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Shoreline Evolution: York County, Virginia York River, Chesapeake Bay and Poquoson River Shorelines

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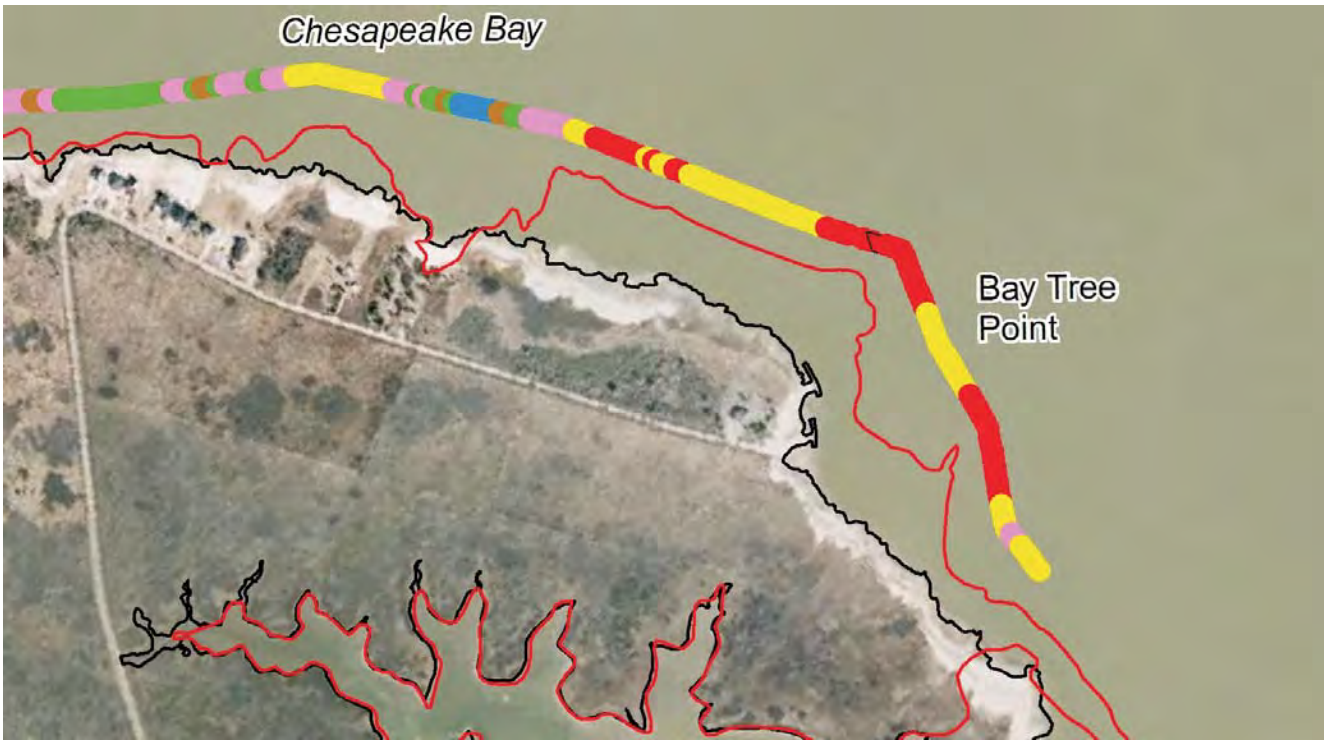
Shoreline Evolution:
York County, Virginia
York River, Chesapeake Bay and
Poquoson River Shorelines

Data Report



Shoreline Studies Program
Department of Physical Sciences

Virginia Institute of Marine Science
College of William & Mary
Gloucester Point, Virginia
March 2010

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March 2010

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1 Introduction

Shoreline evolution is the change in the shore zone through time. Along the shores of Chesapeake Bay, it is a process and response system. The processes at work include winds, waves, tides and currents which shape and modify coastlines by eroding, transporting and depositing sediments. The shore line is commonly plotted and measured to provide a rate of change, but it is as important to understand the geomorphic patterns of change. Shore analysis provides the basis to know how a particular coast has changed through time and how it might proceed in the future.

The purpose of this data report is to document how the shore zone of York (Figure 1) has evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year, and can be used to assess the geomorphic nature of shore change. Aerial imagery shows how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man through shore hardening or inlet stabilization come to dominate a given shore reach. The change in shore positions along the rivers and larger creeks in York County will be quantified in this report. The shorelines of very irregular coasts, small creeks around inlets, and other complicated areas, will be shown but not quantified.

2 Shore Settings

2.1 Physical Setting

York County is located on Virginia's Peninsula and has about 230 miles of tidal shoreline on several bodies water including the York River, Chesapeake Bay, and Poquoson River. When all creeks and rivers drain into these bodies of water are included these areas have 142 miles, 25 miles and 63 miles respectively. Historic shore change rates vary from -0.8 ft/yr along the York River and -0.7 ft/yr along the Poquoson River (Byrne and Anderson, 1978).

The coastal geomorphology of the County is a function of the underlying geology and the hydrodynamic forces operating across the land/water interface, the shoreline. The Atlantic Ocean has come and gone numerous times over the Virginia coastal plain over the past million years. The effect has been to rework older deposits into beach and lagoonal deposits at the time of the transgressions. The surface geology of York County is varied (Figure 2). At the northern end of the County on the York River, the sediments of th Shirley Formation were deposited during an interglacial, high stand of sea level approximately 200 - 250,000 years ago (Toscano, 1992). Just southeast of the Route 17/Coleman Bridge at Yorktown, the Chuckatuck Formation which, like the Shirley Formation, was formed in the Middle Pleistocene. It is slightly older than the Shirley Formation and is underlain by the Yorktown Formation which was deposited in the Pliocene. Along the high banks in this area, the Yorktown Formation is eroding at the base of the banks.

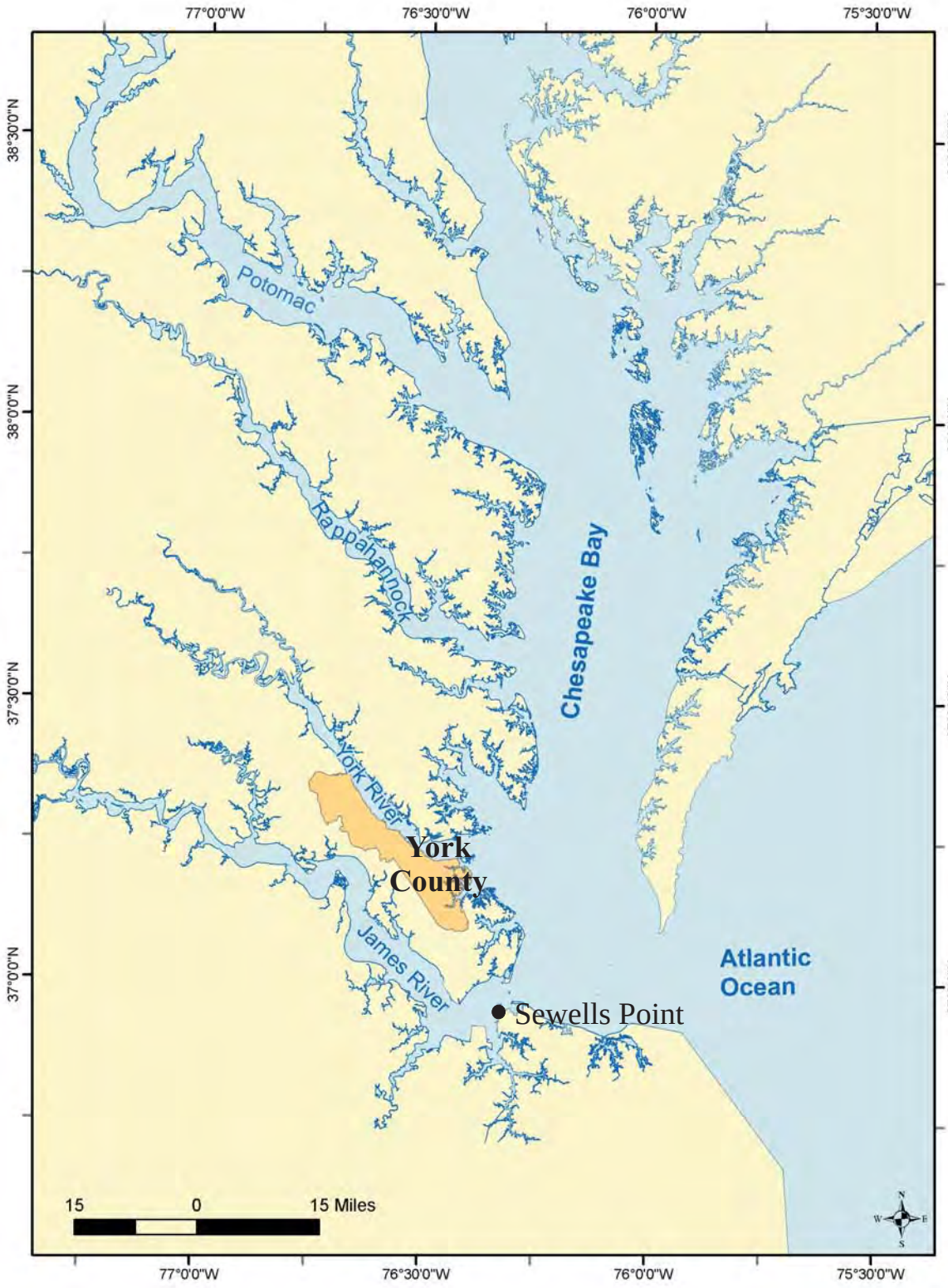
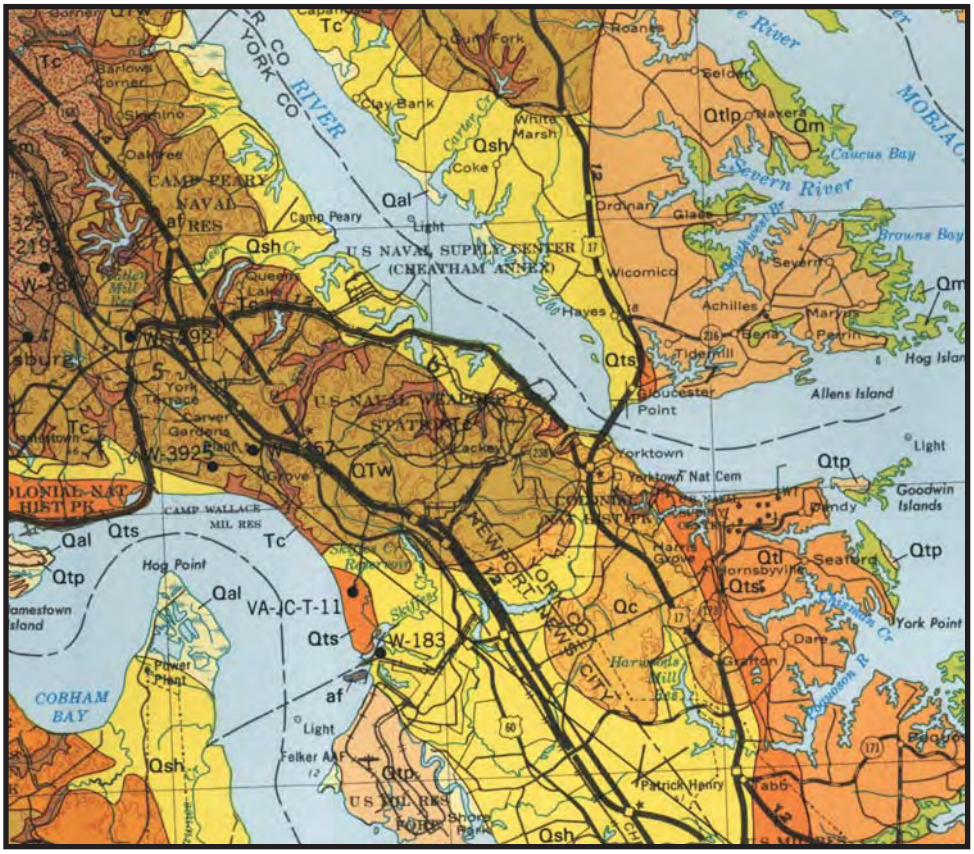


Figure 1. Location of York County within the Chesapeake Bay Estuarine System



Regional stratigraphic column of Formations and Members.

System	Series		Mixon and others (1989)	
Quaternary 1.8 mya-todaay	Holocene Last 10,000 years		Coastal barriers, lagoons, alluvial, swamp, eolian	
	Pleistocene 1.8 mya-10,000 ybp	U	Tabb Fm.	Poquoson Mem.
				Lynnhaven Mem.
				Sedgefield Mem.
		M	Shirley Fm.	
			Chuckatuck Fm.	
		L	Charles City Fm.	
			Windsor Fm.	
Tertiary 65-1.8 mya	Pliocene 5.3 mya-1.8 mya	U	Moorings Unit	
			Bacons Castle Fm.	
		L	Chesapeake Group	Yorktown Fm.
	Miocene 23.8 mya-5.3 mya			Eastover Fm.

Mya=millions of years ago
ybp=years before present
U=Upper; M=Middle;L=Lower
Fm.=Formation
Mem.=Member

Qm — **Holocene Soft Mud -** Medium to dark-gray, and peat, grayish brown. Comprises sediment of marshes in coastal areas and Chesapeake Bay. Thickness is 0-10 ft.

Qtl — **Lynnhaven Member of Tabb Formation** - Pebbly and cobbly, fine to coarse gray sand grading upward into clayey and silty fine sand and sandy silt; locally, at base of unit, medium to coarse crossbedded sand and clayey silt containing abundant plant material fill channels cut into underlying stratigraphic units. Thickness is 0-20 ft.

Qts — **Sedgefield Member of Tabb Formation -** Pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandyand clayey silt. Unit constitutes surficial deposit of river- andcoast parallel plains (alt. 20-30 ft) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0-50 ft.

Qsh — **Shirley Formation (middle Pleistocene)** - Light-to dark-gray and brown sand, gravel, silt, clay, and peat.Thickness is 0-80 ft.

Qc — **Chuckatuck formation (middle (?) Pleistocene) -** Light- to medium-gray, yellowish-orange, and reddish-brown sand. silt and clay and minor amounts of dark-brown and brownish-black peat. Unit is 0 - 26 ft thick.

QTw — **Windsor Formation (lower Pleistocene or upper Pliocene) -** Gray and yellow to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits if extensive plain (alt. 85-95 ft) seaward of Surry scarp and coeval, fluvial-estuarine terrace west of scarp. Unit is 0-40 ft thick.

Tm — **Moorings unit of Oaks and Coch (1973) (upper Pliocene) -** White, light-gray, and grayish-yellow quartzose sand and gray to grayish-brown clayed silt and silty clay. Constitutes discontinuous linear body along and just west of Surry scrap. Unit is as much as 30 ft thick.

Tb¹ Tb² — **Bacons Castle Formation of Chesapeake Group (upper Pliocene) -** Gray, yellowish-orange, and reddish-brown sand, gravel, silt, and

Tc — **Chesapeake Group (upper Pliocene to lower Miocene) -** Fine to coarse, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters.

Figure 2. Geologic map of York County (from Mixon *et al*., 1989).

From Yorktown toward Chesapeake Bay, the geology gets younger. It is formed by various members of the Tabb Formation during the Upper Pliestocene. The Tabb Formation was deposited during the last major high stand of sea level that extended from about 135,000 to 70,000 years ago. The differentiation between the three members, Sedgefield, Lynnhaven, and Poquoson, are likely the result of small-scale variations in the shoreline with peaks at 80,000, 105,000, and 125,000 years ago (Toscano, 1992). The Goodwin Island marshes and those marshes north of York Point are formed on sediments deposited during the Holocene, in the last 10,000 years.

The last low stand found the ocean coast about 60 miles to the east when sea level about 400 feet lower than today and the coastal plain was broad and low (Toscano, 1992). This low-stand occurred about 18,000 years ago during the last glacial maximum. The present estuarine system was a meandering series of rivers working their way to the coast. As sea level began to rise and the coastal plain watersheds began to flood, shorelines began to recede. The slow rise in sea level is one of two primary long-term processes which cause the shoreline to recede; the other is wave action, particularly during storms. As shorelines recede or erode the bank material provides the sands for the offshore bars, beaches and dunes.

Sea level rise has been well documented in the Tidewater Region. Tide data collected at Gloucester Point show that sea level has risen 0.15 inches/yr or 1.25 ft/century (http://www.co-ops.nos.noaa.gov/). This directly effects the reach of storms and their impact on shorelines. Anecdotal evidence of storm surge during Hurricane Isabel, which impacted North Carolina and Virginia on September 18, 2003, put it on par with the storm surge from the "storm of the century" which impacted the lower Chesapeake Bay in August 1933. Boon (2003) showed that even though the tides during the storms were very similar, the difference being only 1.5 inches, the amount of surge was different. The 1933 storm produced a storm surge that was greater than Isabel's by slightly more than a foot. However, analysis of the mean water levels for the months of both August 1933 and September 2003 showed that sea level has risen by 1.35 ft at Hampton Roads in the seventy years between these two storms (Boon, 2003). This is the approximate time span between our earliest aerial imagery (1937) and our most recent (2009), which means the impact of sea level rise to shore change is significant.

Three reaches exist along the coast of York County (Figure 3). Reach 1 extends from Skimino Creek to the Coleman Bridge along the south bank of the York River. Reach 2 also is on the York River and extends from the Coleman Bridge to Goodwin Islands. Reach 3 extends from the south side of Goodwin Islands to Lambs Creek in the Poquoson River.

2.2 Hydrodynamic Setting

Tide range varies from 2.2 to 2.8 ft in York County. Along Reach 1 on the York River, the mean is tidal range 2.8 ft (3.3 ft spring range) at the Allmondsville tide station (Figure 3) and 2.5 ft (3.0 ft spring range) at Penniman Spit tide station.

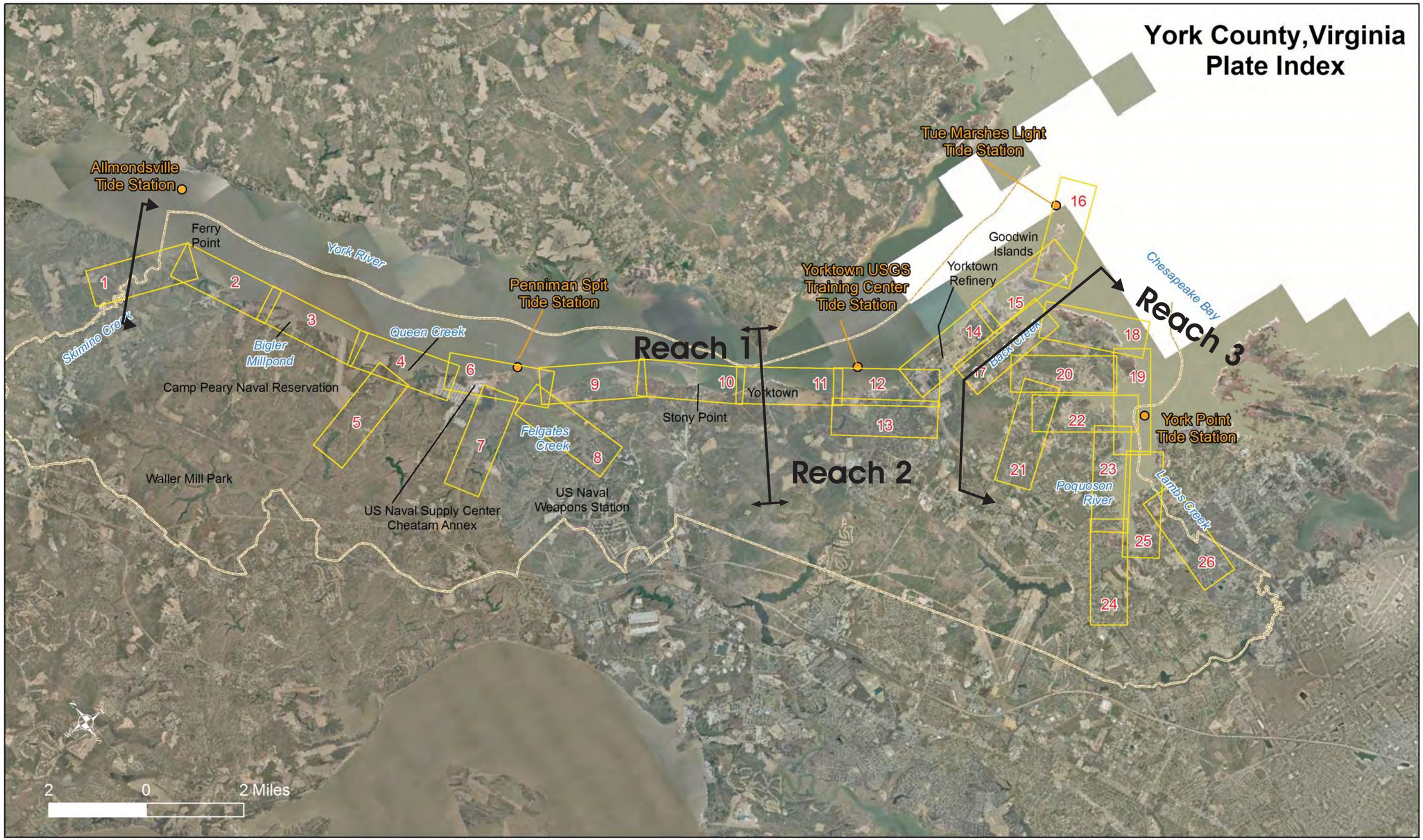


Figure 3. Index of shoreline plates.

The mean tide range of Reach 2 is 2.3 ft (2.6 ft spring range) at Yorktown USCG Training Center tide station and decreases slightly to 2.2 ft (2.9 ft spring range) at Tue Marshes Light Tide Station (Figure 3). Reach 3 is along Chesapeake Bay and the Poquoson River and has a mean tide range of 2.4 ft (2.9 ft spring range) at York Point tide Station (Figure 3).

Wind data from Norfolk International Airport reflect the frequency and speeds of wind occurrences from 1960 to 1990 (Table 1). These data provide a summary of winds possibly available to generate waves. Winds from the north and south have the largest frequency of occurrence, but the north and northeast have the highest occurrence of large waves. Reach 1 has a limited fetch for northeast winds; however, during northeast storms, the winds frequently shift to the northwest during the course of the storm. The waves generated by these winds have an impact on Reach 1. Reach 2 is more exposed than Reach 1 even though they are both on the York River. Wind-generated waves from the northeast and east can enter the mouth of the York River and impact this shore reach. The Goodwin Islands and parts of Reach 3 are very exposed to an open bay hydrodynamic wave conditions. However, the sections of Reach 3 on the Poquoson River and it's associated creeks are relatively sheltered from open bay conditions.

Table 1. Summary wind conditions at Norfolk International Airport from 1960-1990.

		WIND DIRECTION								
Wind Speed (mph)	**Mid Range (mph)**	**South**	**South west**	**West**	**North west**	**North**	**North east**	**East**	**South east**	**Total**
< 5	3	5497* 2.12+	3316 1.28	2156 0.83	1221 0.47	35748 13.78	2050 0.79	3611 1.39	2995 1.15	56594 21.81
5-11	8	21083 8.13	15229 5.87	9260 3.57	6432 2.48	11019 4.25	13139 5.06	9957 3.84	9195 3.54	95314 36.74
11-21	16	14790 5.70	17834 6.87	10966 4.23	8404 3.24	21816 8.41	16736 6.45	5720 2.20	4306 1.66	100572 38.77
21-31	26	594 0.23	994 0.38	896 0.35	751 0.29	1941 0.75	1103 0.43	148 0.06	60 0.02	6487 2.5
31-41	36	25 0.01	73 0.03	46 0.02	25 0.01	162 0.06	101 0.04	10 0.00	8 0.00	450 0.17
41-51	46	0 0.00	0 0.00	0 0.00	1 0.00	4 0.00	4 0.00	1 0.00	0 0.00	10 0.00
Total		41989 16.19	37446 14.43	23324 8.99	16834 6.49	70690 27.25	33133 12.77	19447 7.50	16564 6.38	259427 100.00

*Number of occurrences +Percent

Hurricanes, depending on their proximity and path also can have an impact on the York County's coast. On September 18, 2003, Hurricane Isabel passed through the Virginia coastal plain. The main damaging winds began from the north and shifted to the east then south. Gloucester Point recorded wind gusts at 69 mph, a peak gust at 91 mph with a storm surge 8.3 ft (Beven and Cobb, 2004) and having water levels 8.2 ft above mean lower low water (MLLW) and rising when the Gloucester Point station was destroyed during the storm (NOAA, 2009). Hurricane Isabel was not the only recent tropical event to pass though the County; Tropical Storm Ernesto (September 1, 2006) brought wind speeds of 20 mph and a peak gust of 27 mph with water levels rising above 6.0 ft above MLLW at the Yorktown USCG Training Center tide station (NOAA, 2009). York County also was hit by the Veteran's Day Storm on November 11, 2009 which had water levels of 6.9 ft above MLLW with wind speeds at 48 mph with gusts at 58 mph (NOAA, 2009).

3 Methods

3.1 Photo Rectification and Shoreline Digitizing

An analysis of aerial photographs provides the historical data necessary to understand the suite of processes that work to alter a shoreline. Images of the York County's shoreline from 1937, 1963, 1994, 2002, and 2007 were used in the analysis. The 1994, 2002, and 2007 images were available from other sources. The 1994 imagery was orthorectified by the U.S. Geological Survey (USGS) and the 2002 and 2007 imagery was orthorectified by the Virginia Base Mapping Program (VBMP). The 2002 VBMP images did not include Goodwin Islands. However, the shoreline for this section of shore was available from the Virginia Institute of Marine Science's Submerged Aquatic Vegetation images.

The 1937 and 1963 images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. They were orthorectified to a reference mosaic, the 1994 Digital Orthophoto Quarter Quadrangles (DOQQ) from USGS. The original DOQQs were in MrSid format but were converted into .img format. ERDAS Orthobase image processing software was used to orthographically correct the individual flightlines using a bundle block solution. Camera lens calibration data were matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. A minimum of four ground control points was used per image, allowing two points per overlap area. The exterior and interior models were combined with a digital elevation model (DEM) from the USGS National Elevation Dataset to produce an orthophoto for each aerial photograph. The orthophotographs that cover each USGS 7.5 minute quadrangle area were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic also in .img format. To maintain an accurate match with the reference images, it was necessary to distribute the control points evenly. This can be challenging in areas with little development. Good examples of control points were manmade features such as corners of buildings or road intersections and stable natural landmarks such as easily recognized isolated trees. Some areas of the county were particularly difficult to rectify due to the lack of development that provide good control points.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background. The morphologic toe of the beach or edge of marsh was used to approximate mean low water (MLW). Mean high water (MHW)/ limit of runup is difficult to determine on much of the shoreline due to narrow or non-existant beaches against upland banks or vegetated cover. In areas where the shoreline was not clearly identifiable on the aerial photography, the location was estimated based on the experience of the digitizer. The displayed shorelines are in shapefile format. One shapefile was produced for each year that was mosaicked.

Horizontal positional accuracy is based upon orthorectification of scanned aerial photography using USGS DOQQs. Vertical control is the USGS 100 ft (30 m) DEM. The 1994 USGS reference images were developed in accordance with National Map Accuracy Standards (NMAS) for Spatial Data Accuracy at the 1:12,000 scale. The 2002 and 2007 Virginia Base Mapping Program's orthophotography were developed in accordance with the National Standard for Spatial Data Accuracy (NSSDA). Horizontal root mean square error (RMSE) for historical mosaics was held to less than 20 ft.

Using methodology reported in Morton *et al.* (2004) and National Spatial Data Infrastructure (1998), estimates of error in orthorectification, control source, DEM and digitizing were combined to provide an estimate of total maximum shoreline position error. The data sets that were orthorectified (1937 and 1963) have an estimated total maximum shoreline position error of 20.0 ft, while the total shoreline error for the three existing datasets are estimated at 18.3 ft for USGS and 10.2 ft for VBMP. The maximum annualized error for the shoreline data is $\pm$0.7 ft/yr. The smaller rivers and creeks are more prone to error due to their general lack of good control points for photo rectification, narrower shore features, tree and ground cover and overall smaller rates of change. For these reasons, some areas were only digitized in 1937 and 2007. It was decided that digitizing the intervening years would introduces more errors rather then provide additional information. In addition, some of the individual 1937 images were difficult to digitize and a best estimate was used in these areas. The 1963 photos had ice along the shoreline and also had to be estimated in some sections.

3.2 Rate of Change Analysis

The Digital Shoreline Analysis System (DSAS) was used to determine the rate of change for the County's shoreline (Himmelstoss, 2009). All DSAS input data must be managed within a personal geodatabase, which includes all the baselines for York and the digitized shorelines for 1937, 1963, 1994, 2002 and 2007. Baselines were created about 200 feet seaward of the 1937 shoreline and encompassed most of the County's main shorelines but generally did not include the smaller creeks. It also did not include areas that have unique shoreline morphology such as creek mouths and spits. DSAS generated transects perpendicular to the baseline about 33 ft apart. For York County, this method represented about 34 miles of shoreline along 5,450 transects.

Two types of shoreline change rates are determined by the program. The End Point Rate (EPR) is calculated by determining the distance between the oldest and most recent shoreline in

the data and dividing it by the number of years between them (Figure 4A). This method providesan accurate net rate of change over the long term and is relatively easy to apply to most shorelines since it only requires two dates. However, this method does not use the intervening shorelines so it may not account for changes in accretion or erosion rates that may occur through time.

The Linear Regression Rate (LRR) is determined in DSAS by fitting a least-squares regression line to all shoreline points for given transect. The LRR is the slope of the calculated line (Figure 4B). This method uses all data and is based on accepted statistical concepts. In all areas, a rate can be determined by regression analysis because there is change in the shoreline position. However, mathematically it may not be significant because the line is so flat. In an estuarine environment, variable rates of change led to concerns that the slope of the calculated regression line may not be significantly different from zero. In order to determine if the shoreline data was amenable to explanation by regression analysis, a two-tailed t-test at 95% significance was run on the data to determine if the rate is statistically significant.

In ArcMap, the rates of change were categorized and plotted at the intersection of individual transects and the baseline. This provided a relatively efficient way to express rates of change along 34 miles of shoreline. For the Linear Regression Rate maps, only those transects that passed the significance test were plotted. The rates calculated along the other transects were not considered statistically significant. In addition, for York, LRR that used less than five shorelines available for analysis were not plotted.

4 Results and Discussion

York County's shoreline through time is depicted in 26 map plates in Appendix A & B. These plates show the individual photos and shorelines for each date analyzed. In addition, the Linear Regression Rates and End Point Rates were plotted where available/significant. County-wide and in subreaches, the average End Point and Linear Regression rates of change are nearly identical (Table 2). The maximum and minimum rates did vary slightly, but generally, they were similar. This analysis includes all the regression rates, not just those that are statistically significant. Using only those transects that passed the t-test removes about 59% of the transects from the data. This study showed that the use of the LRR method to report erosion rate does not provide additional information when compared to the EPR particularly in situations where the rate is minimized such that the slope of the regression line is shown not to be significantly different from zero.

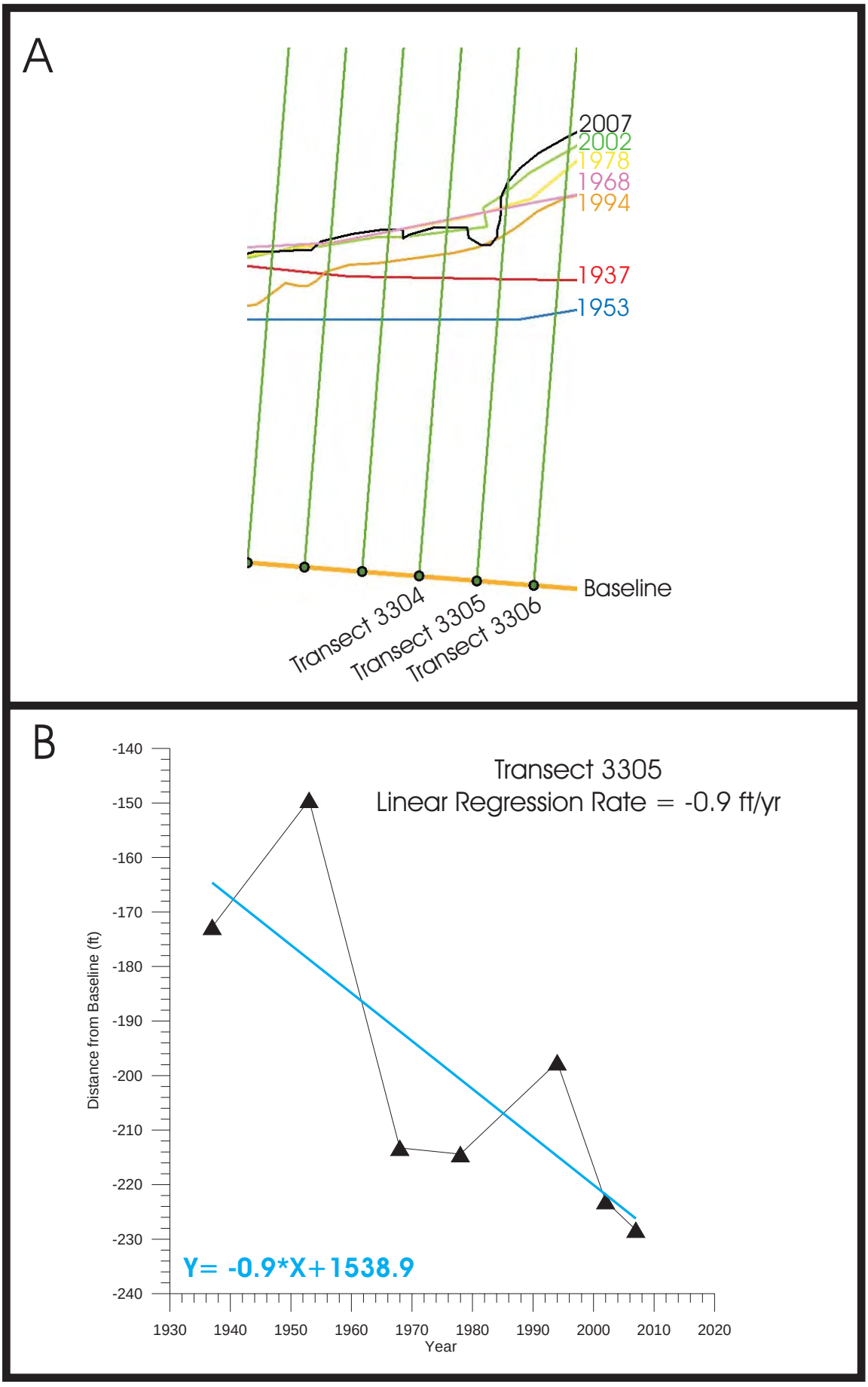


Figure 4. Graphics depicting A) sample DSAS baseline, transects and measured shoreline, and B) how the measured shoreline data is analyzed in a linear regression.

Table 2. Comparison of the End Point Rate and the Linear Regression Rate results for York's shorelines. The Linear Regression Rate uses all data, not just those that were determined to be statistically significant. Rates are in feet per year.

Location	End Point Rate			Linear Regression Rate		
	Avg	Max	Min	Avg	Max	Min
County-Wide	**-0.8**	**4.0**	**-11.7**	**-0.8**	**3.5**	**-13.0**
York River West of Yorktown	-0.7	2.4	-3.7	-0.7	2.1	-4.1
York River East of Yorktown	-1.0	4.0	-5.2	-1.0	3.5	-5.2
Chesapeake Bay	-0.8	1.8	-11.7	-0.8	1.4	-13.0

4.1 Reach 1

Reach 1 extends from Skimino Creek to the Coleman Bridge along the south bank of the York River and contains Plates 1-10. Reach 1 has an average long-term erosion rate of -0.7 ft/yr (Table 2) with higher rates recorded at Ferry Point on Plate 1 and Queen Creek on Plate 4; both with rates from -2 to -5 ft/yr. Accretion occurred in front of the Cheatham Annex on Plate 6 due to the installation of a breakwater system and around a pier at Stoney Point on Plate 10. Both have rates from +1 to +2 ft/yr. Much of the shoreline along the Colonial National Historical Parkway is protected by revetments. This accounts for the very low erosion rate along most of the River. At Yorktown, waterfront revitalization has resulted in many changes along the shoreline including the installation of breakwaters and beach fill.

4.2 Reach 2

Reach 2 extends from the Coleman Bridge to Goodwin Islands along the York River and contains Plates 11-16. Reach 2 has an average long-term erosion rate of -1.0 ft/yr (Table 2). However, accretion due to Yorktown's waterfront revitalization project was recorded on Plate 11 with a rate of +1 to +2 ft/yr. The section of shore east of Yorktown in the Colonial National Historical Park has a high erosion rate of -5 to -10 ft/yr. However, most of this shore is protected with rock revetments which have reduced the more recent erosion rate to very low erosion as indicated along the rest of the Parks shoreline. Accretion at the Yorktown Refinery on Plate 14 is due to man-made construction of the pier. The Goodwin Islands are undergoing low to medium erosion on their most exposed side. Erosion is slightly lower on the Islands back side and in creeks.

4.3 Reach 3

Reach 3 extends from the south side of Goodwin Islands to Lambs Creek in the Poquoson River and Plates 17 - 26. Reach 3 has an average long-term erosion rate of -0.8 ft/yr (Table 2) with higher rates at Bay Tree Point on Plate 18 with a rate of -5 to -10 ft/yr. Bay Tree Point and

the surrounding shoreline is exposed to the Chesapeake Bay and is eroding quickly. A small amount of accretion on the Thorofare in Plate 17 on Crab Neck due to man-made industrial use.

5 Summary

Shoreline change rates vary around York County. Generally, the subreaches with smaller fetches such as along the Poquoson River and tributaries to the larger rivers and bays had smaller rates of change. However, a good portion of the York River shoreline is protected by rock revetments which will reduce the change along the shoreline. The Goodwin Islands and Bay Tree Point are exposed to the Chesapeake Bay wave climate and are rapidly eroding.

Along some individual transects, the LRR may provide better information than the EPR; however, County-wide and in individual subreaches, this was not the case. In addition, the LRR along many transects could not reliably be used in all shoreline situations as could the EPR. So, in York County, the EPR is a reliable indicator of shoreline change rates even when intervening dates are available.

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Appendix A
Shoreline Change Rates

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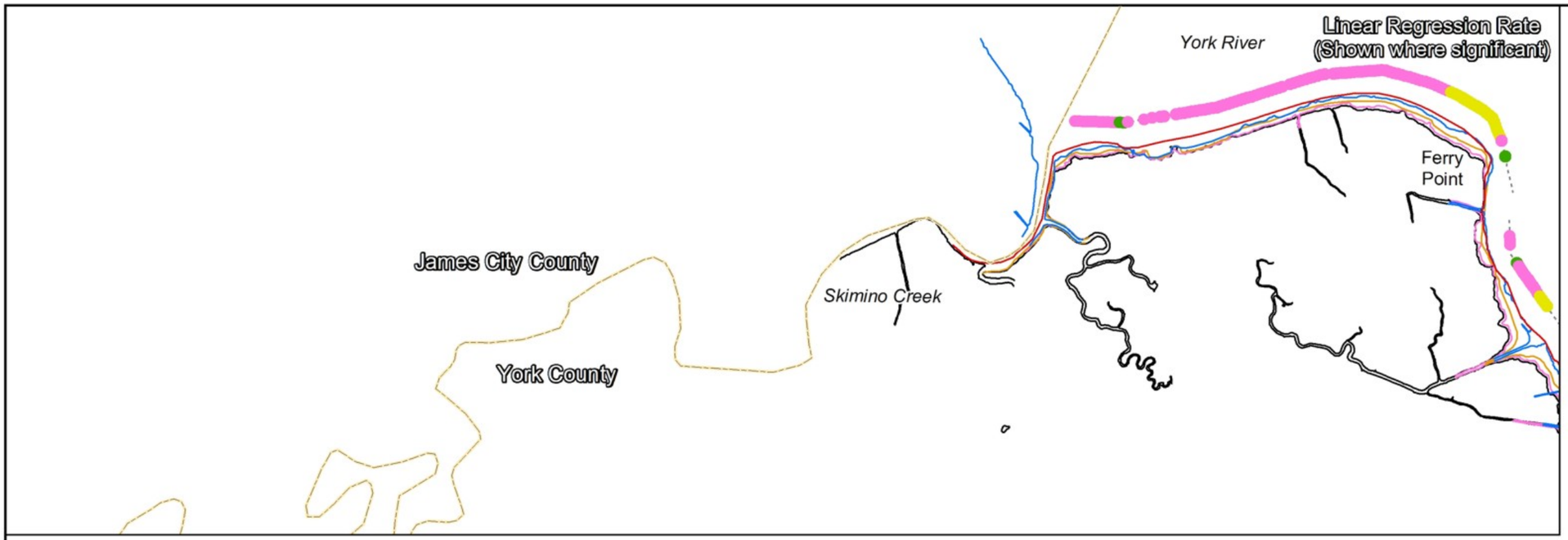
York County Virginia

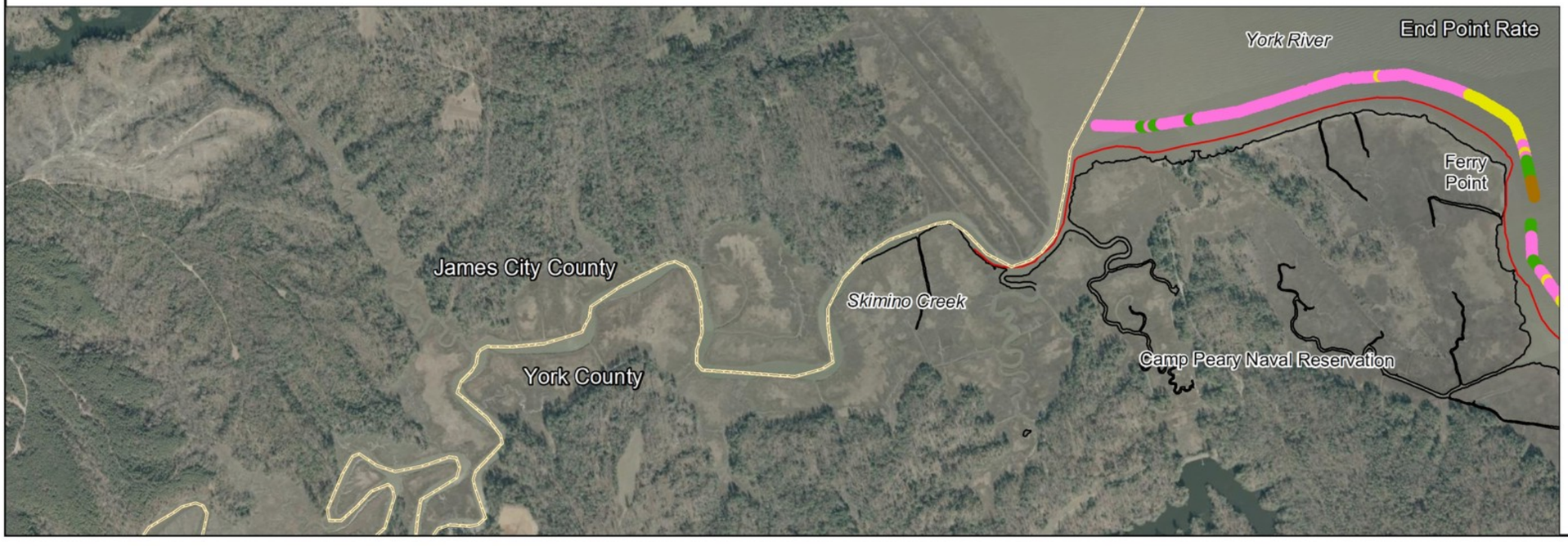
Plate 1

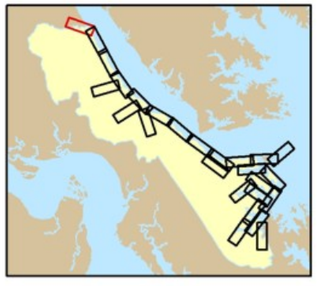


Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline





Shoreline Studies Program
VIMS

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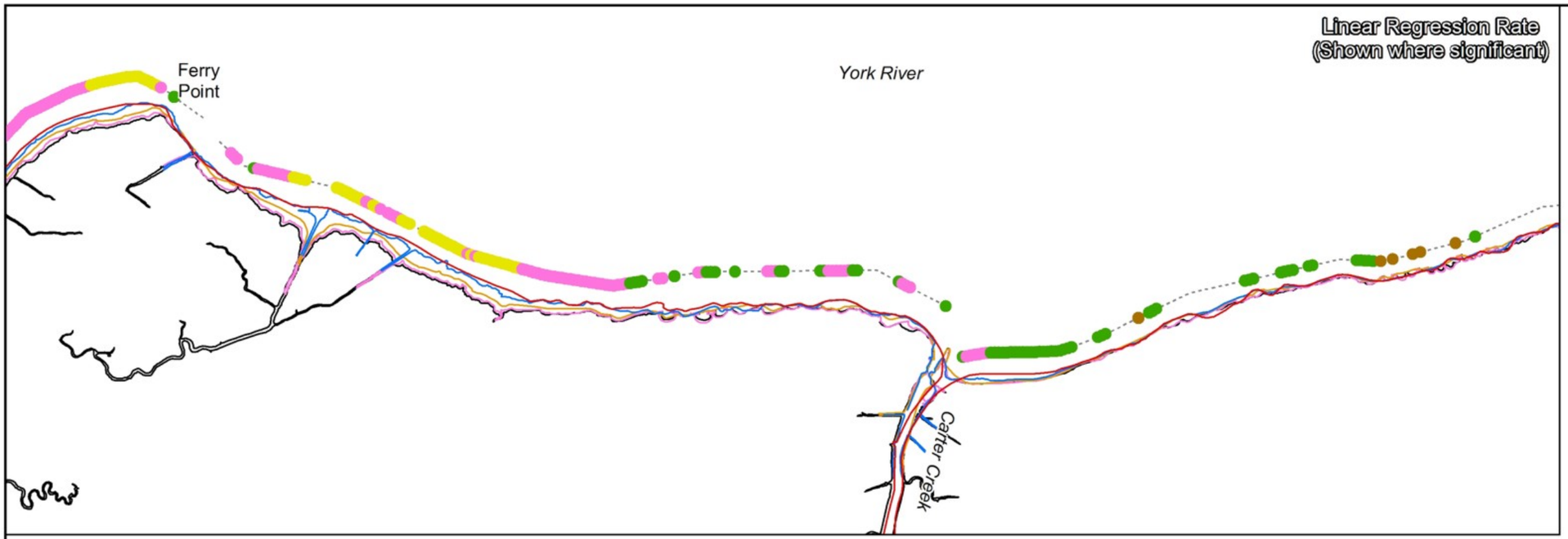
Feet

Image Date: 2007



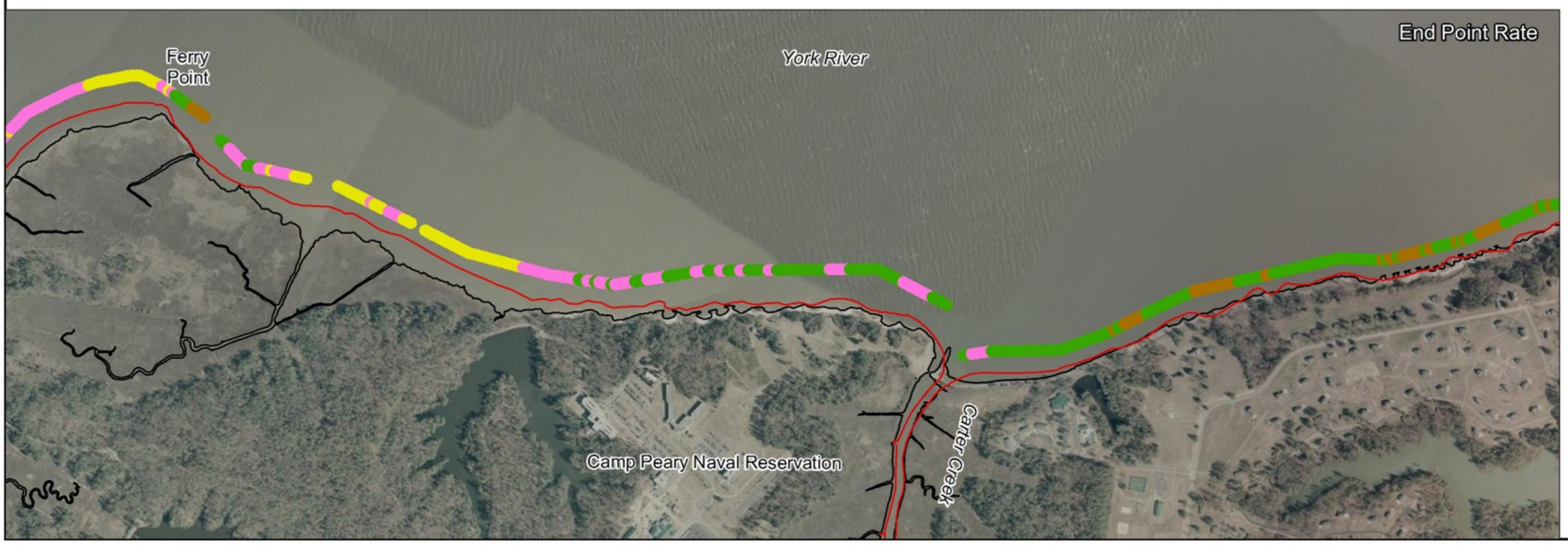
York County Virginia

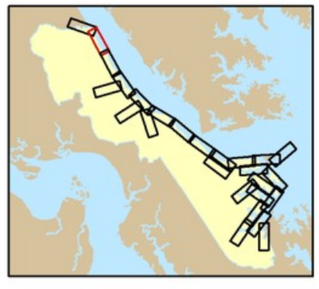
Plate 2

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline





Shoreline Studies Program
VIMS

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Feet

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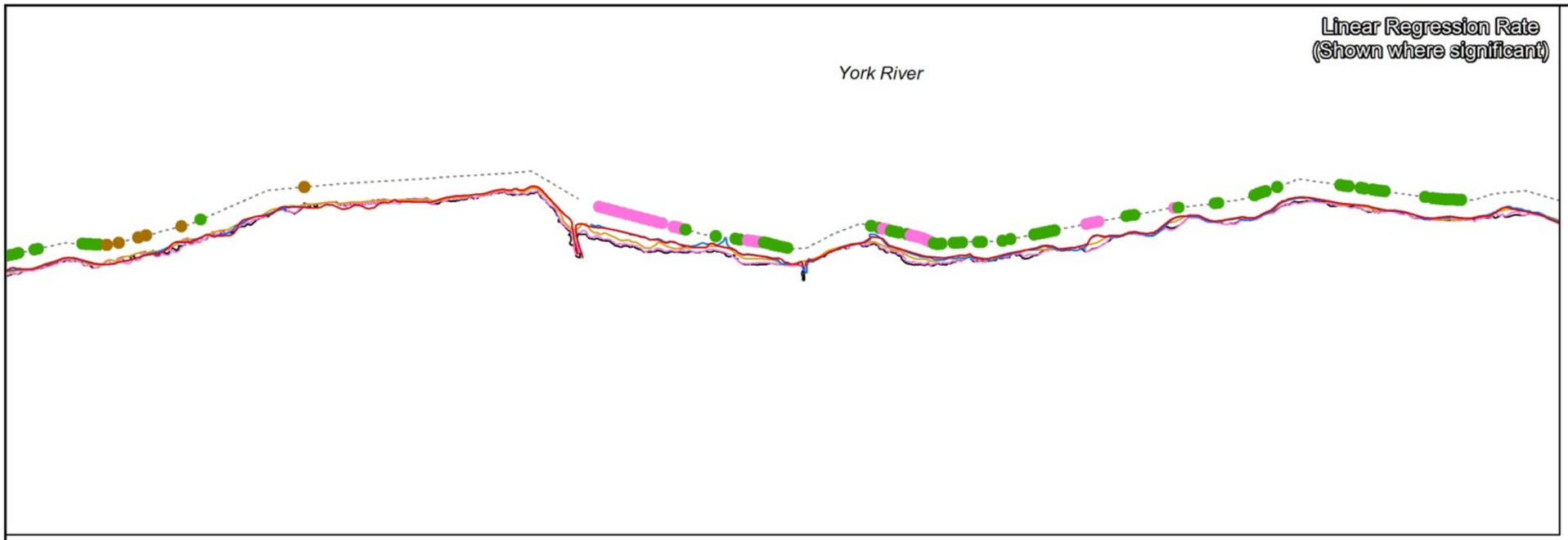


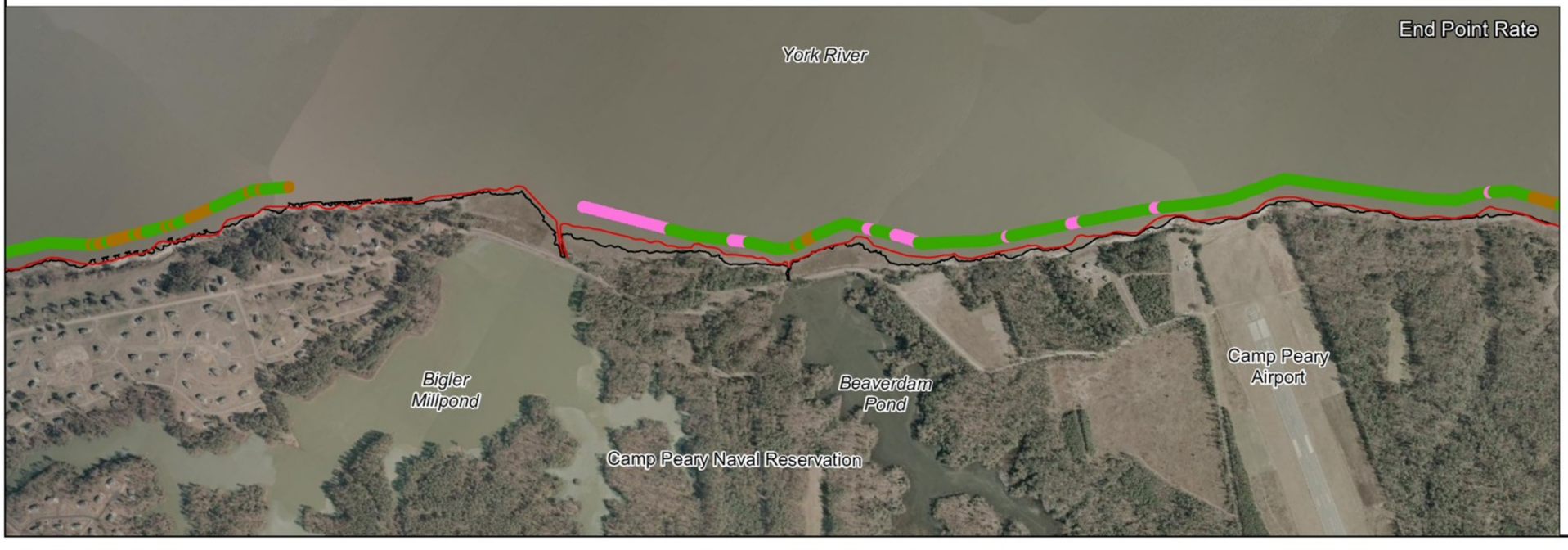
York County Virginia

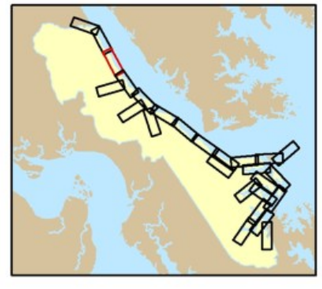
Plate 3

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline





Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Image Date: 2007

York County Virginia

Plate 4

Linear Regression Rate
(Shown where significant)

York River

Queen Creek

Cheatham Pond

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline

End Point Rate

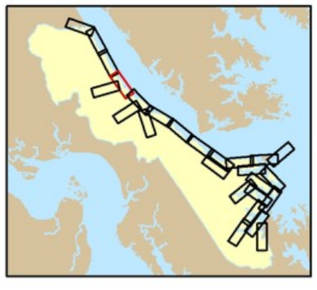
York River

Camp Peary Naval Reservation

Queen Creek

Cheatham Pond

Cheatham Annex
Naval Supply Center



Shoreline Studies Program
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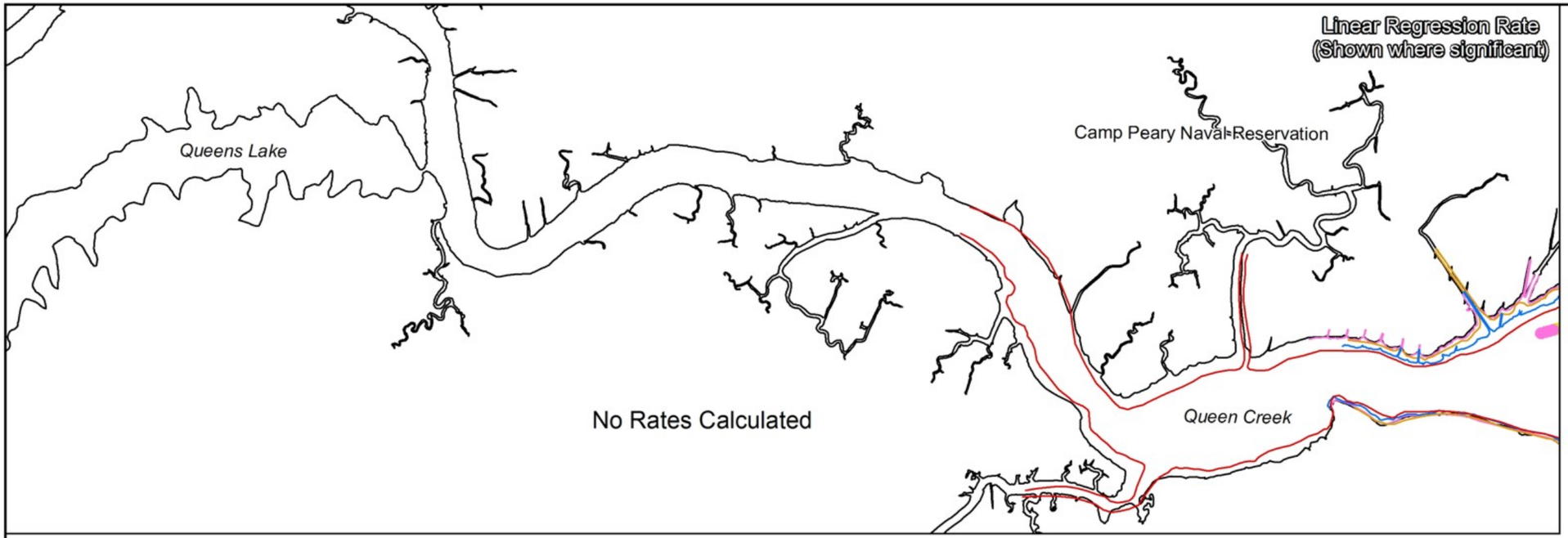
Feet

Image Date: 2007



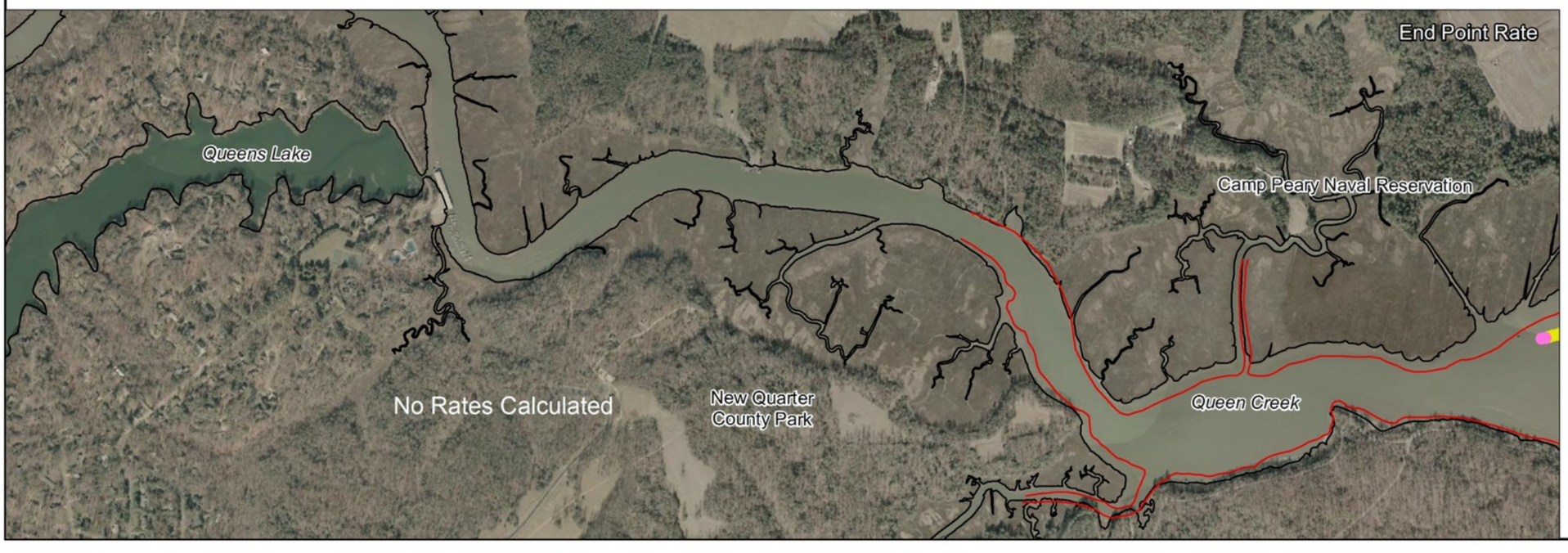
York County Virginia

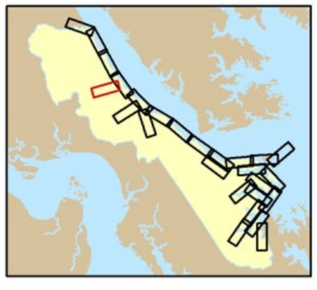
Plate 5

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline





Shoreline Studies Program
VIMS

1,000 0 1,000

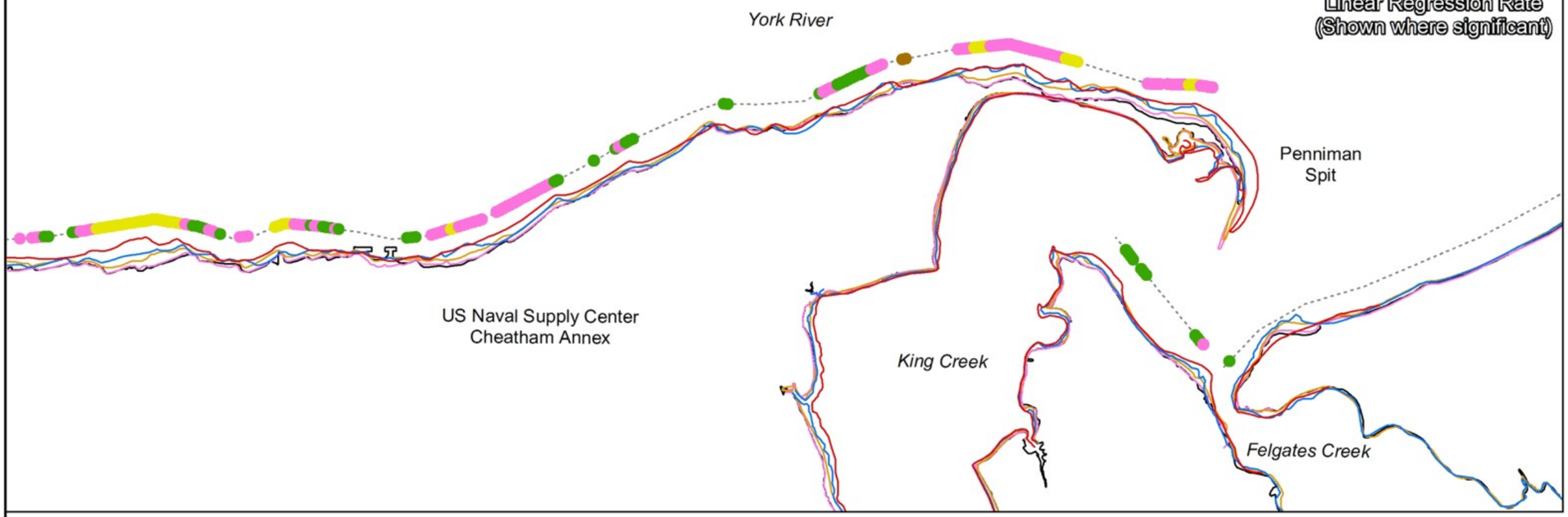
Feet

Image Date: 2007

York County Virginia

Plate 6

Linear Regression Rate
(Shown where significant)

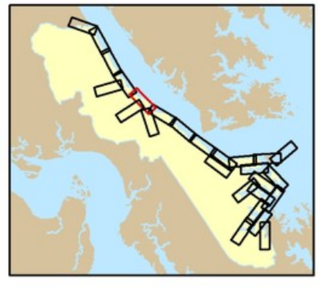


Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

1937 Shoreline
2002 Shoreline
1963 Shoreline
2007 Shoreline
1994 Shoreline
Baseline

End Point Rate



Shoreline Studies Program
VIMS

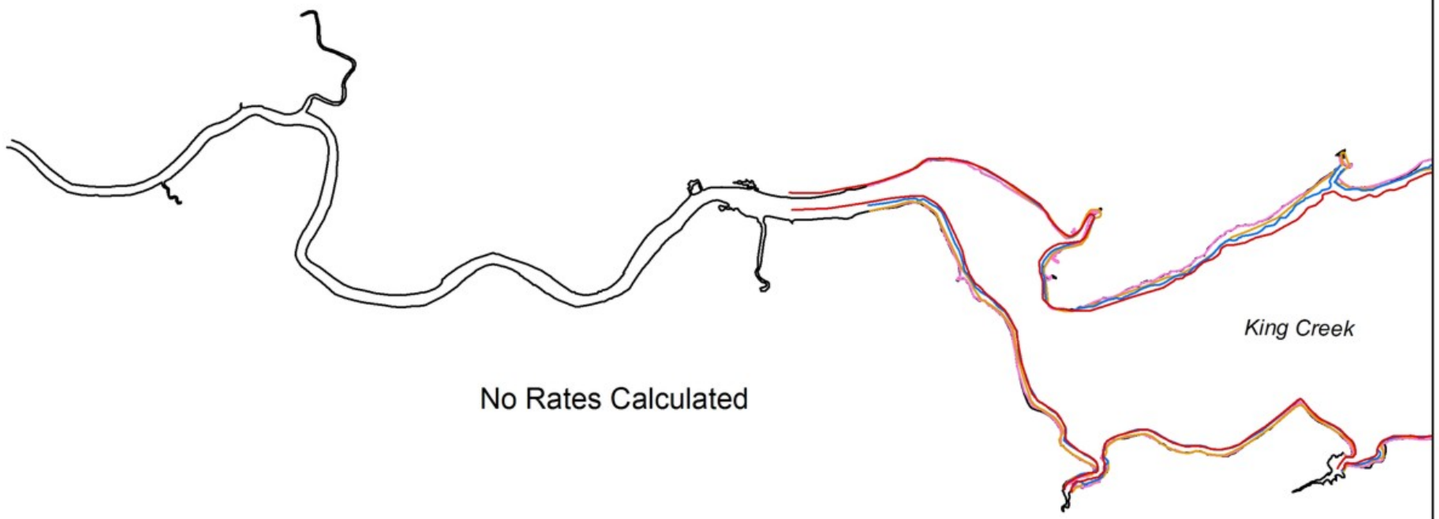
1,000 0 1,000
Feet

Image Date: 2007

York County Virginia

Plate 7

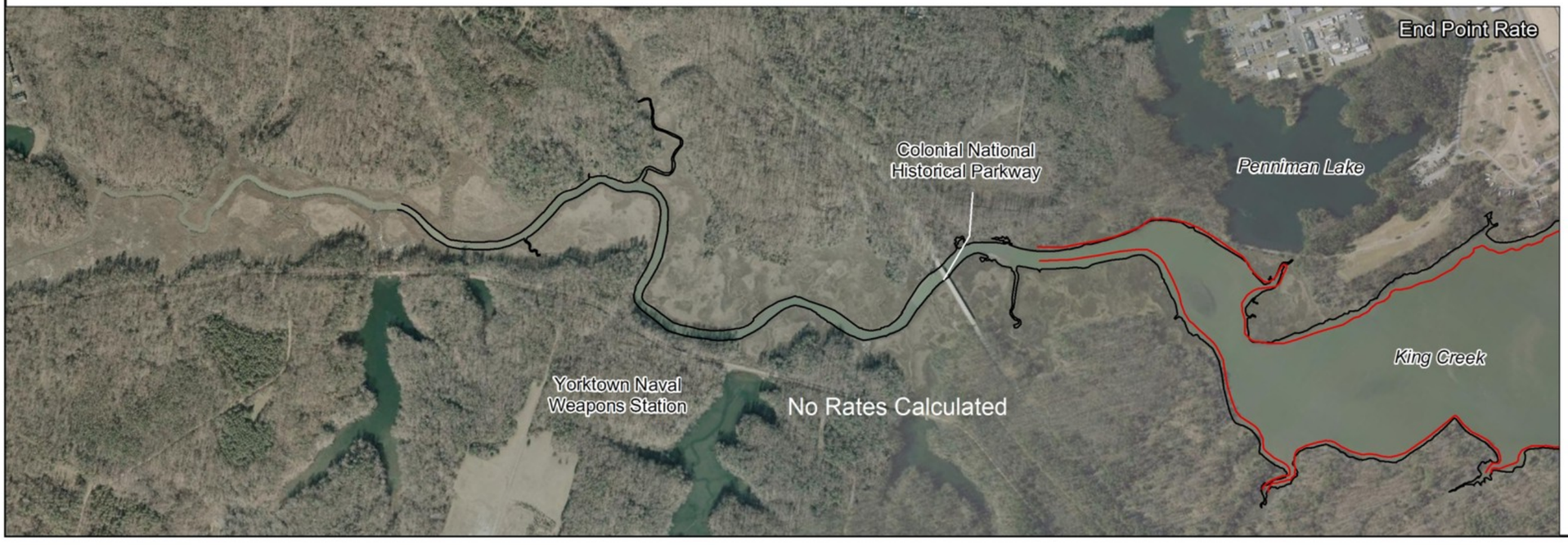
Linear Regression Rate
(Shown where significant)

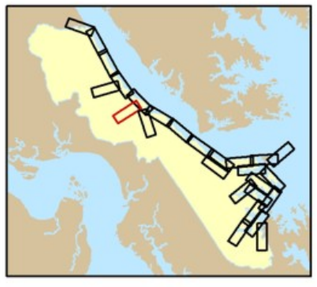


Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 1963 Shoreline
- 1994 Shoreline
- 2002 Shoreline
- 2007 Shoreline
- Baseline





Shoreline Studies Program
VIMS

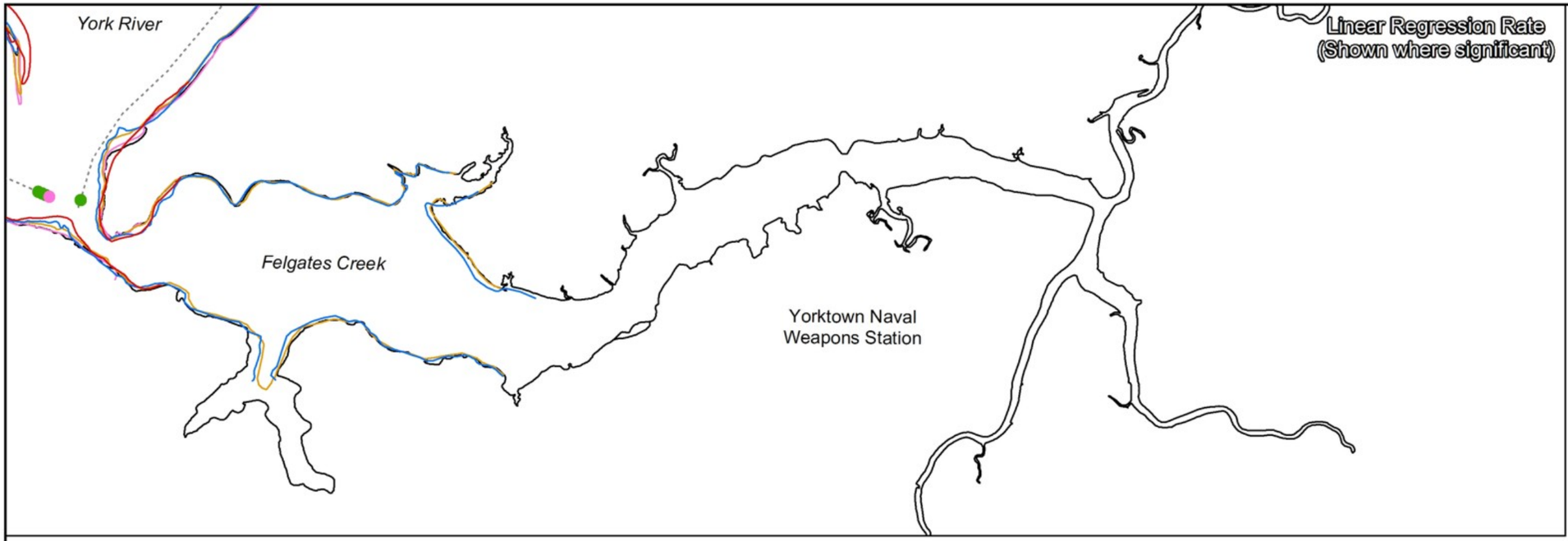
1,000 0 1,000

Feet

Image Date: 2007

York County Virginia

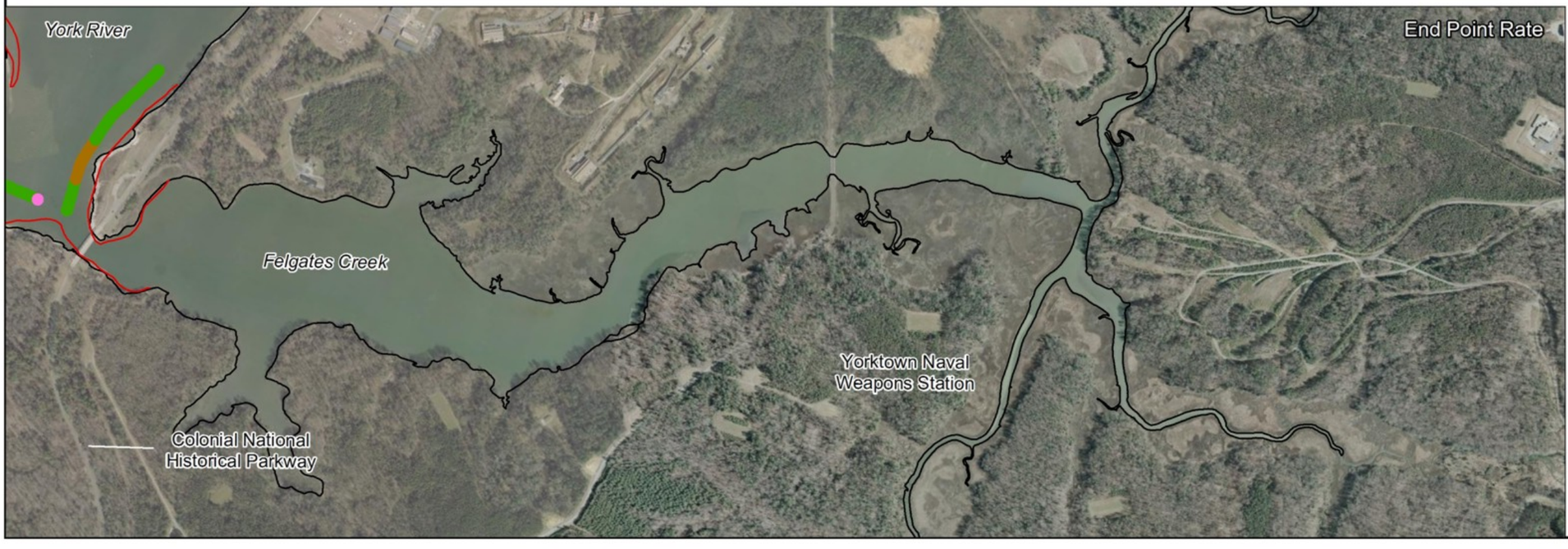
Plate 8

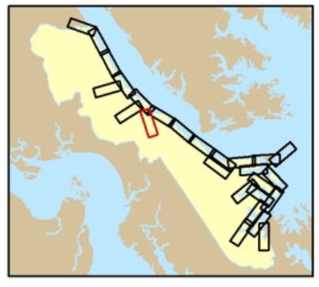


Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 1963 Shoreline
- 1994 Shoreline
- 2002 Shoreline
- 2007 Shoreline
- Baseline





Shoreline Studies Program
VIMS

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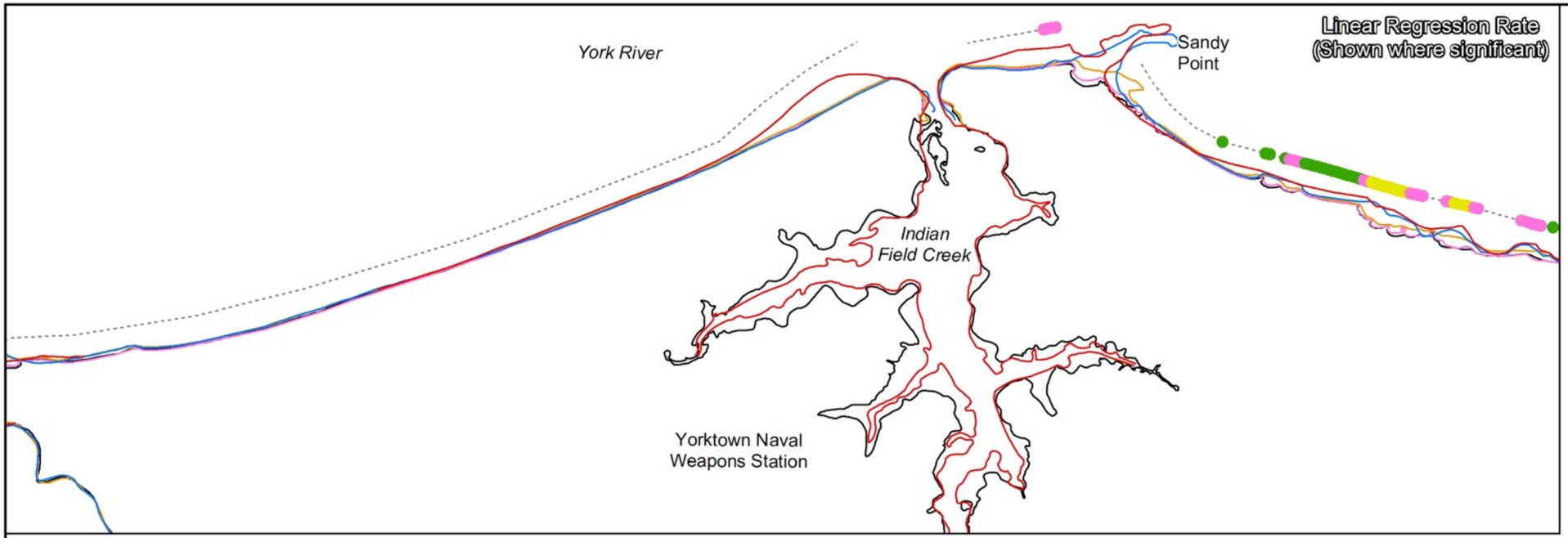
Feet

Image Date: 2007



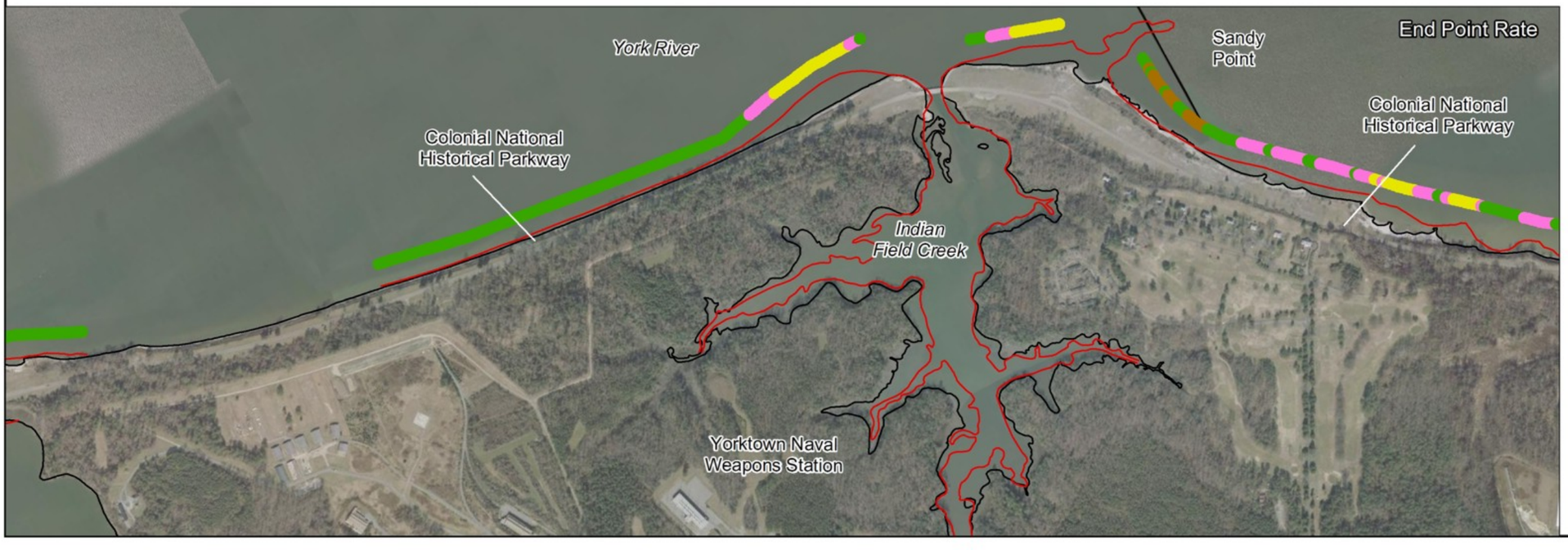
York County Virginia

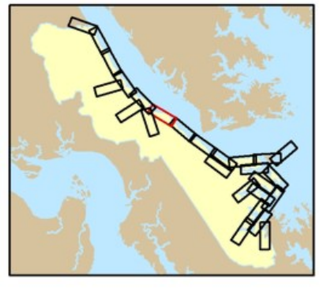
Plate 9

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 1963 Shoreline
- 1994 Shoreline
- 2002 Shoreline
- 2007 Shoreline
- Baseline





Shoreline Studies Program
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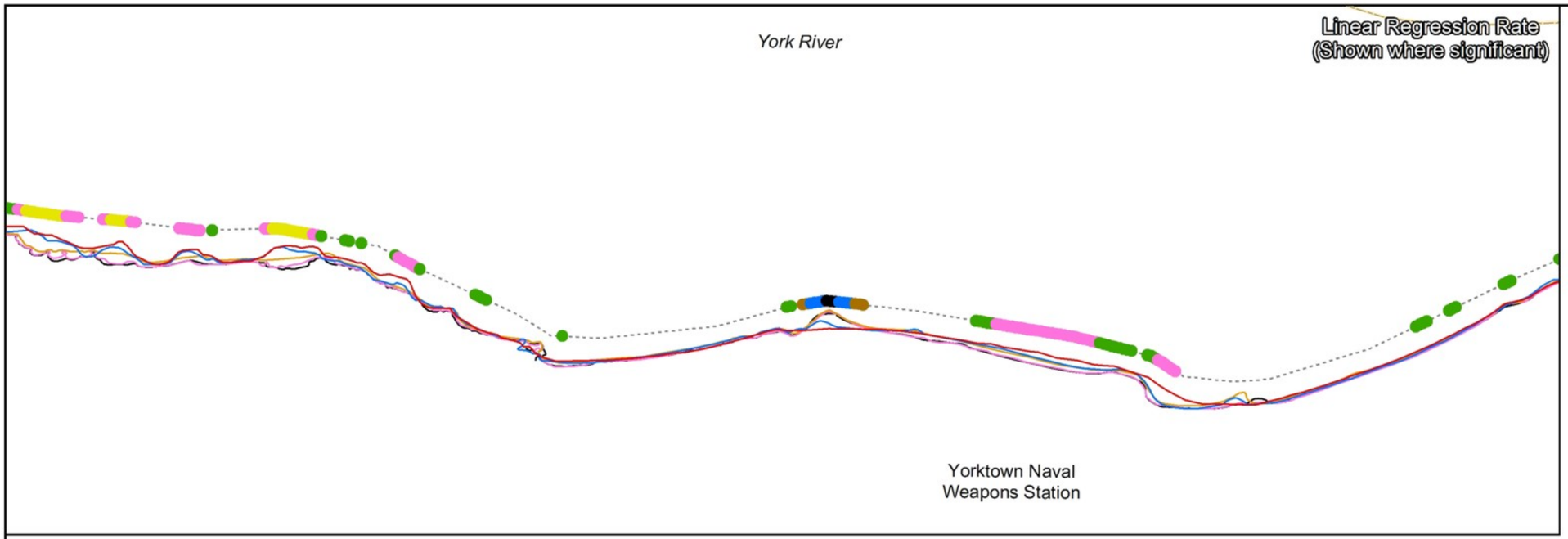
Feet

Image Date: 2007



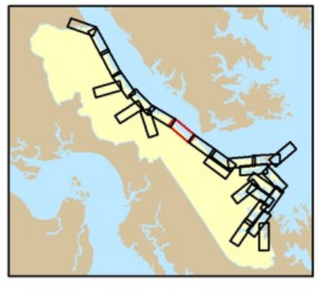
York County Virginia

Plate 10

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline



Shoreline Studies Program
VIMS

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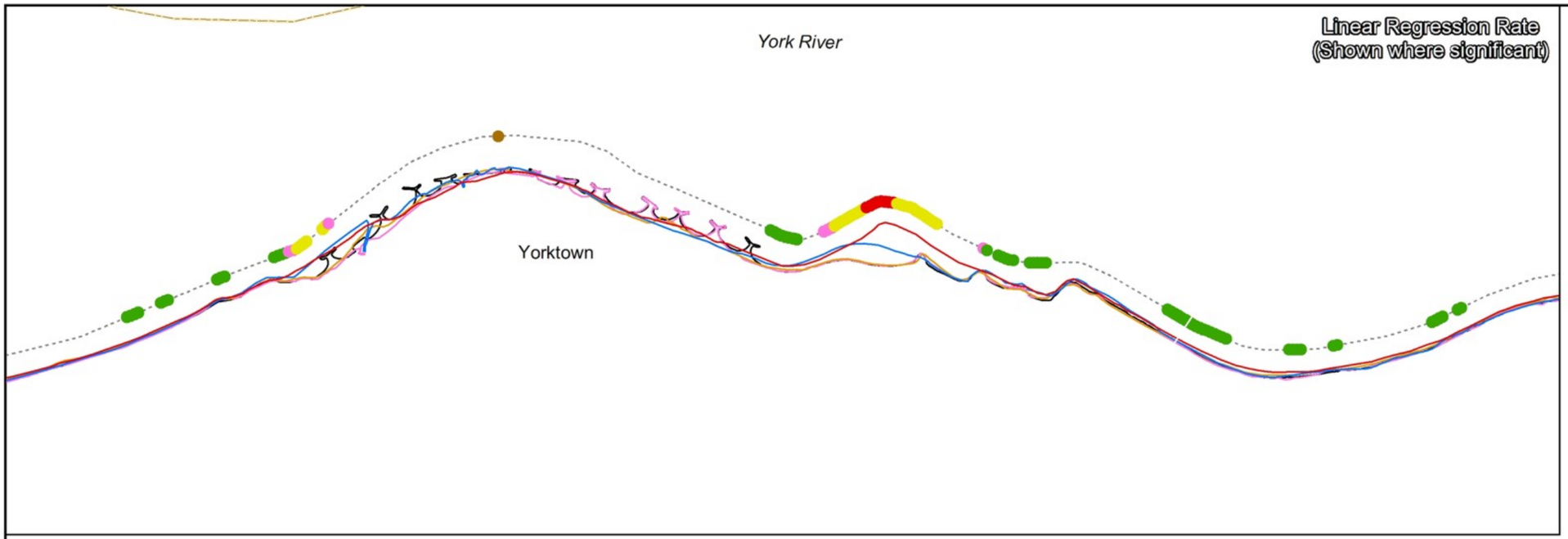
Feet

Image Date: 2007



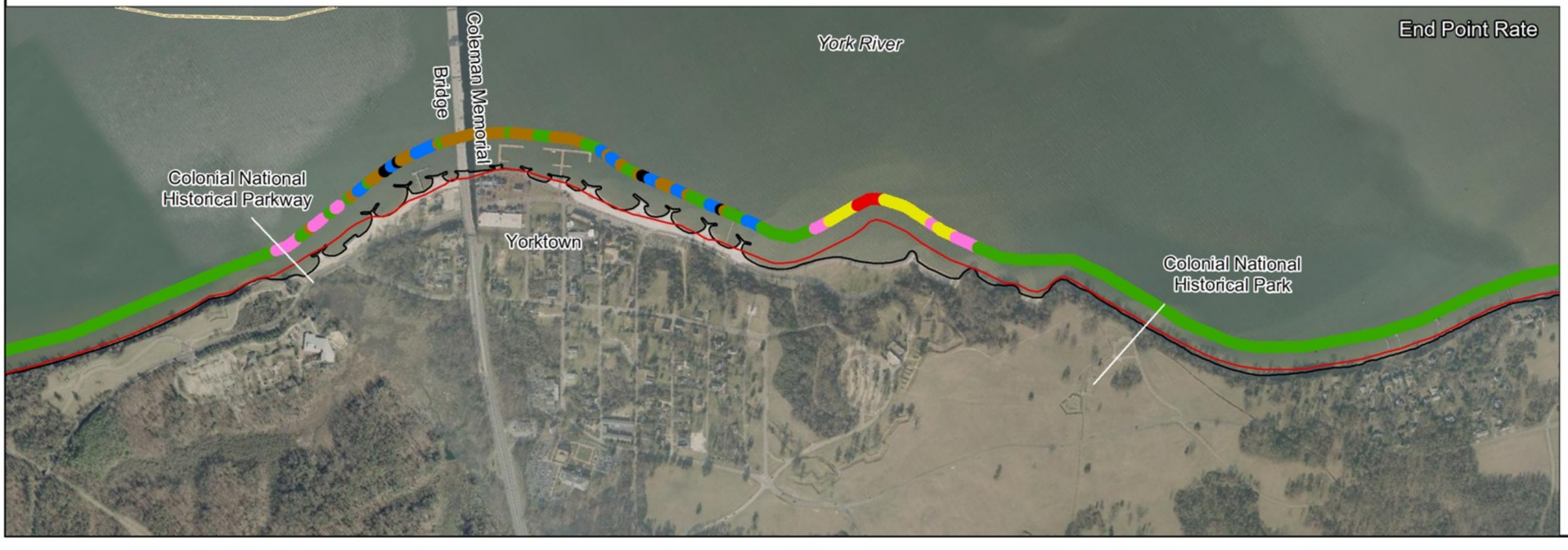
York County Virginia

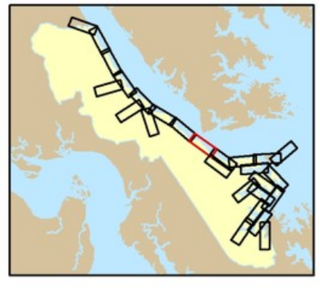
Plate 11

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline





Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Image Date: 2007

York County Virginia

Plate 12

Linear Regression Rate
(Shown where significant)

York River

Yorktown
Refinery

Us Coast Guard
Reserve Training Center

West Branch

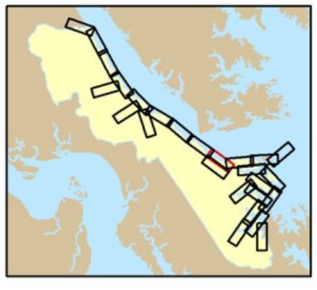
Wormley Creek

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline

End Point Rate



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Image Date: 2007

York County Virginia

Plate 13

Linear Regression Rate
(Shown where significant)

West Branch

Wormley Creek

No Rates Calculated

Colonial National
Historical Park

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline

End Point Rate

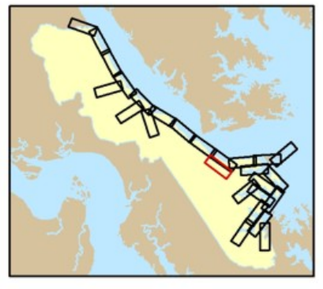
West Branch

Wormley Creek

Wormley
Pond

No Rates Calculated

Colonial National
Historical Park



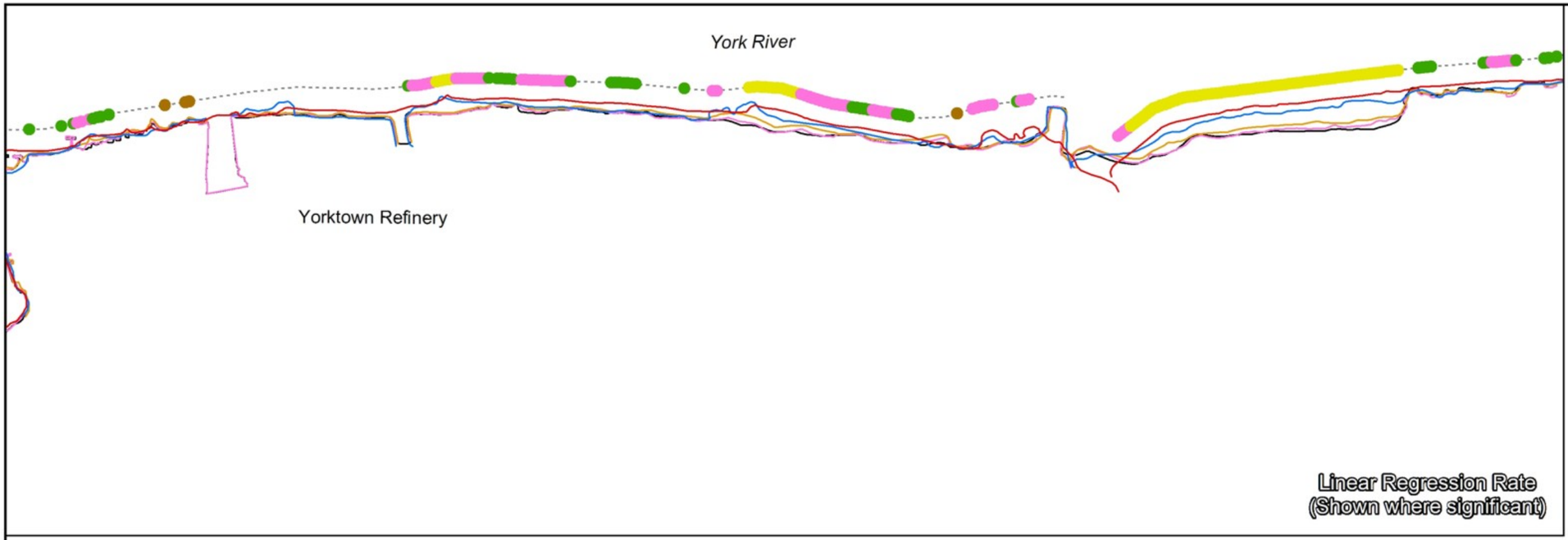
Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Image Date: 2007

York County Virginia

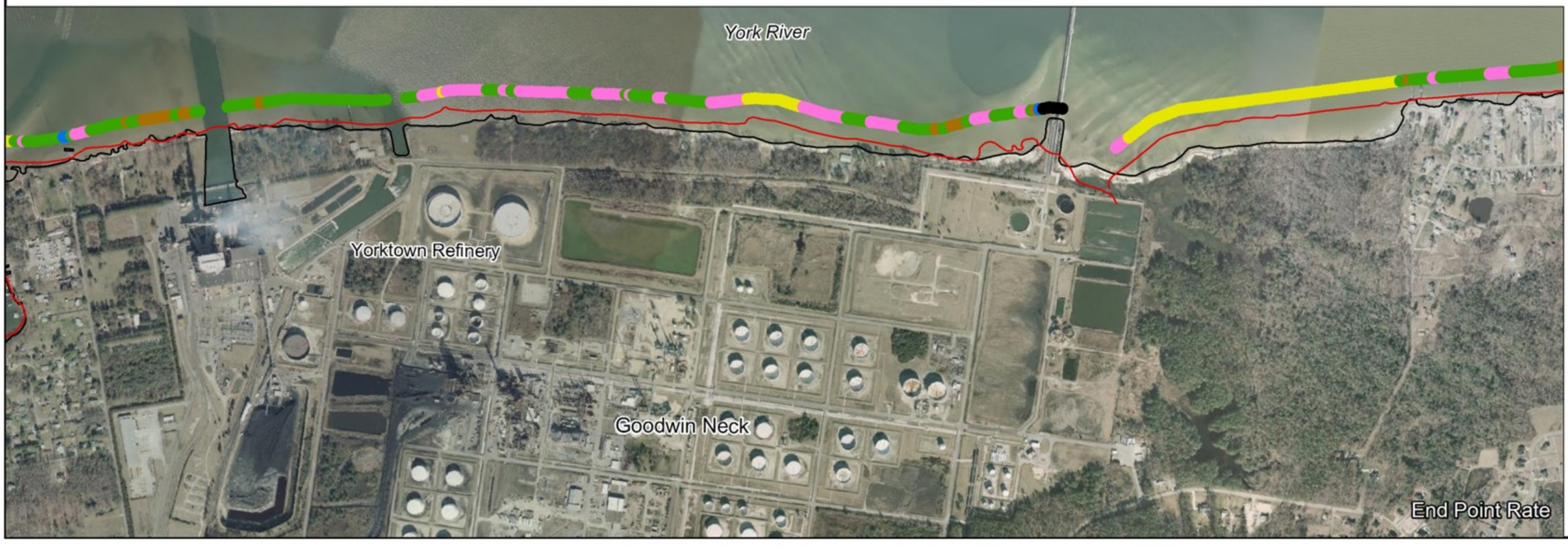
Plate 14

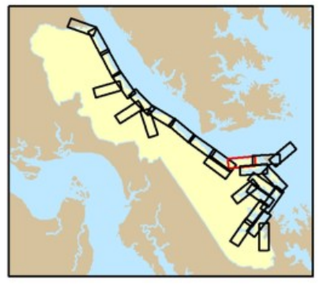


Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline





Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Image Date: 2007

York County Virginia

Plate 15

Linear Regression Rate
(Shown where significant)

York River

Goodwin Islands

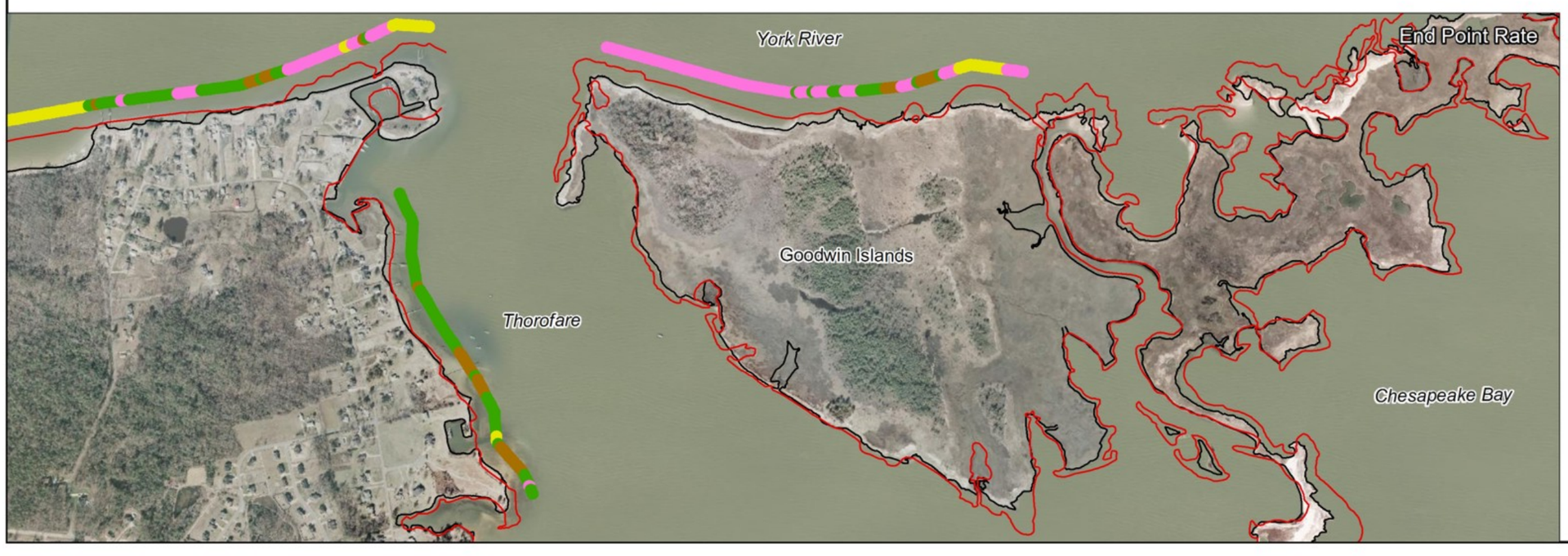
Thorofare

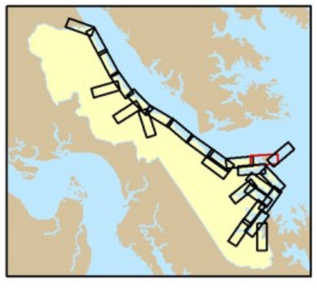
Chesapeake Bay

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

1937 Shoreline
2002 Shoreline
1963 Shoreline
2007 Shoreline
1994 Shoreline
Baseline

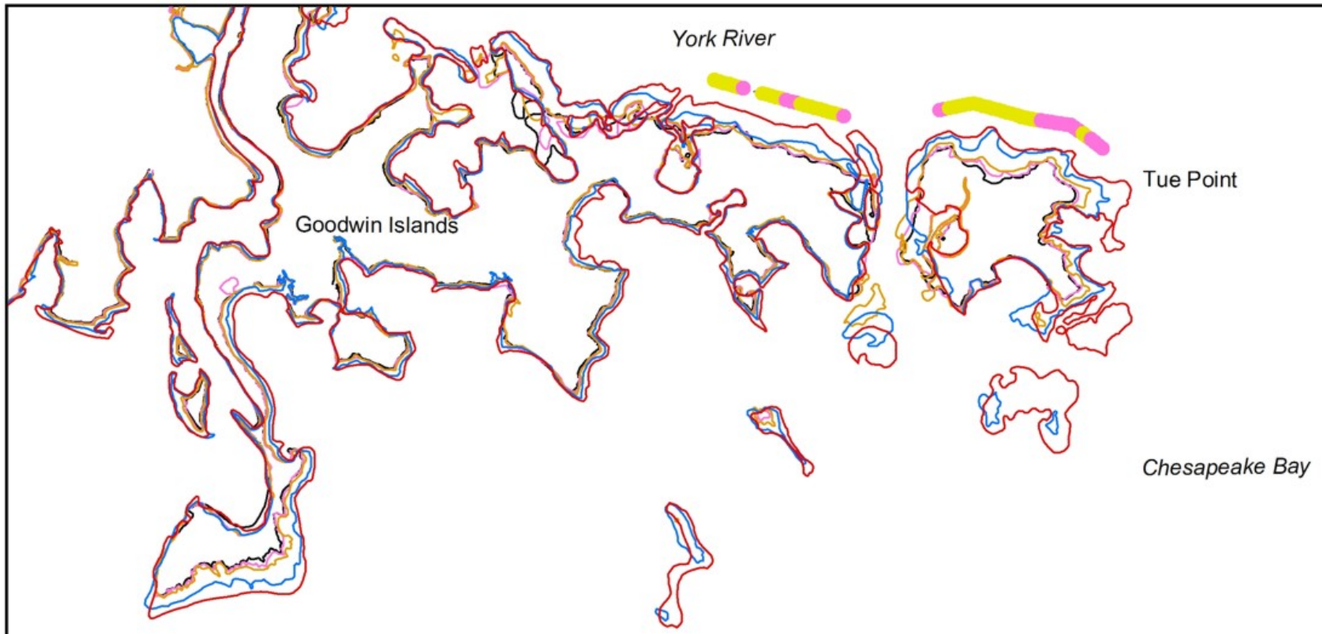




Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Image Date: 2007



Linear Regression Rate
(Shown where significant)

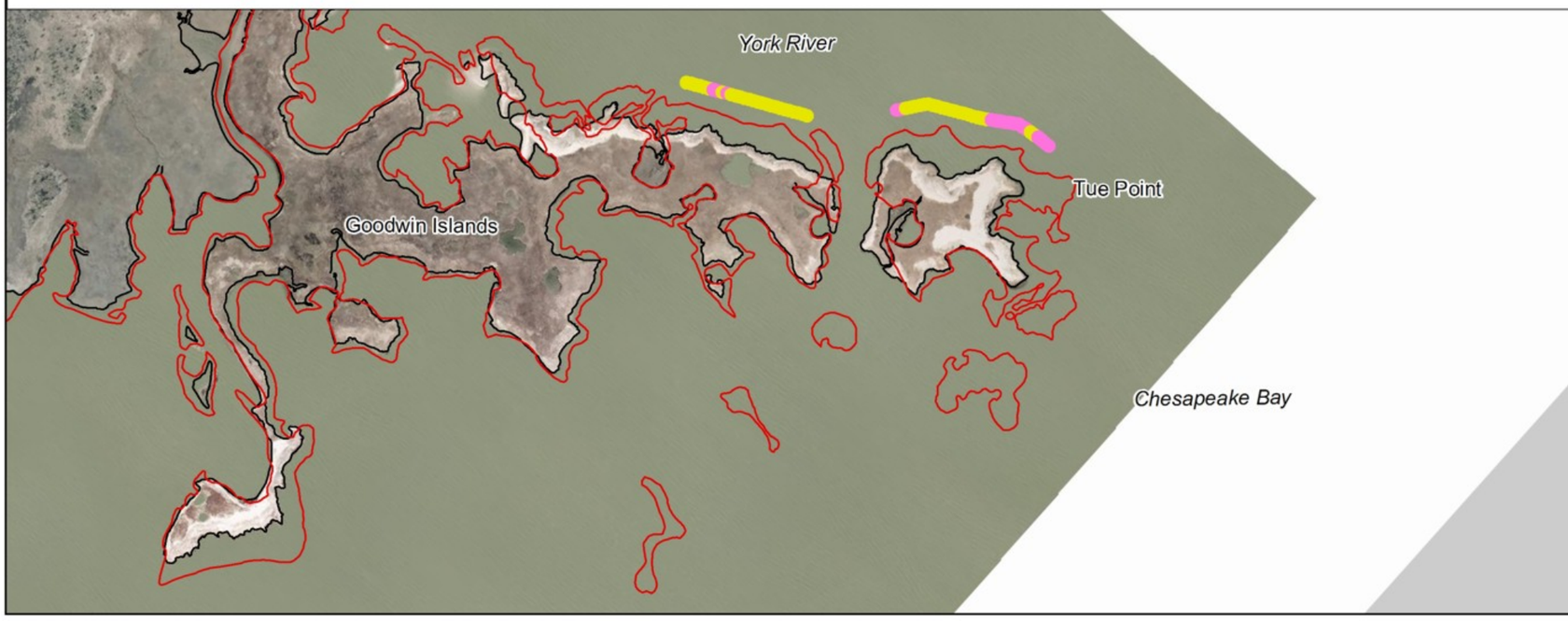
York County Virginia

Plate 16

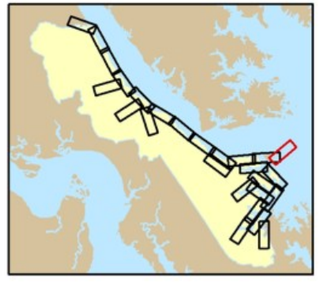
Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline



End Point Rate



Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Image Date: 2007

York County Virginia

Plate 17

Linear Regression Rate
(Shown where significant)

Thorofare

Back Creek

Crab Neck

Claxton Creek

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline

End Point Rate

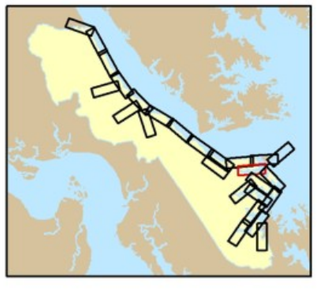
Yorktown Refinery

Thorofare

Back Creek

Crab Neck

Claxton Creek

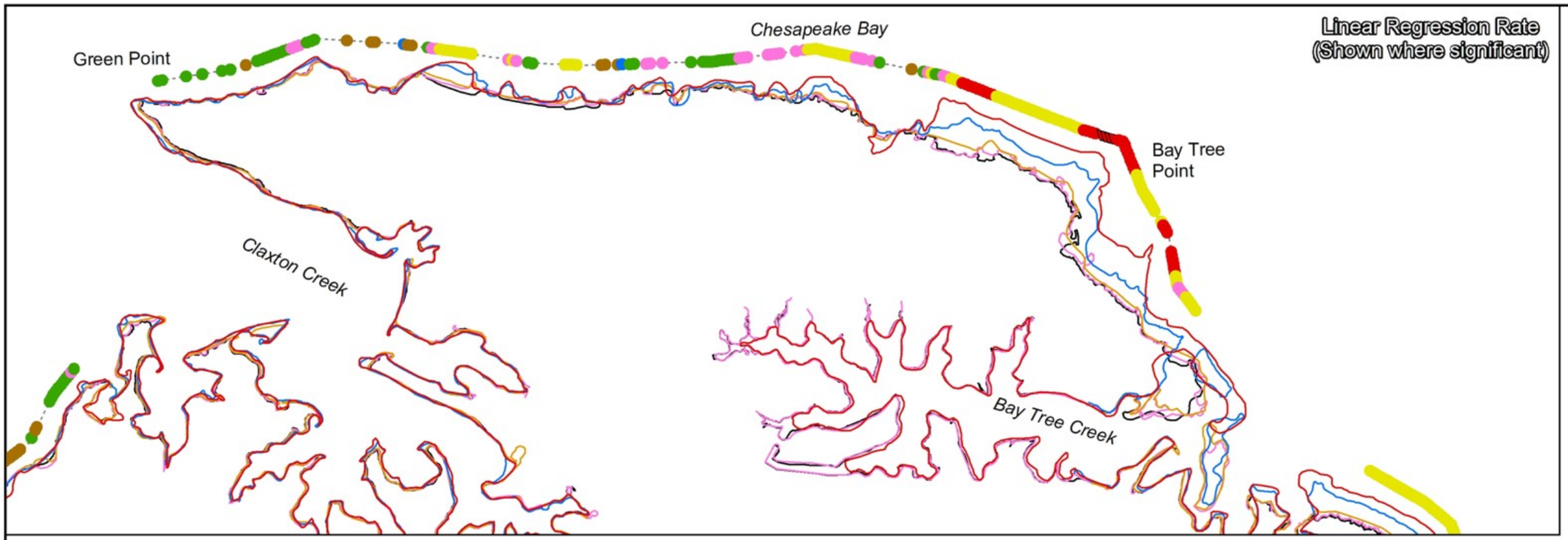


Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Image Date: 2007



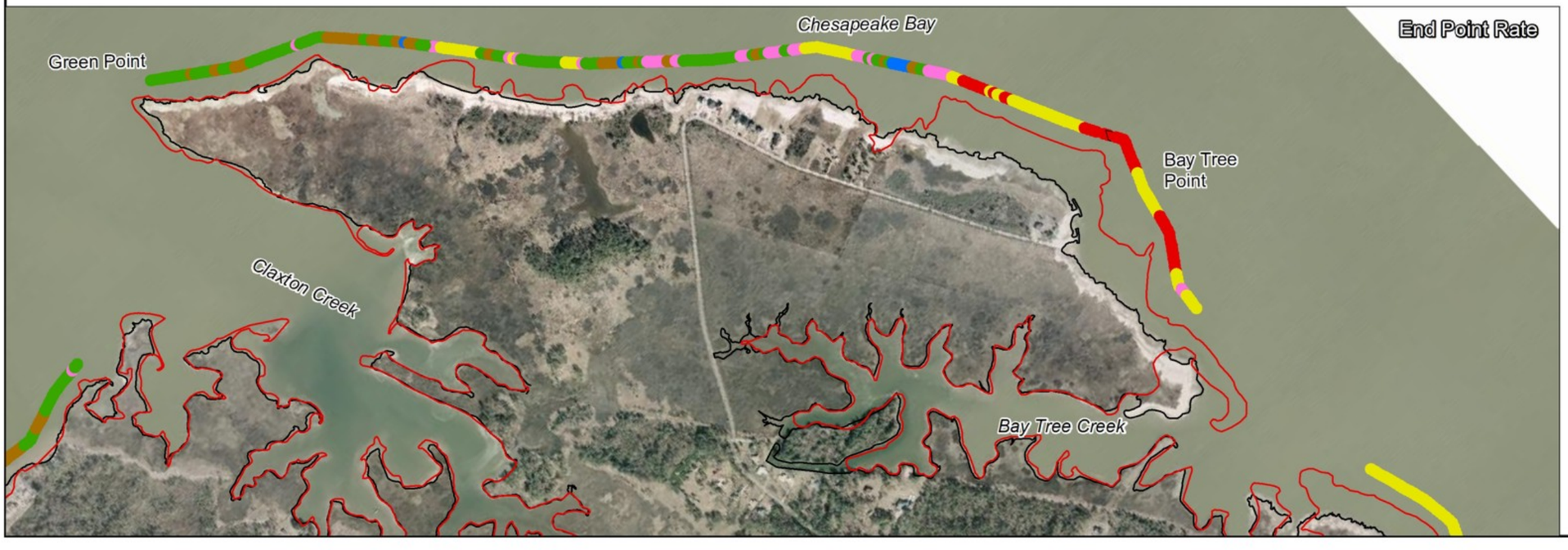
York County
Virginia

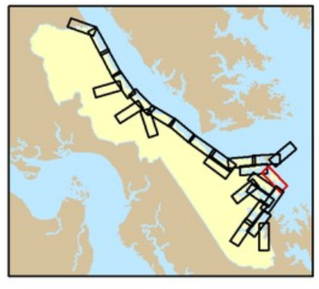
Plate 18

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline





Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Image Date: 2007

York County Virginia

Plate 19

Chesapeake Bay

York Point

Bay Tree Creek

Cabin Creek

Linear Regression Rate
(Shown where significant)

City of Poquoson

Poquoson River

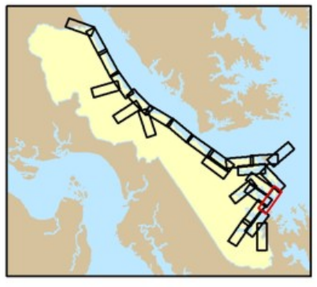
York County

Hodges Cove

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

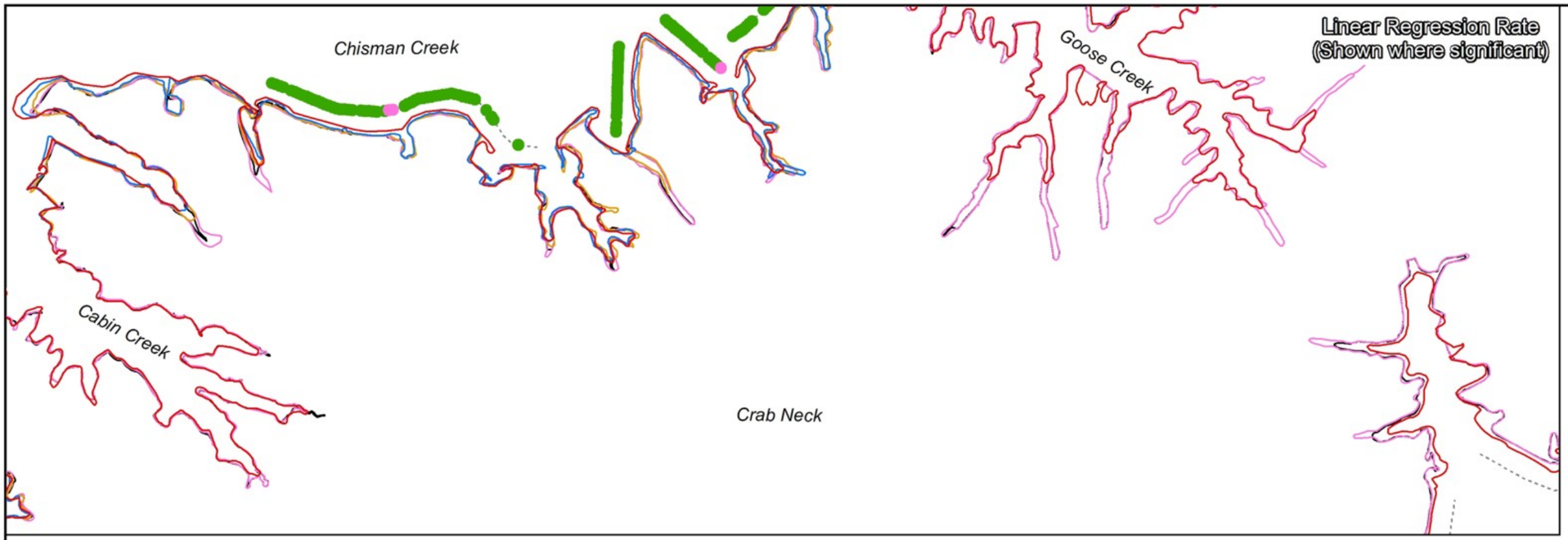
1937 Shoreline
2002 Shoreline
1963 Shoreline
2007 Shoreline
1994 Shoreline
Baseline

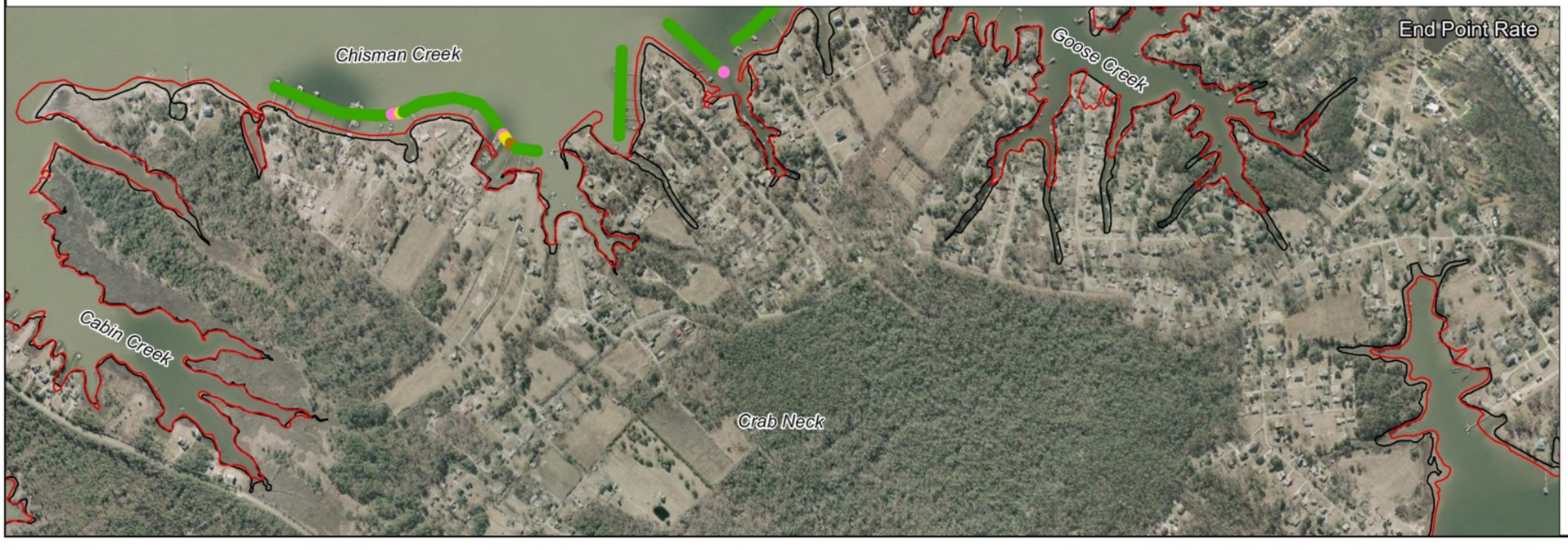


Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Image Date: 2007





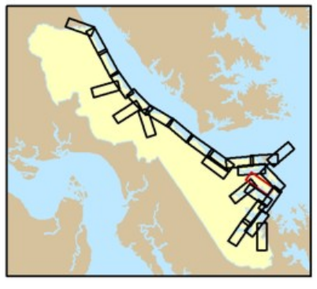
York County Virginia

Plate 20

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline



Shoreline Studies Program
VIMS

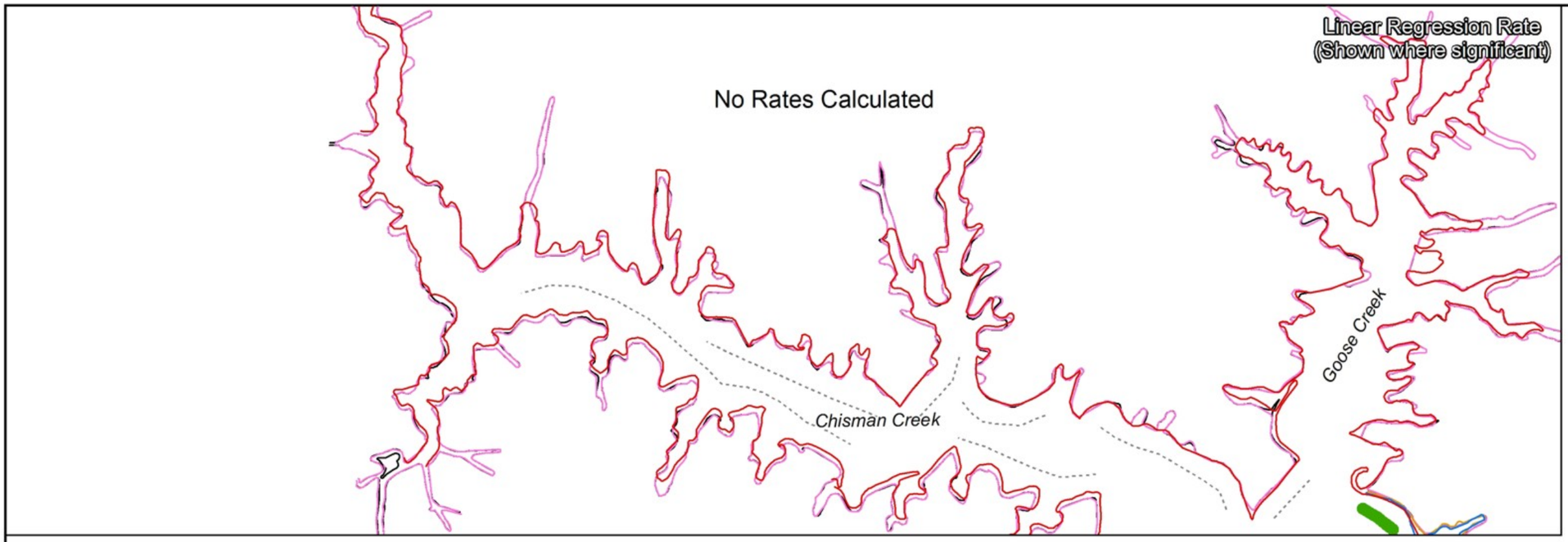
1,000 0 1,000

Feet

Image Date: 2007

York County Virginia

Plate 21



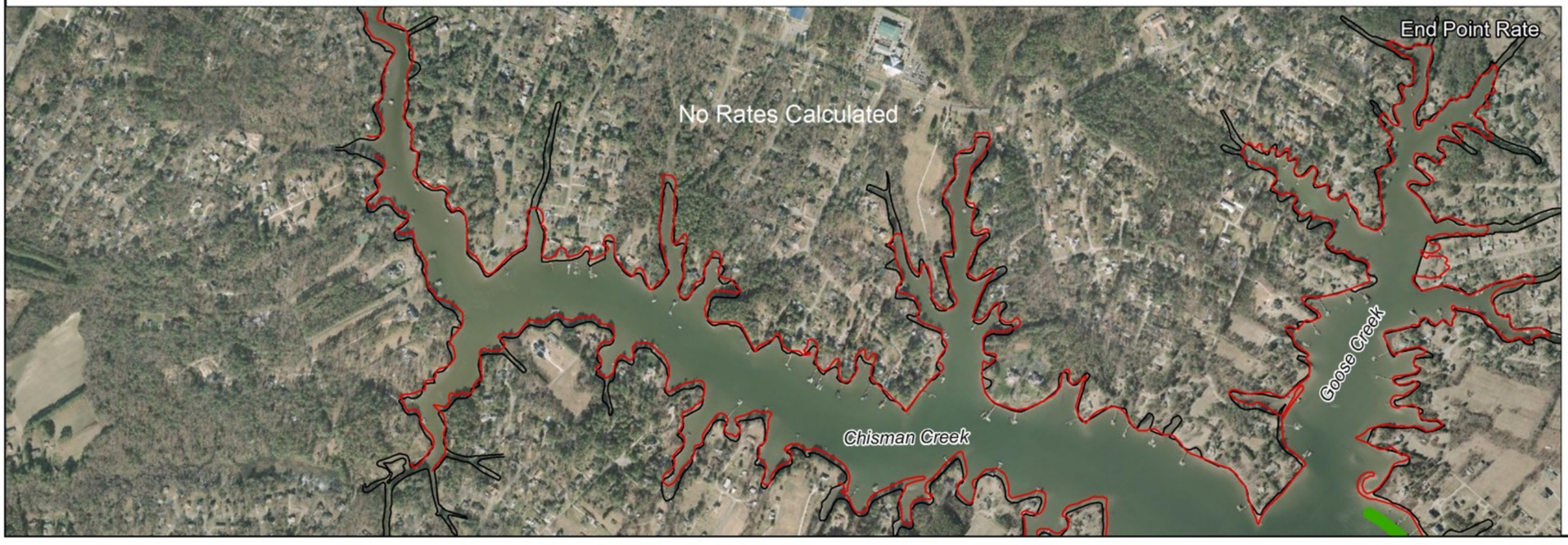
Legend

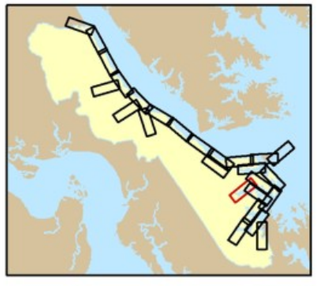
- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

1937 Shoreline — 2002 Shoreline

1963 Shoreline — 2007 Shoreline

1994 Shoreline ---------- Baseline





Shoreline Studies Program
VIMS

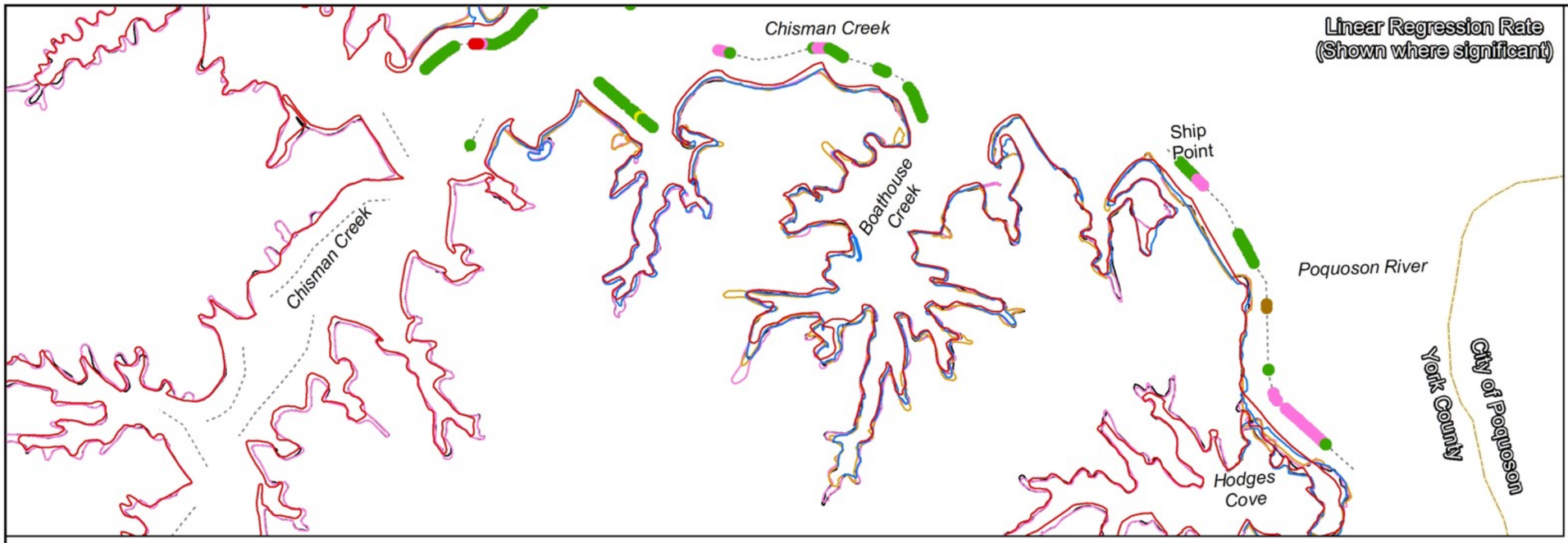
1,000 0 1,000

Feet

Image Date: 2007

York County Virginia

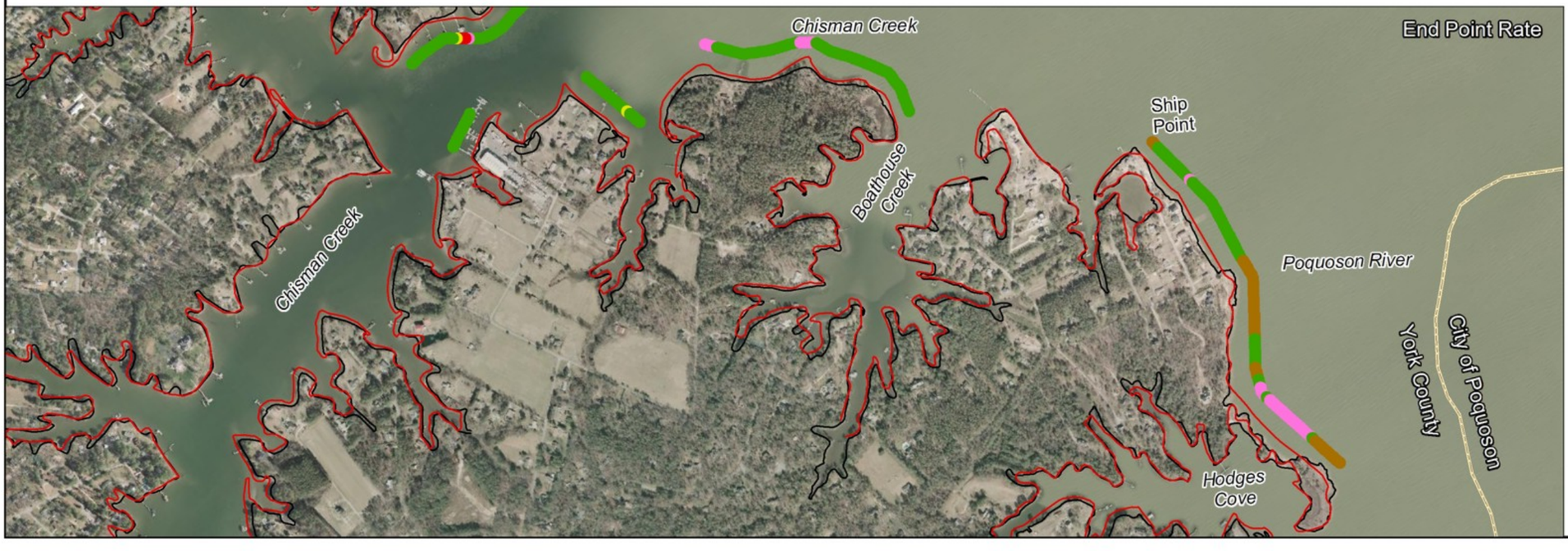
Plate 22

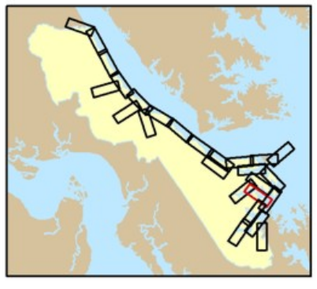


Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline





Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Image Date: 2007

York County Virginia

Plate 23

Linear Regression Rate
(Shown where significant)

0

Quarter Marsh Creek

Hunters Creek

Patrick's Creek

Fish Neck

Hodges Cove

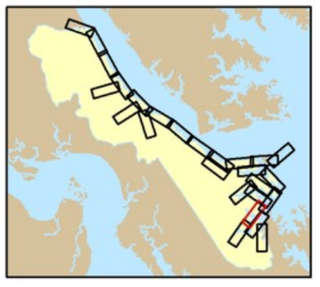
Poquoson River

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

1937 Shoreline
2002 Shoreline
1963 Shoreline
2007 Shoreline
1994 Shoreline
Baseline

End Point Rate

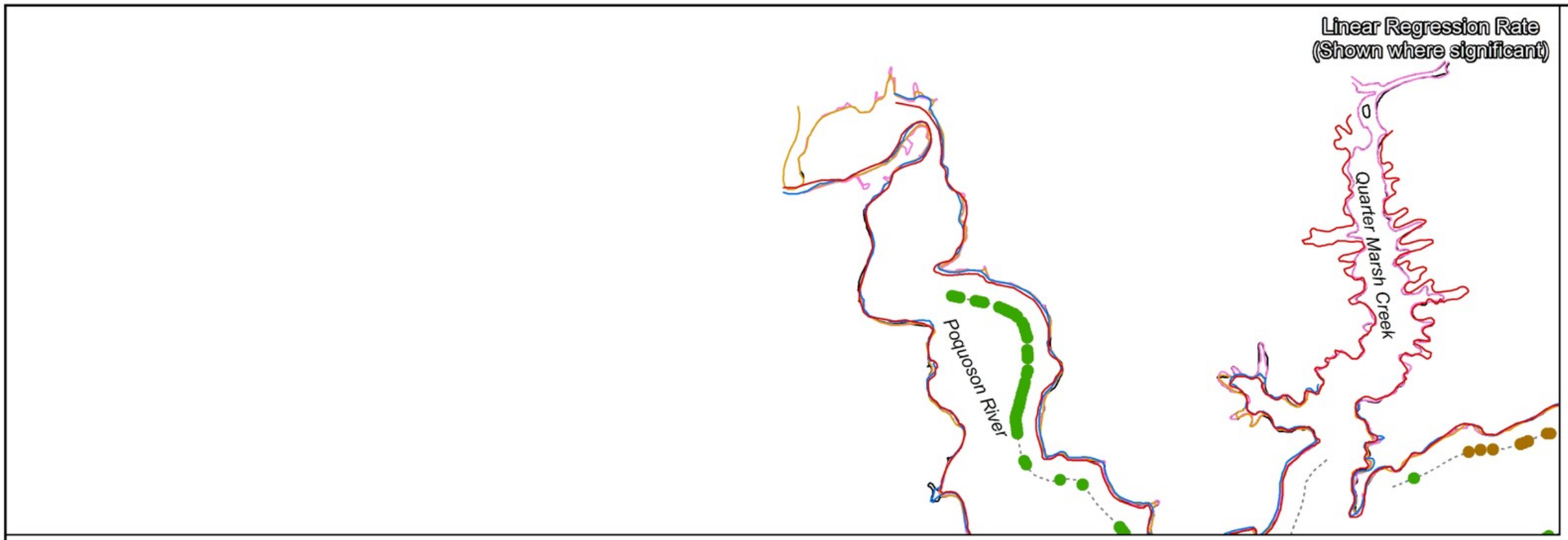


Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Image Date: 2007



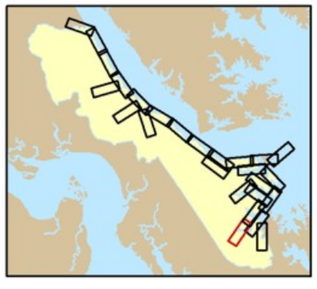
York County Virginia

Plate 24

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Image Date: 2007

York County Virginia

Plate 25

Linear Regression Rate
(Shown where significant)

Poquoson River

Calthrop Neck

Moores Creek

Lambs Creek

York County

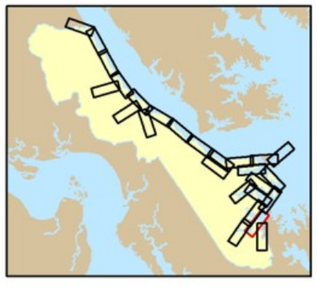
City of Poquoson

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 1963 Shoreline
- 1994 Shoreline
- 2002 Shoreline
- 2007 Shoreline
- Baseline

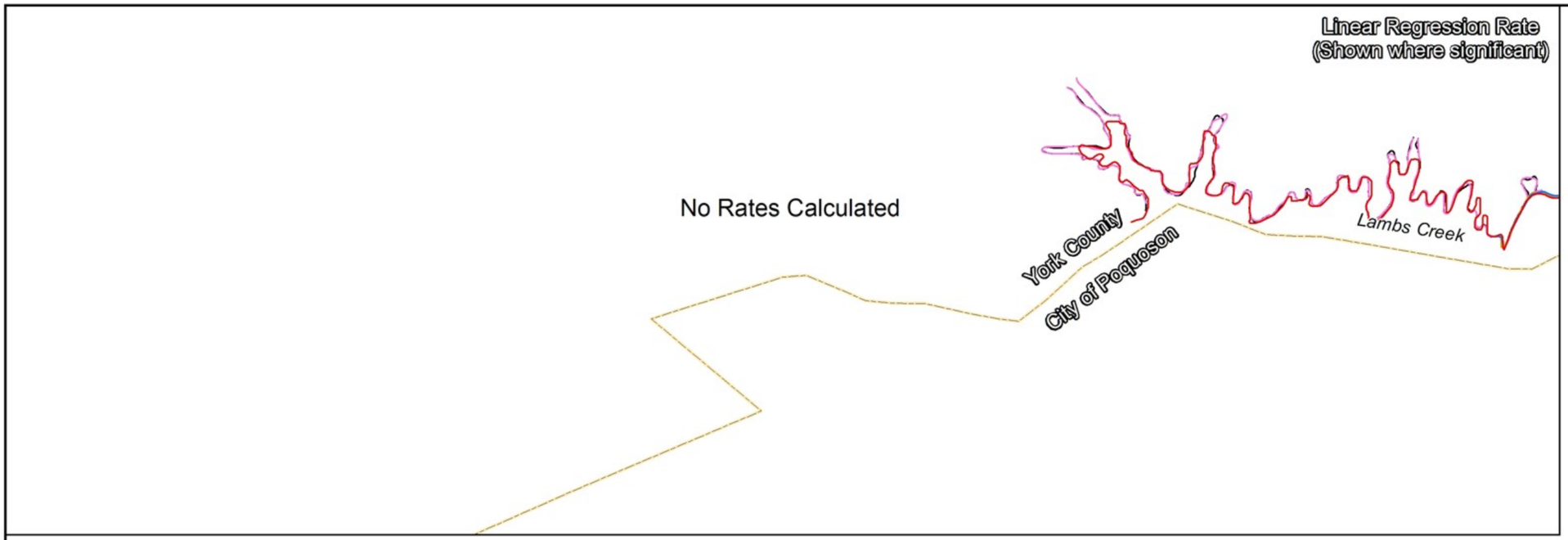
End Point Rate



Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Image Date: 2007



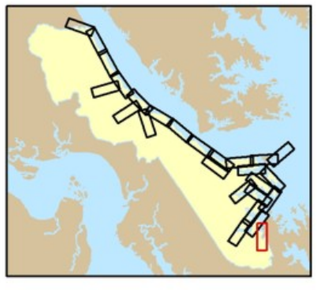
York County Virginia

Plate 26

Legend

- Medium Accretion: >2 ft/yr
- Low Accretion: +1 to +2 ft/yr
- Very Low Accretion: 0 to +1 ft/yr
- Very Low Erosion: 0 to -1 ft/yr
- Low Erosion: -1 to -2 ft/yr
- Medium Erosion: -2 to -5 ft/yr
- High Erosion: -5 to -10 ft/yr
- Very High Erosion: >-10 ft/yr

- 1937 Shoreline
- 2002 Shoreline
- 1963 Shoreline
- 2007 Shoreline
- 1994 Shoreline
- Baseline



Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

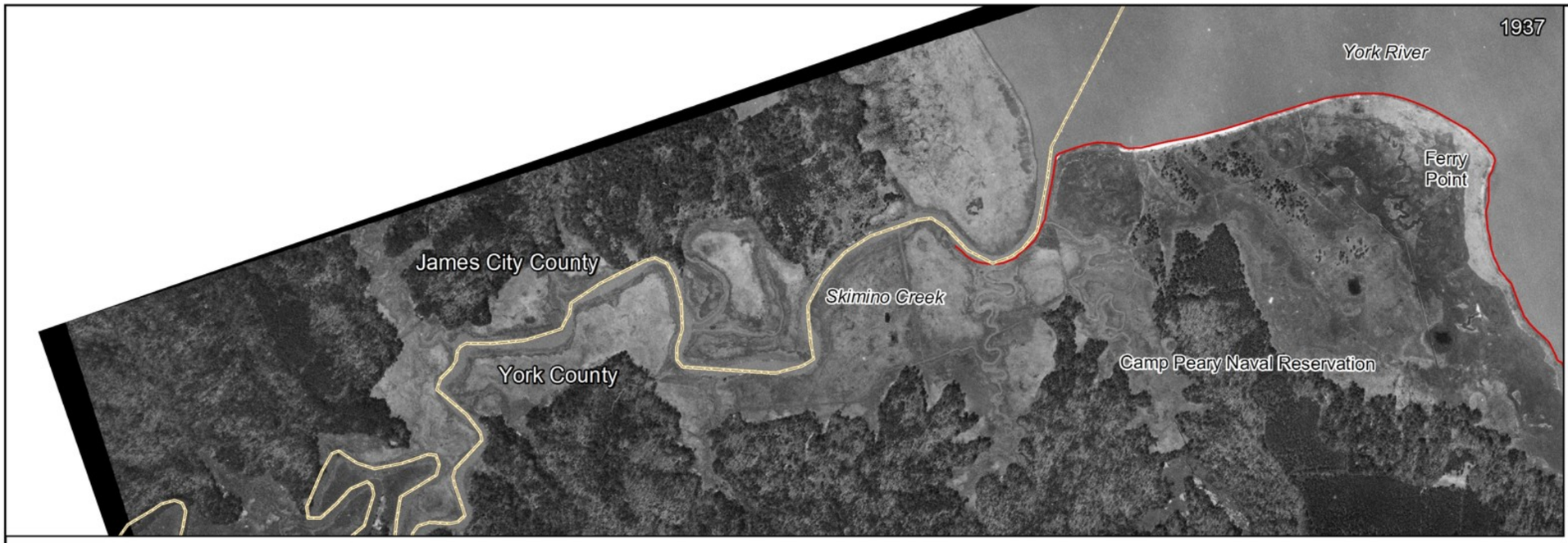
Image Date: 2007

Appendix B
Historical Shoreline Photos

Plate 1
Plate 2
Plate 3
Plate 4
Plate 5
Plate 6
Plate 7
Plate 8
Plate 9
Plate 10
Plate 11
Plate 12
Plate 13
Plate 14
Plate 15
Plate 16
Plate 17
Plate 18
Plate 19
Plate 20
Plate 21
Plate 22
Plate 23
Plate 24
Plate 25
Plate 26

York County Virginia

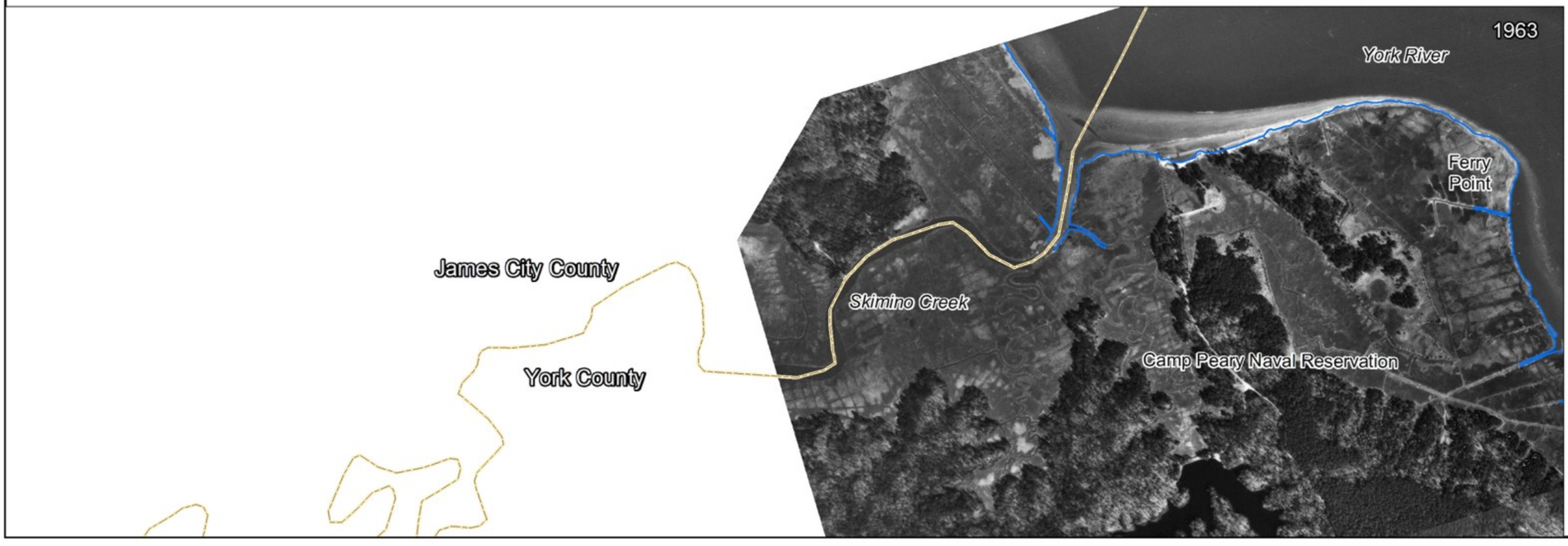
Plate 1

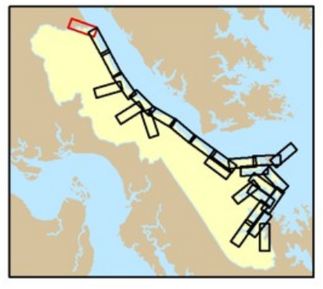


Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program VIMS

1,000 0 1,000

Feet

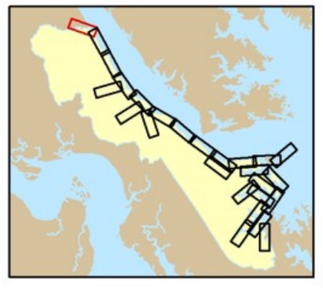
Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

Plate 1

Legend

- 1994 Shoreline
- 2002 Shoreline



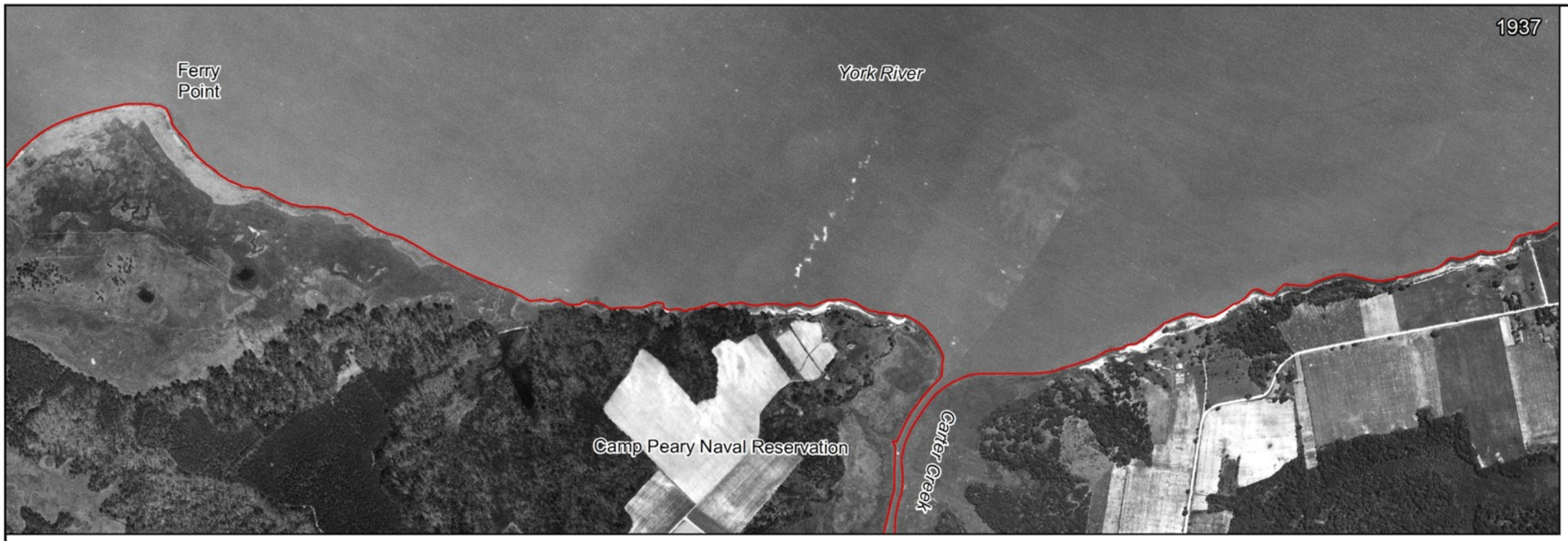
Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

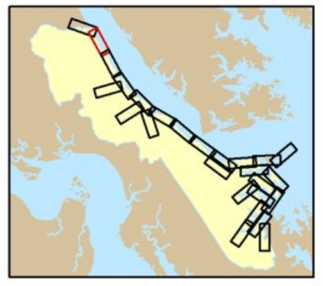
Plate 2



Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

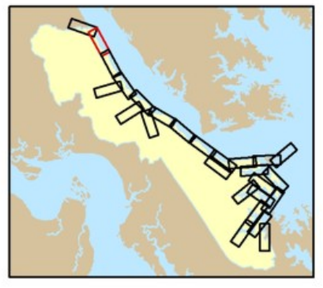
York County Virginia

Plate 2

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program
VIMS

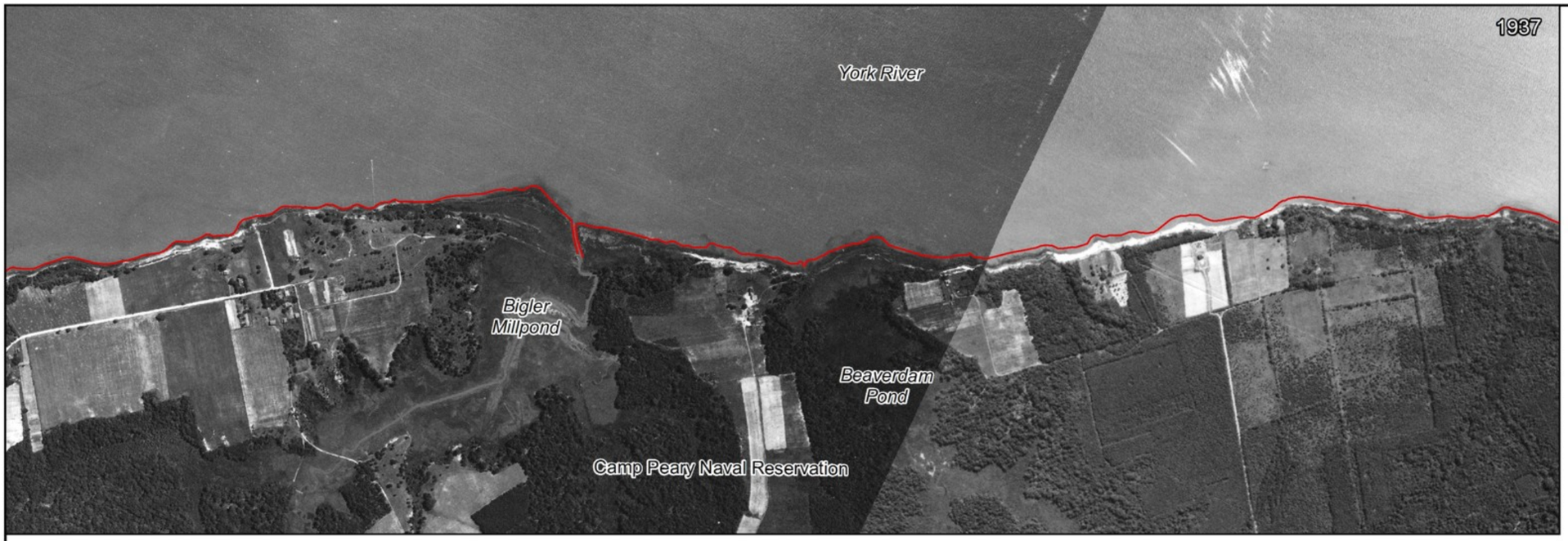
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

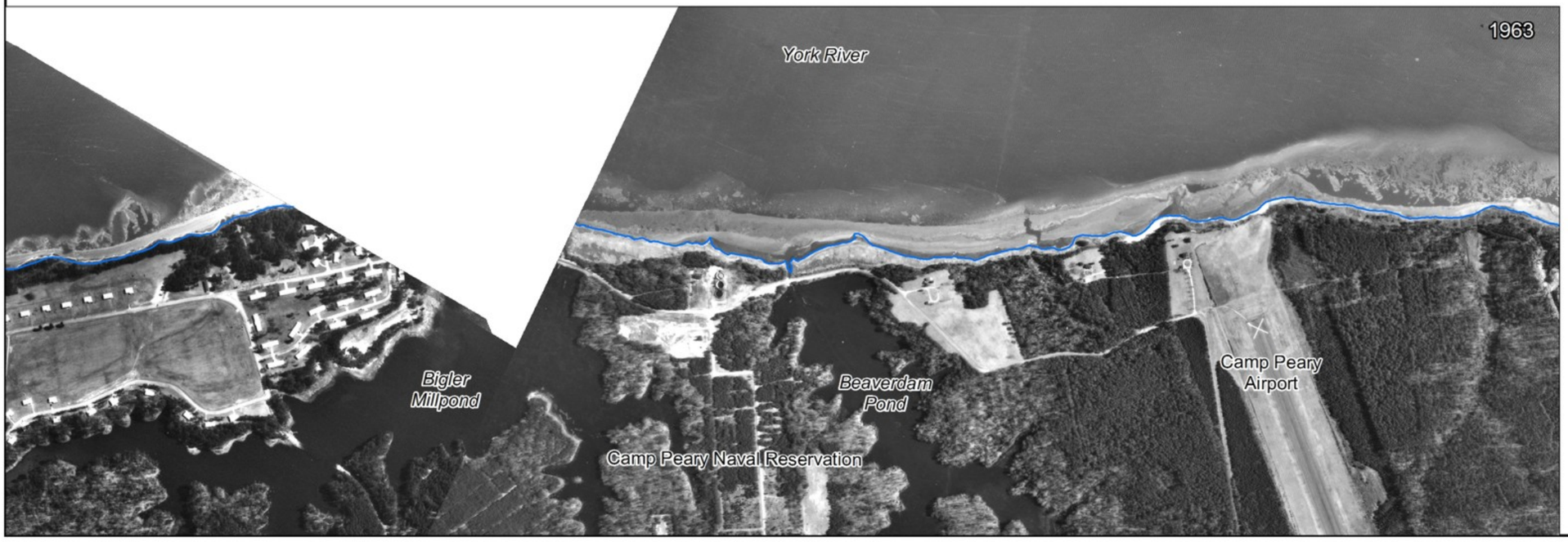
Plate 3

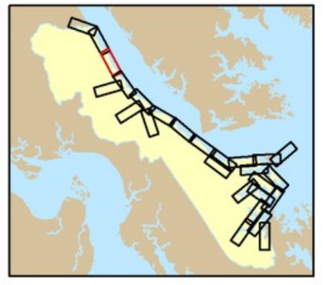


Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

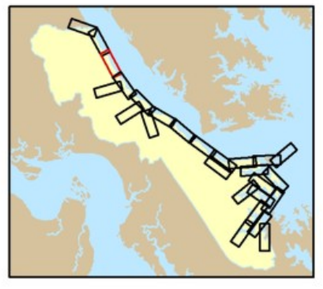
York County
Virginia

Plate 3

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program
VIMS

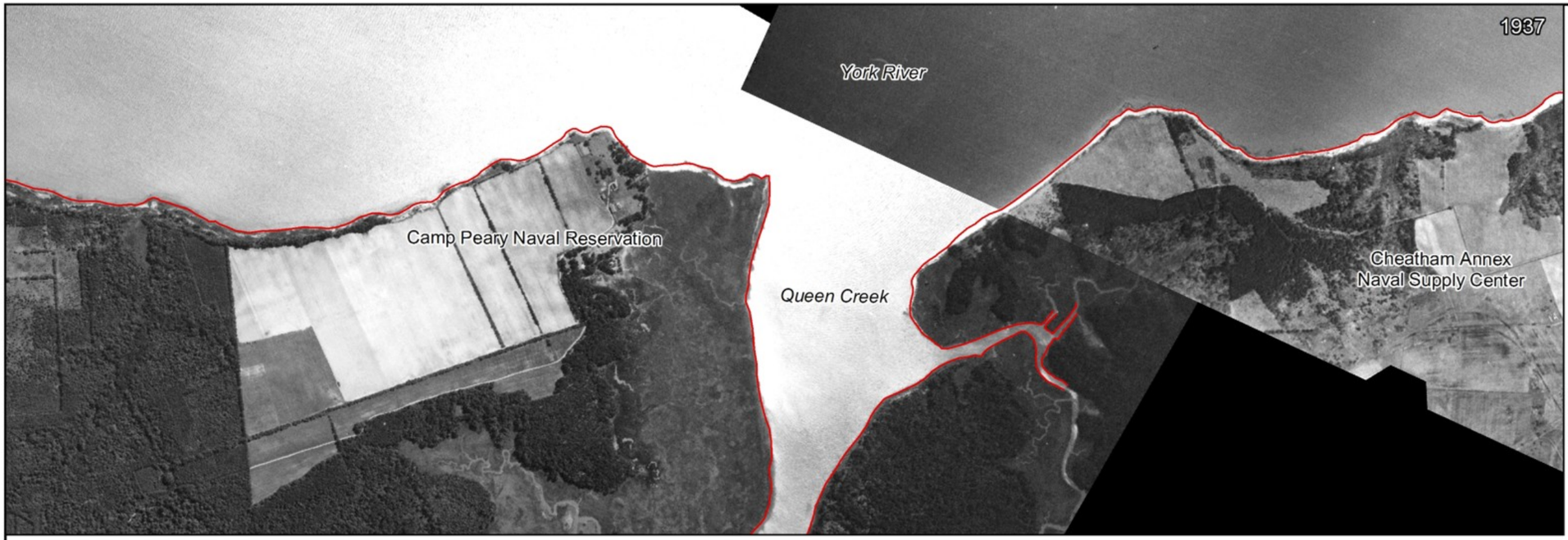
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County
Virginia

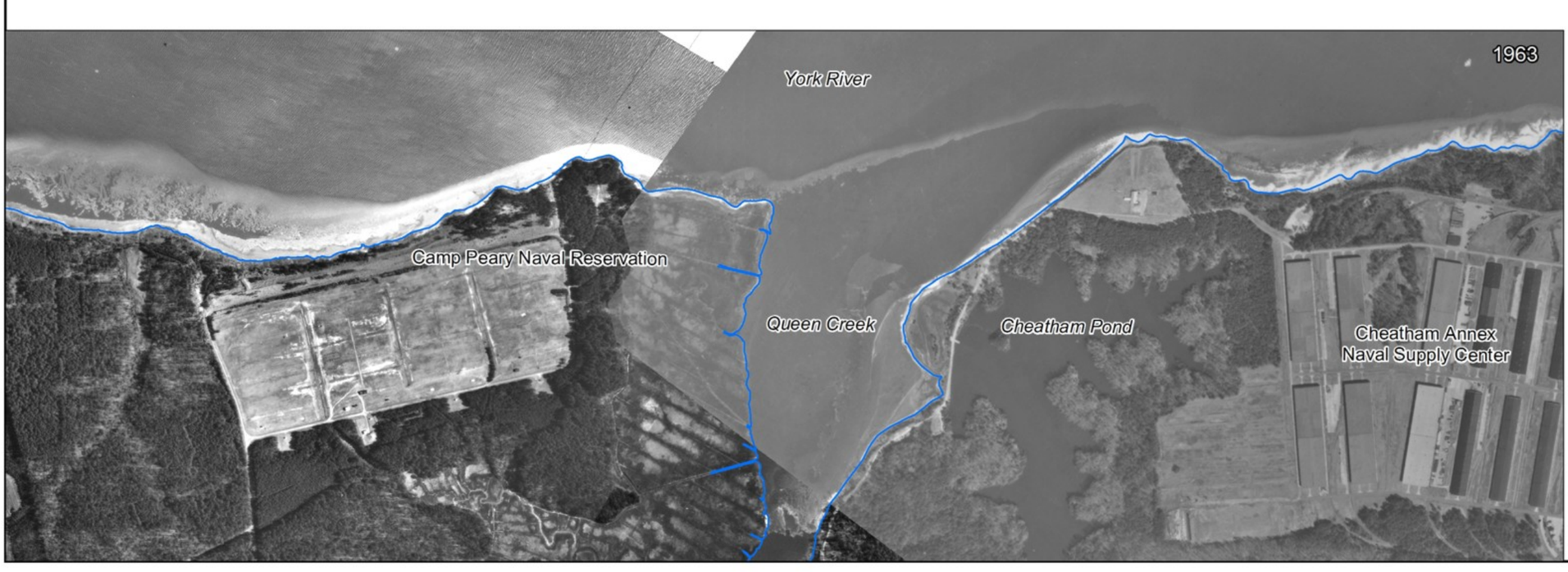
Plate 4

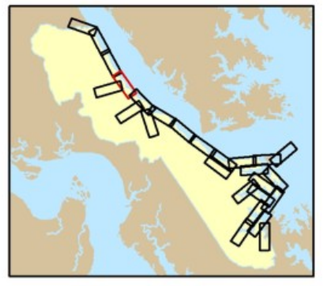


Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

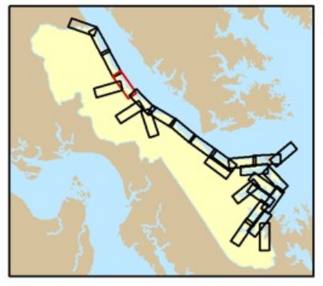
York County
Virginia

Plate 4

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

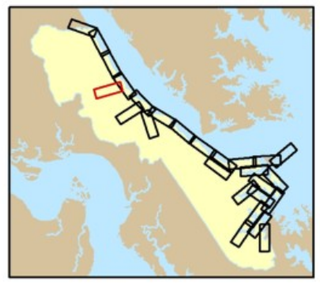
York County
Virginia

Plate 5

Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

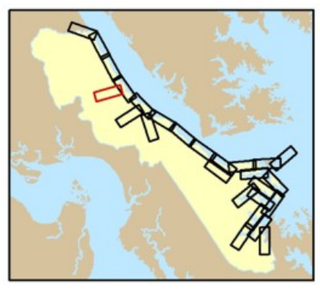
York County
Virginia

Plate 5

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program
VIMS

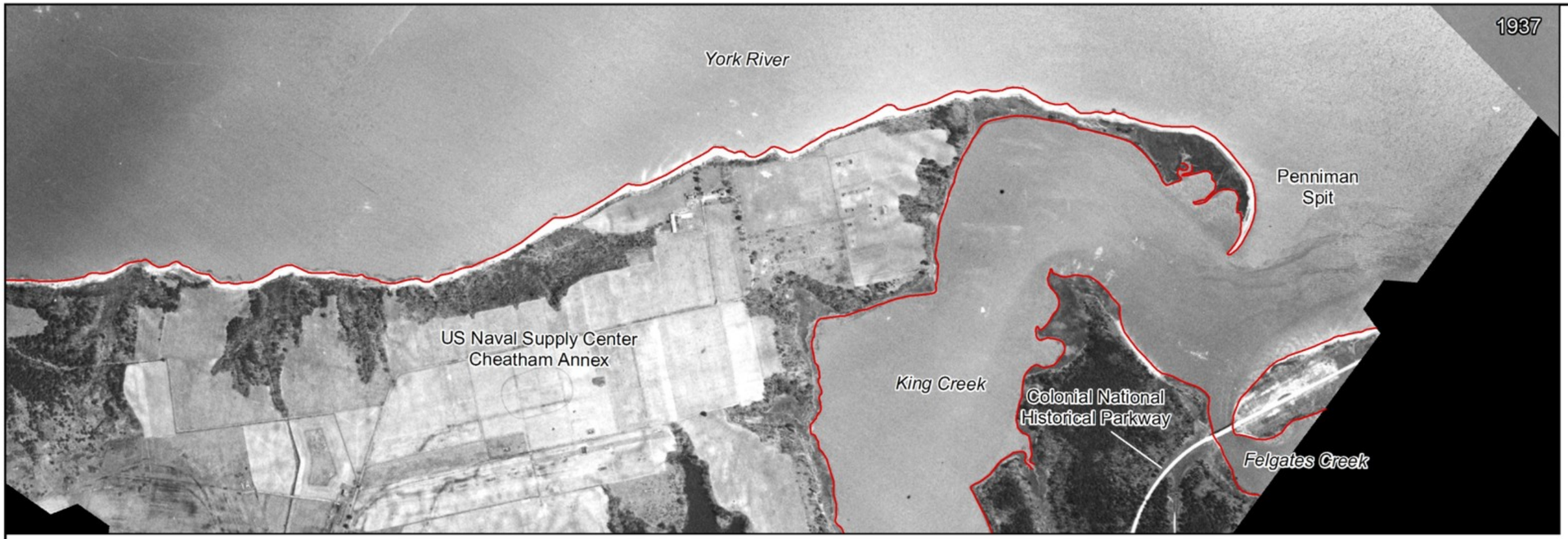
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County
Virginia

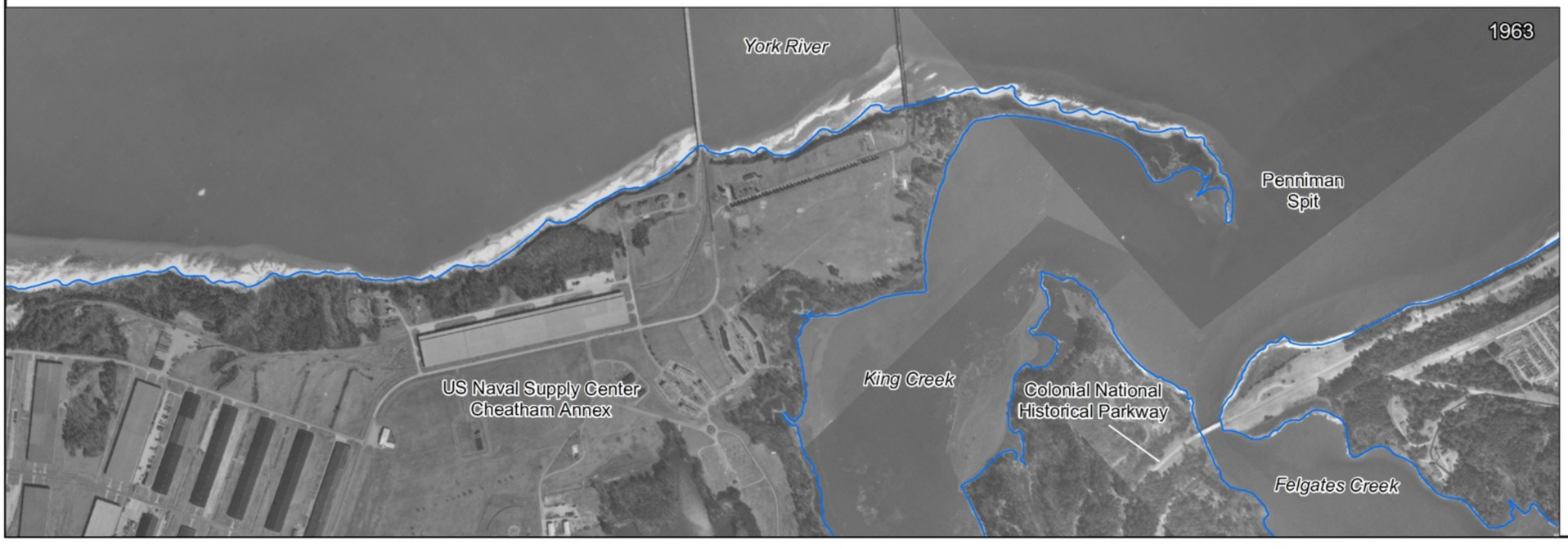
Plate 6

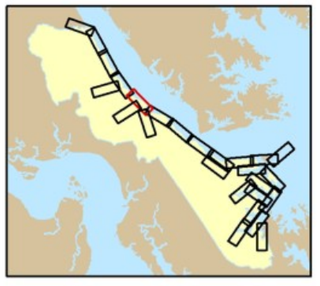


Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program
VIMS

1,000 0 1,000

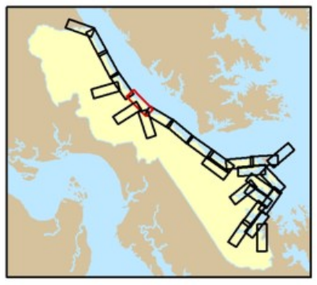
Feet

York County Virginia

Plate 6

Legend

- 1994 Shoreline
- 2002 Shoreline



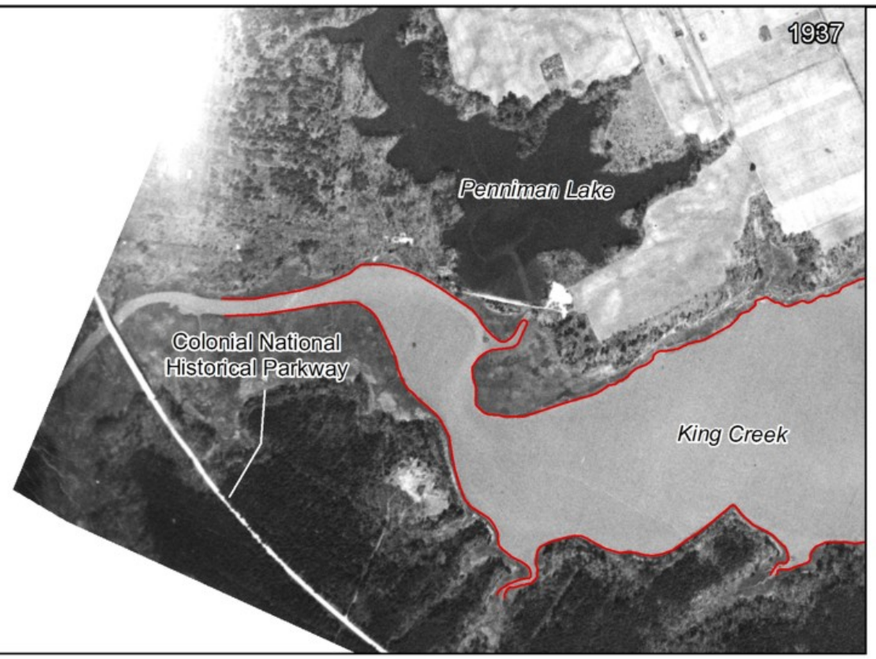
Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

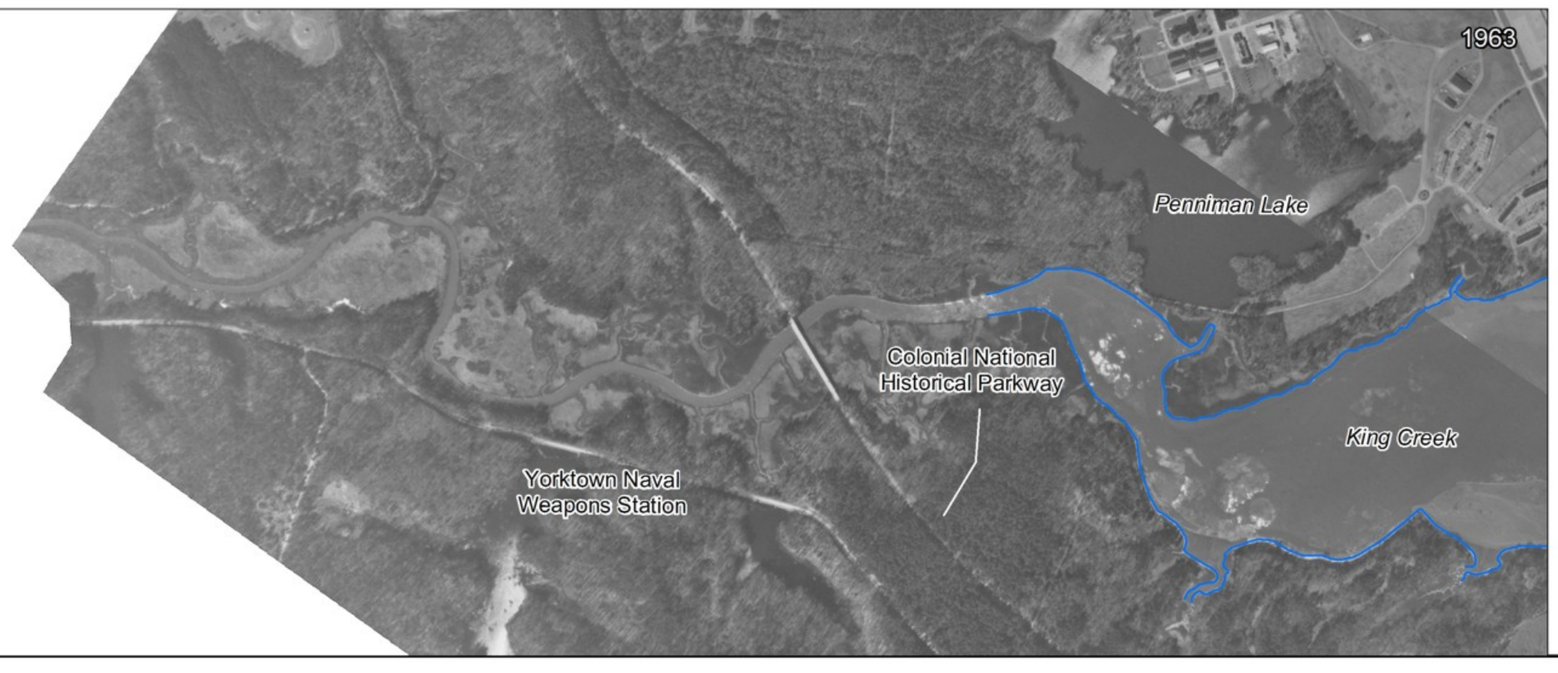
York County Virginia

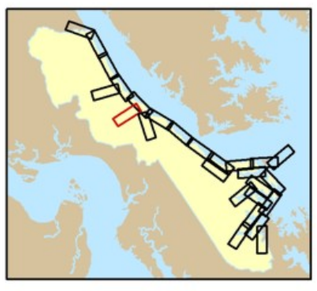
Plate 7



Legend

- 1937 Shoreline
- 1963 Shoreline





Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

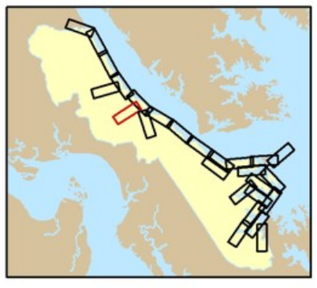
York County Virginia

Plate 7

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program
VIMS

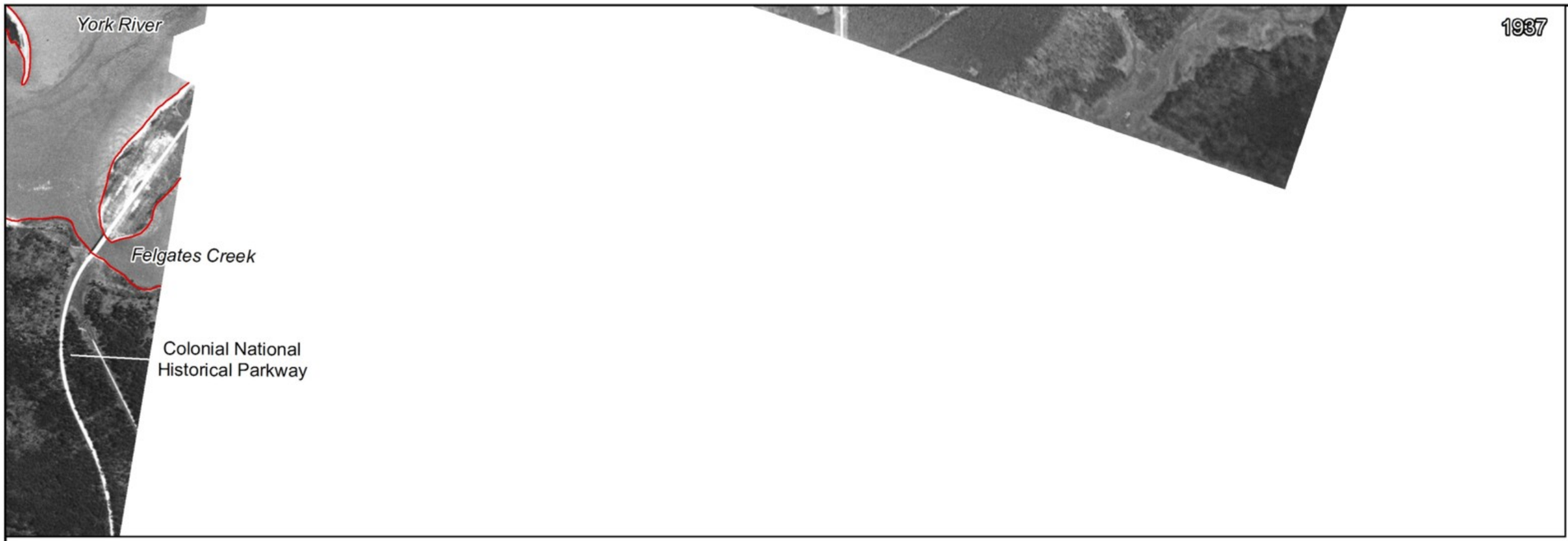
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

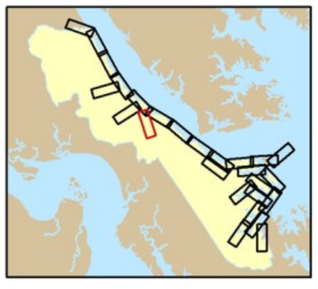
York County Virginia

Plate 8



Legend

- 1937 Shoreline
- 1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

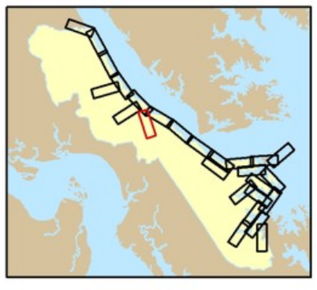
York County
Virginia

Plate 8

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program
VIMS

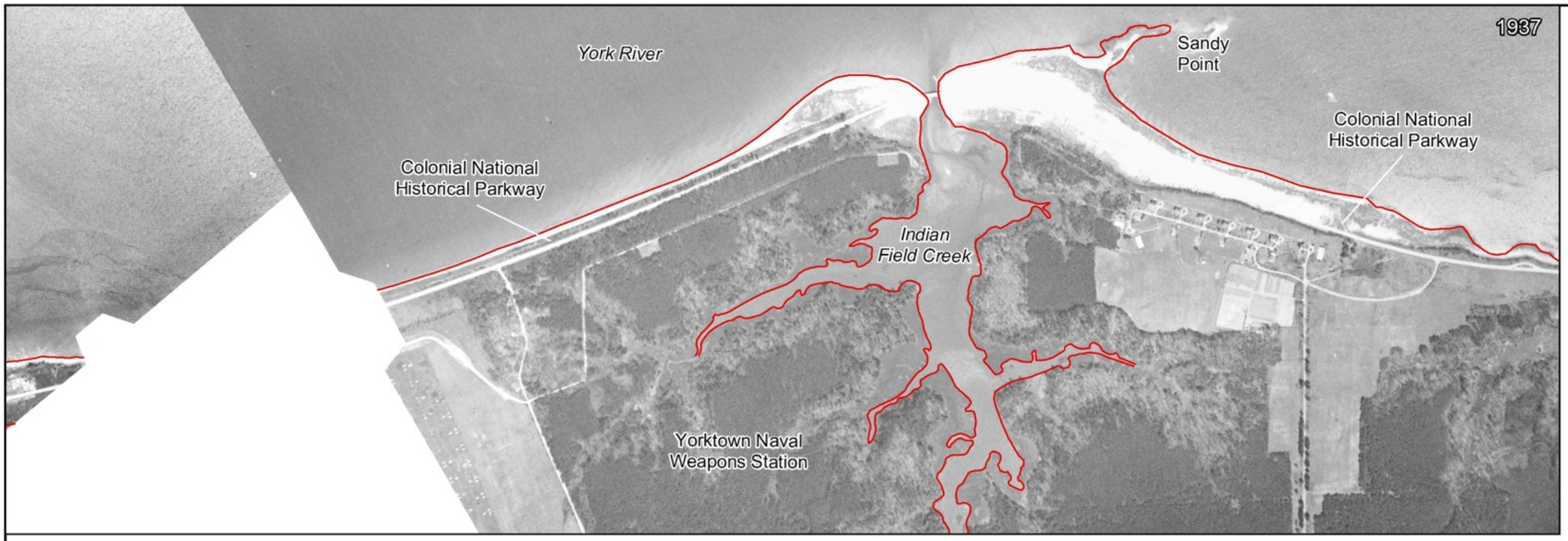
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

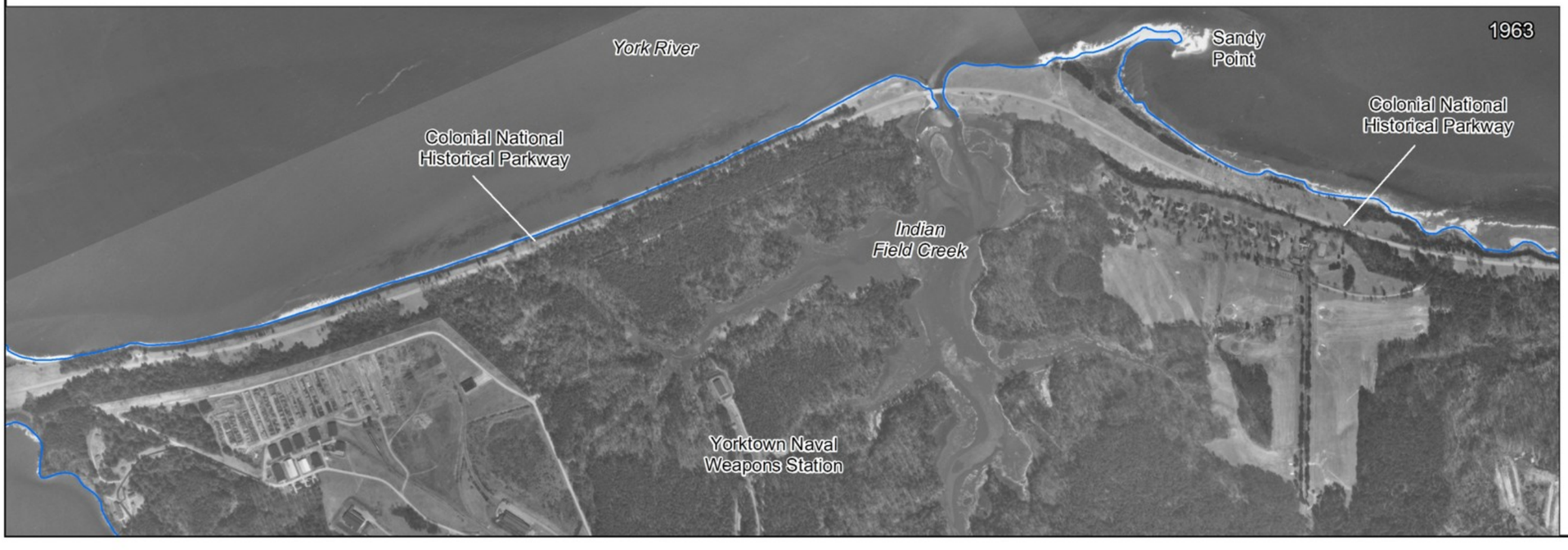
Plate 9

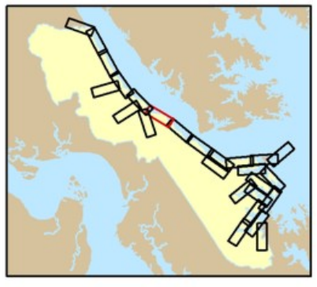


Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program

VIMS

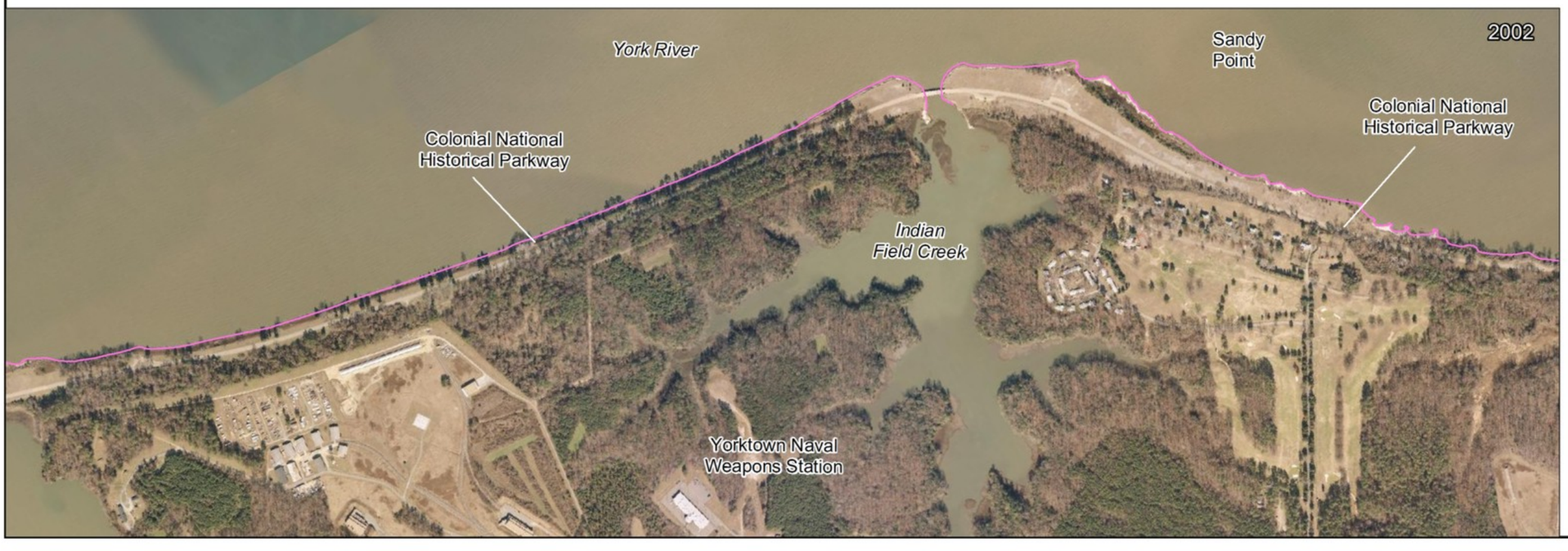
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

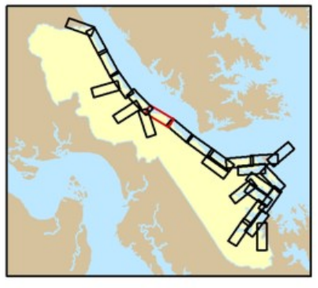
Plate 9



Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program

VIMS

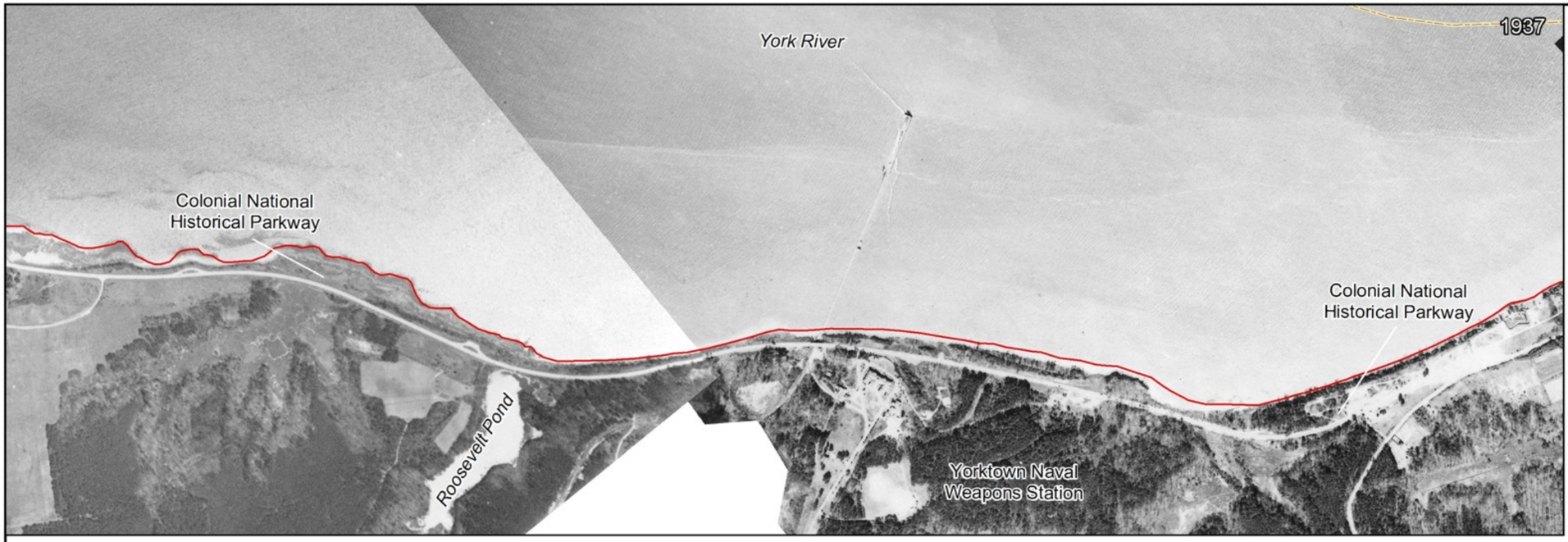
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

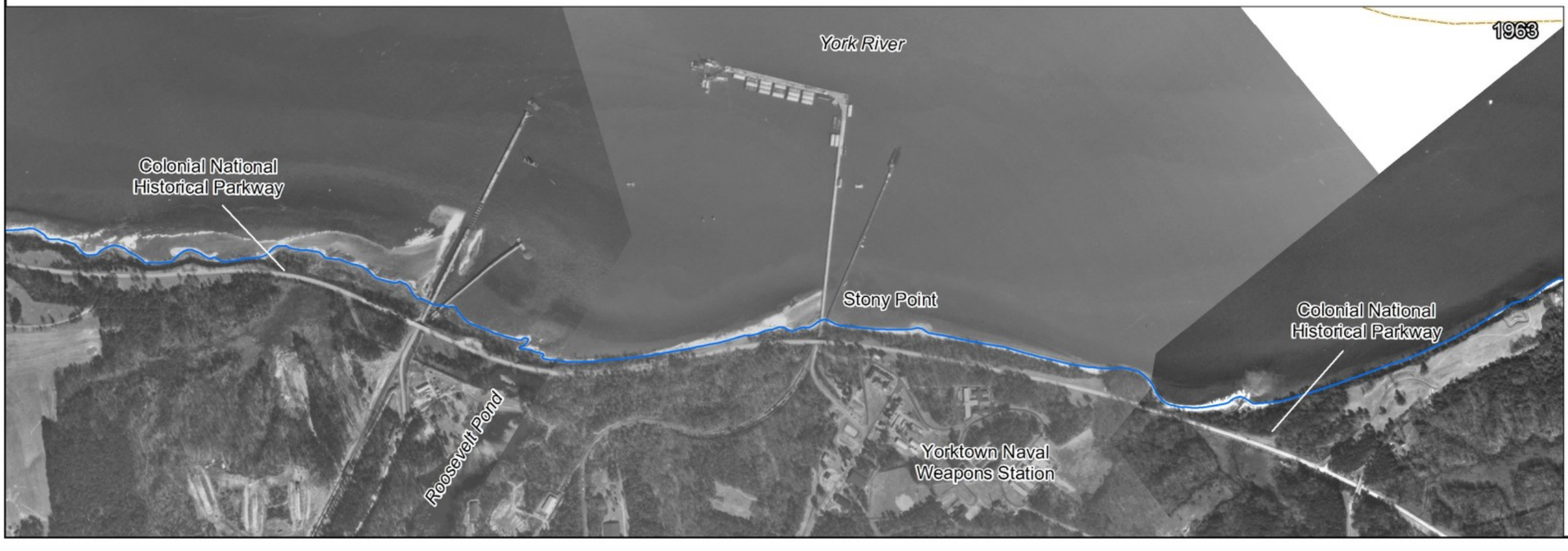
Plate 10

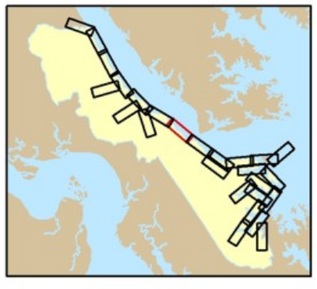


Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

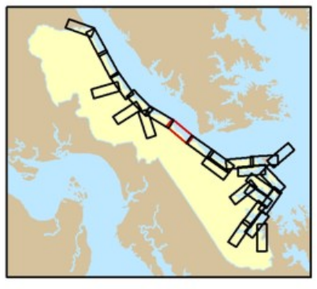
Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

Plate 10

Legend

- 1994 Shoreline
- 2002 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

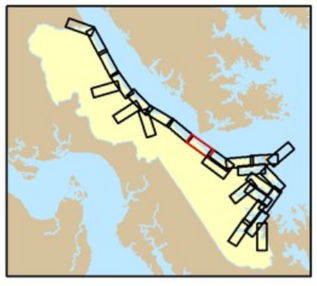
York County
Virginia

Plate 11

Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

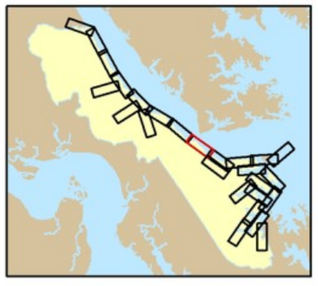
Feet

York County
Virginia

Plate 11

Legend

- 1994 Shoreline
- 2002 Shoreline

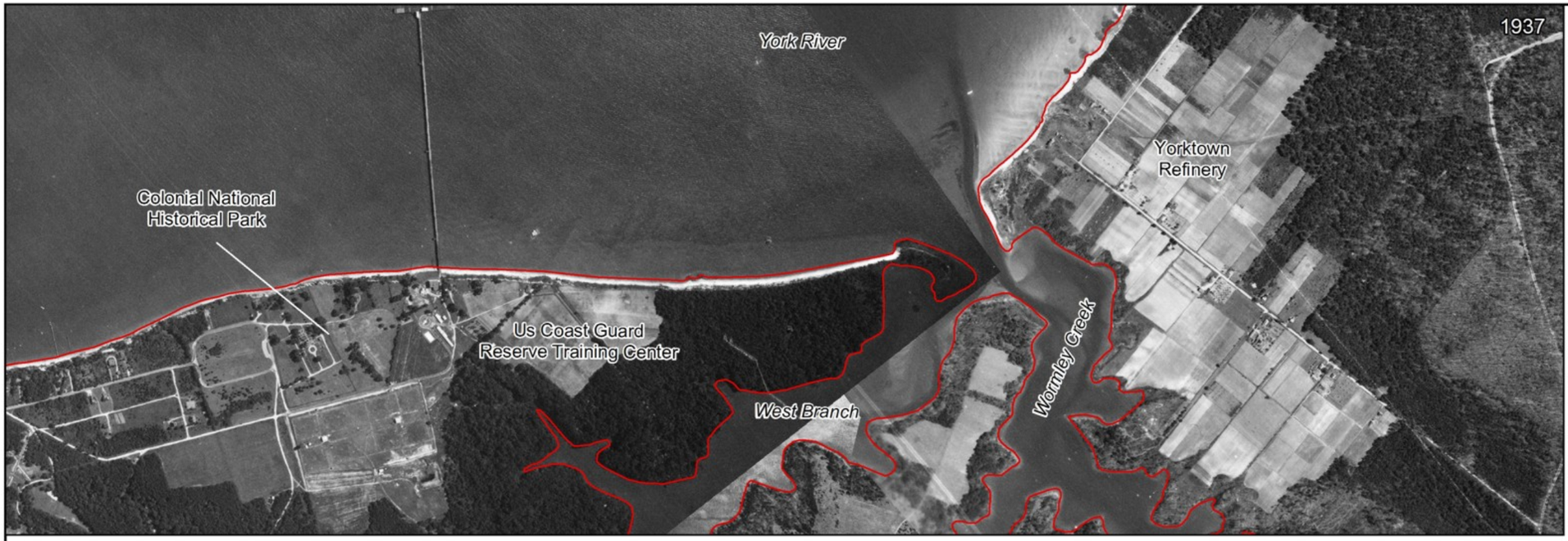


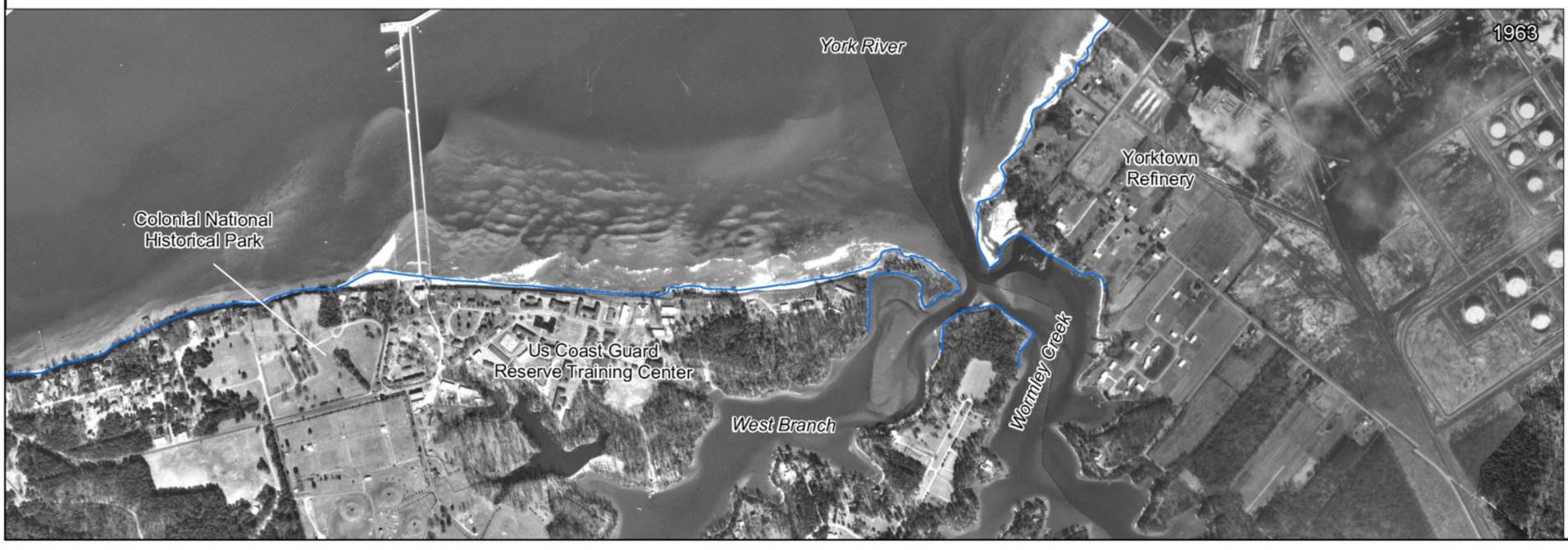
Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

York County Virginia

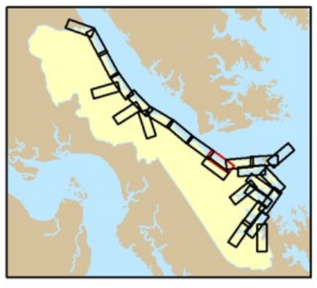
Plate 12





Legend

- 1937 Shoreline
- 1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

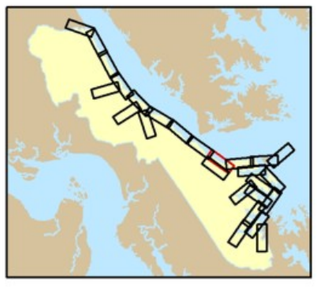
Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

Plate 12

Legend

- 1994 Shoreline
- 2002 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

Plate 13

Legend

1937 Shoreline

1963 Shoreline

Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

Plate 13

Legend

1994 Shoreline

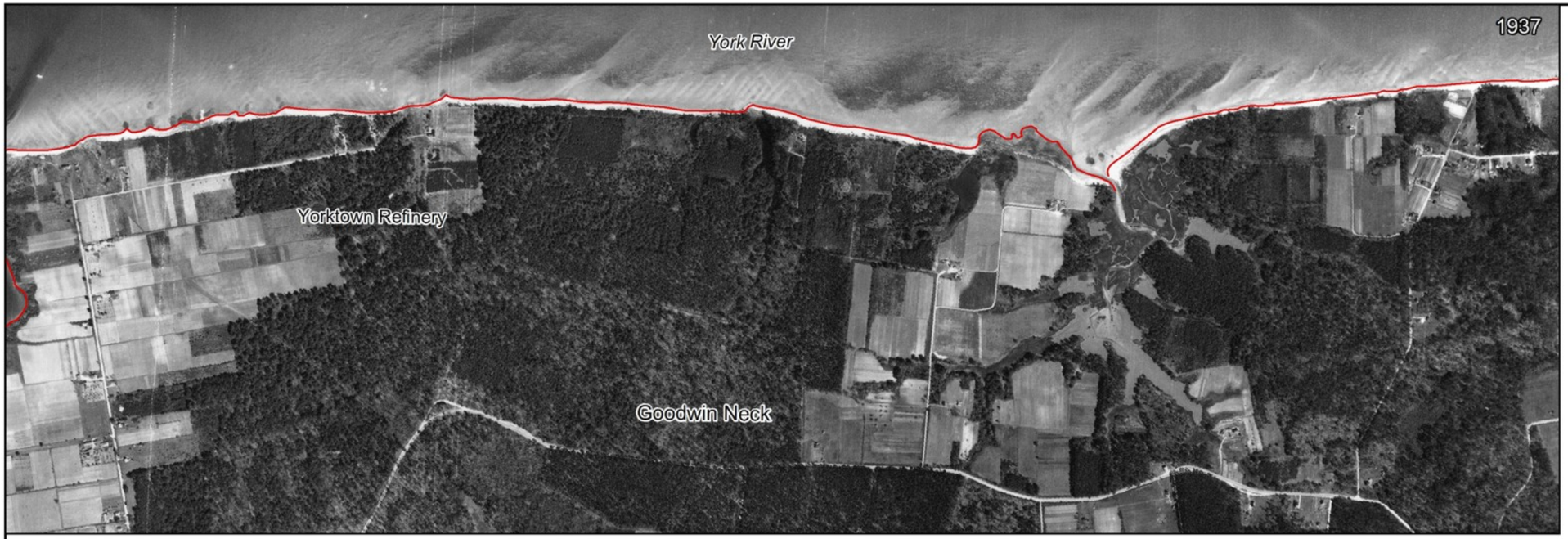
2002 Shoreline

Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.



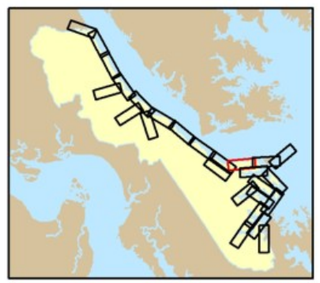
York County Virginia

Plate 14

Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

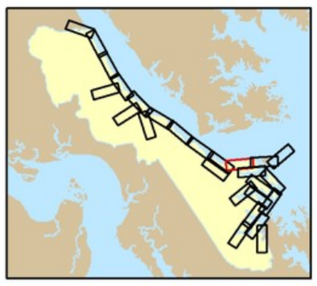
York County Virginia

Plate 14

Legend

1994 Shoreline

2002 Shoreline



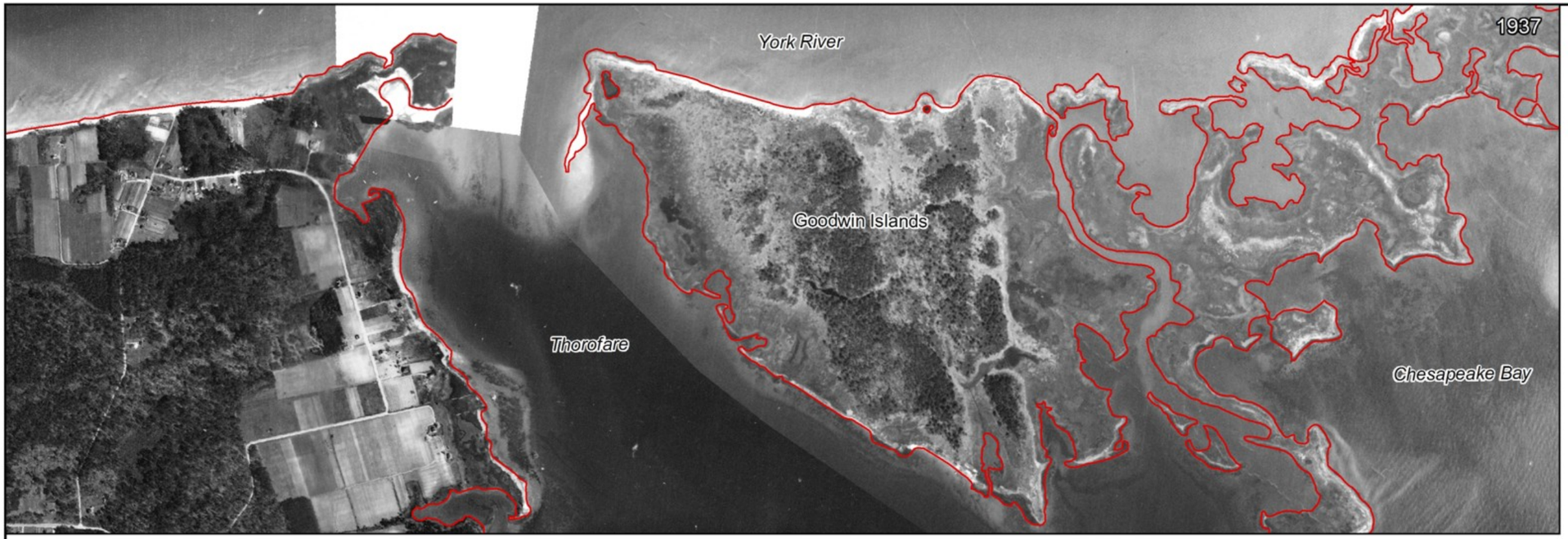
Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

York County Virginia

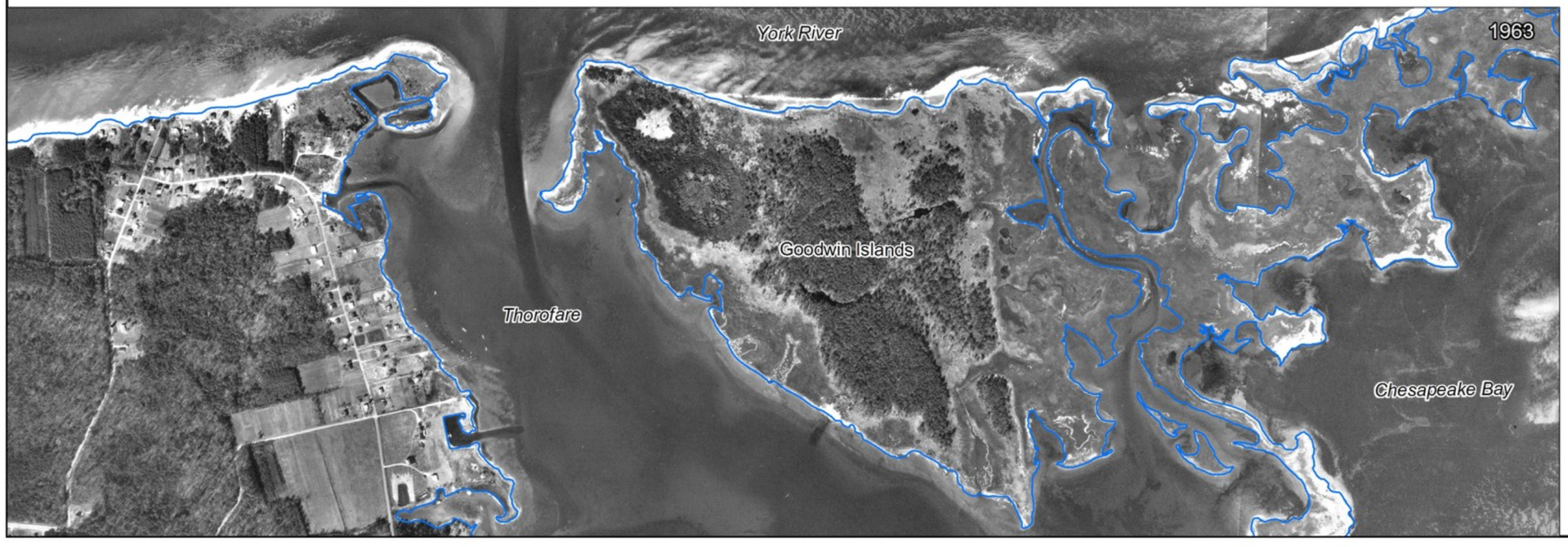
Plate 15

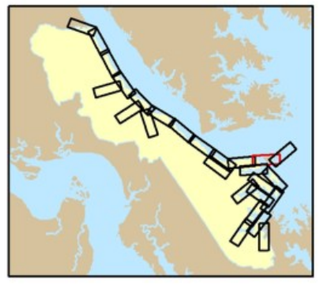


Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

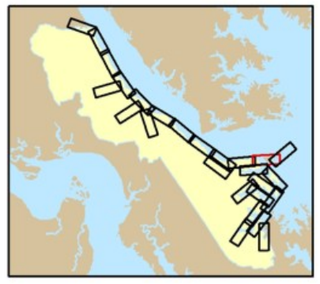
York County Virginia

Plate 15

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program

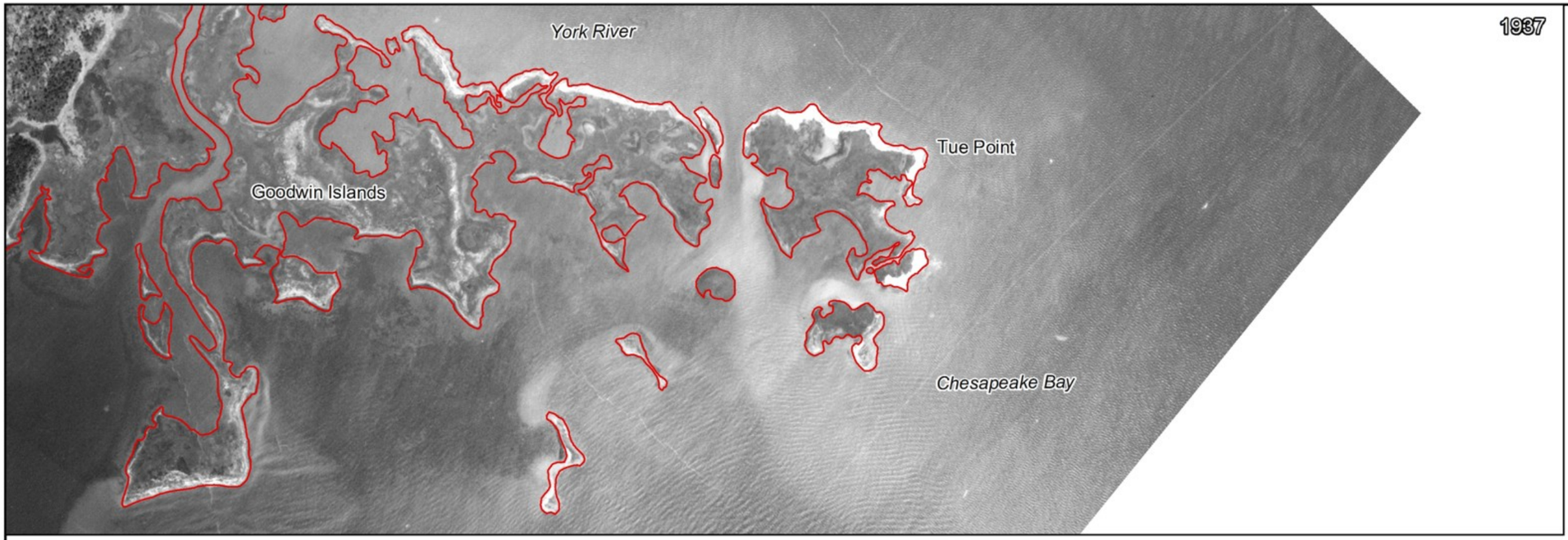
VIMS

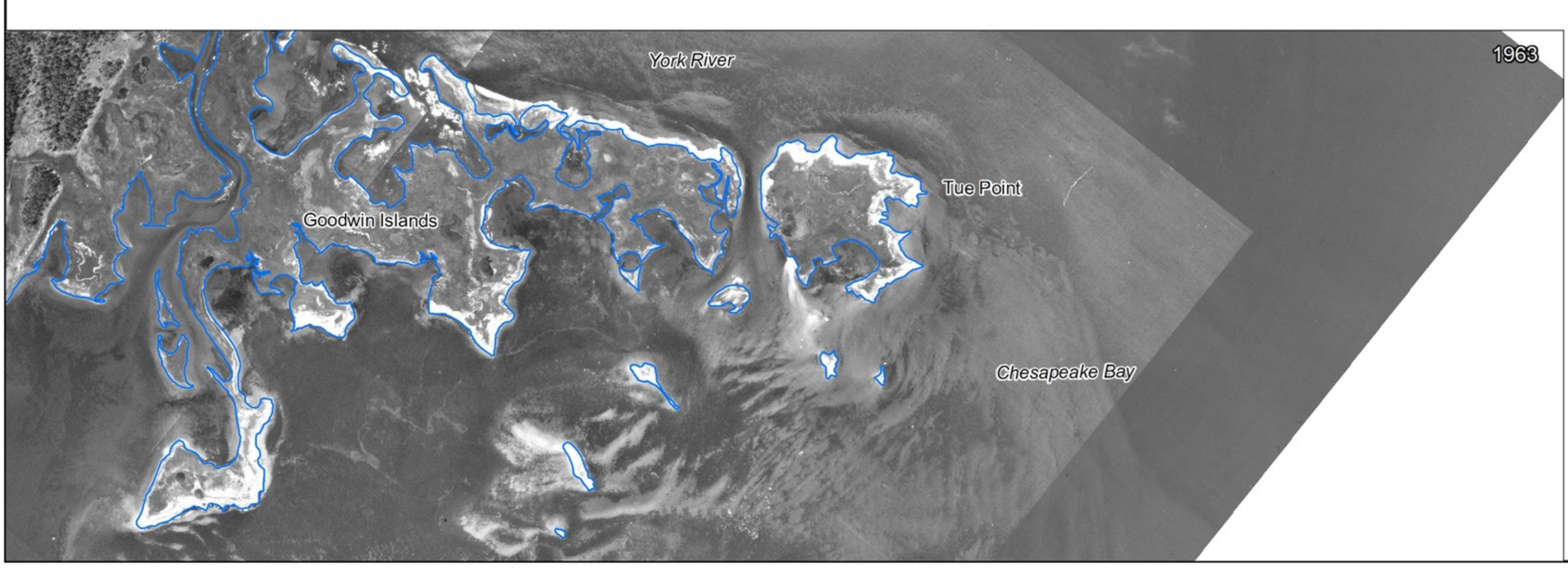
1,000 0 1,000

Feet

York County Virginia

Plate 16

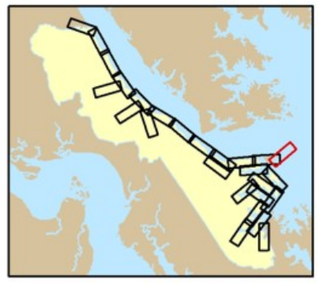




Legend

1937 Shoreline

1963 Shoreline

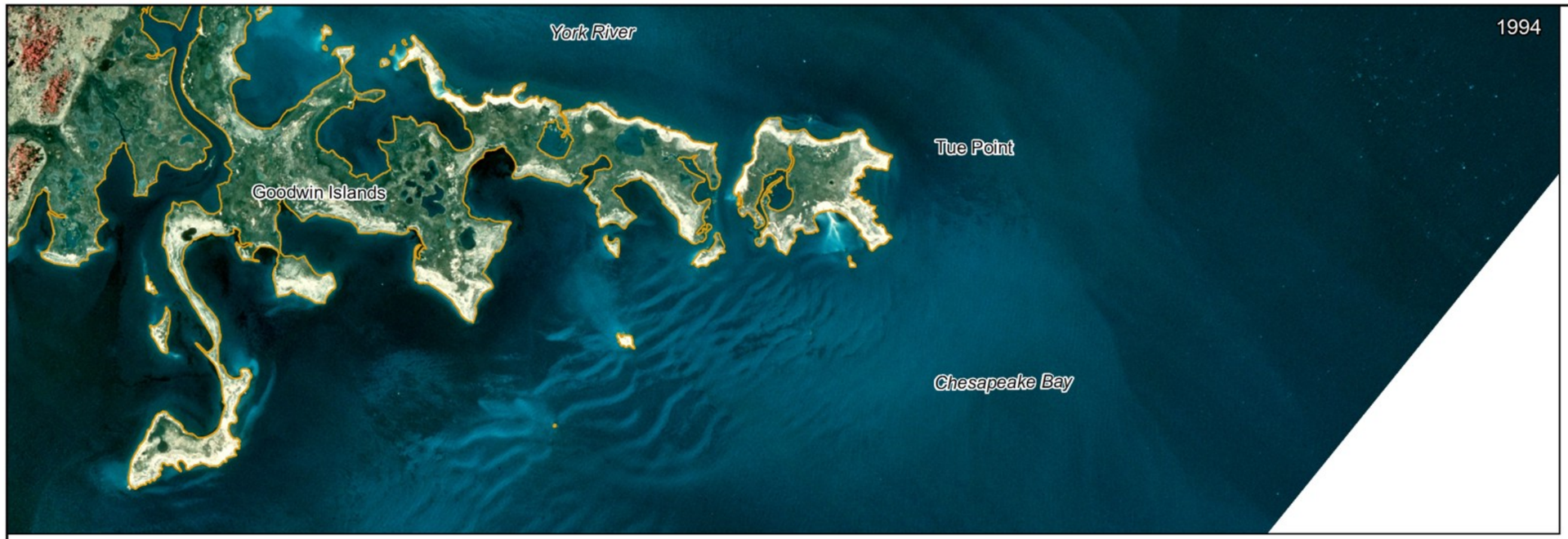


Shoreline Studies Program

VIMS

1,000 0 1,000

Feet



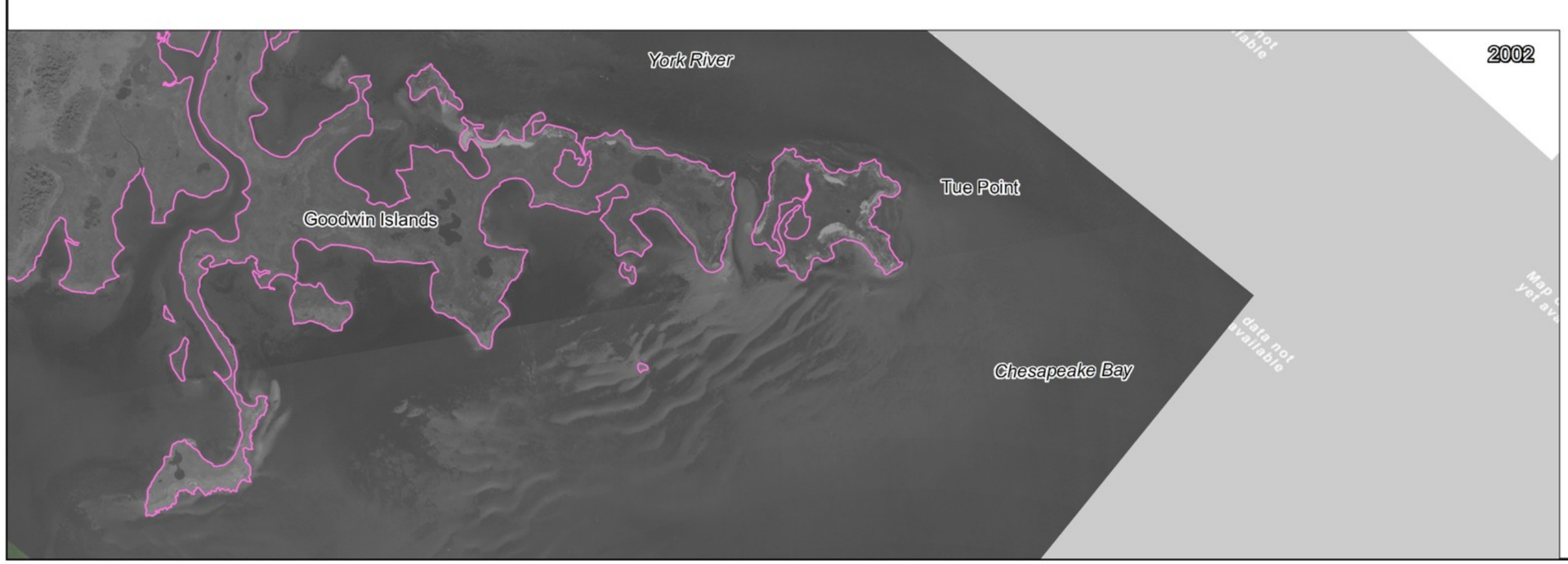
York County Virginia

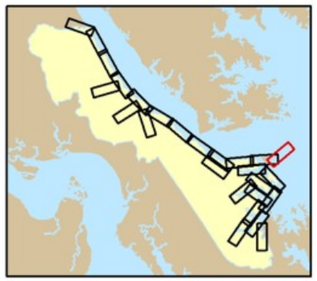
Plate 16

Legend

1994 Shoreline

2002 Shoreline





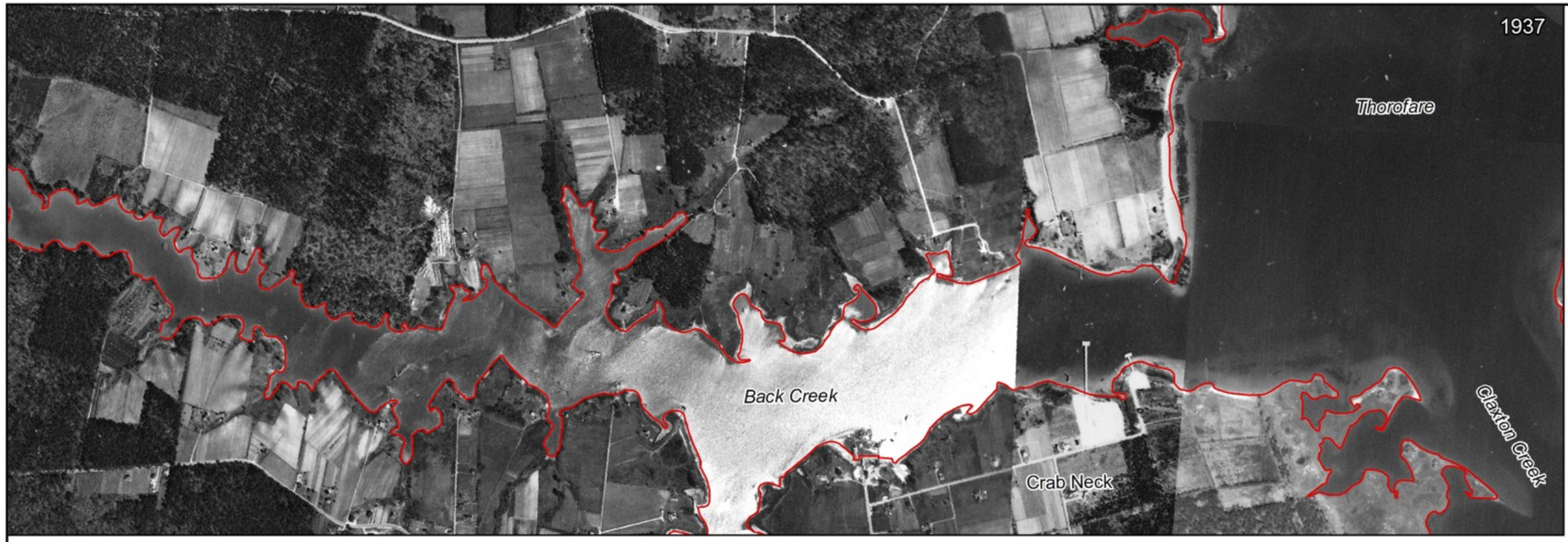
Shoreline Studies Program VIMS

1,000 0 1,000

Feet

York County Virginia

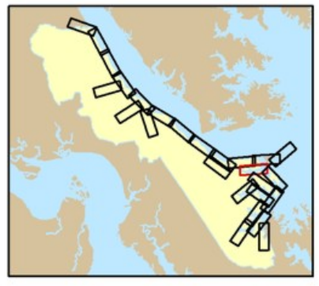
Plate 17



Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

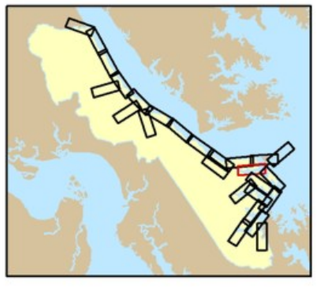
York County Virginia

Plate 17

Legend

1994 Shoreline

2002 Shoreline

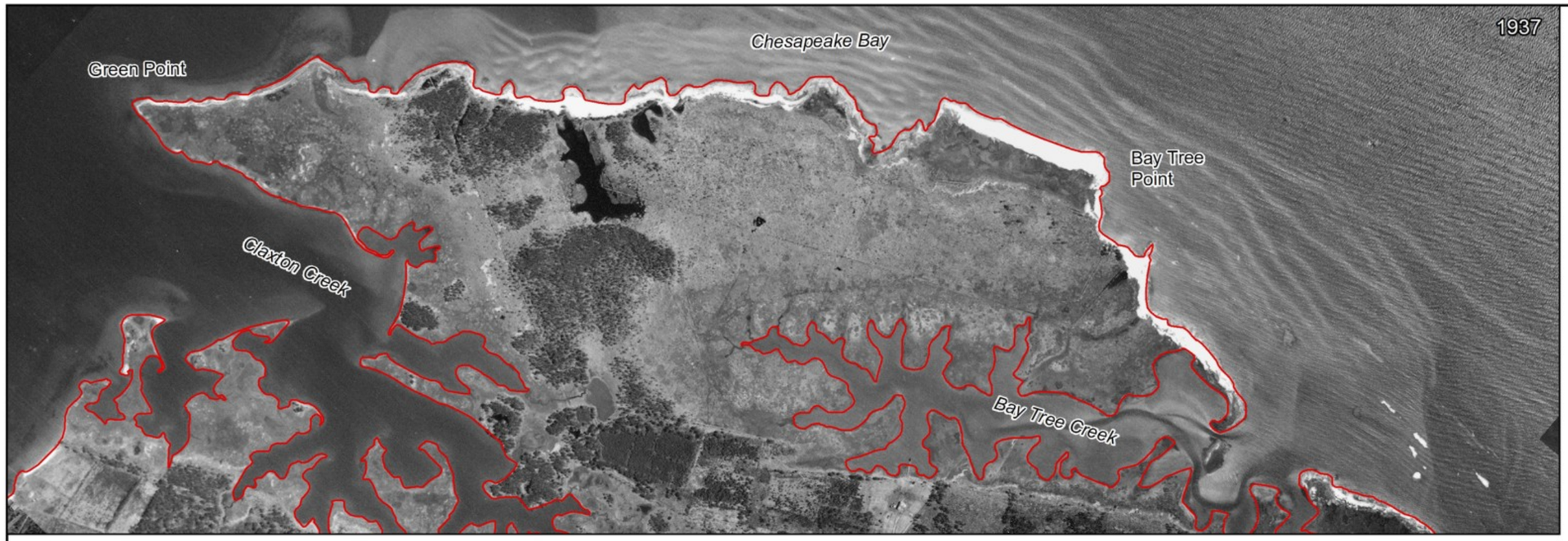


Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.



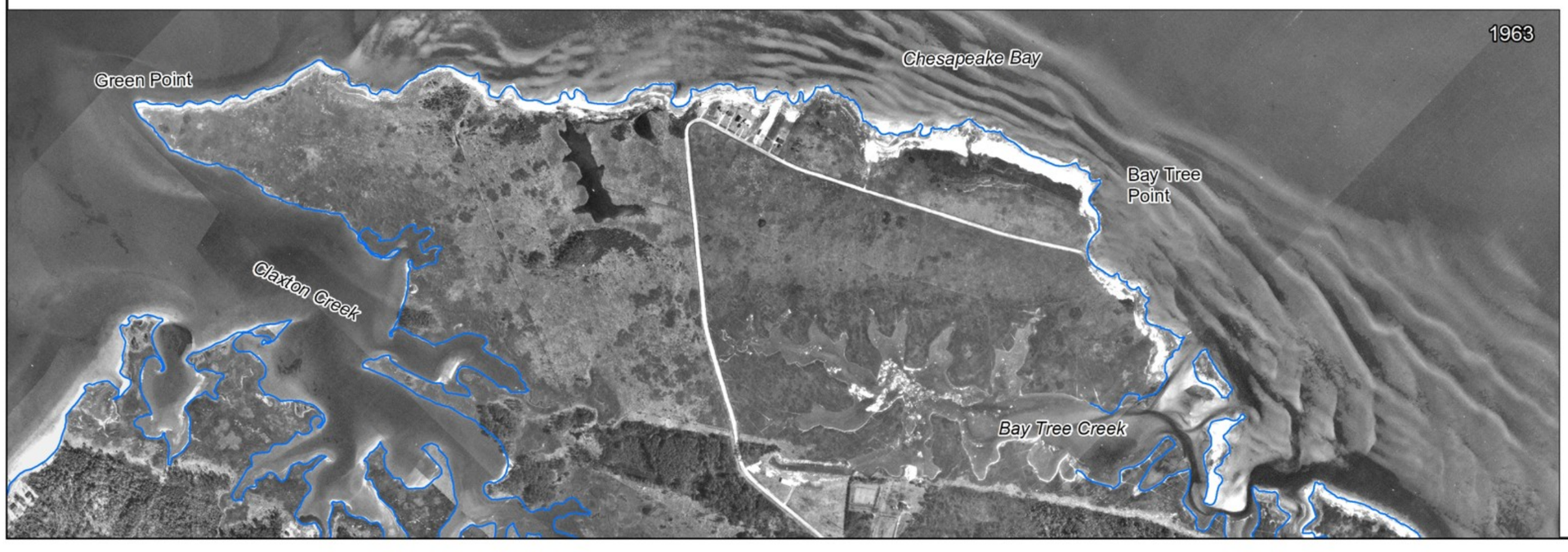
York County
Virginia

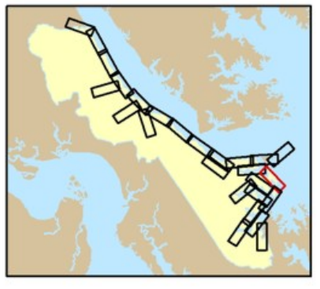
Plate 18

Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

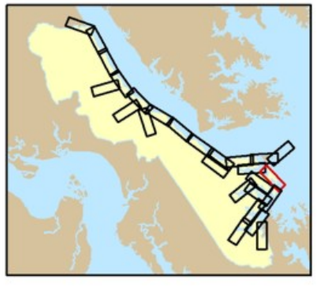
York County
Virginia

Plate 18

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program
VIMS

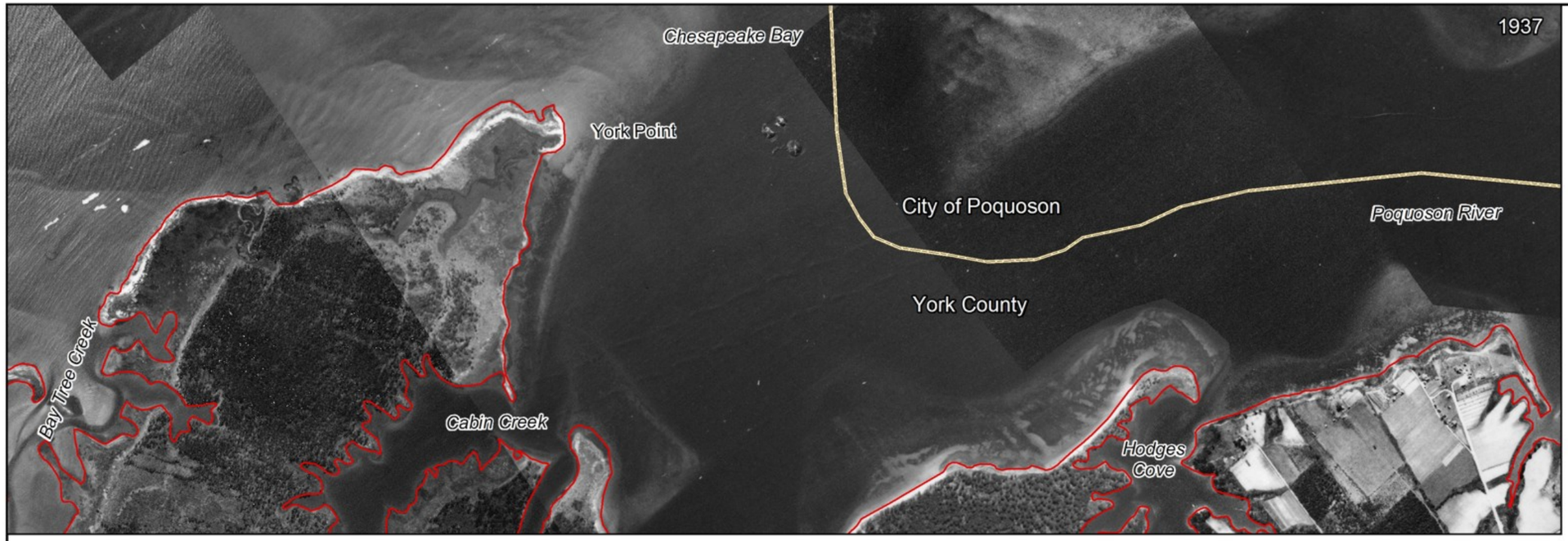
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

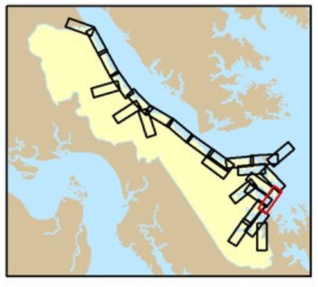
Plate 19



Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

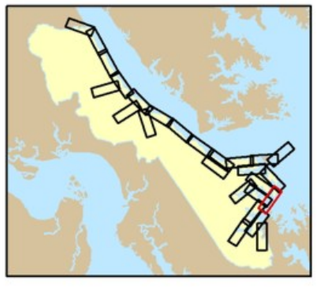
York County Virginia

Plate 19

Legend

1994 Shoreline

2002 Shoreline



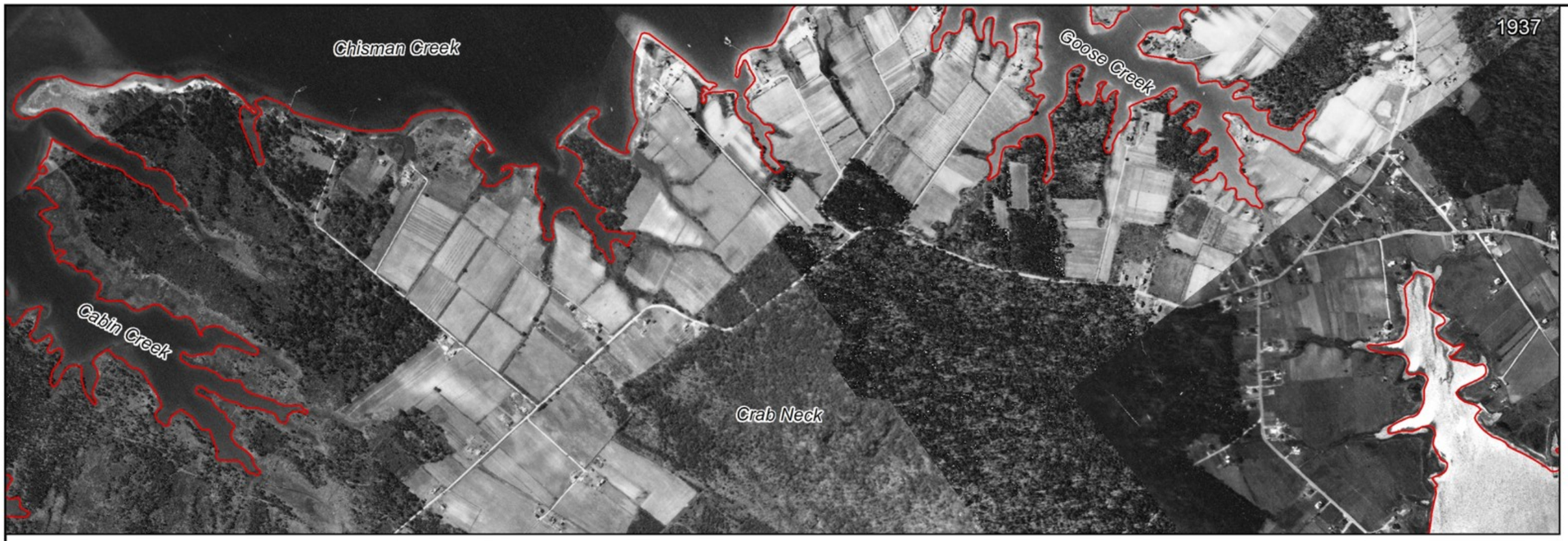
Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.



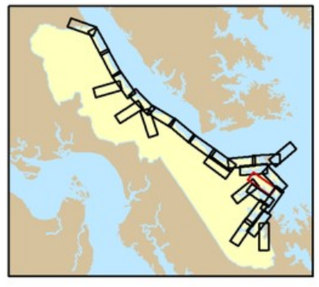
York County Virginia

Plate 20

Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

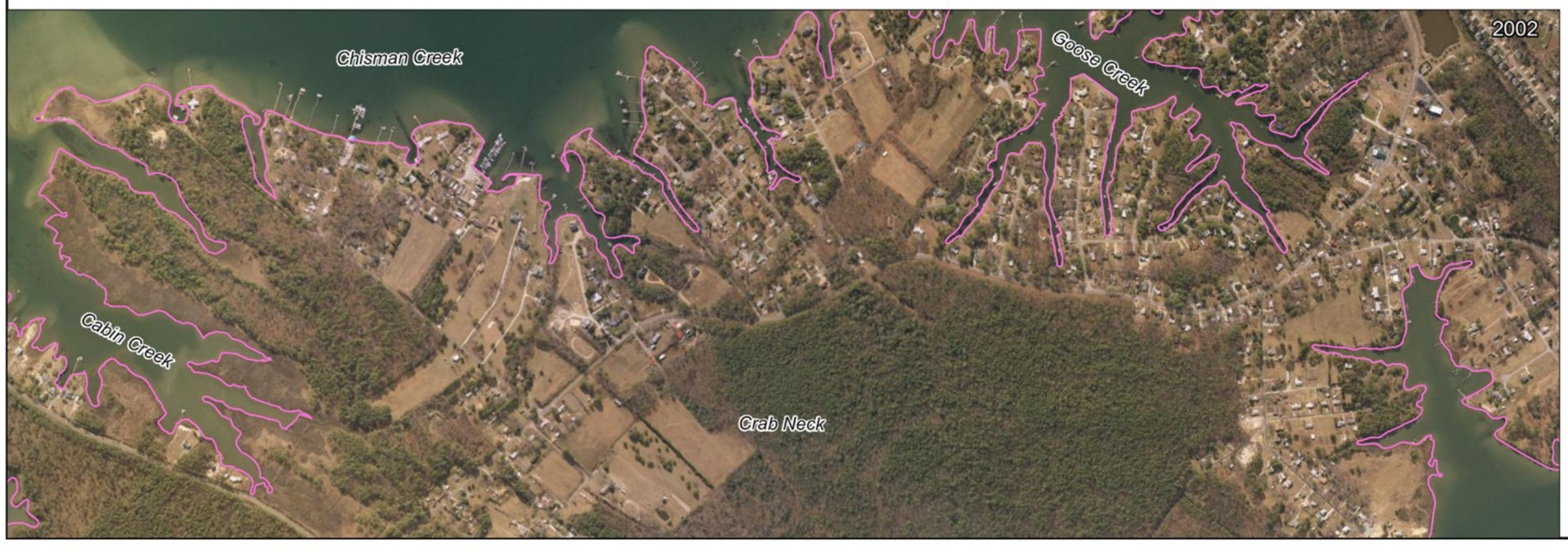
York County Virginia

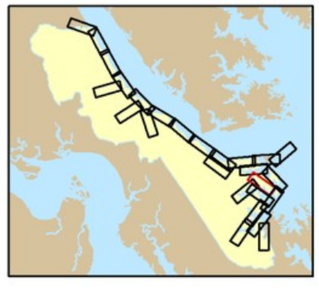
Plate 20

Legend

1994 Shoreline

2002 Shoreline





Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

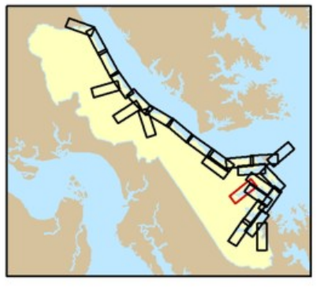
York County Virginia

Plate 21

Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

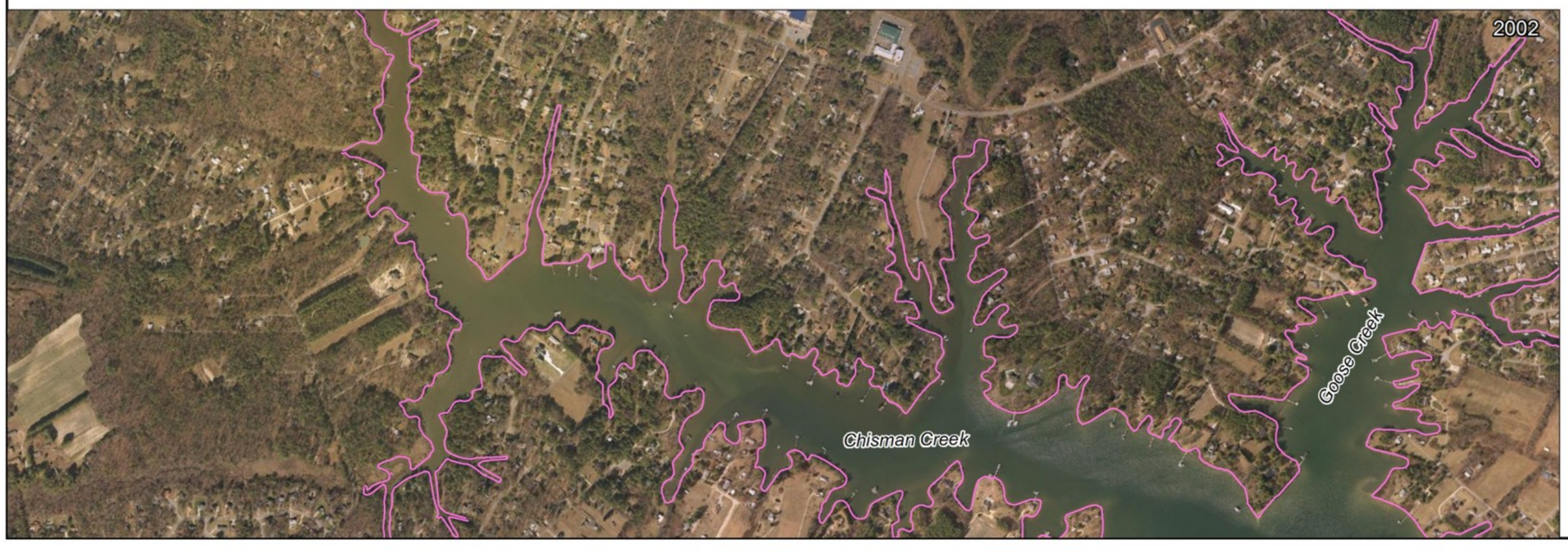
York County Virginia

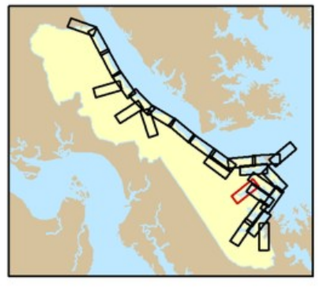
Plate 21

Legend

1994 Shoreline

2002 Shoreline



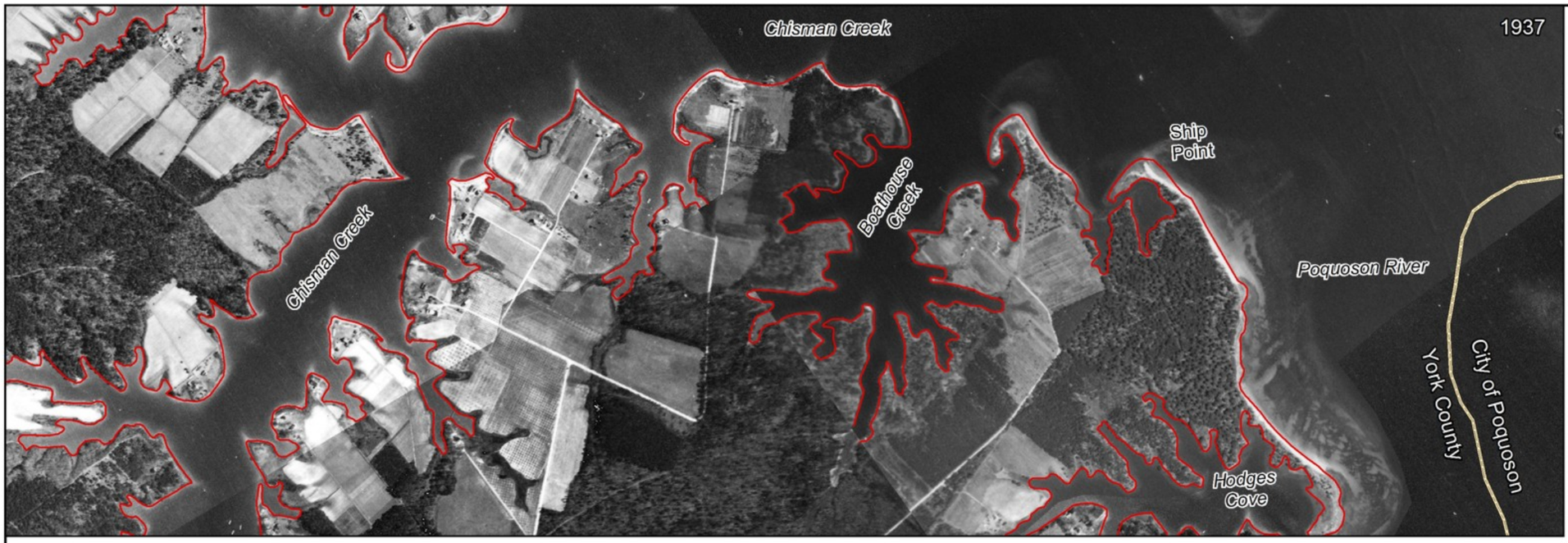


Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.



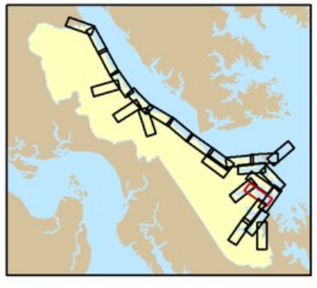
York County Virginia

Plate 22

Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

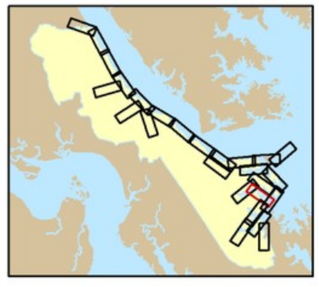
Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

Plate 22

Legend

- 1994 Shoreline
- 2002 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

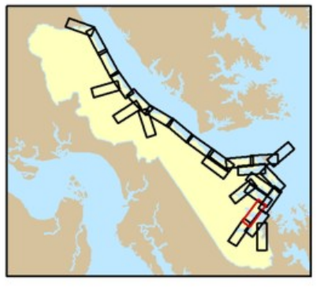
Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County Virginia

Plate 23

Legend

- 1937 Shoreline
- 1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000
Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

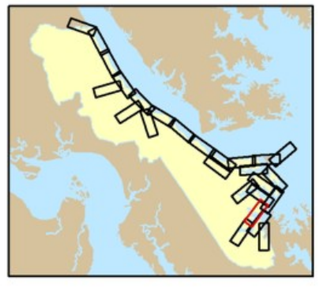
York County Virginia

Plate 23

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program

VIMS

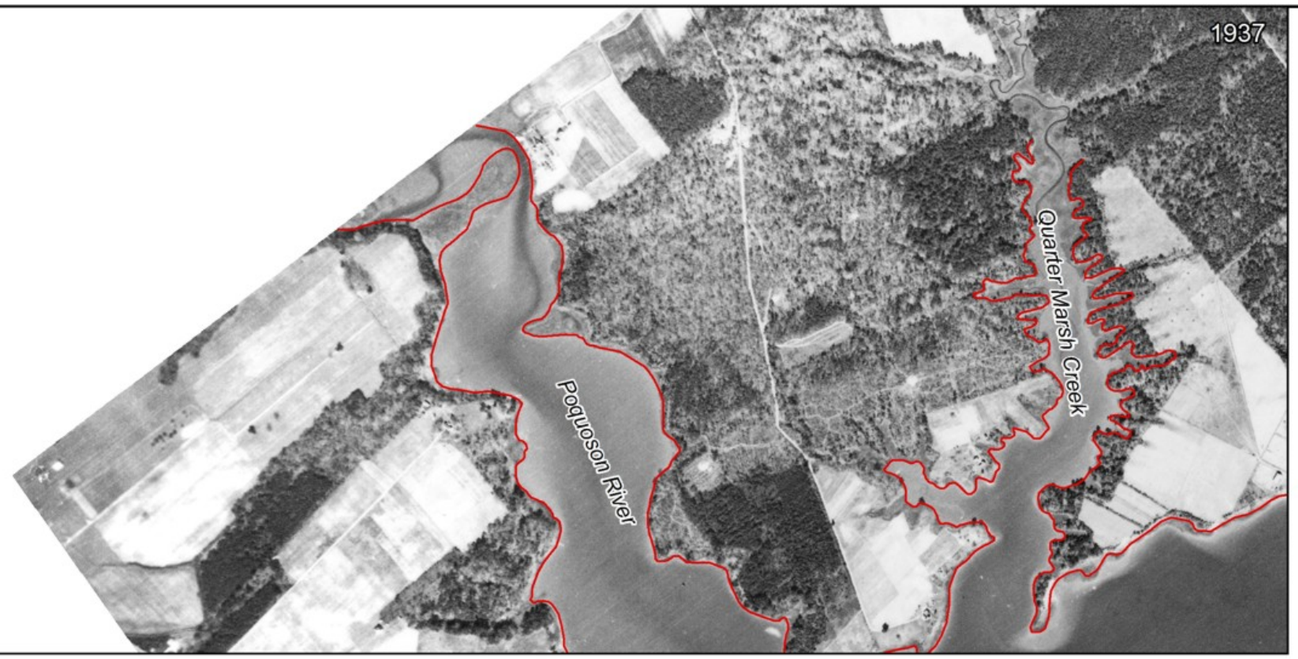
1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

York County
Virginia

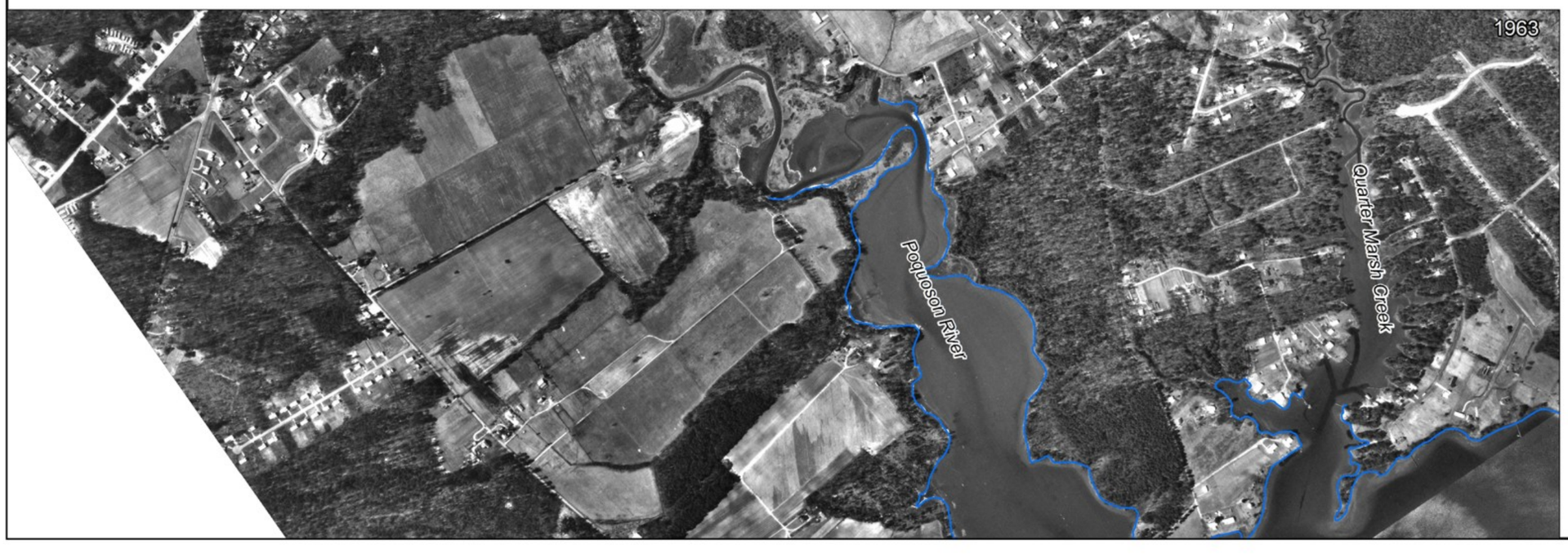
Plate 24

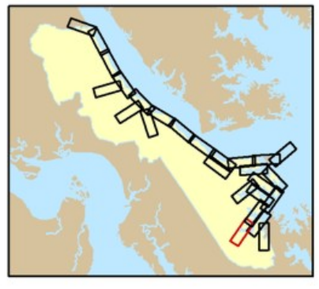


Legend

1937 Shoreline

1963 Shoreline





Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

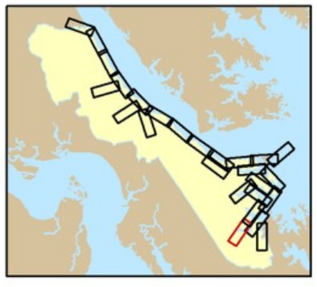
York County Virginia

Plate 24

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

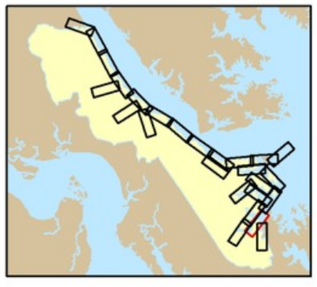
York County
Virginia

Plate 25

Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

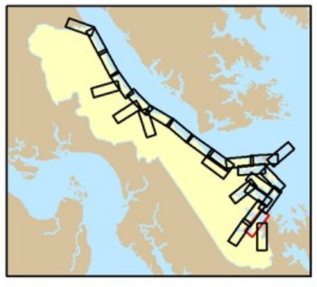
York County Virginia

Plate 25

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

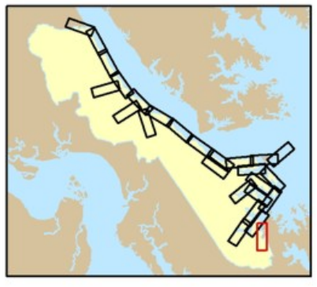
York County Virginia

Plate 26

Legend

1937 Shoreline

1963 Shoreline



Shoreline Studies Program
VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.

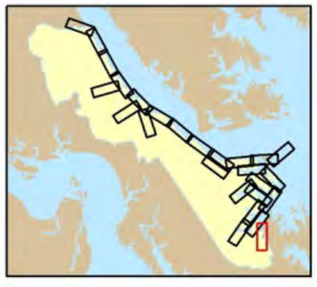
York County Virginia

Plate 26

Legend

1994 Shoreline

2002 Shoreline



Shoreline Studies Program

VIMS

1,000 0 1,000

Feet

Note: The digitized shorelines are not available for the upper reaches of some creeks between the years 1937 and 2007.