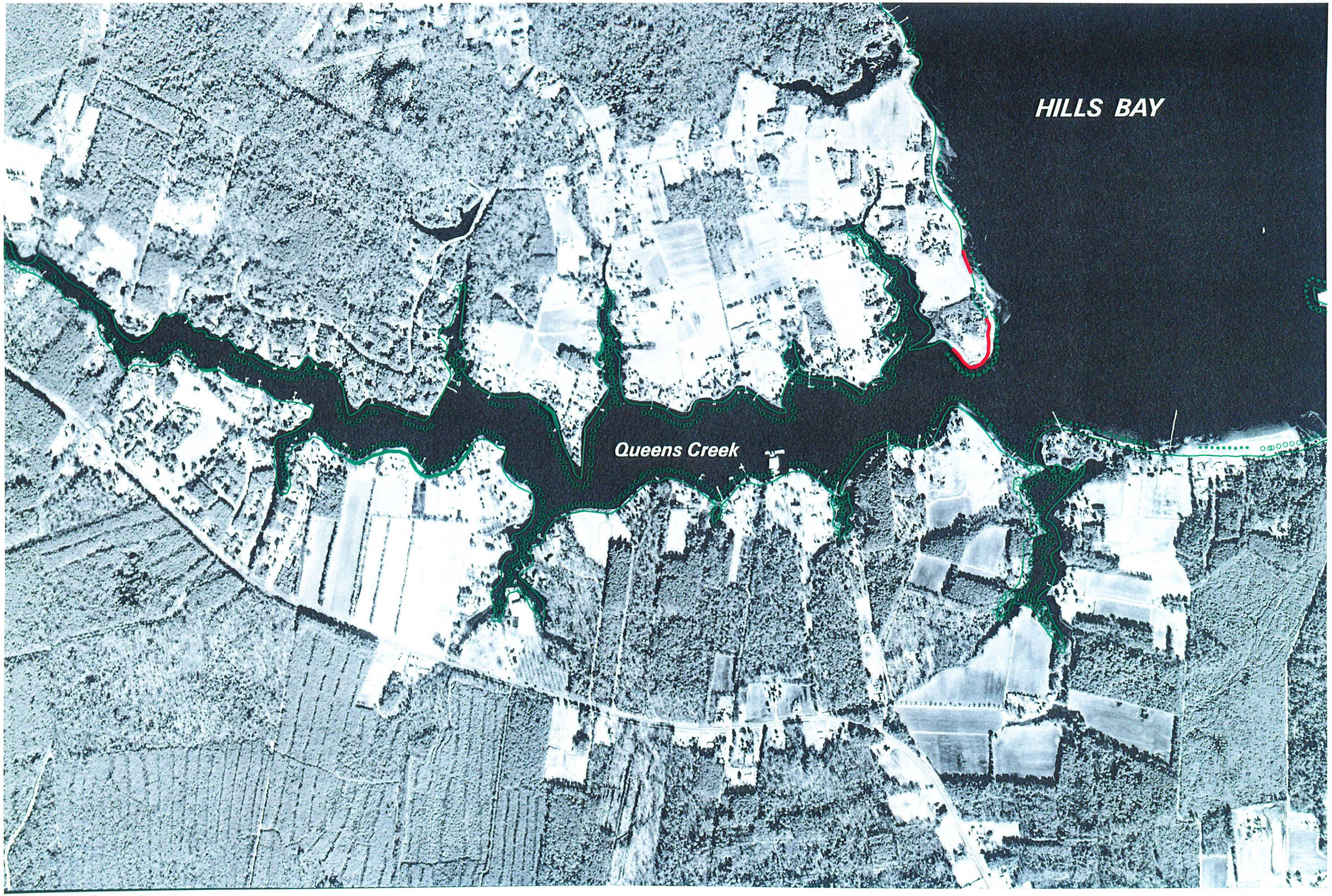
Virginia Institute of Marine Science



PIANKATANK RIVER
PLATE 10b

Bank and Buffer Conditions

Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

N

Scale

1,000 0 1,000 Feet

1:12,000

Comprehensive Coastal Inventory
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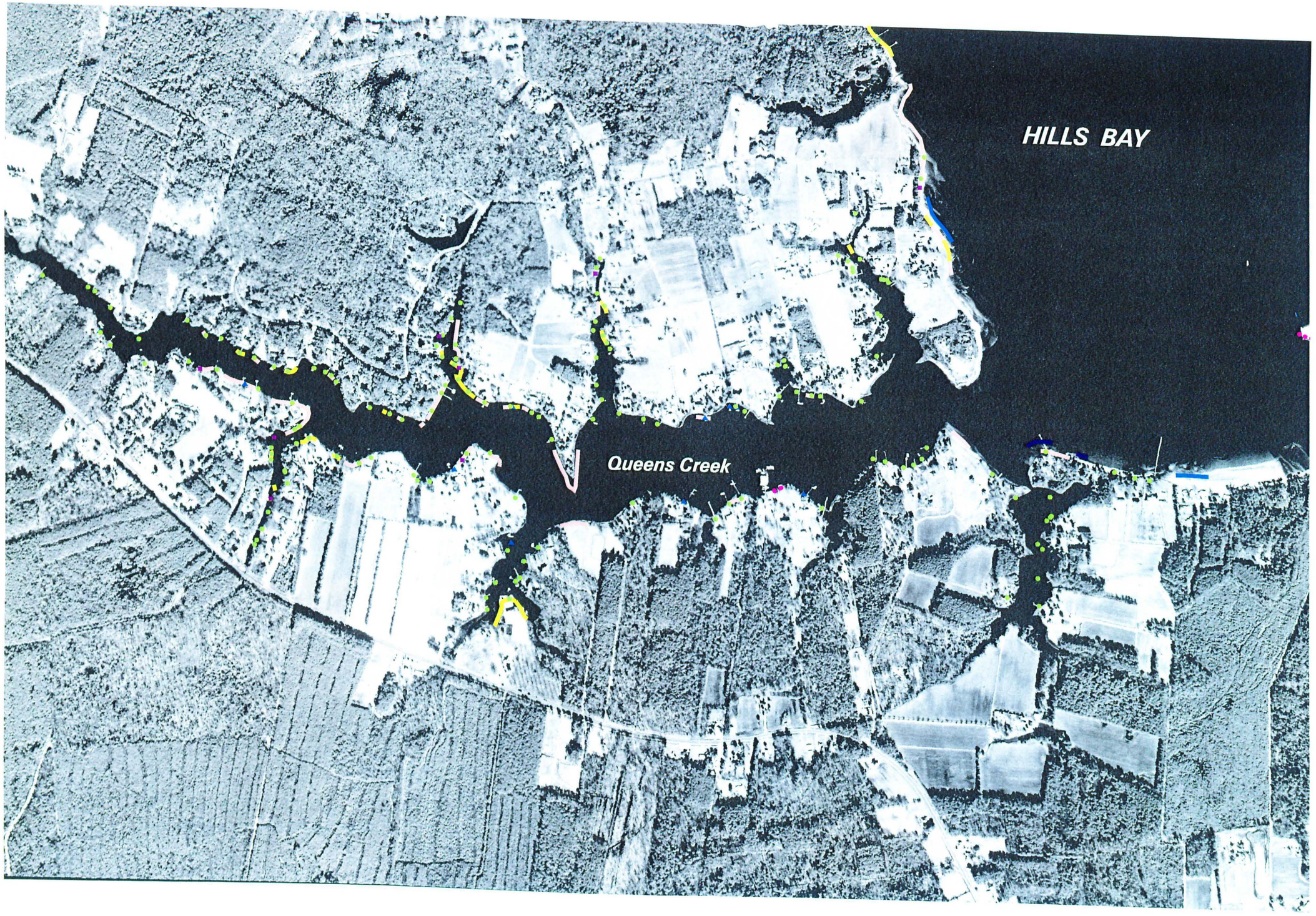
cci



PIANKATANK RIVER
PLATE 10c

Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- boathouse
- pier/wharf
- boat ramp

N

Scale

1,000 0 1,000 Fe

1:12,000

Comprehensive Coastal Inventory
Center for Coastal Resources Management
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Location Map
Piankatank River
Plate 11

N

Scale

1 0 1 Miles

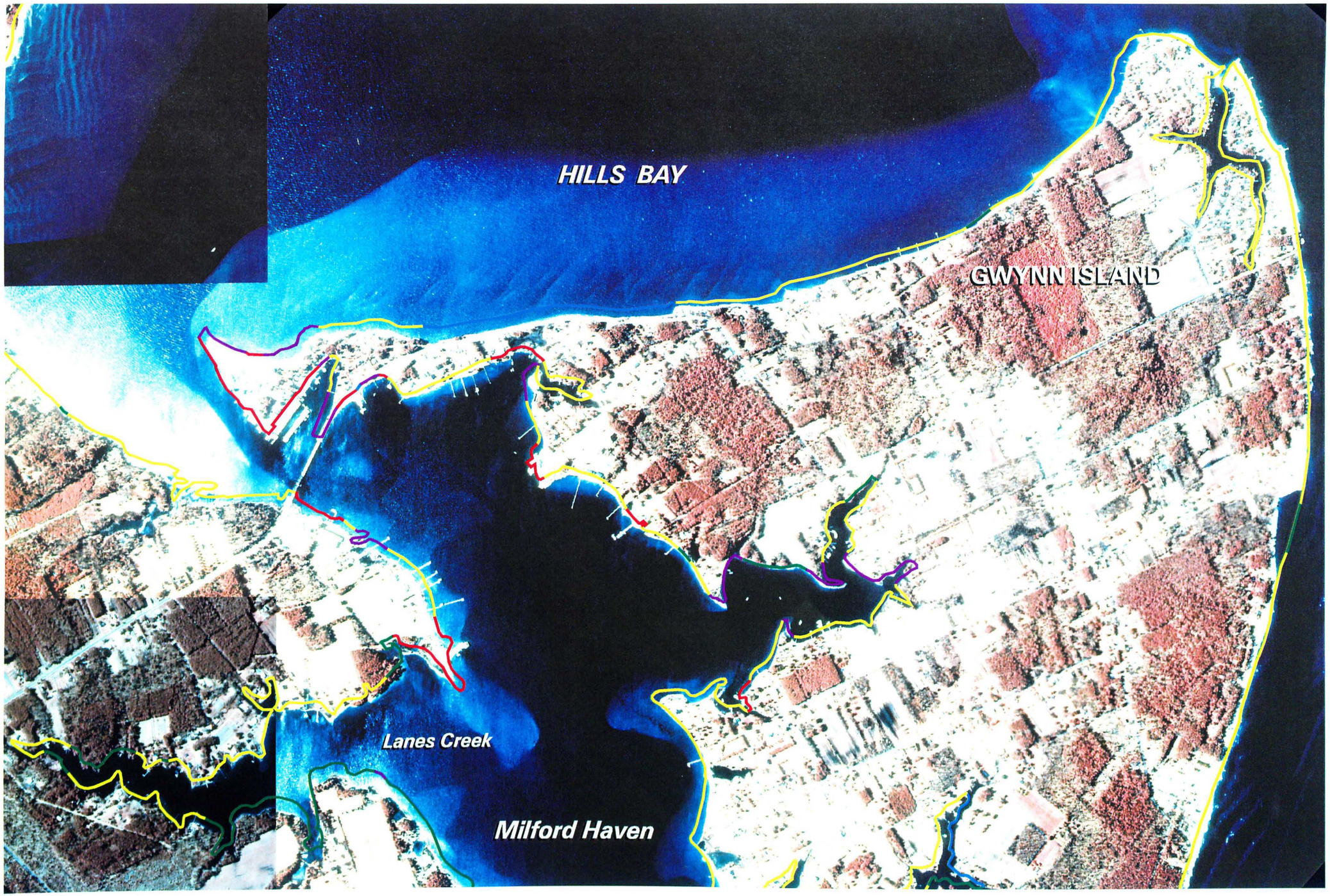
1 : 65000

Comprehensive Coastal Inventory
Center for Coastal Resources Management
Virginia Institute of Marine Science

cci

PIANKATANK RIVER
PLATE 11a

Riparian Land Use



Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

Scale

1,000 0 1,000 Feet

1:12,000

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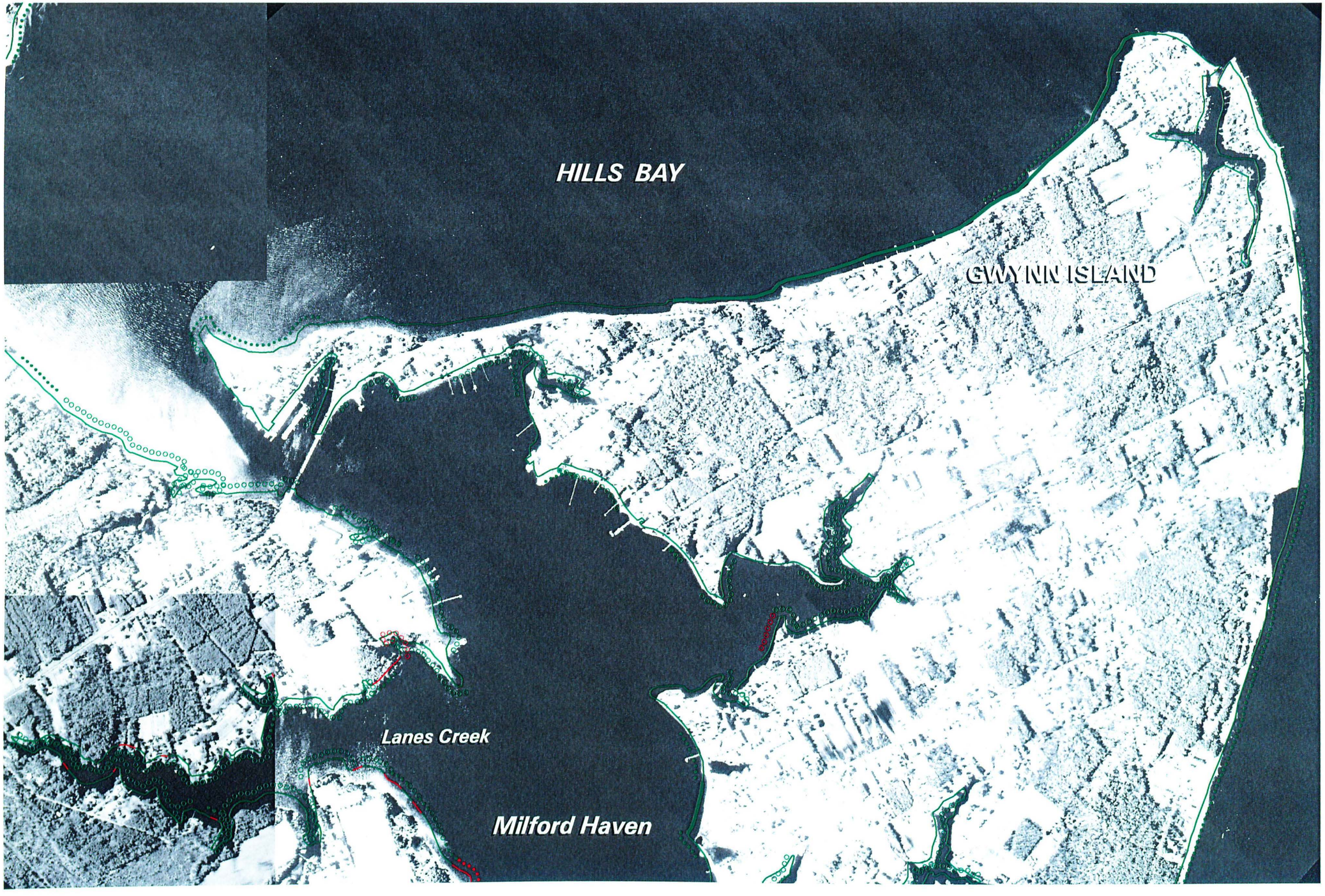
Center for Coastal Resources Management
Virginia Institute of Marine Science

PIANKATANK RIVER

PLATE 11b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

N

Scale

1,000 0 1,000 Feet

1:12,000

Comprehensive Coastal Inventory
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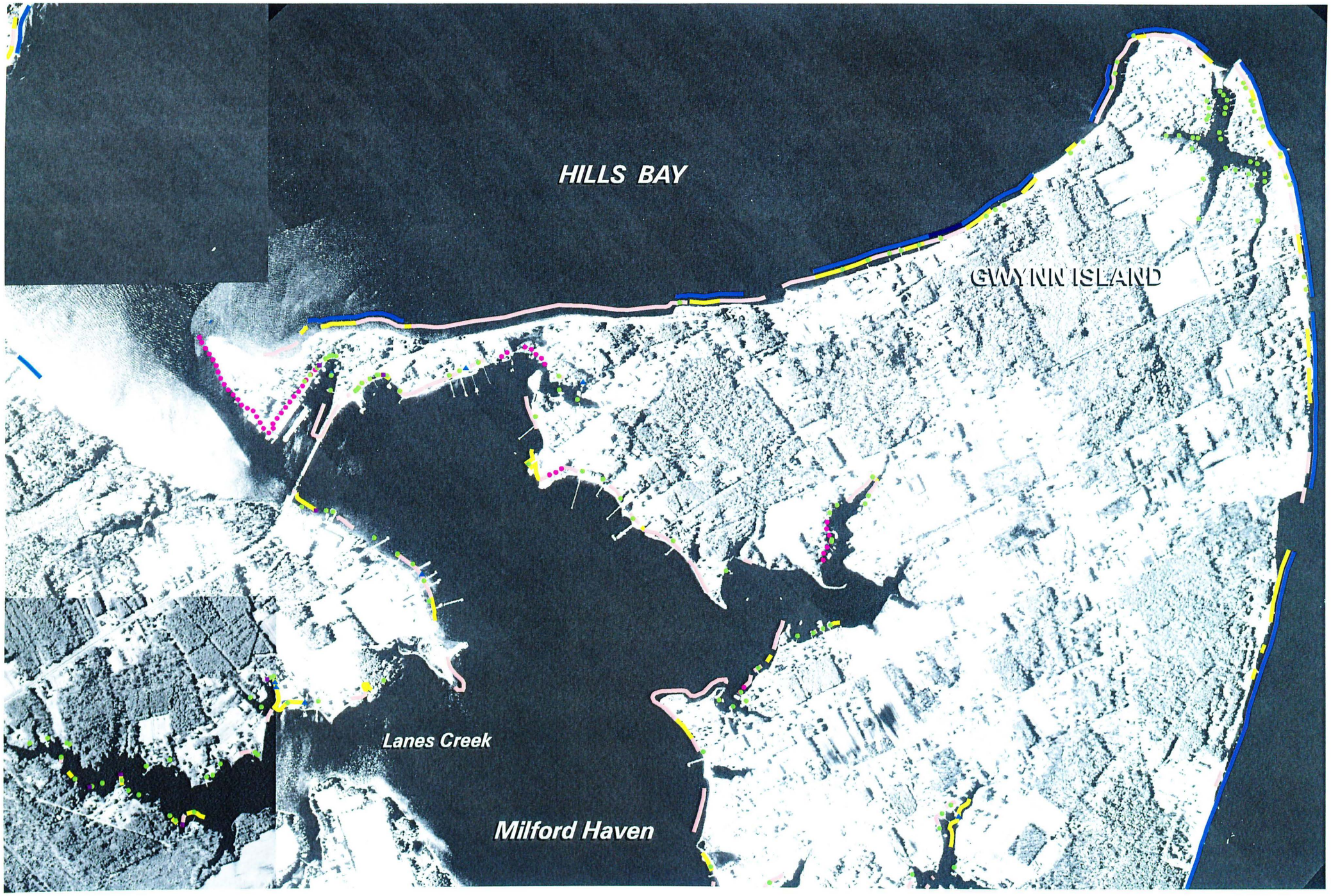
PIANKATANK RIVER
PLATE 11c



Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- boathouse
- pier/wharf
- boat ramp

Scale

1,000 0 1,000 Feet

1:12,000

Comprehensive Coastal Inventory
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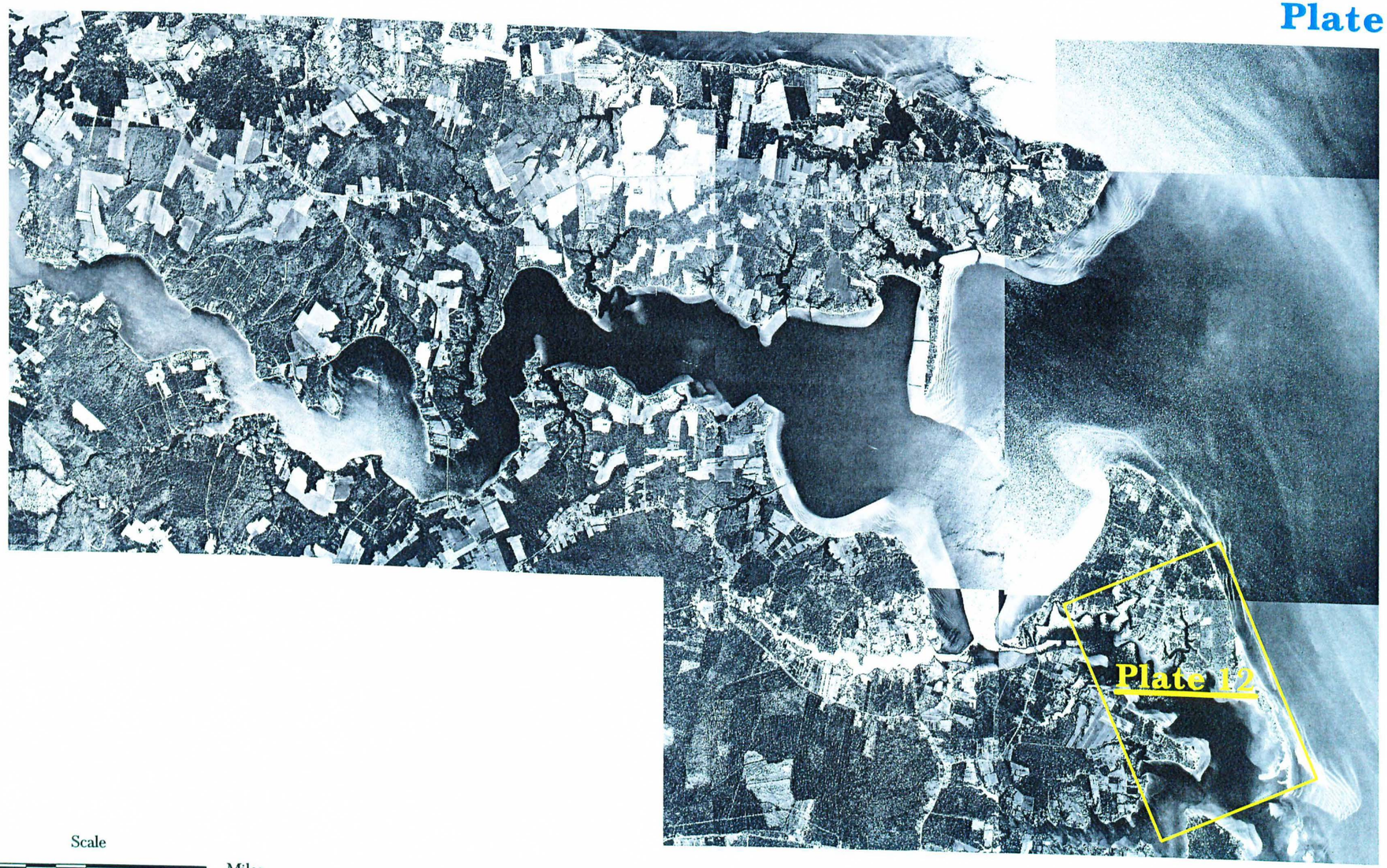
Location Map
Piankatank River
Plate 12



N

Scale

1 0 1 Miles

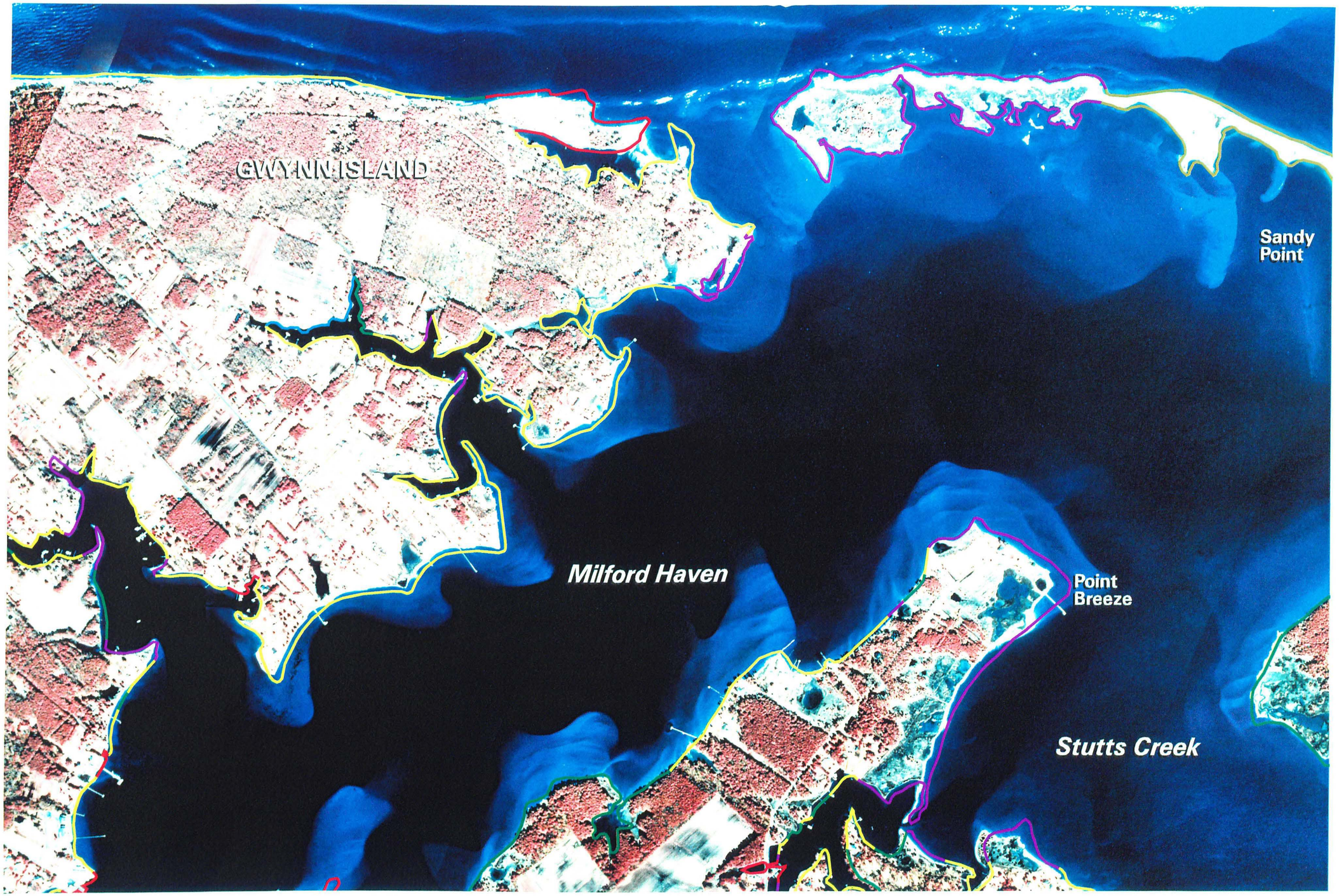
1 : 65000

Comprehensive Coastal Inventory
Center for Coastal Resources Management
Virginia Institute of Marine Science
cci

PIANKATANK RIVER

PLATE 12a

Riparian Land Use



Legend

- forest
- scrub-shrub
- grass
- residential
- commercial
- bare

Scale

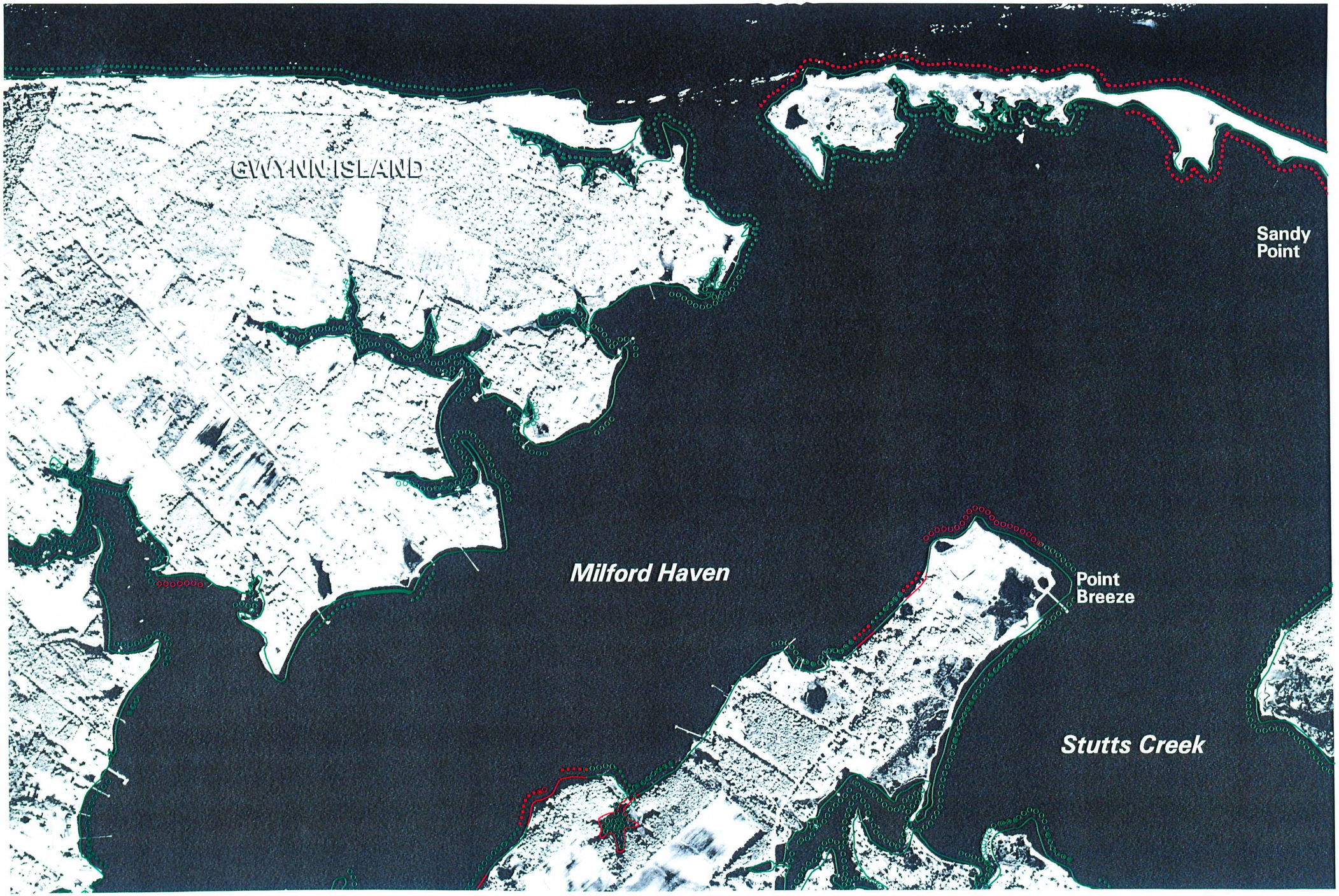
1,000 0 1,000 Feet

1:12,000

Comprehensive Coastal Inventory
Center for Coastal Resources Management
Virginia Institute of Marine Science

PIANKATANK RIVER
PLATE 12b

Bank and Buffer Conditions



Legend

- 0-5 ft/low erosion
- 0-5 ft/high erosion
- 5-10 ft/low erosion
- 5-10 ft/high erosion
- >10 ft/low erosion
- >10 ft/high erosion
- Beach/low erosion
- Beach/high erosion
- Marsh/low erosion
- Marsh/high erosion

Scale

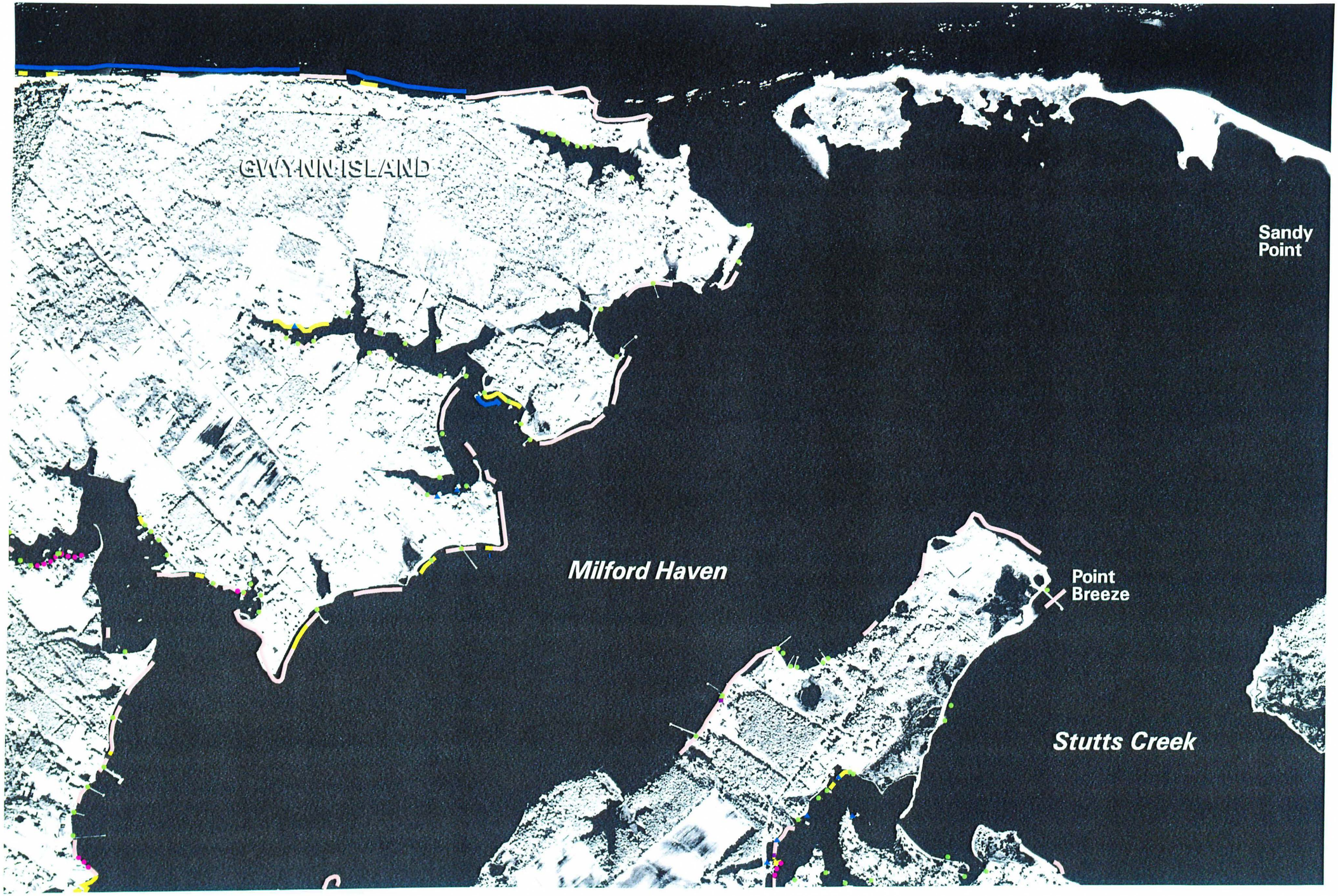
1,000 0 1,000 Feet

1:12,000

Comprehensive Coastal Inventory
Center for Coastal Resources Management
Virginia Institute of Marine Science

PIANKATANK RIVER

PLATE 12c



Shoreline Features

Legend

- bulkhead
- riprap
- marina
- groinfield
- breakwater
- jetty
- boathouse
- pier/wharf
- boat ramp

Scale

1,000 0 1,000 Feet

1:12,000

Comprehensive Coastal Inventory
Center for Coastal Resources Management
Virginia Institute of Marine Science

Glossary of Shoreline Features Defined

Bare - Land use defined as bare includes areas void of any vegetation or obvious land use. Bare areas include those which have been cleared for construction.

Beaches - Beaches are sandy shores which are subaerial during mean high water. These features can be thick and persistent, or very thin lenses of sand.

Boat house - A boathouse is considered any covered structure alongside a dock or pier built to cover a boat. They include true "houses" for boats with roof and siding, as well as awnings which offer only overhead protection. Since nearly all boat houses have adjoining piers, piers are not surveyed separately, but are assumed. Boat houses may be difficult to see in aerial photography. On the maps they are denoted with a blue triangle.

Boat Ramp - Boat ramps provide vessels access to the waterway. They are usually constructed of concrete, but wood and gravel ramps are also found. Point identification of boat ramps does not discriminate based on type, size, material, or quality of the launch. Access at these sites is not guaranteed, as many may be located on private property. The location of these ramps was determined from static ten second GPS observations. Ramps are illustrated as purple squares on the maps.

Breakwaters - Breakwaters are structures which sit parallel to the shore, and generally occur in a series along the shore. Their purpose is to attenuate and deflect incoming wave energy, protecting the fastland behind the structure. In doing so, a beach may naturally accrete behind the structures if sediment is available. A beach nourishment program is frequently part of the construction plan.

The position of the breakwater offshore, the number of breakwaters in a series, and their length depends on the size of the beach which must be maintained for shoreline protection. Most breakwater systems sit with the top at or near MHW and are partially exposed during low water. Breakwaters can be composed of a variety of materials. Large rock breakwaters, or breakwaters constructed of gabion baskets filled with smaller stone are popular today. Breakwaters are not easily observed from aerial imagery. However, the symmetrical cuspate sand bodies which may accumulate behind the structures can be. In this survey, individual breakwaters are not mapped. The first and last breakwater in the series are surveyed as a ten-second static GPS observation. The system is delineated on the maps as a line paralleling the linear extent of the breakwater series along the shore.

Bulkhead - Bulkheads are traditionally treated wood or steel "walls" constructed to offer protection from wave attack. More recently, plastics are being used in the construction. Bulkheads are vertical structures built slightly seaward of the problem area and backfilled with suitable fill material. They function like a retaining wall, as they are designed to retain upland soil, and prevent erosion of the bank from impinging waves. The recent proliferation of vertical concrete cylinders, stacked side by side along an eroding stretch of shore offer a similar level of protection as bulkheads, and include some of the same considerations for placement and success. These structures are also included in the bulkhead inventory.

Bulkheads are found in all types of environments, but they perform best in low to moderate energy conditions. Under high energy situations, the erosive power of reflective waves off bulkheads can scour material from the base, and cause eventual failure of the structure.

Bulkheads are common along residential and commercially developed shores. From aerial photography, long stretches of bulkheaded shoreline may be observed as an unnaturally straight or angular coast. In this inventory, they are mapped using kinematic GPS techniques. The data are displayed as linear features on the maps.

Commercial - Commercial zones include small commercial operations and larger industrial facilities. These operations are not necessarily water dependent businesses.

Dock/Pier - In this survey, a dock or pier is a structure, generally constructed of wood, which is built perpendicular or parallel to the shore. These are typical on private property, particularly residential areas. They provide access to the water, usually for recreational purposes. Docks and piers are mapped as point features on the shore. Pier length is not surveyed. In the map compositions, docks are denoted by a small green dot. Depending on resolution, docks can be observed in aerial imagery, and may be seen in the maps if the structure was built prior to 1994, when the photography was taken.

Forest Land Use - Forest cover includes deciduous, evergreen, and mixed forest stands greater than 18 feet high. The riparian zone is classified as forested if the tree stand extends at least 33 feet inland of the seaward limit of the riparian zone.

Grass - Grass lands include large unmanaged fields, managed grasslands adjacent to large estates, agriculture tracts reserved for pasture, and cultivated fields.

Groinfield - Groins are low profile structures that sit perpendicular to the shore. They are generally positioned at, or slightly above, the mean low water line. They can be constructed of rock, timber, or concrete. They are frequently set in a series known as a groinfield, which may extend along a stretch of shoreline for some distance.

The purpose of a groin is to trap sediment moving along shore in the littoral current. Sediment is deposited on the updrift side of the structure and can, when sufficient sediment is available in the system, accrete a small beach area. Some fields are nourished immediately after construction with suitable beach fill material. This approach does not deplete the longshore sediment supply, and offers immediate protection to the fastland behind the system.

For groins to be effective there needs to be a regular supply of sediment in the littoral system. In sediment starved areas, groin fields will not be particularly effective. In addition they can accelerate erosion on the downdrift side of the groin. The design of "low profile" groins was intended to allow some sediment to pass over the structure during intermediate and high tide stages, reducing the risk of down drift erosion.

From aerial imagery, most groins cannot be observed. However, effective groin fields appear as asymmetrical cusps where sediment has accumulated on the updrift side of the groin. The direction of net sediment drift is also evident.

This inventory does not delineate individual groins. In the field, the first and last groin of a series is surveyed. Others between them are assumed to be evenly spaced. On the map composition, the groin field is designated as a linear feature extending along the shore.

Marina - Marinas are denoted as line features in this survey. They are a collection of docks and wharfs which can extend along an appreciable length of shore. Frequently they are associated with extensive bulkheading. Structures associated with a marina are not identified individually. This means any docks, wharfs, and bulkheads would not be delineated separately. Marinas are generally commercial operations. Community docks offering slips and launches for community residents are becoming more popular. They are usually smaller in scale than a commercial operation. To distinguish these facilities from commercial marinas, the riparian land use map (Plate A) will denote the use of the land at the site as residential for a community facility, rather than commercial.

Marshes - Marshes can be extensive embayed marshes, or narrow, fragmented fringe marshes. The vegetation must be relatively well established, although not necessarily healthy.

Miscellaneous - Miscellaneous point features represent short isolated segments along the shore where material has been dumped to protect a section of shore undergoing chronic erosion. Longer sections of shore are illustrated as line features. They can include tires, bricks, broken concrete rubble, and railroad ties as examples.

Residential - Residential zones include rural and suburban size plots, as well as multi-family dwellings.

Riprap - Generally composed of large rock to withstand wave energy, riprap revetments are constructed along shores to protect eroding fastland. Revetments today are preferred to bulkhead construction. They reduce wave reflection which causes scouring at the base of the structure, and are known to provide some habitat for aquatic and terrestrial species. Most revetments are constructed with a fine mesh filter cloth placed between the ground and the rock. The filter cloth permits water to permeate through, but prevents sediment behind the cloth from being removed, and causing the rock to settle. Revetments can be massive structures, extending along extensive stretches of shore, and up graded banks. When a bulkhead fails, riprap is often placed at the base for protection, rather than a bulkhead replacement. Riprap is also used to protect the edge of an eroding marsh. This use is known as toe protection. This inventory does not distinguish among the various types of revetments.

Riprap revetments are popular along residential waterfront as a mechanism for stabilizing banks. Along commercial or industrial waterfront development such as marinas, bulkheads are still more common since they provide a facility along which a vessel can dock securely.

Riprap is mapped as a linear feature using kinematic GPS data collection techniques. The maps illustrate riprap as a linear feature along the shore.

Scrub-shrub - Scrub-shrub zones include trees less than 18 feet high, and is usually dominated by shrubs and bushy plants.

References

Anderson, G.L., Williams, G.B., Peoples, M.H., and L. Weishar, 1976. Shoreline Situation Report - Gloucester County, Virginia. Special Report in Applied Marine Science and Ocean Engineering No. 83, Virginia Institute of Marine Science, Gloucester Point, VA, 71 pp.

Byrne, R.J. and G.L. Anderson, 1978. Shoreline Erosion in Tidewater Virginia. Special Report in Applied Marine Science and Ocean Engineering No. 111, Virginia Institute of Marine Science, Gloucester Point, VA, 102 pp.

Hardaway, C.S., Thomas, G.R., Glover, J.B., Smithson, J.B., Berman, M.R., and A.K. Kenne, 1992. Bank Erosion Study. Special Report in Applied Marine Science and Ocean Engineering No. 319, Virginia Institute of Marine Science, School of Marine Science, College of William and Mary, Gloucester Point, VA, 73 pp.

Hobbs, C.H., III, G.L. Anderson, Byrne, R.J., and J.M. Zeigler, 1975. Shoreline Situation Report - Mathews County, Virginia. Special Report in Applied Marine Science and Ocean Engineering No. 77, Virginia Institute of Marine Science, Gloucester Point, VA, 99 pp.

Hobbs, C.H., III, Owen, D.W., and L.C. Morgan, 1979. Summary of Shoreline Situation Reports for Virginia's Tidewater Localities. Special Report in Applied Marine Science and Ocean Engineering No. 209, Virginia Institute of Marine Science, Gloucester Point, VA, 32 pp.

Ibison, N.A., Baumer, J.C., Hill, C.L., Burger, N.H., and J.E. Frye, 1992. Eroding bank nutrient verification study for the lower Chesapeake Bay. Department of Conservation and Recreation, Division of Soil and Water Conservation, Shoreline Programs Bureau, Gloucester Point, VA.

Whitcomb, N.J., Patton, M.A., Peoples, M.H., Anderson, G.L., and C.H. Hobbs III, 1975. Shoreline Situation Report - Middlesex County, Virginia. Special Report in Applied Marine Science and Ocean Engineering No. 100, Virginia Institute of Marine Science, Gloucester Point, VA, 65 pp.

Bridge over Milford Haven to Gywnn Island