9-2013

# Shoreline Evolution: Northampton County, Virginia Chesapeake Bay Shoreline 2013

Donna A. Milligan
*Virginia Institute of Marine Science*

Christine A. Wilcox
*Virginia Institute of Marine Science*

C. Scott Hardaway Jr.
*Virginia Institute of Marine Science*



Recommended Citation

Milligan, D. A., Wilcox, C. A., & Hardaway, C. (2013) Shoreline Evolution: Northampton County, Virginia Chesapeake Bay Shoreline 2013. Virginia Institute of Marine Science, William & Mary. https://doi.org/10.21220/V58017

# Shoreline Evolution: Northampton County, Virginia Chesapeake Bay Shoreline

Shoreline Studies Program
Virginia Institute of Marine Science
College of William & Mary
Gloucester Point, Virginia

September 2013

# Shoreline Evolution: Northampton County, Virginia Chesapeake Bay Shoreline

## Data Summary Report

Donna A. Milligan
Christine Wilcox
C. Scott Hardaway, Jr.

Shoreline Studies Program
Department of Physical Sciences
Virginia Institute of Marine Science
College of William & Mary
Gloucester Point, Virginia

This project was funded by the Virginia Coastal Zone Management Program through Grant # NA12NOS4190168 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its subagencies.

September 2013

# Table of Contents



# List of Figures



# List of Tables

# 1 Introduction

Northampton County is situated along Virginia's Eastern Shore (Figure 1). Because the County's shoreline is continually changing, determining where the shoreline was in the past, how far and how fast it is moving, and what factors drive shoreline change will help define the shoreline's future movement. These rates and patterns of shore change along Chesapeake Bay's estuarine shores will differ through time as winds, waves, tides and currents shape and modify coastlines by eroding, transporting and depositing sediments.

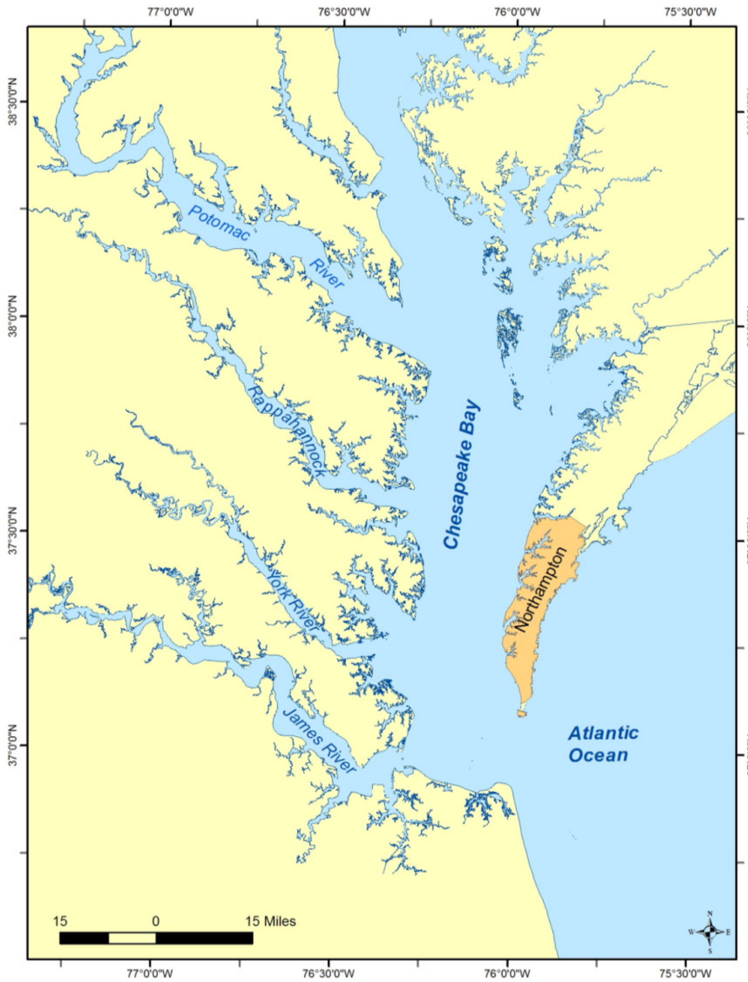



**Figure 1. Location of Northampton County in the Chesapeake Bay estuarine system.**

The purpose of this report is to document how the Chesapeake Bay shoreline of Northampton County has evolved since 1938. 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. Only shorelines of Chesapeake Bay and its tributaries on the Bay side of Northampton County are included in this report. The present report is an update to Hardaway *et al.* (2004) which documented shoreline change in order to determine the evolution of Bay dunes. While determining how the ocean side shoreline and marshes are changing is important, it would have greatly increased the scope of this project.

Aerial photos show 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. In addition to documenting historical shorelines, the change in shore positions along the Bay and larger creeks in Northampton County will be quantified in this report. The shorelines of very irregular coasts, small creeks and around inlets, and other complicated areas will be shown but not quantified.

# 2 Methods

## 2.1 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 Northampton County Shoreline from 1938, 1949, 1972, 1994, 2002, and 2009 were used in the analysis. The 1994, 2002 and 2009 images were available from other sources. The 1994 imagery was orthorectified by the U.S. Geological Survey (USGS) and the 2002 and 2009 imagery was orthorectified by the Virginia Base Mapping Program (VBMP). The 1938, 1949 and 1972 photos are part of the VIMS Shoreline Studies Program archives. The historical aerial images used to analyze the entire County shoreline were not always flown on the same day. The exact dates that the 1994 images were flown could not be ascertained; however, the dates for the other years are as follows:
1938 – May 6, 7, and 17;
1949 – February 3 and 17, March 13, May 14, and November 8;
1972 - December 1;
2002 – February 14, 19, 22, and 24;
2009 – February 6, 7, and 13.

The 1938, 1949 and 1972 images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. These aerial photographs were orthographically corrected to produce a seamless series of aerial mosaics following a set of standard operating procedures. The 1994 Digital Orthophoto Quarter Quadrangles (DOQQ) from USGS were used as the reference images. The 1994 photos are used rather than higher quality, more recent aerials because of the difficulty in finding control points that match the earliest 1938 images.

ERDAS Orthobase image processing software was used to orthographically correct the individual flight lines 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. 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 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 .img format. To maintain an accurate match with the reference images, it is necessary to distribute the control points evenly, when possible. This can be challenging in areas given the lack of ground features and poor photo quality on the earliest photos. Good examples of control points were manmade features such as road intersections and stable natural landmarks such as ponds and creeks that have not changed much over time. The base of tall features such as buildings, poles, or trees can be used, but the base can be obscured by other features or shadows making these locations difficult to use accurately. Many areas of the County were particularly difficult to rectify due to the lack of development in the historical and the reference images.

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 low water. High water limit of run-up can be difficult to determine on some shorelines due to narrow or non-existent beaches against upland banks or vegetated cover. The feature digitized is noted in the shoreline attributes for the 2009 photos. Ice along some sections of the 2009 photos obscures the shoreline. 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. The area was calculated for several islands in Northampton County. The shoreline shapefiles were converted to polygons and their area determined.

Horizontal positional accuracy is based upon orthorectification of scanned aerial photography against the USGS digital orthothophoto quadrangles. For vertical control, the USGS 30m DEM data was used. 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 2009 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.

## 2.2 Rate of Change Analysis

AMBUR (Analyzing Moving Boundaries Using R) is a suite of tools that are used to better analyze and understand historic shoreline changes. These tools use the open-source R software and can be customized to perform not only advanced statistics but also geospatial and geostatistical functions. The AMBUR package provides robust tools for investigating diverse shoreline types through: multiple shoreline settings, improved transect casting methods, and detailed analysis and output. The package allows import and export of geospatial data in ESRI shapefile format. The "baseline and transect" method is the primary technique used to quantify distances and rates of shoreline movement, and to detect classification changes across time.

One hundred and fifty three miles of baselines and 23,300 transects about 30 feet apart were created for Northampton County. Baselines were digitized slightly seaward of the 1938 shoreline and encompassed most of the County's coast. The baselines may not include very small creeks and areas that have unique shoreline morphology such as creek mouths and spits.

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. This method provides an accurate net rate of change over the long term and is relatively easy to apply to most shorelines since it only requires two dates. 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. However, Milligan *et al.* (2010a, 2010b, 2010c, 2010d) found that in several localities within the bay, EPR is a reliable indicator of shore change even when intermediate dates exist.

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 (1938, 1949, and 1972) have an estimated total maximum shoreline position error of 20.0 ft, while the total maximum 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 ±0.7 ft/yr. The smaller rivers and creeks are more prone to error due to their lack of good control points for photo rectification, narrower shore features, tree and ground cover and overall smaller rates of change. These areas are digitized but due to the higher potential for error, rates of change analysis are not calculated. Many areas of Northampton County have shore change rates that fall within the calculated error. Some of the areas that show very low accretion can be due to errors within the method as described above.

The Northampton County shoreline was divided into 15 plates (Figure 2) in order to display the shoreline data. In Appendix A, the 2009 image is shown with only the 1937 and 2009 shorelines and the calculated EPR of change. In Appendix B, one photo date and the associated shoreline is shown on each. These include the photos taken in 1937, 1949, 1972, 1994, 2002 and 2009. The shorelines are summarized on the 2009 image.

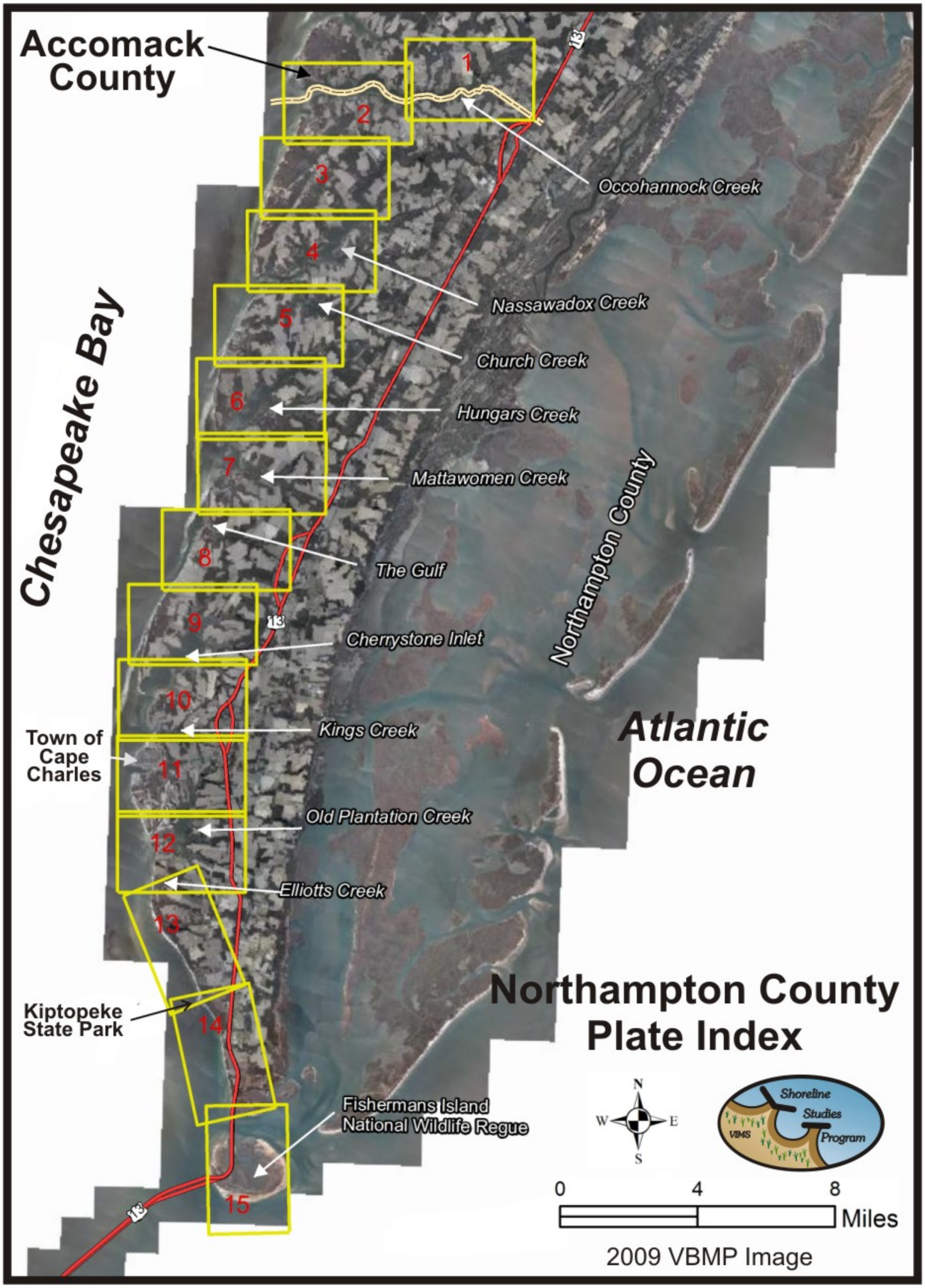



**Figure 2. Plate index for Northampton County shorelines.**

# 3 Results and Discussion

Table 1 shows the average EPR (1938-2009) for sections of the County where bold reaches are on the mainstem of Chesapeake Bay. Most of the shoreline in Northampton County, is experiencing very low erosion (<1 ft/yr). The exceptions are on the northern and southern ends of the County. Between Occohannock Creek and Nassawadox Creek, the shoreline is eroding at -1.5 ft/yr (Plates 2, 3 and 4). While the rate varies considerably over the entire reach, some sections have a high erosion rate, between -5 and -10 ft/yr. Several residential areas have built shore protection structures between 1938 and 2009 which affect the erosion rate.

The reach from The Gulf to Cherrystone Inlet (Plates 8, 9, and 10) is eroding on average at a rate of -2.4 ft/yr. The highest erosion rates occurred in the center of the reach at Tankards Beach. This shoreline faces northwest and receives the brunt of northeast storms when winds switch to the northwest – a common occurrence of those storms. Farther south, headland breakwaters have been constructed to protect the shoreline. Their construction resulted in an accretionary rate of change if the structure was built seaward of the 1938 shoreline. The very low accretion rate of change between Kings Creek and Cape Charles Harbor (Plates 10 and 11) was also the result of headland breakwater construction. South of Cape Charles Harbor (Plates 12 and 13), industrial expansion and headland breakwater construction result in an overall medium accretion rate. Some sections of the shoreline between Old Plantation Creek and the north end of Pond Drain have a high rate of erosion although overall, the average rate is between -2 to -5 ft/yr. This shoreline reach faces northwest and can be greatly affected after the passage of northeast storms when winds subsequently shift to the northwest.

Pond Drain occurs at a change of shore direction of face which likely accounts for its medium accretion rate (Plate 13). The sediment eroded south of Old Plantation Creek are transported south where the change in shore direction provides some protection for storm winds and waves allowing sediment to accumulate into a wide beach and dune system. The average accretion rate for the reach between Picketts Harbor and Kiptopeke is misleading (Plate 13). A great deal of accretion has occurred at Kiptopeke State Park due to the jetties and bulkheads. On the north side of these structures, sand transported south accumulates and the ships offshore can protect the shoreline from direct wave attack during northeast storms. However, north of there at Butlers Bluff, the shore is experiencing erosion at a rate of -2 to -5 ft/yr. Homeowners installed headland breakwaters for shore protection. Plate 14 shows that the shoreline south of Kiptopeke State Park is eroding as much as -5 ft/yr. However, the shoreline on the south side of the bulkhead is accreting due its protection for storms as well as sand transport into the Bay from the ocean.

Table 1. Average end point rates of shoreline change in feet per year along sections of Northampton County's coast. Chesapeake Bay sections are shown in bold.

| Reach Name | Plate Number | Avg EPR (ft/yr) | Category |
|---|---|---|---|
| In Occahannock Ck | 1 and 2 | -0.3 | Very Low Erosion |
| **Occohannock Ck to Nassawadox Ck** | **2, 3, 4** | **-1.5** | **Low Erosion** |
| In Nassawadox Ck | 3, 4 | -0.2 | Very Low Erosion |
| In Church Creek | 4, 5 | -0.2 | Very Low Erosion |
| **Nassawadox to Westerhouse Ck** | **5** | **-0.9** | Very Low Erosion |
| In Westerhouse Ck | 5 | -0.3 | Very Low Erosion |
| **Westerhouse Ck to Hungars Ck** | **5, 6, 7** | **-0.5** | Very Low Erosion |
| In Hungars Ck (Includes Jacobus Ck) | 5, 6, 7 | -0.2 | Very Low Erosion |
| In Mattawoman Ck | 7 | -0.3 | Very Low Erosion |
| Mattawoman Ck to The Gulf | 7, 8 | 0.0 | Very Low Erosion |
| In The Gulf | 8 | -0.2 | Very Low Erosion |
| **The Gulf to Cherrystone Inlet** | **8, 9, 10** | **-2.4** | **Medium Erosion** |
| In Cherrystone Inlet | 9, 10 | -0.2 | Very Low Erosion |
| In Kings Ck | | -0.2 | Very Low Erosion |
| **Kings Ck to Cape Charles Harbor** | **10, 11** | **0.6** | **Very Low Accretion** |
| **Cape Charles Harbor to Old Plantation Ck** | **11, 12** | **3.1** | **Medium Accretion** |
| In Old Plantation Creek | 11, 12 | -0.2 | Very Low Erosion |
| **Old Plantation to Pond Drain (includes Elliots Ck)** | **12, 13** | **-1.8** | **Low Erosion** |
| **Pond Drain to Pickett's Harbor** | **13** | **2.8** | **Medium Accretion** |
| **Pickett's Harbor to Kiptopeke** | **13** | **1.1** | **Low Accretion** |
| **Kiptopeke to Fishermans Island** | **14** | **-0.6** | **Very Low Erosion** |

Several marsh islands exist along the shoreline. Two such islands, Sandy Island (Plate 10) and Horse Island (Plate 4), are both disappearing. These islands were not included in the shoreline rate of change calculation due to complexity of shoreline. However, the area of these islands was calculated in 1938 and 2009. Sandy Island was 5 acres in area in 1938, but by 2009, it had virtually disappeared since it had less than a tenth of an acre left. Horse Island was 16 acres in 1938, but by 2009 it had been reduced in size to 5 acres. These islands are indicative of many areas of marsh and marsh islands in the medium to high energy environments of Chesapeake Bay and its tributaries. Both shoreline erosion and sea-level rise is affecting their ability to maintain themselves.

Along Church Neck (Plates 5 and 6) south of Westerhouse Creek, a great deal of sand regularly shifts from north to south creating dynamic spits on the shoreline. The 1938 shoreline shows that no spits exist along this section of shoreline. However, by 1949, a large spit has developed to the north (Plate 5) and a very small one occurs more south (Plate 6). By 1972, the smaller spit had reattached to the shoreline and the large spit had migrated southward (Plate 6). The location of the spit's attachment to the upland varied little between 1972 and 1994; however, the spit lengthened significantly. Between 1994 and 2009, the location of spit attachment has continued its southward migration and, by 2009, was wider at its tip than in previous years. The spit is fed by erosion of the sandy banks from the north and will continue to change depending on sediment supply and wave climate. This dynamic shift affects the patterns of shore change. As the location of attachment shifts, where it was previously attached to the upland will experience erosion. As the spit shifts southward, the upland that becomes protected behind the spit will stop eroding and possibly even accrete.

Fishermans Island (Plate 15), however, is in a different environment. It is located at the southernmost point of Northampton County at the mouth of Chesapeake Bay. In 1938, its area was calculated to be 750 acres, but between then and 2009, it had grown to 1750 acres. While a direct comparison was not made, an 1863 map of Fisherman's Island shows a much smaller land mass than the 1938 date indicating that this island has been accreting for over 150 years. Being at the confluence of the Chesapeake Bay and Atlantic Ocean has allowed this island to grow, even though it is in a high energy environment, due to the amount of sand traveling south from erosion of the Eastern Shore as well sand as moving into the Bay from the ocean. The shape of the island is in constant flux due to wind, waves, and currents acting on it.

# 4 Summary

The rates of change shown in Table 1 are averaged across large sections of shoreline and may not be indicative of rates at specific sites within the reach. Some areas of the County, where the shoreline change rates are categorized as accretion, have structures along the shoreline which results in a positive long-term rate of change due to the structures themselves. Some of the areas with very low accretion, particularly in the smaller creeks and rivers, may be the result of errors within photo rectification and digitizing wooded shorelines.

Generally, the shoreline along the creeks of Northampton County are changing at less than -1 ft/yr. Along the Bay shoreline, change results are more variable and depend on the direction of shore face, available for transport, as well as the influence of man-made features.

# 5 References

Hardaway, Jr., C. Scott, Donna A. Milligan, Lyle M. Varnell, Christine Wilcox, George R. Thomas, and Travis R. Comer, 2004. Shoreline Evolution: Northampton County, Virginia Chesapeake Bay Shoreline. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA.

Milligan, D. A., K.P. O'Brien, C. Wilcox, C. S. Hardaway, JR, 2010a. Shoreline Evolution: City of Newport News, Virginia James River and Hampton Roads Shorelines. Virginia Institute of Marine Science. College of William & Mary, Gloucester Point, VA. http://web.vims.edu/physical/research/shoreline/docs/dune_evolution/NewportNews/1NewportNews_Shore_Evolve.pdf

Milligan, D. A., K.P. O'Brien, C. Wilcox, C. S. Hardaway, JR, 2010b. Shoreline Evolution: City of Poquoson, Virginia, Poquoson River, Chesapeake Bay, and Back River Shorelines. Virginia Institute of Marine Science. College of William & Mary, Gloucester Point, VA. http://web.vims.edu/physical/research/shoreline/docs/dune_evolution/Poquoson/1Poquoson_Shore_Evolve.pdf

Milligan, D. A., K.P. O'Brien, C. Wilcox, C. S. Hardaway, JR, 2010c. Gloucester County, Virginia York River, Mobjack Bay, and Piankatank River Shorelines. Virginia Institute of Marine Science. College of William & Mary, Gloucester Point, VA. http://web.vims.edu/physical/research/shoreline/docs/dune_evolution/Gloucester/1Gloucester_Shore_Evolve.pdf

Milligan, D. A., K.P. O'Brien, C. Wilcox, C. S. Hardaway, JR, 2010d. Shoreline Evolution: York County, Virginia York River, Chesapeake Bay and Poquoson River Shorelines. Virginia Institute of Marine Science. College of William & Mary, Gloucester Point, VA. http://web.vims.edu/physical/research/shoreline/docs/dune_evolution/York/1York_Shore_Evolve.pdf

Morton, R.A., T.L. Miller, and L.J. Moore, 2004. National Assessment of Shoreline Change: Part 1 Historical Shoreline Change and Associated Coastal Land Loss along the U.S. Gulf of Mexico. U.S. Department of the Interior, U.S. GeologicalSurvey Open-File Report 2004-1043, 45 p.

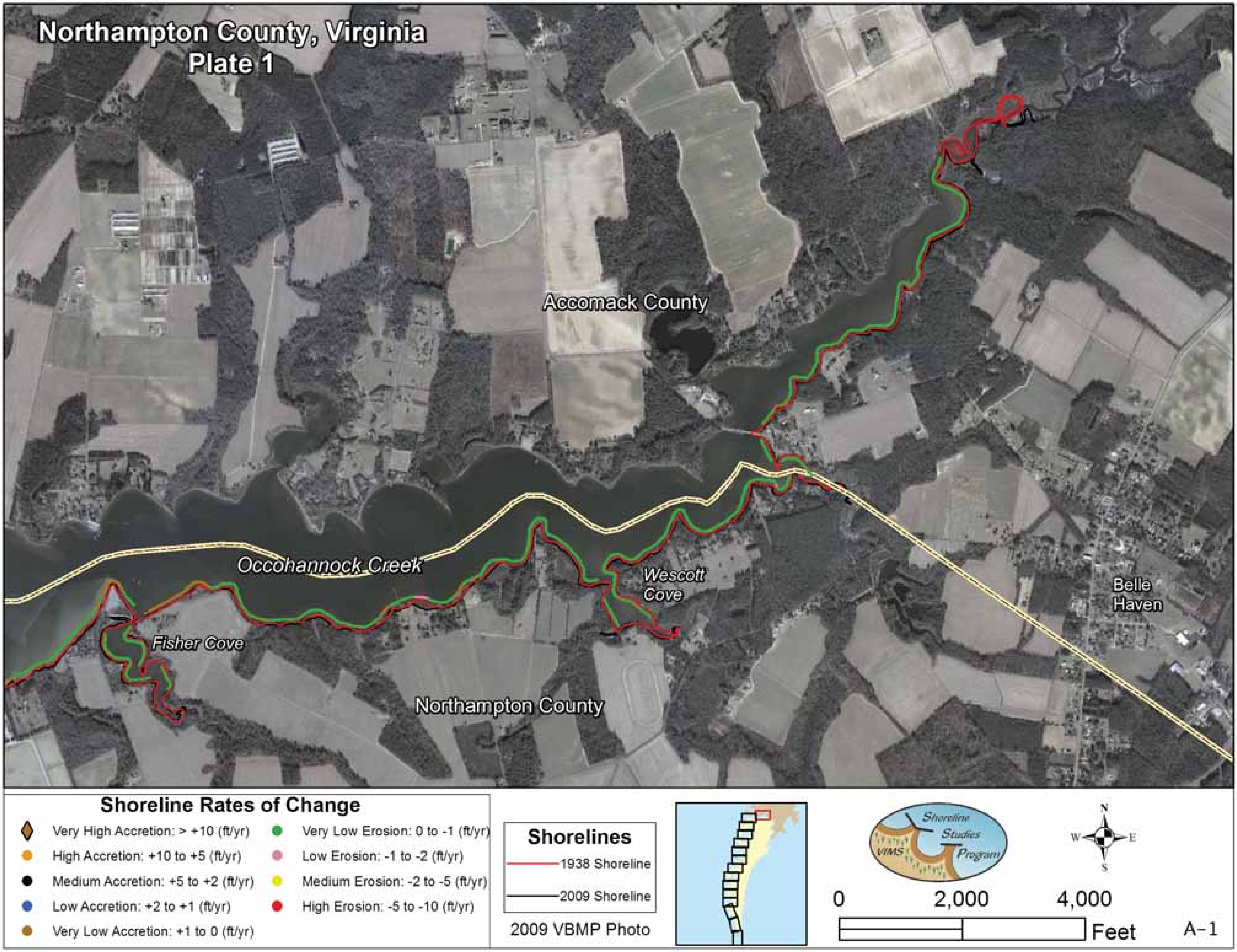
National Spatial Data Infrastructure, 1998. Geospatial Positional Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy. Subcommittee for Base Cartographic Data. Federal Geographic Data Committee. Reston, VA.

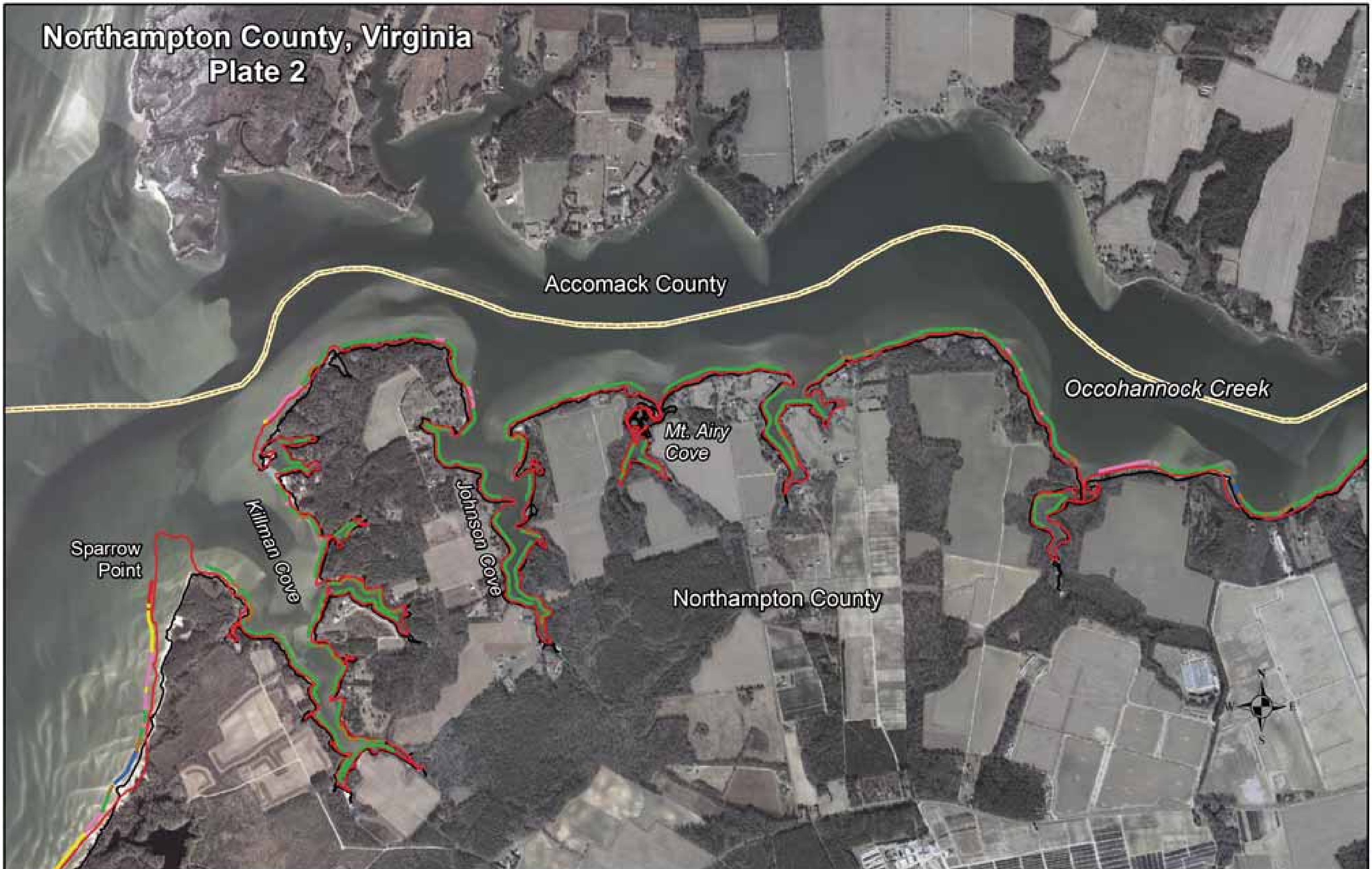
# Appendix A

# End Point Rate of Shoreline Change Maps

Shoreline change rate segments are shown on the top map. The calculated rates of change for each transect within the segment were averaged to determine an average rate of change as shown in Table 1 of the report.

Note: The location labels on the plates come from U.S. Geological Survey topographic maps, Google Earth, and other map sources and may not be accurate for the historical or even more recent images. They are for reference only.


Northampton County, Virginia
Plate 1
Accomack County
Occohannock Creek
Wescott Cove
Fisher Cove
Belle Haven
Northampton County
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
W
E
S
0
2,000
4,000
Feet




**Shoreline Rates of Change**

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

**Shorelines**

1938 Shoreline

2009 Shoreline

2009 VBMP Photo

Shoreline Studies Program VIMS

0 2,000 4,000 Feet


**Shoreline Rates of Change**

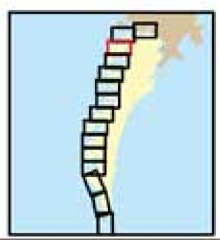
- Very High Accretion: > +10 (ft/yr)
- High Accretion: +10 to +5 (ft/yr)
- Medium Accretion: +5 to +2 (ft/yr)
- Low Accretion: +2 to +1 (ft/yr)
- Very Low Accretion: +1 to 0 (ft/yr)
- Very Low Erosion: 0 to -1 (ft/yr)
- Low Erosion: -1 to -2 (ft/yr)
- Medium Erosion: -2 to -5 (ft/yr)
- High Erosion: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

**Shorelines**

1938 Shoreline

2009 Shoreline

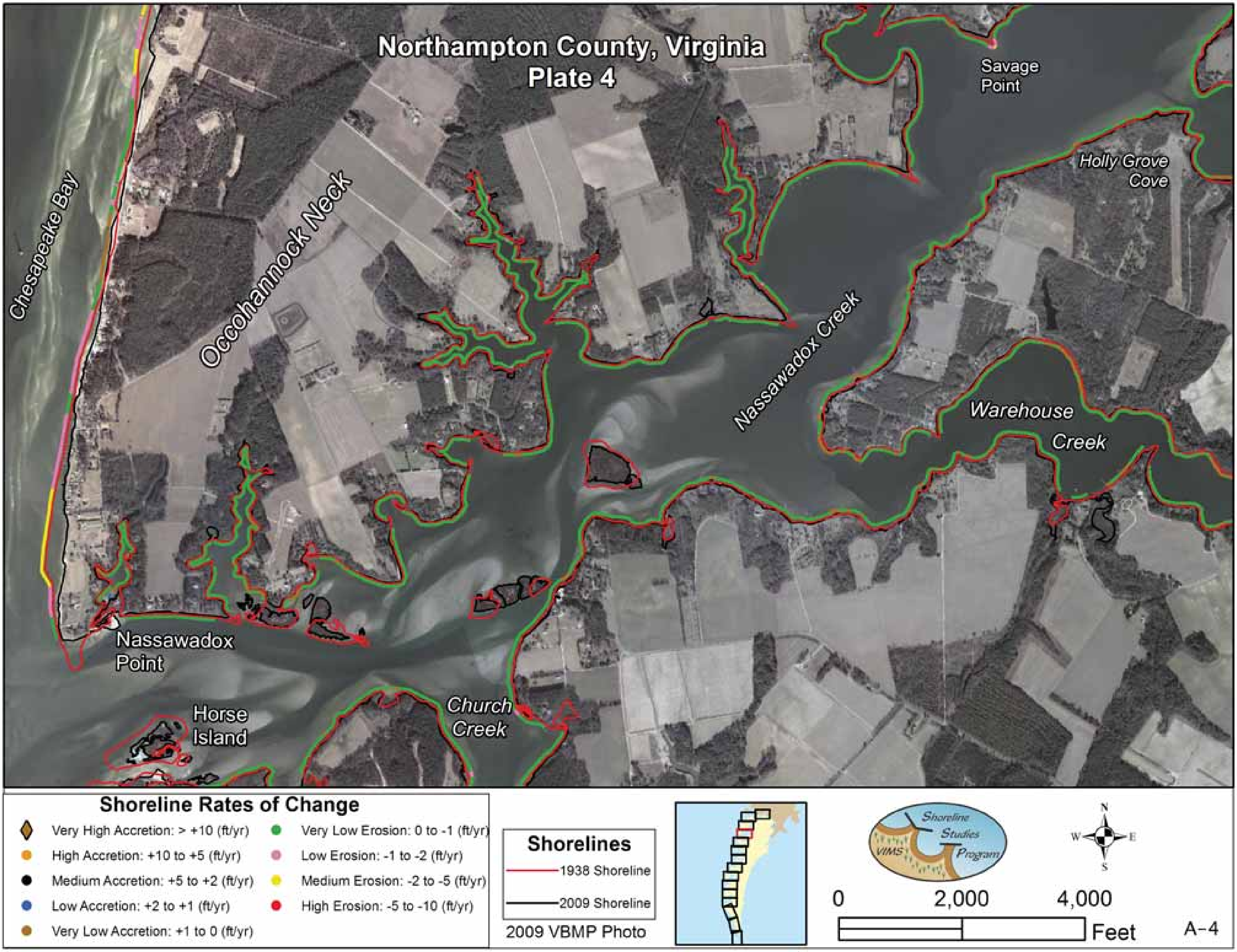
2009 VBMP Photo

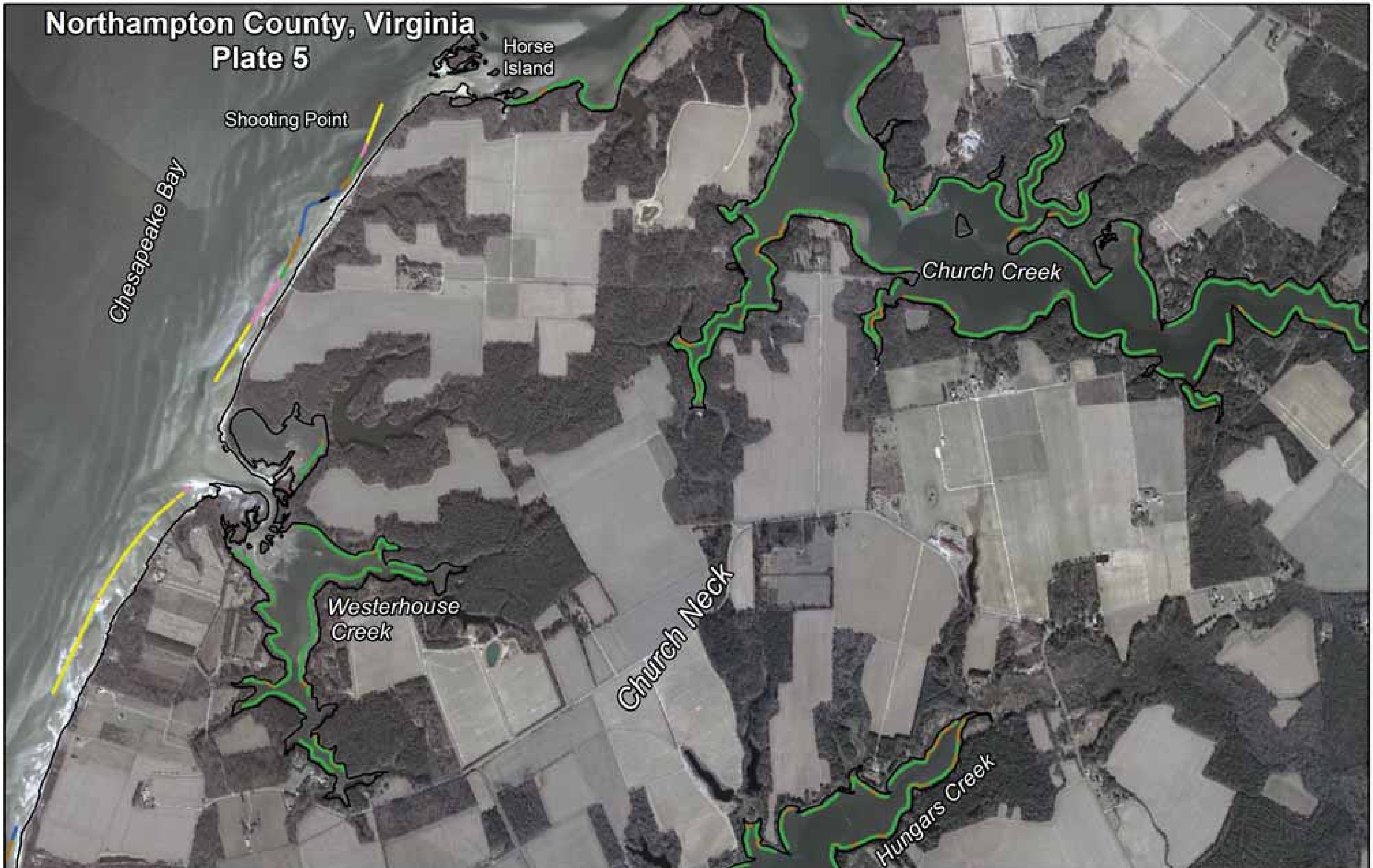


Shoreline Studies Program VIMS

N W E S

0 2,000 4,000 Feet


Northampton County, Virginia
Plate 4
Savage Point
Holly Grove Cove
Chesapeake Bay
Occohannock Neck
Nassawadox Creek
Warehouse Creek
Nassawadox Point
Horse Island
Church Creek
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
W
E
S
0
2,000
4,000
Feet



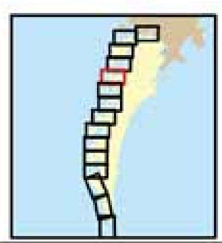

**Shoreline Rates of Change**

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

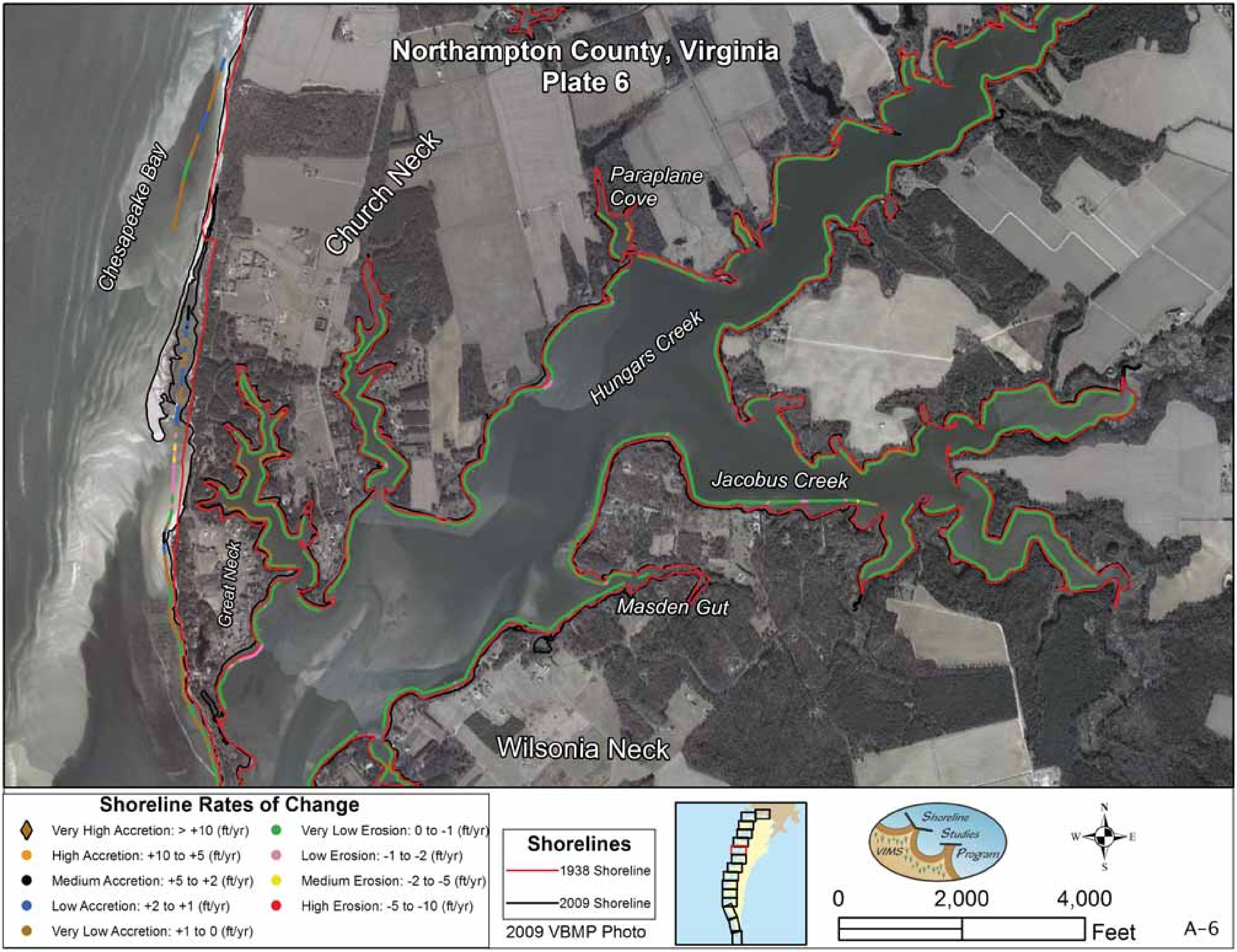
**Shorelines**

1938 Shoreline
2009 Shoreline

2009 VBMP Photo



0 2,000 4,000 Feet



Northampton County, Virginia
Plate 6
Chesapeake Bay
Church Neck
Paraplane Cove
Hungars Creek
Jacobus Creek
Great Neck
Masden Gut
Wilsonia Neck
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
W
E
S
0
2,000
4,000
Feet


A-6


**Shoreline Rates of Change**

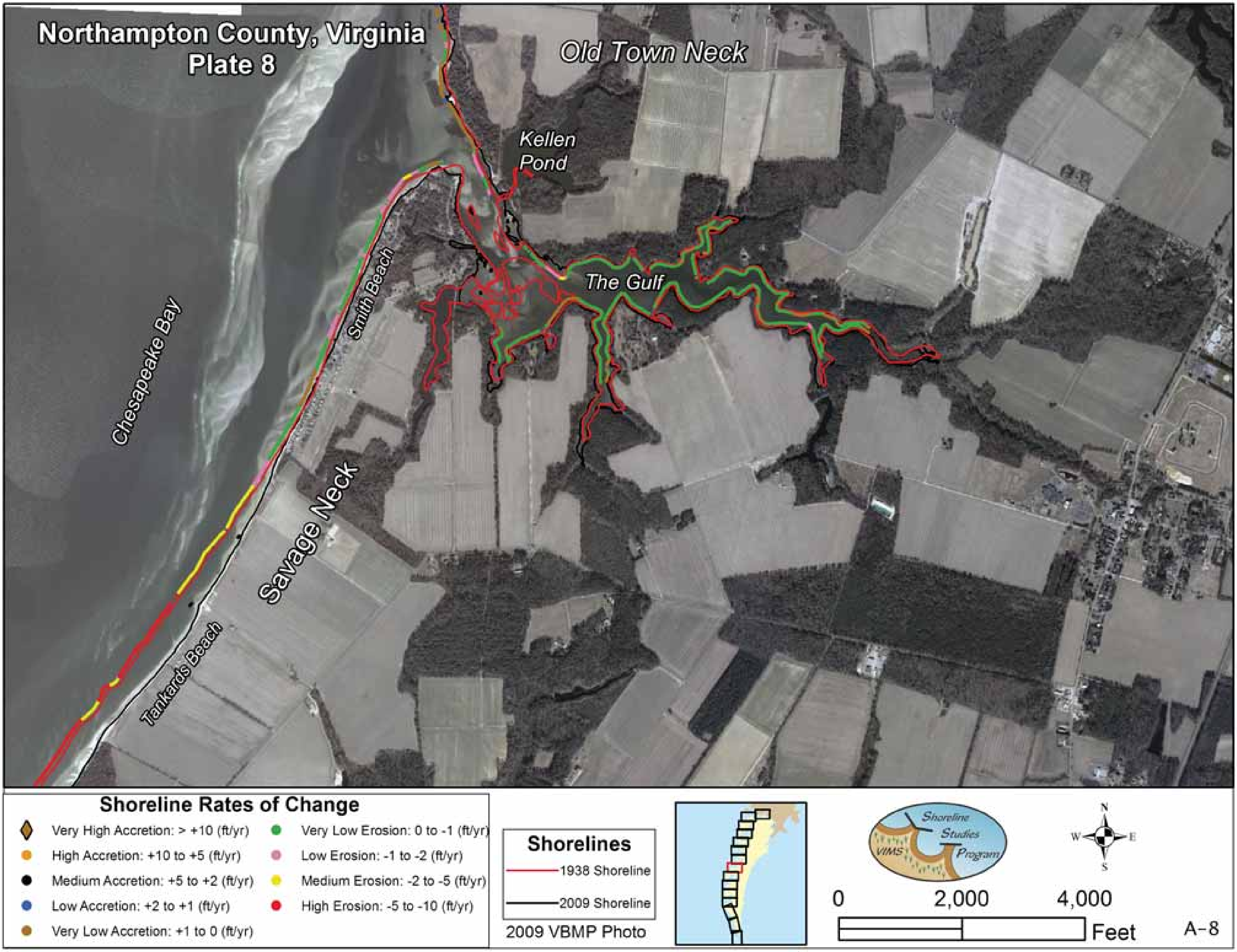
- Very High Accretion: > +10 (ft/yr)
- High Accretion: +10 to +5 (ft/yr)
- Medium Accretion: +5 to +2 (ft/yr)
- Low Accretion: +2 to +1 (ft/yr)
- Very Low Accretion: +1 to 0 (ft/yr)
- Very Low Erosion: 0 to -1 (ft/yr)
- Low Erosion: -1 to -2 (ft/yr)
- Medium Erosion: -2 to -5 (ft/yr)
- High Erosion: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

**Shorelines**

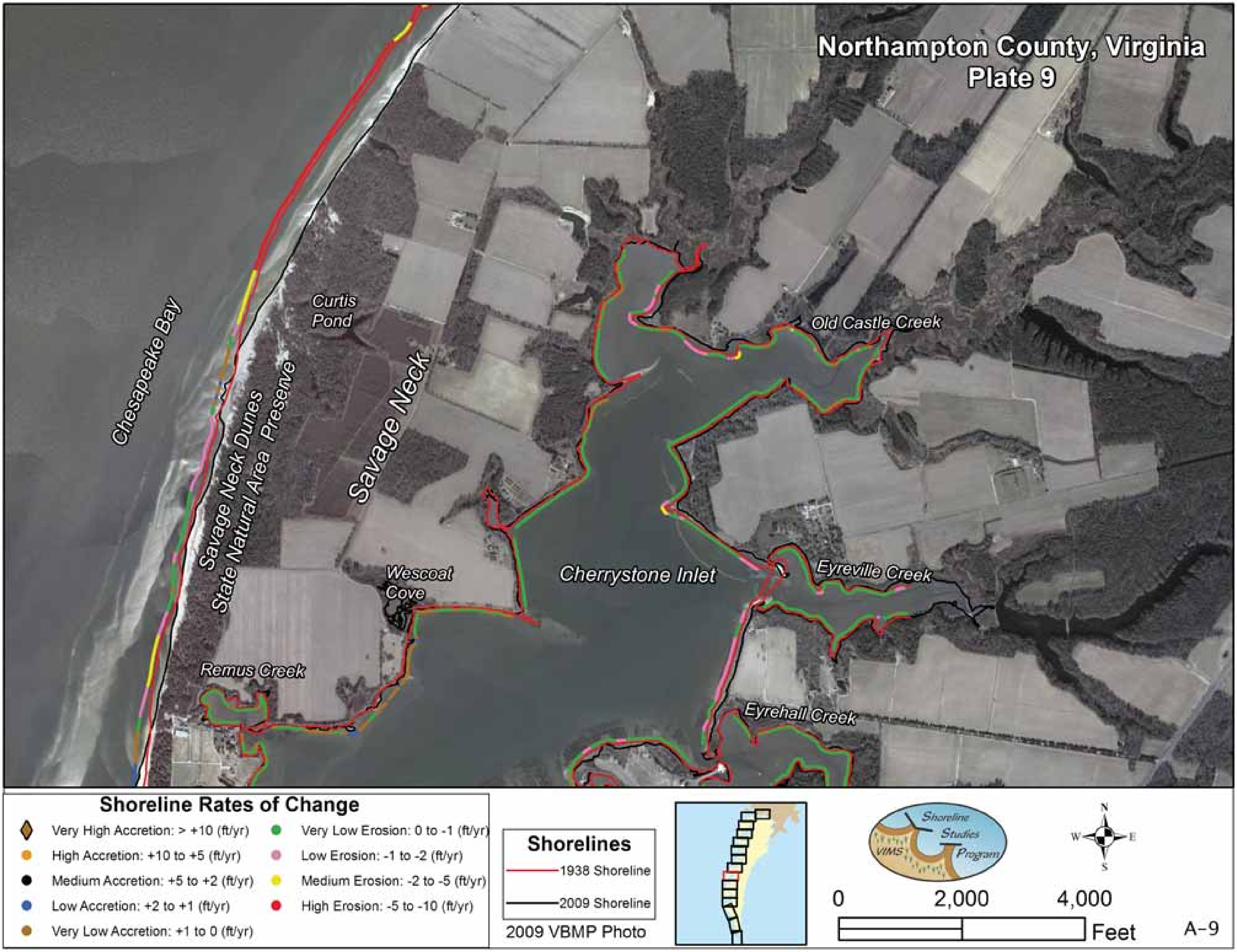
- 1938 Shoreline
- 2009 Shoreline

2009 VBMP Photo

0 2,000 4,000 Feet



Northampton County, Virginia
Plate 8
Old Town Neck
Kellen Pond
The Gulf
Smith Beach
Chesapeake Bay
Savage Neck
Tankards Beach
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
S
W
E
0
2,000
4,000
Feet
A-8


Northampton County, Virginia
Plate 9
Chesapeake Bay
Curtis Pond
Savage Neck Dunes State Natural Area Preserve
Savage Neck
Old Castle Creek
Cherrystone Inlet
Wescoat Cove
Eyreville Creek
Remus Creek
Eyrehall Creek
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
W
E
S
0
2,000
4,000
Feet
A-9


**Shoreline Rates of Change**

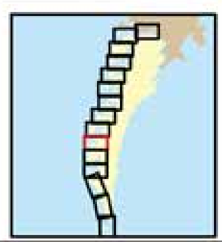
- Very High Accretion: > +10 (ft/yr)
- High Accretion: +10 to +5 (ft/yr)
- Medium Accretion: +5 to +2 (ft/yr)
- Low Accretion: +2 to +1 (ft/yr)
- Very Low Accretion: +1 to 0 (ft/yr)
- Very Low Erosion: 0 to -1 (ft/yr)
- Low Erosion: -1 to -2 (ft/yr)
- Medium Erosion: -2 to -5 (ft/yr)
- High Erosion: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

**Shorelines**

1938 Shoreline

2009 Shoreline

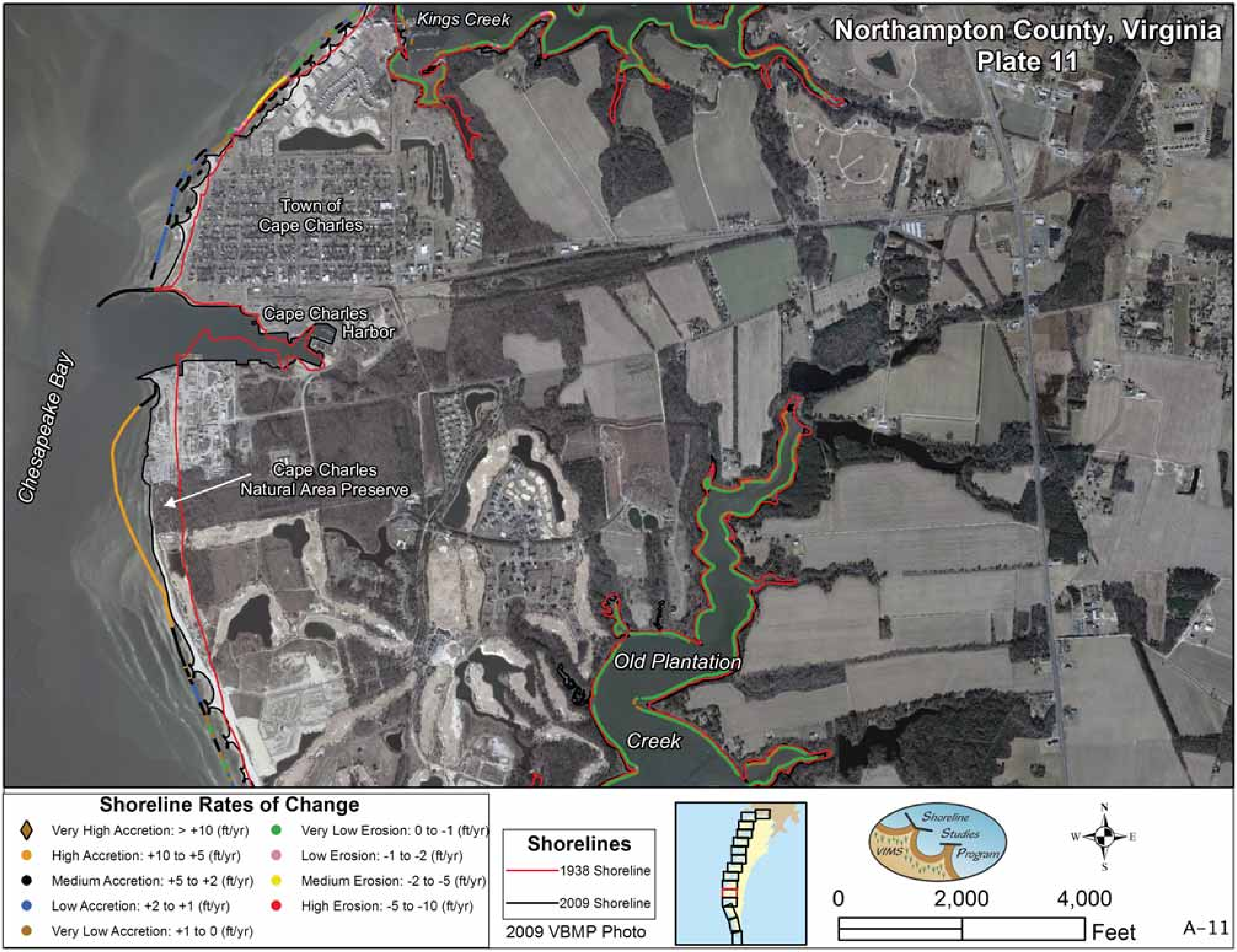
2009 VBMP Photo

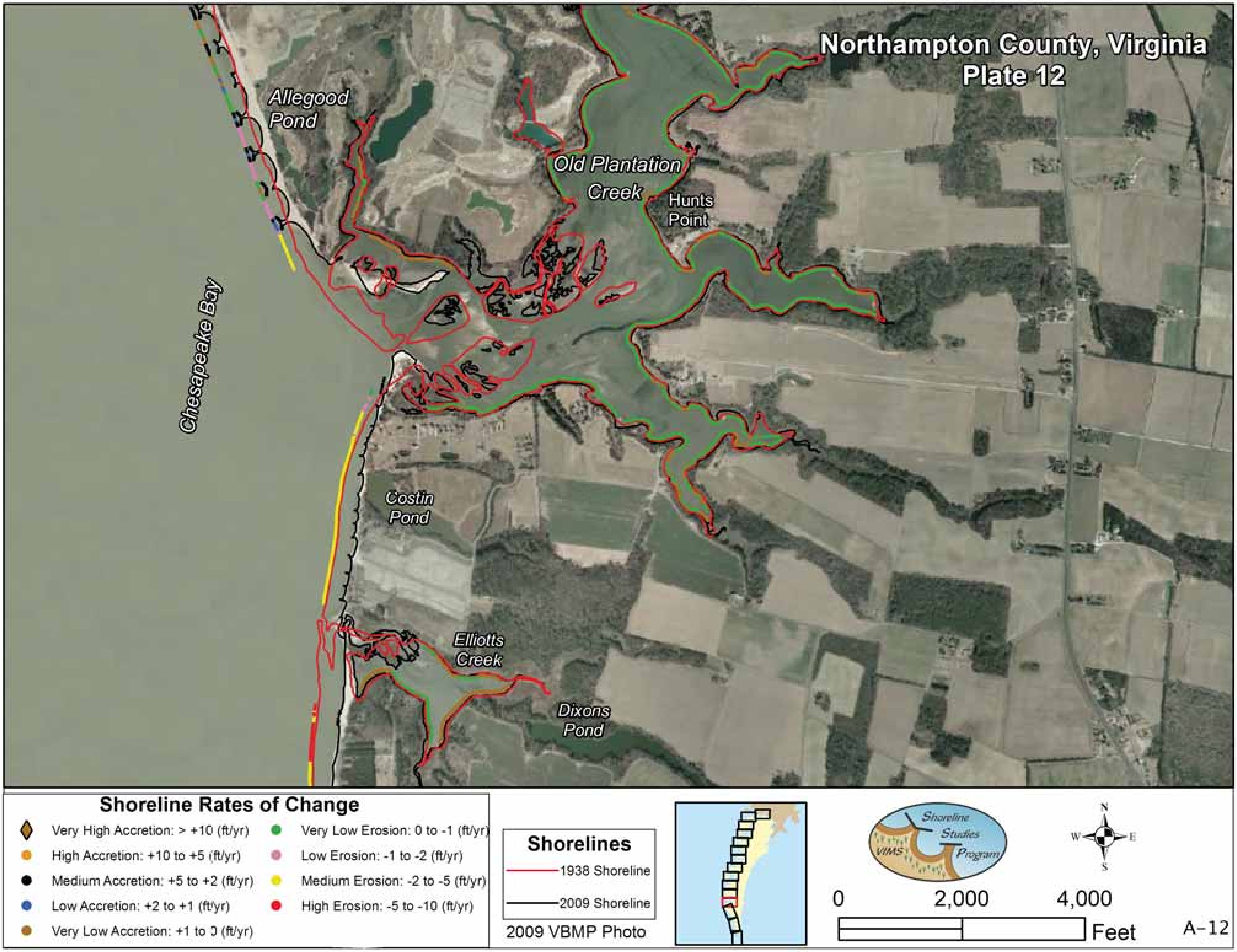


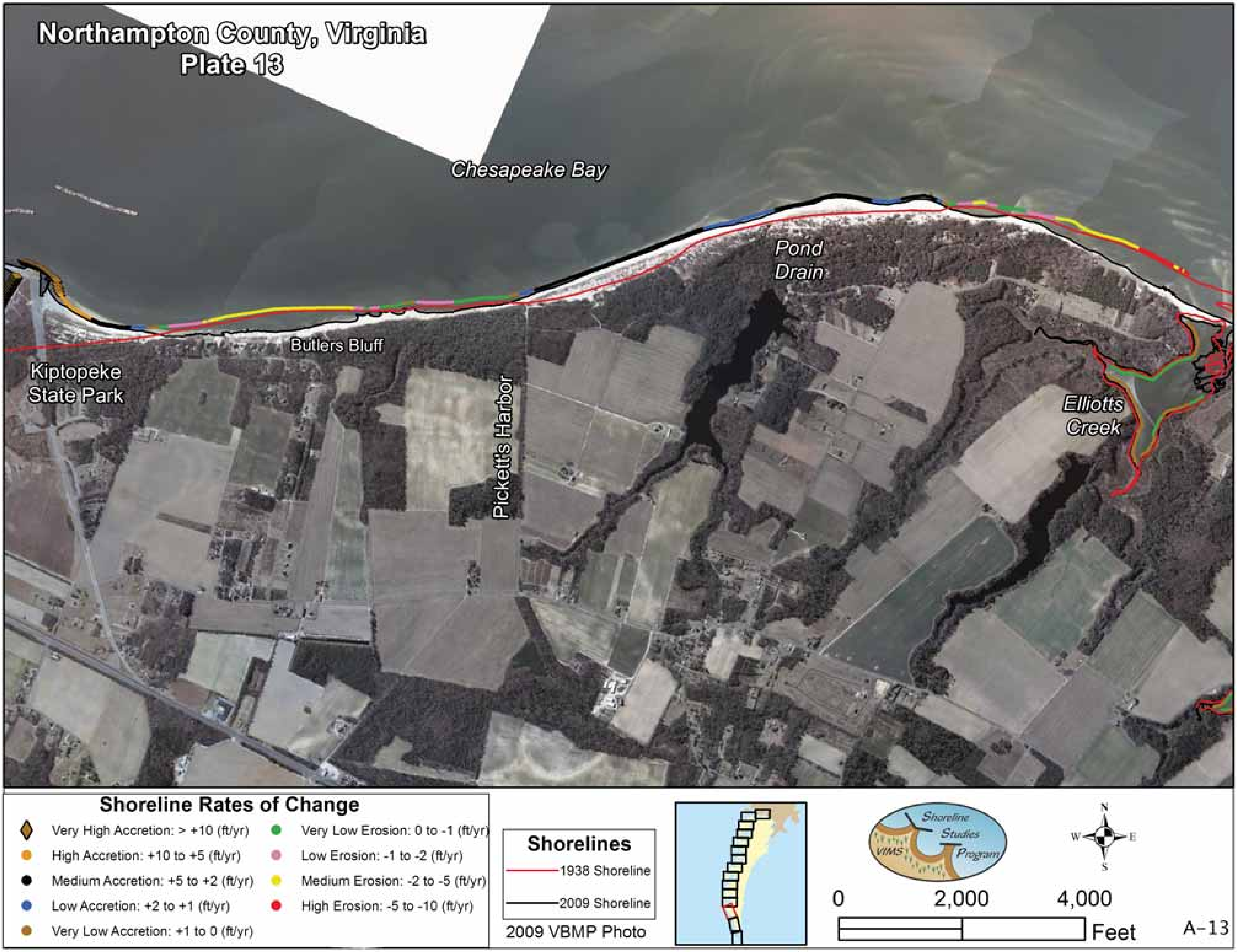
Shoreline Studies Program VIMS

N W E S

0 2,000 4,000 Feet


Northampton County, Virginia
Plate 11
Kings Creek
Town of Cape Charles
Cape Charles Harbor
Chesapeake Bay
Cape Charles Natural Area Preserve
Old Plantation
Creek
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
W
E
S
0
2,000
4,000
Feet


Northampton County, Virginia
Plate 12
Allegood Pond
Old Plantation Creek
Hunts Point
Chesapeake Bay
Costin Pond
Elliotts Creek
Dixons Pond
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
W
E
S
0
2,000
4,000
Feet



Northampton County, Virginia
Plate 13
Chesapeake Bay
Pond Drain
Butlers Bluff
Kiptopeke State Park
Pickett's Harbor
Elliotts Creek
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
S
E
W
0
2,000
4,000
Feet

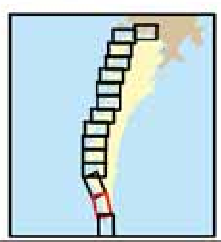

**Shoreline Rates of Change**

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

**Shorelines**

- 1938 Shoreline
- 2009 Shoreline

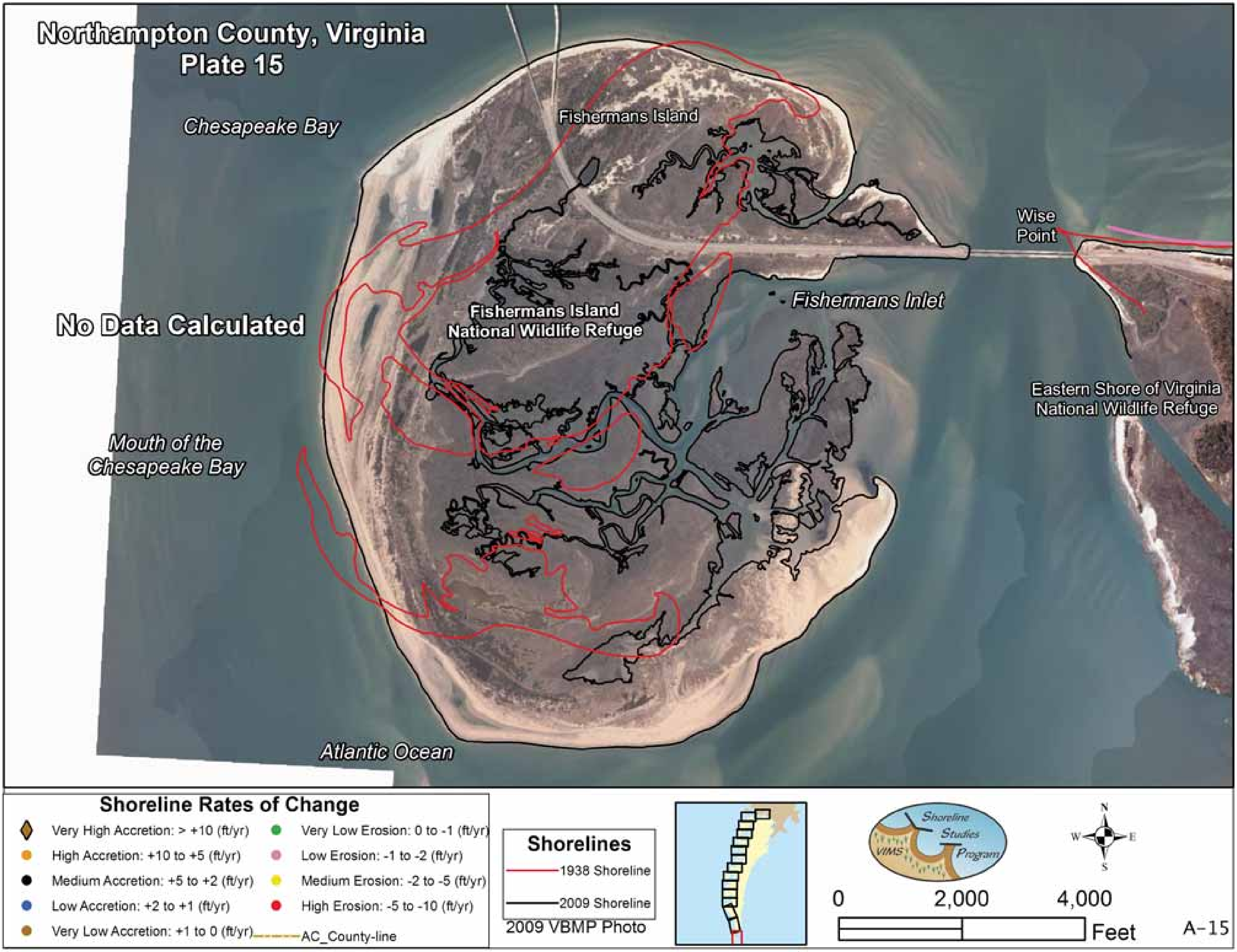
2009 VBMP Photo



Shoreline Studies Program
VIMS

N S W E

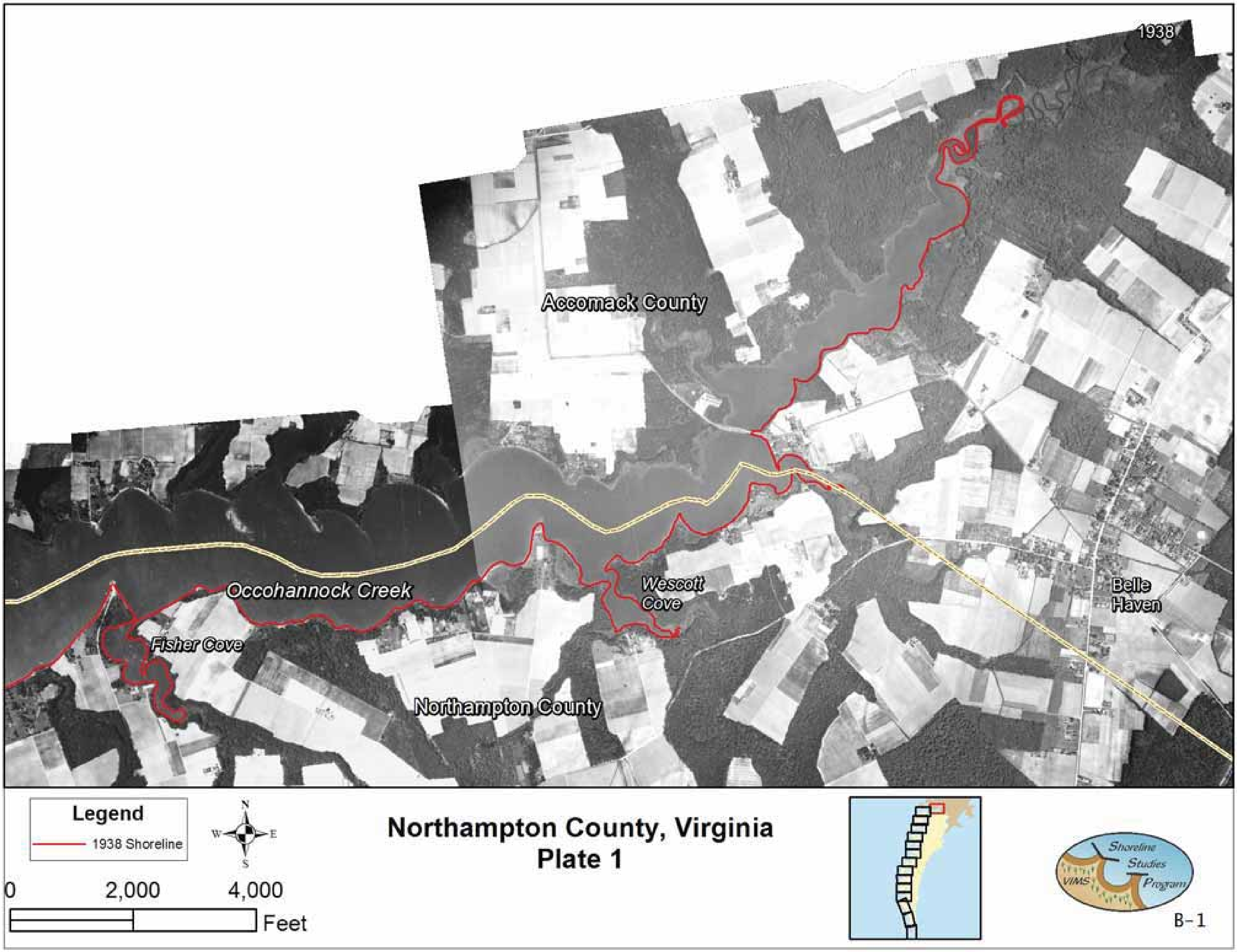
0 2,000 4,000
Feet


Northampton County, Virginia
Plate 15
Chesapeake Bay
Fishermans Island
No Data Calculated
Fishermans Island
National Wildlife Refuge
Fishermans Inlet
Wise
Point
Eastern Shore of Virginia
National Wildlife Refuge
Mouth of the
Chesapeake Bay
Atlantic Ocean
Shoreline Rates of Change
Very High Accretion: > +10 (ft/yr)
High Accretion: +10 to +5 (ft/yr)
Medium Accretion: +5 to +2 (ft/yr)
Low Accretion: +2 to +1 (ft/yr)
Very Low Accretion: +1 to 0 (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)
AC_County-line
Shorelines
1938 Shoreline
2009 Shoreline
2009 VBMP Photo
Shoreline Studies Program
VIMS
N
W
E
S
0
2,000
4,000
Feet

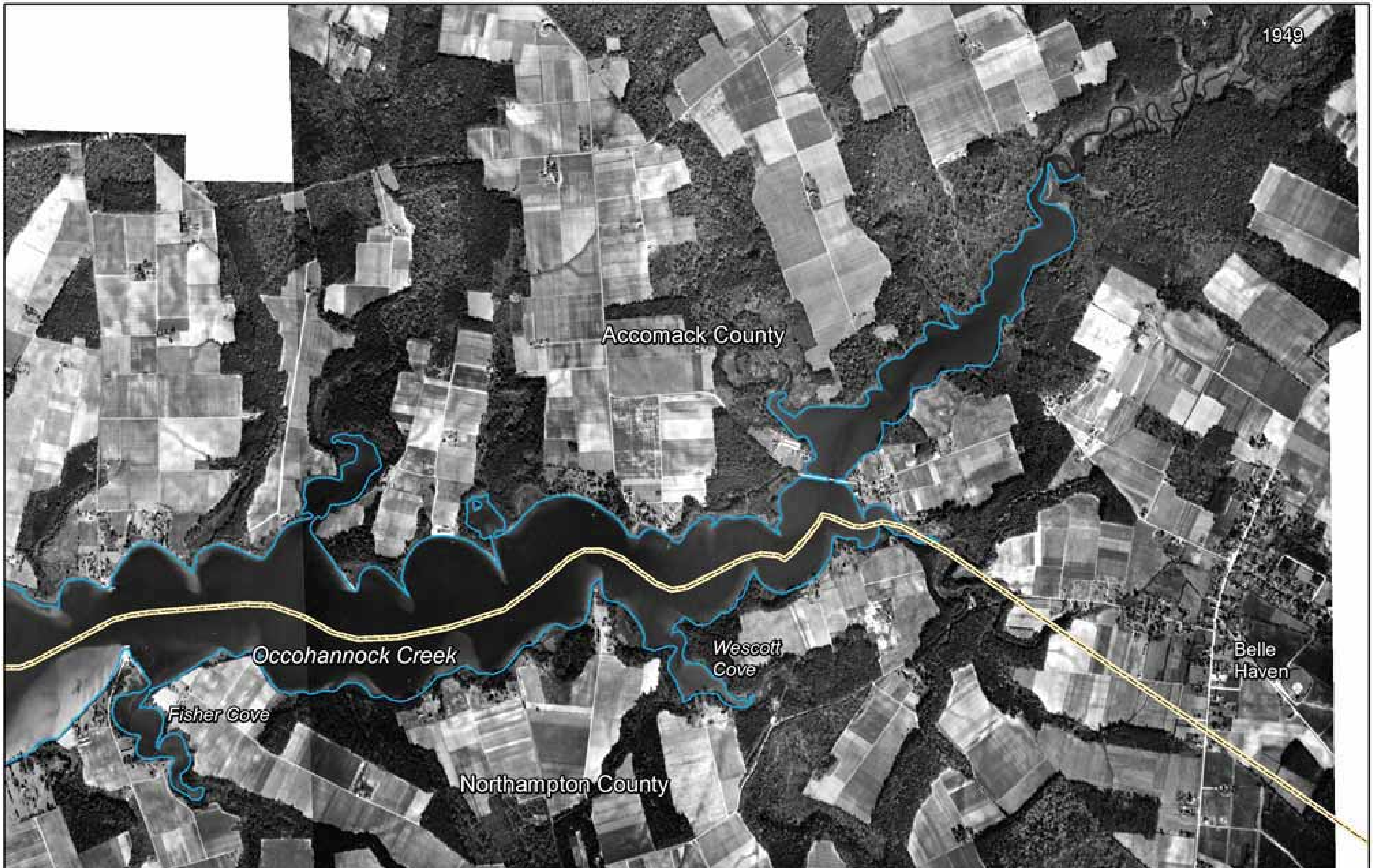
# Appendix B

# Historical Photo and Digitized Shoreline Maps

Note: The location labels on the plates come from U.S. Geological Survey topographic maps, Google Earth, and other map sources and may not be accurate for the historical or even more recent images. They are for reference only.




**Northampton County, Virginia**
**Plate 1**



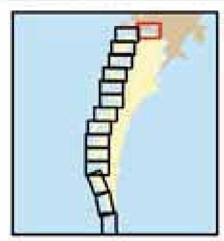

**Legend**

1949 Shoreline

N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
# Plate 1



Shoreline Studies Program
VIMS

B-2


# Northampton County, Virginia
## Plate 1

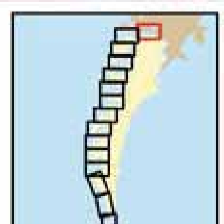

**Legend**

1994 Shoreline

N
W E
S

0 2,000 4,000
Feet

## Northampton County, Virginia
## Plate 1



Shoreline Studies Program
VIMS

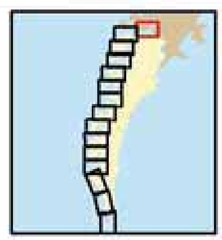

**Legend**

2002 Shoreline

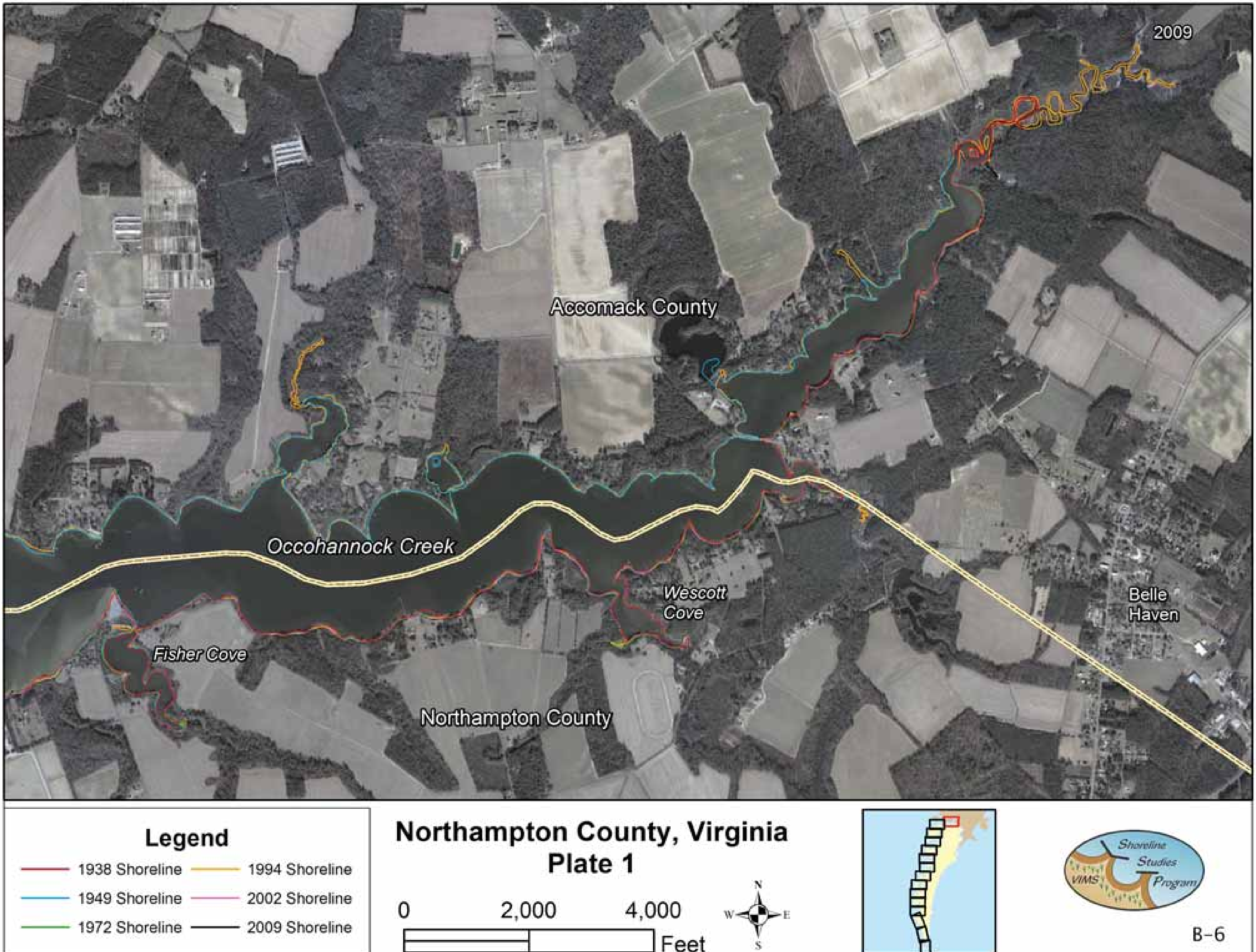
N W E S

0 2,000 4,000 Feet

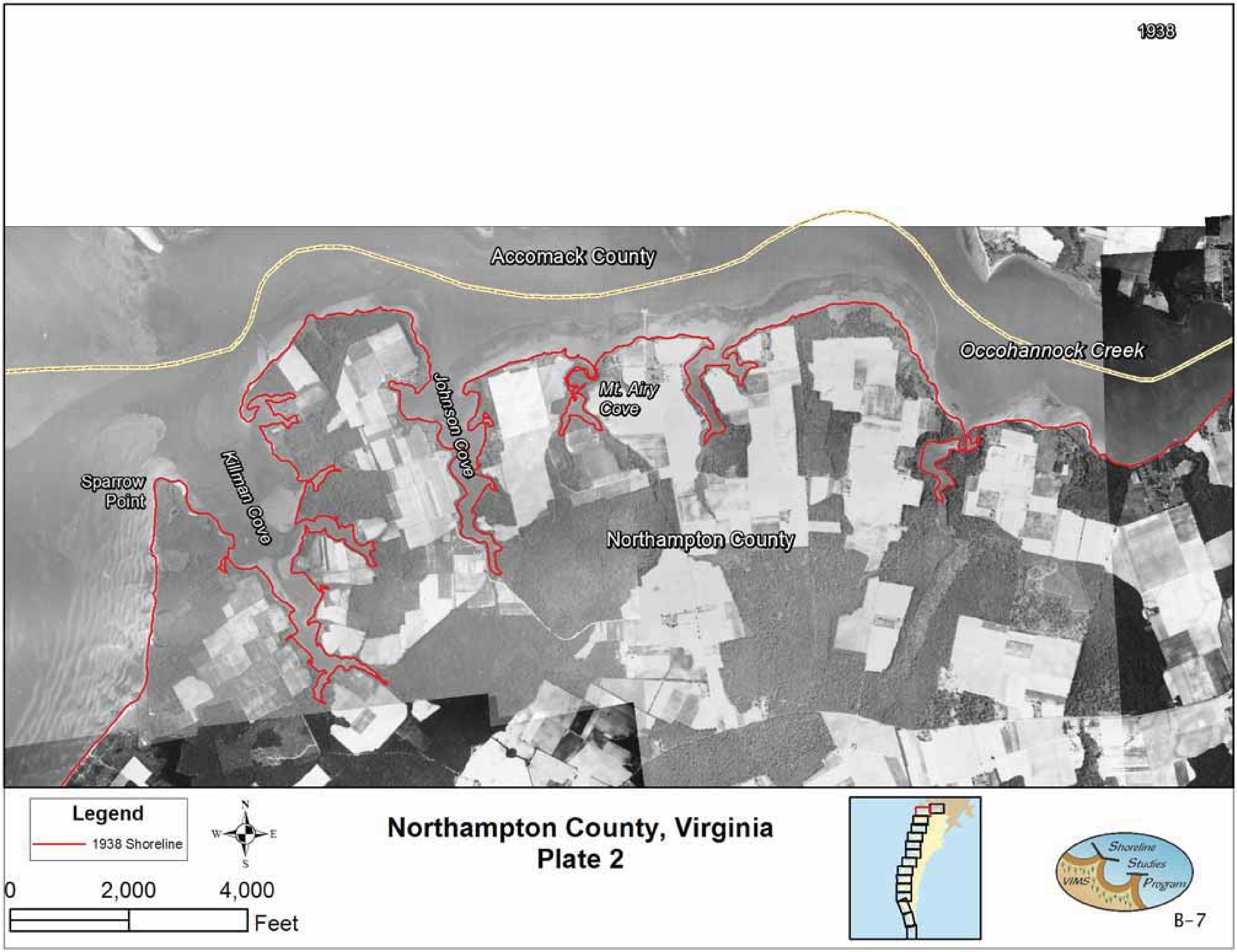
# Northampton County, Virginia
## Plate 1



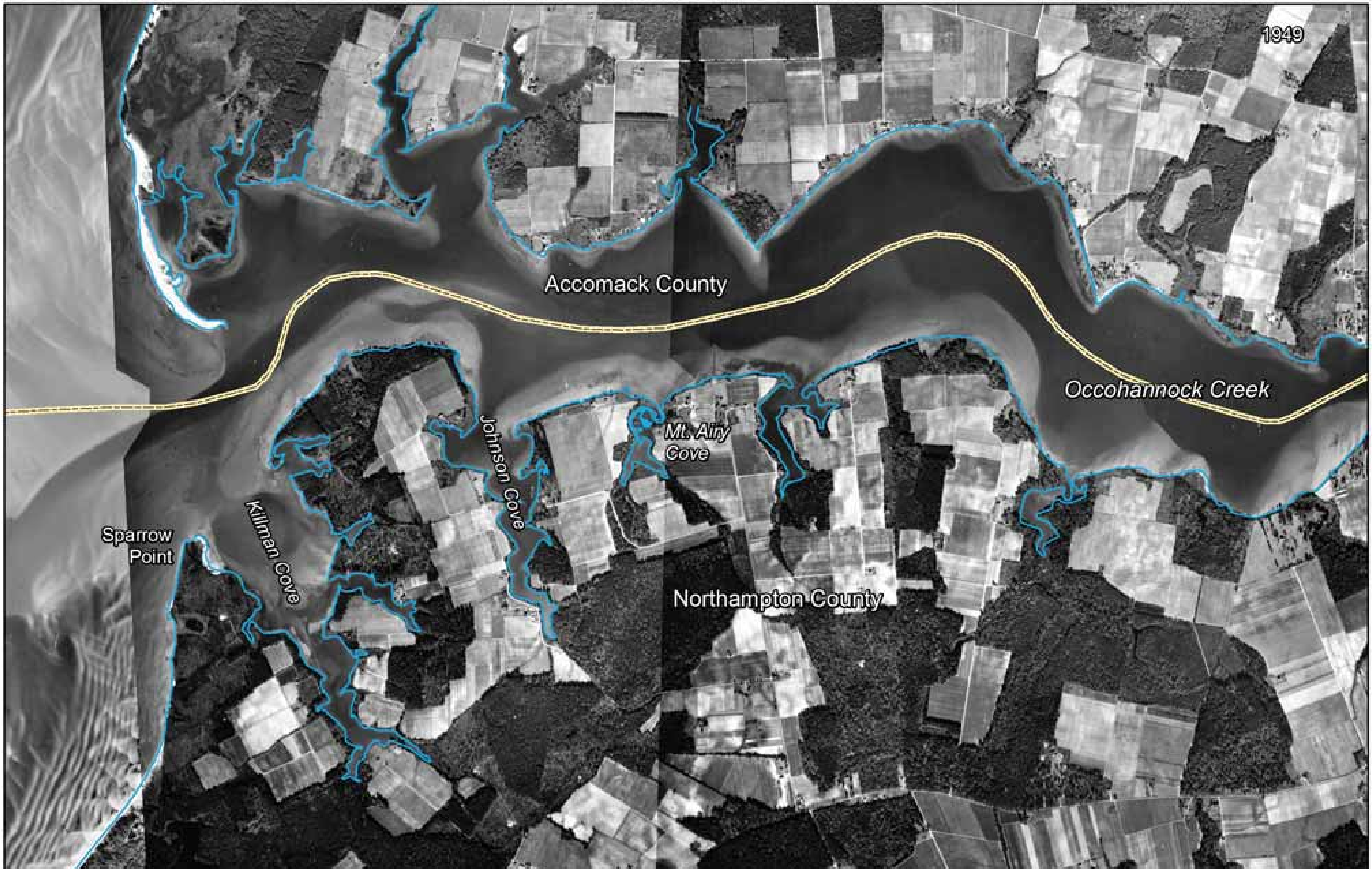
Shoreline Studies Program VIMS




# Northampton County, Virginia
## Plate 1




# Northampton County, Virginia
# Plate 2



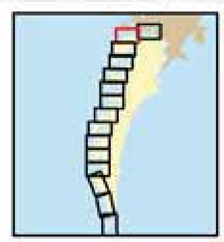

Legend

1949 Shoreline

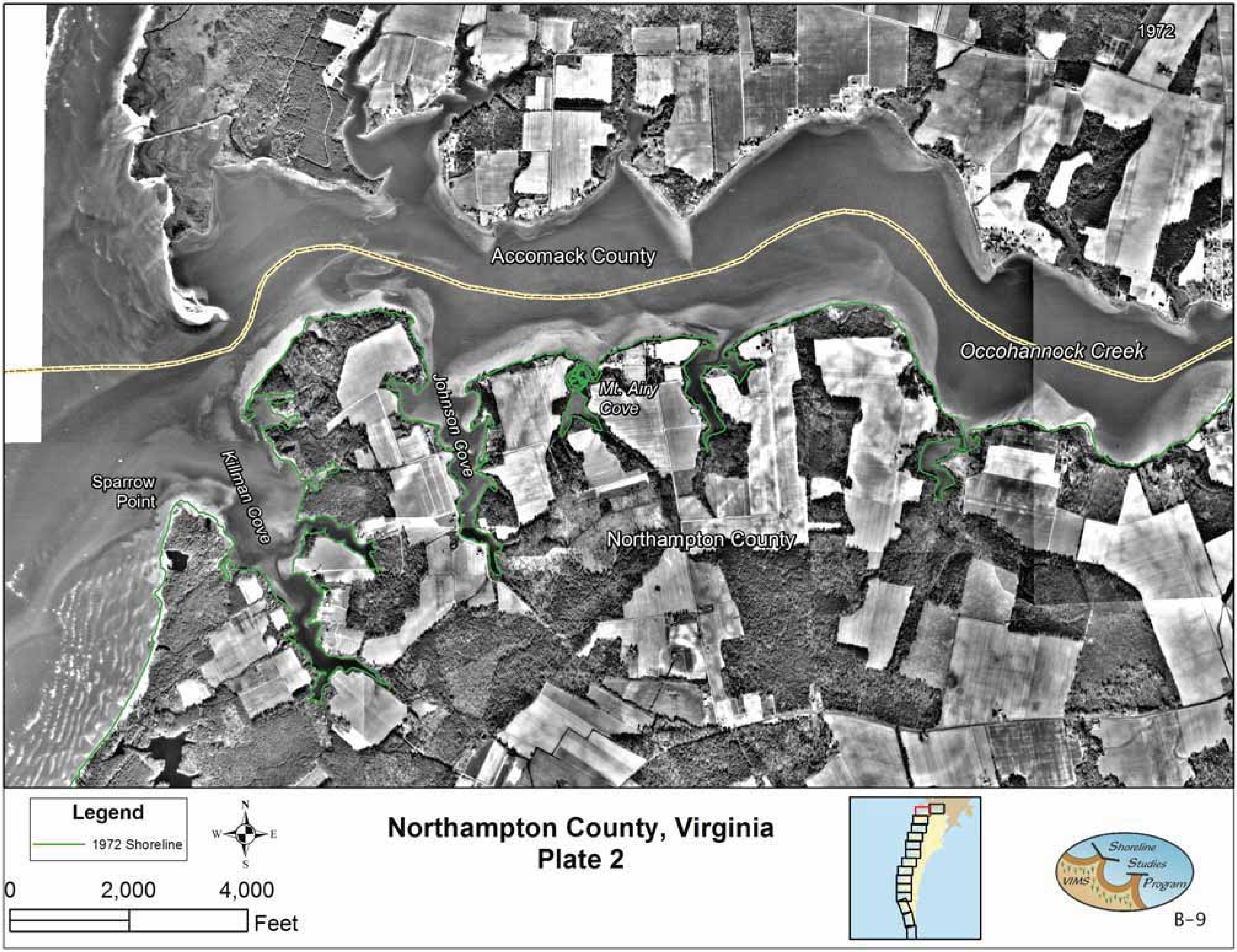
N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
# Plate 2



Shoreline Studies Program
VIMS




# Northampton County, Virginia
# Plate 2

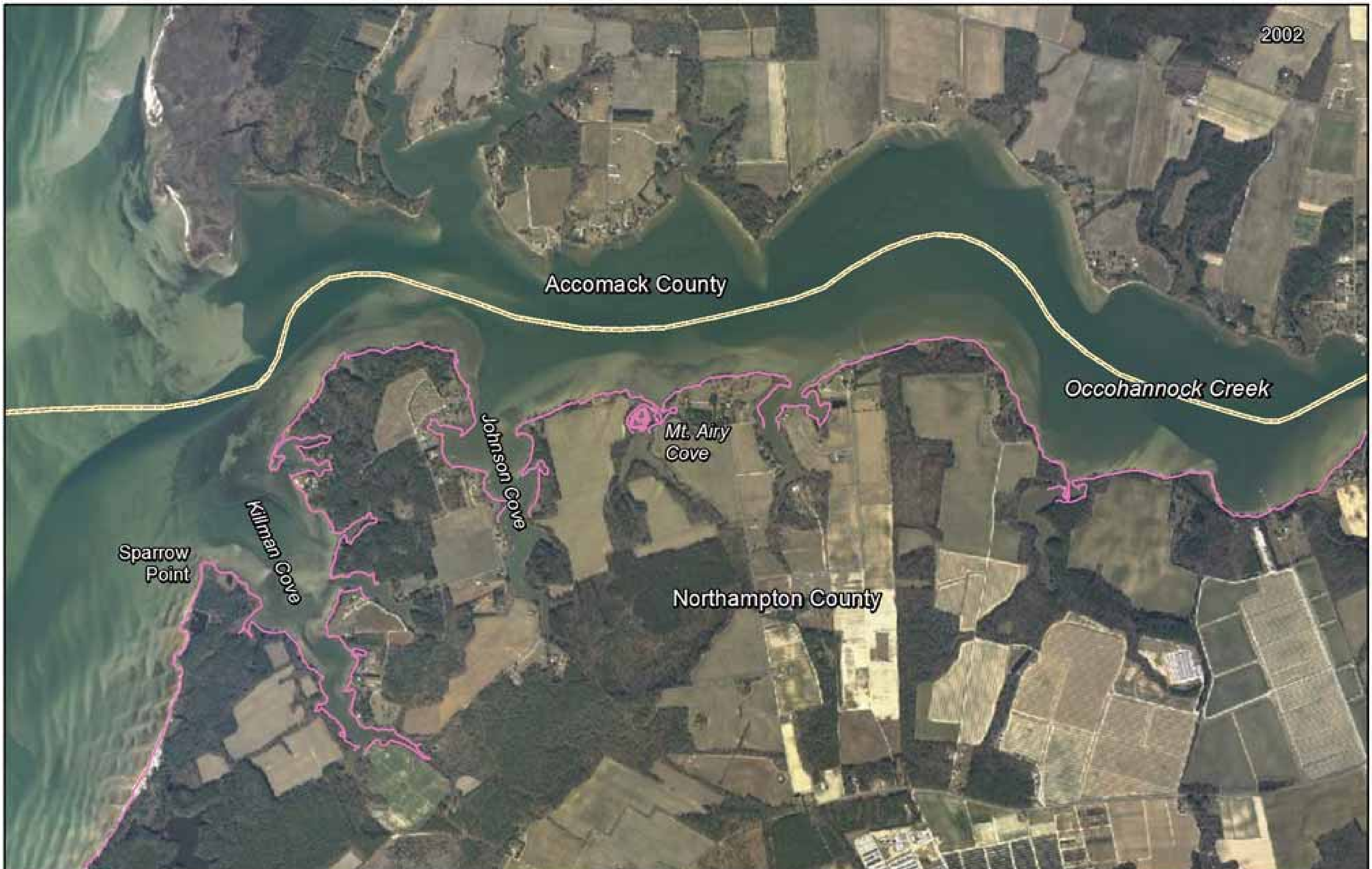

Legend

1994 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 2

Shoreline Studies Program VIMS




Legend

2002 Shoreline

N W E S

0 2,000 4,000 Feet

**Northampton County, Virginia**
**Plate 2**

Shoreline Studies Program VIMS

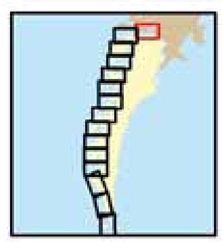

**Legend**

- 1938 Shoreline
- 1949 Shoreline
- 1972 Shoreline
- 1994 Shoreline
- 2002 Shoreline
- 2009 Shoreline

# Northampton County, Virginia
## Plate 2

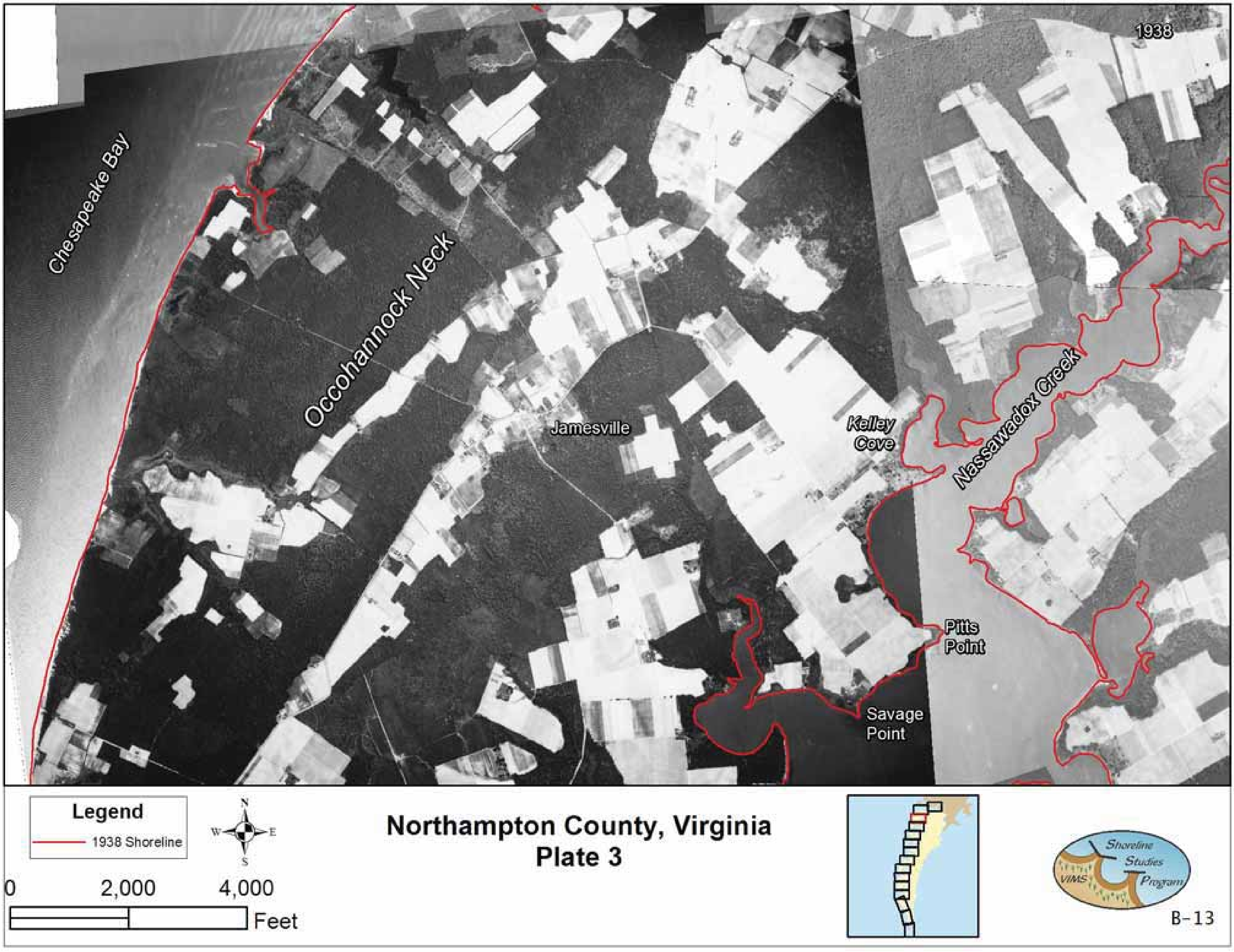
0 2,000 4,000 Feet

N W E S

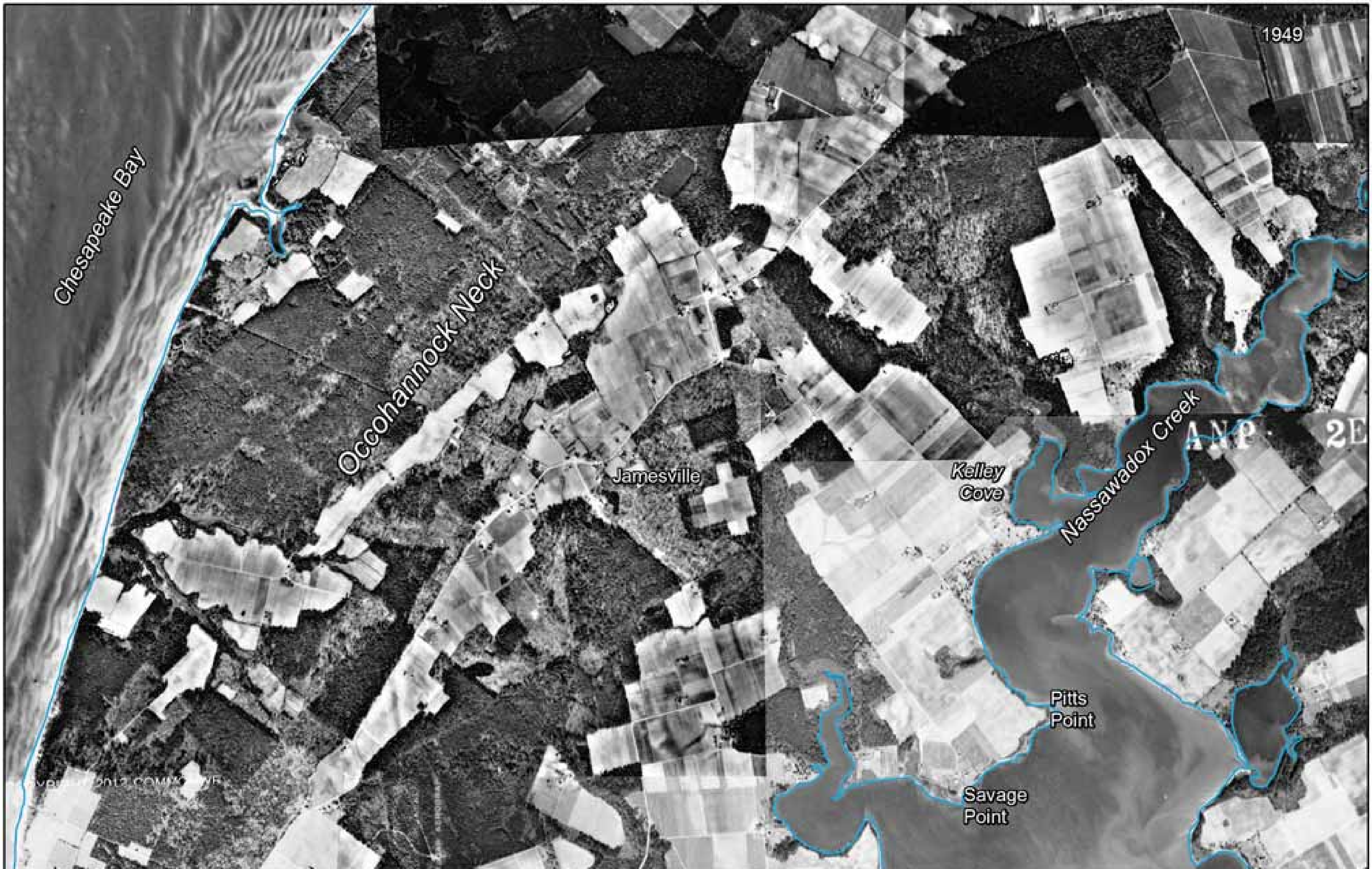


Shoreline Studies Program VIMS

B-12




## Northampton County, Virginia
## Plate 3




Legend

1949 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 3

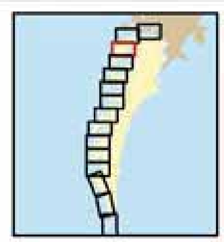

**Legend**

1972 Shoreline

N W E S

0 2,000 4,000 Feet

**Northampton County, Virginia**
**Plate 3**



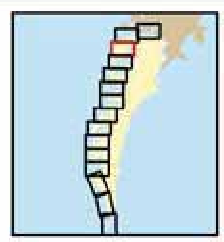
VIMS Shoreline Studies Program


Legend

1994 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 3




Legend

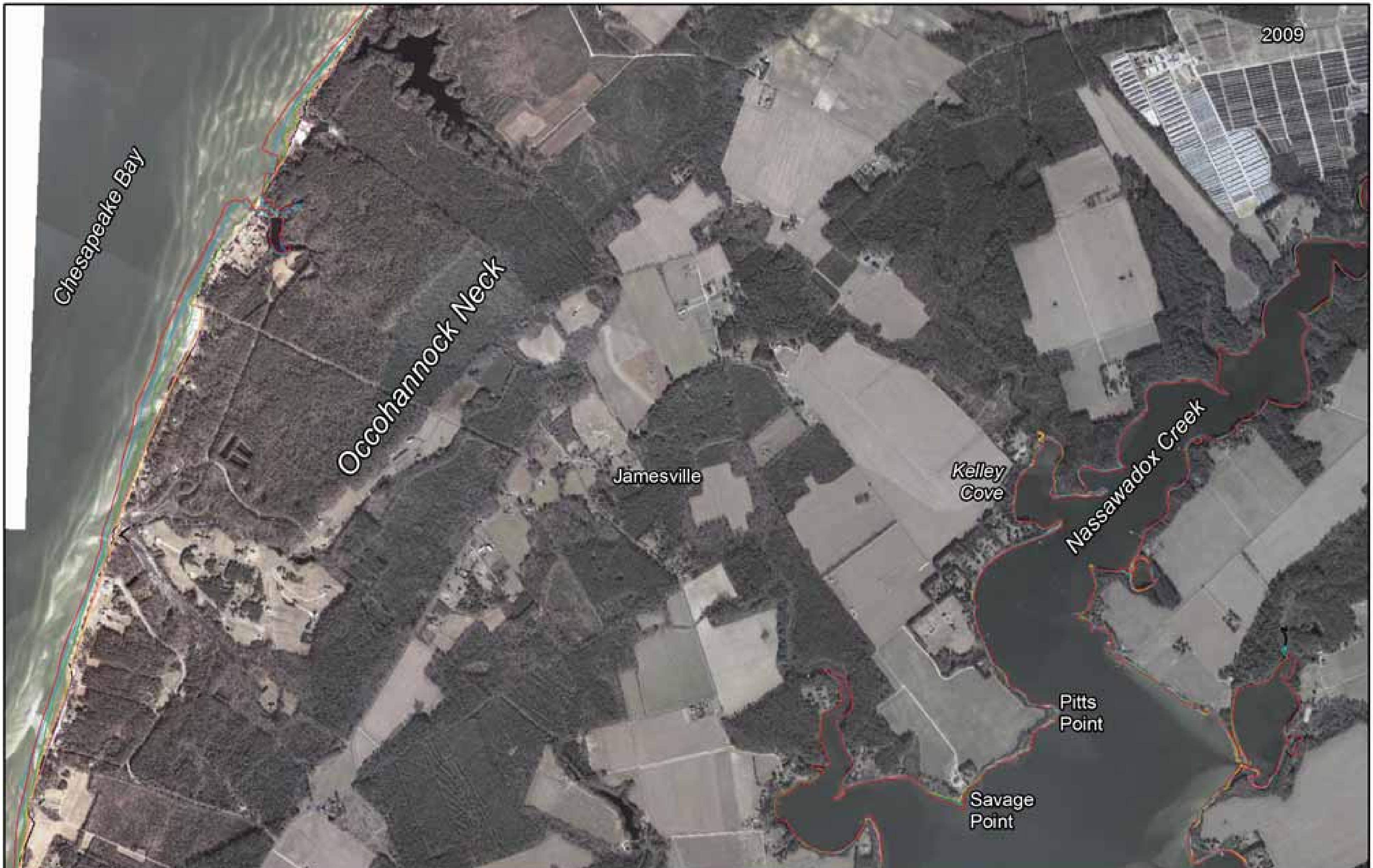
2002 Shoreline

N
W E
S

0 2,000 4,000

Feet

**Northampton County, Virginia**
**Plate 3**



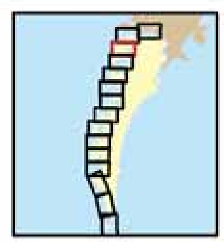

**Legend**

| | |
|---|---|
| 1938 Shoreline | 1994 Shoreline |
| 1949 Shoreline | 2002 Shoreline |
| 1972 Shoreline | 2009 Shoreline |

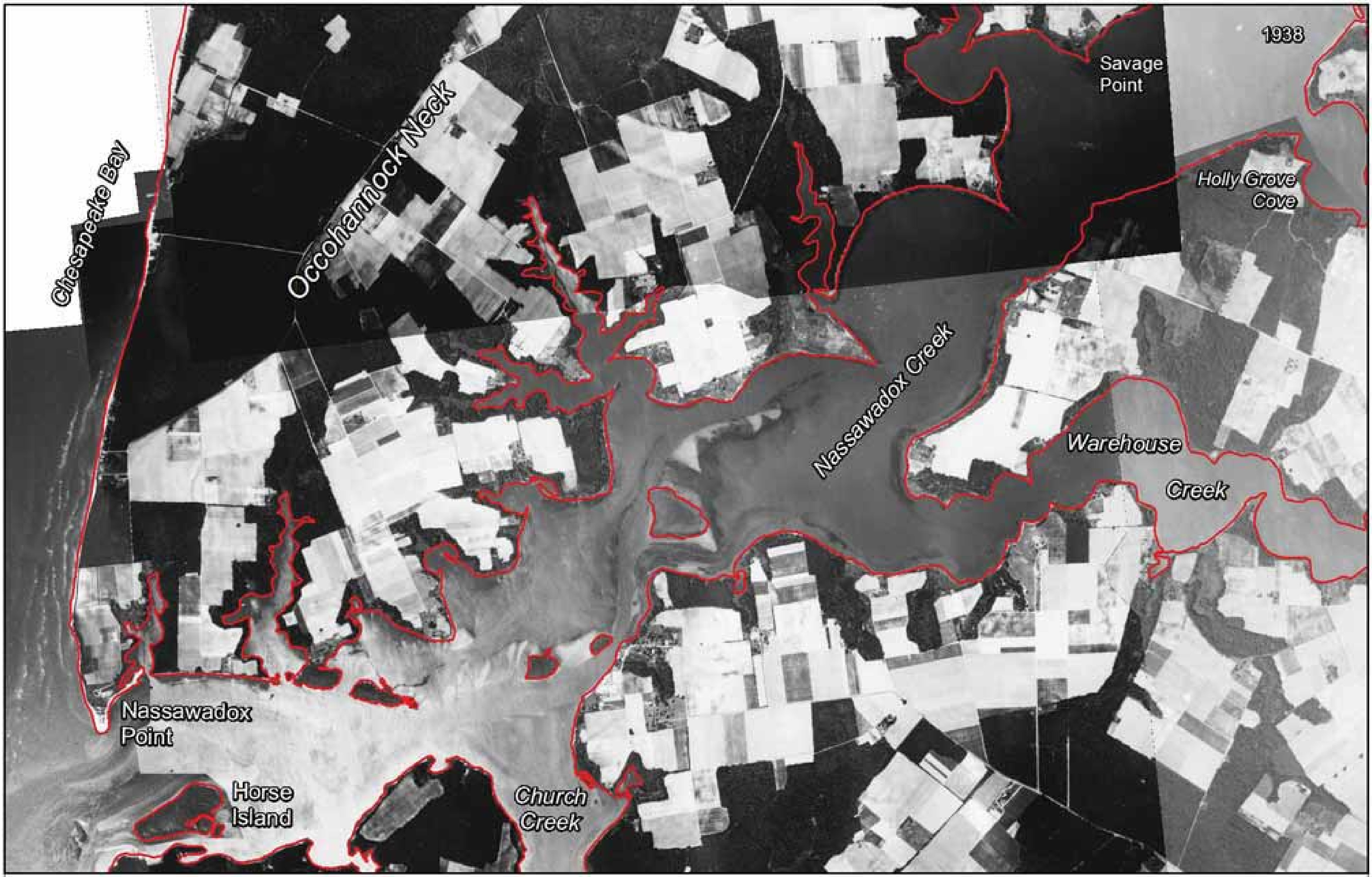
# Northampton County, Virginia
## Plate 3

0 2,000 4,000 Feet

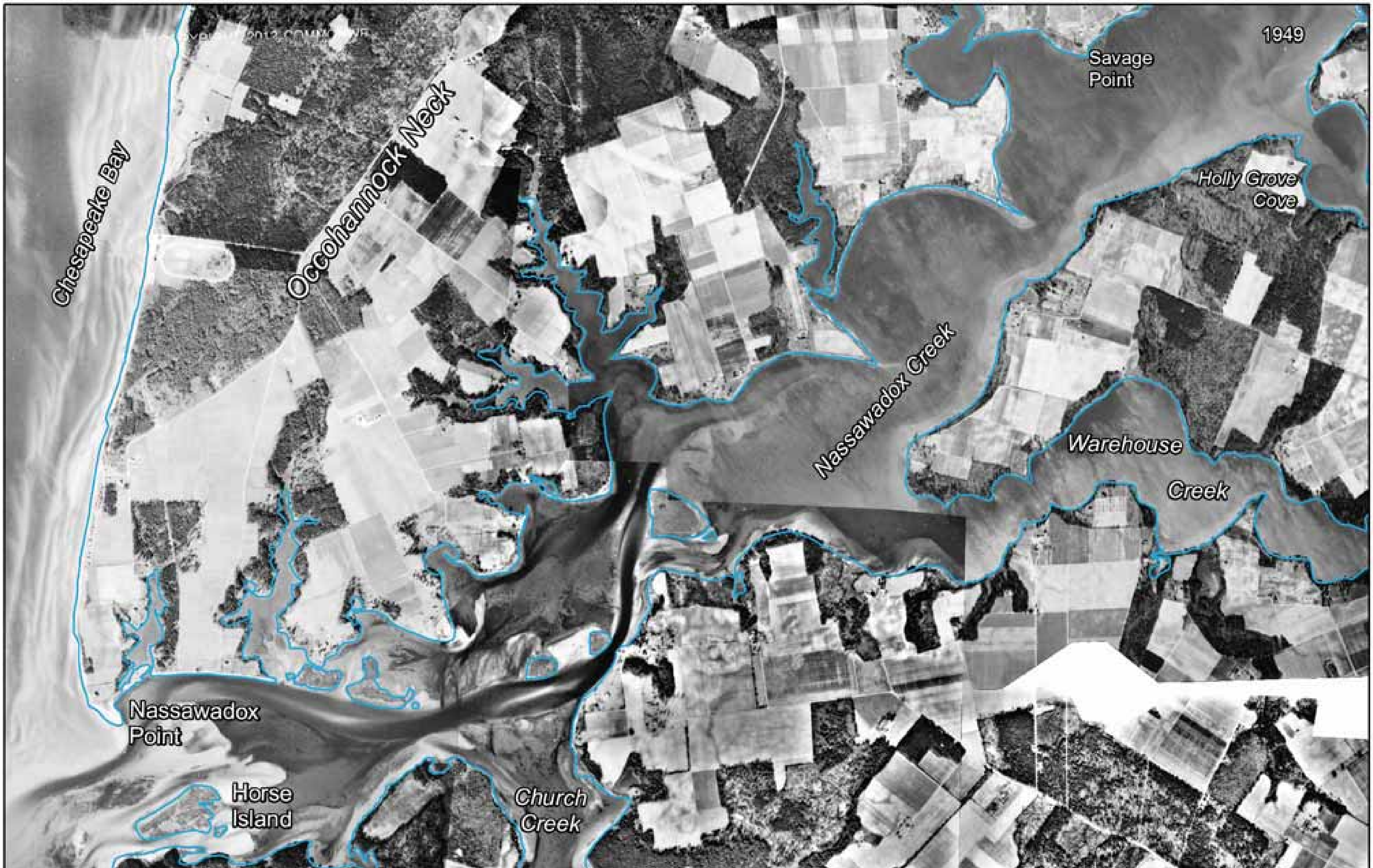
N W E S



Shoreline Studies Program VIMS




**Northampton County, Virginia**
**Plate 4**



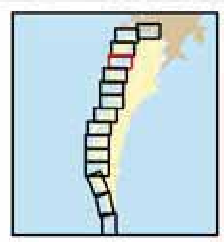

Legend

1949 Shoreline

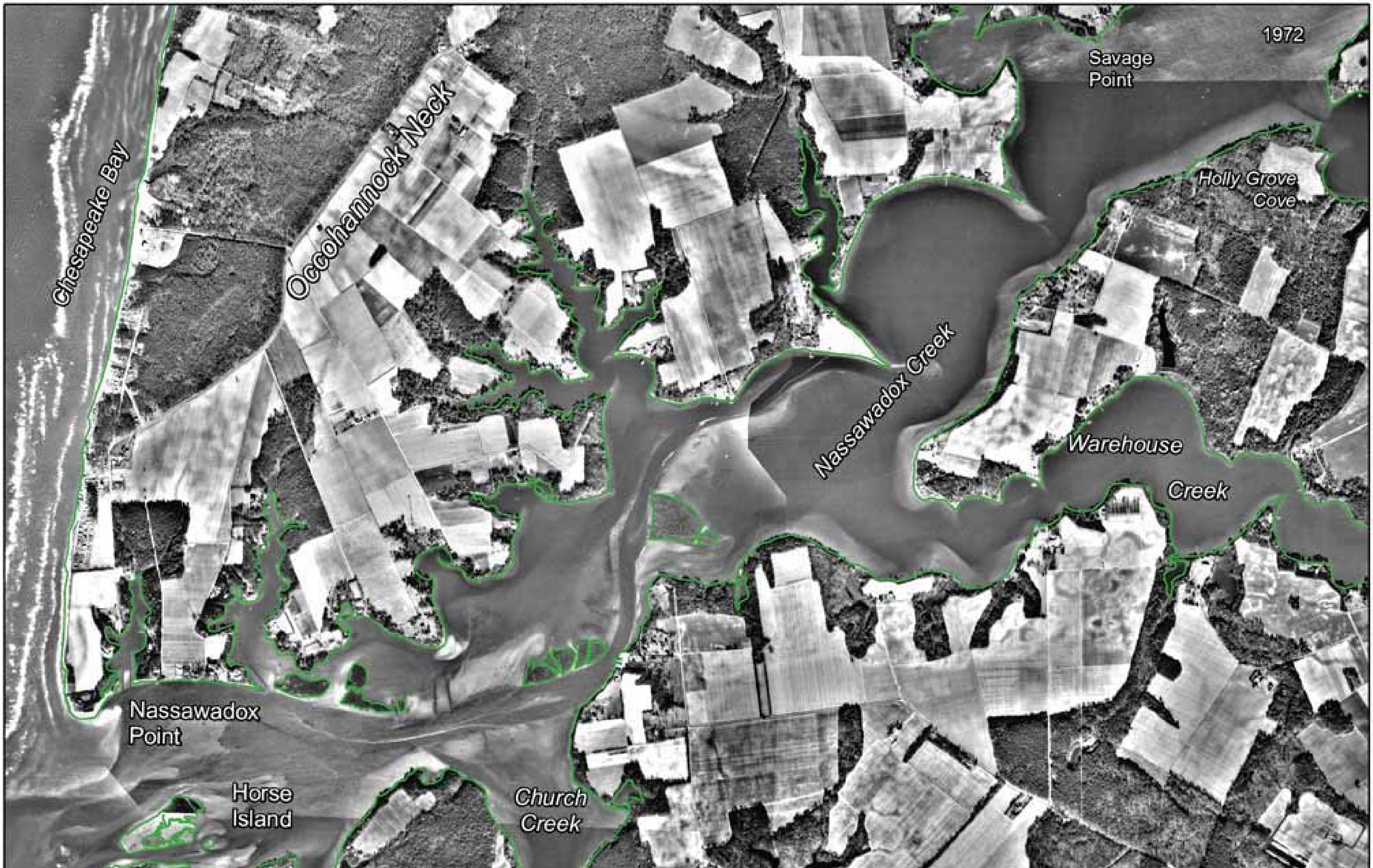
N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
## Plate 4



Shoreline Studies Program
VIMS



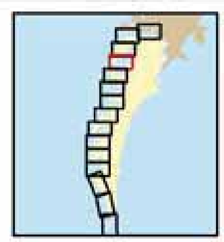

**Legend**

1972 Shoreline

N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
## Plate 4



Shoreline Studies Program
VIMS


Legend

1994 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 4

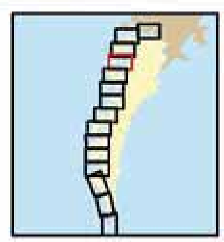

**Legend**

2002 Shoreline

N W E S

0 2,000 4,000 Feet

## Northampton County, Virginia
## Plate 4



Shoreline Studies Program VIMS

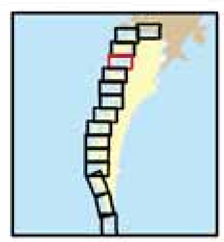

## Legend

- 1938 Shoreline
- 1949 Shoreline
- 1972 Shoreline
- 1994 Shoreline
- 2002 Shoreline
- 2009 Shoreline

# Northampton County, Virginia
# Plate 4

0 2,000 4,000 Feet

N W E S



Shoreline Studies Program VIMS

B-24


Legend

1938 Shoreline

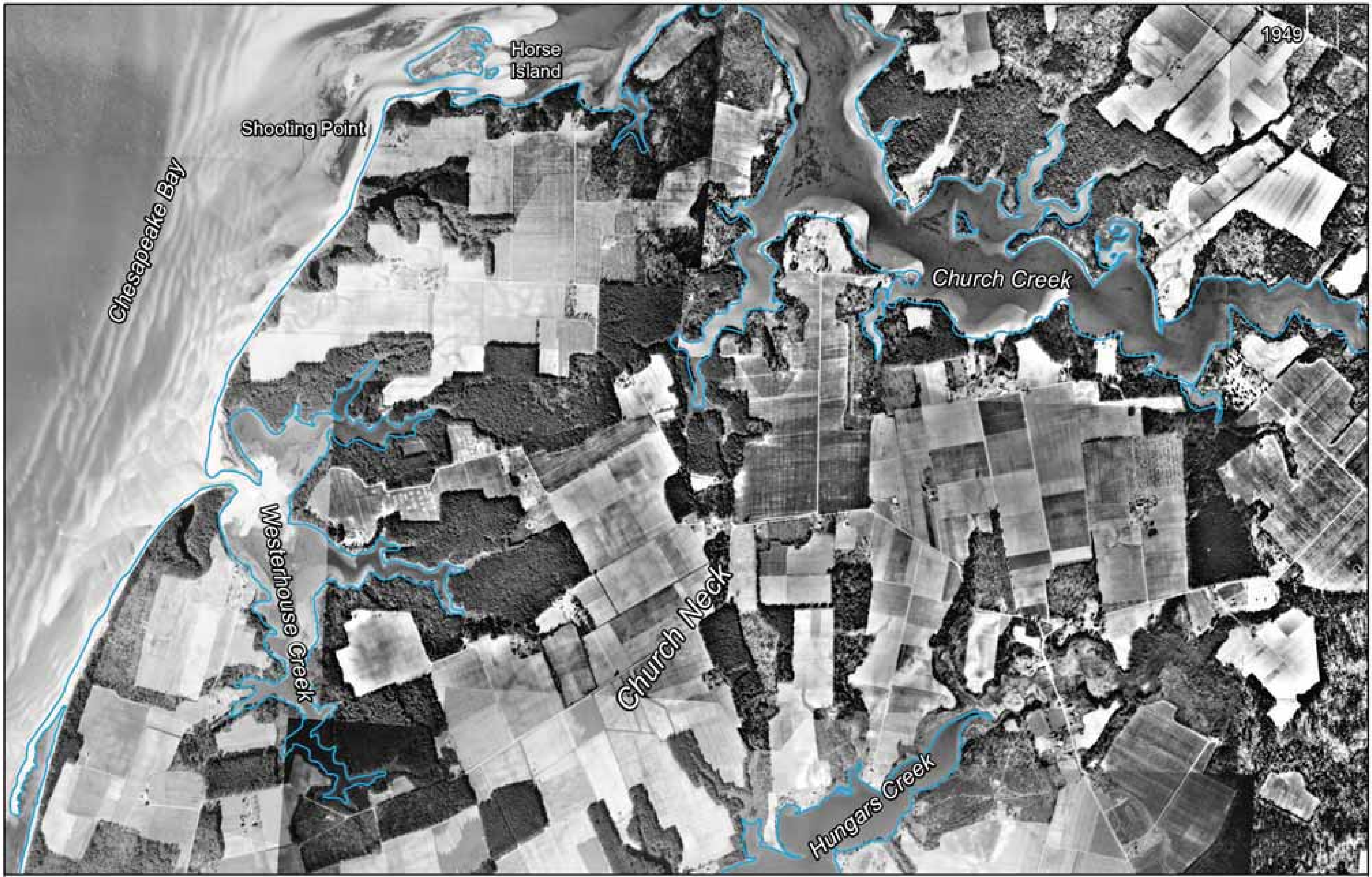
N
W E
S

0 2,000 4,000

Feet

## Northampton County, Virginia
## Plate 5

Shoreline Studies Program
VIMS




Legend

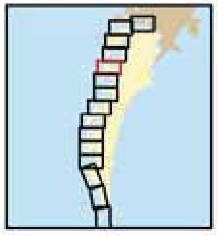
1949 Shoreline

N
W E
S

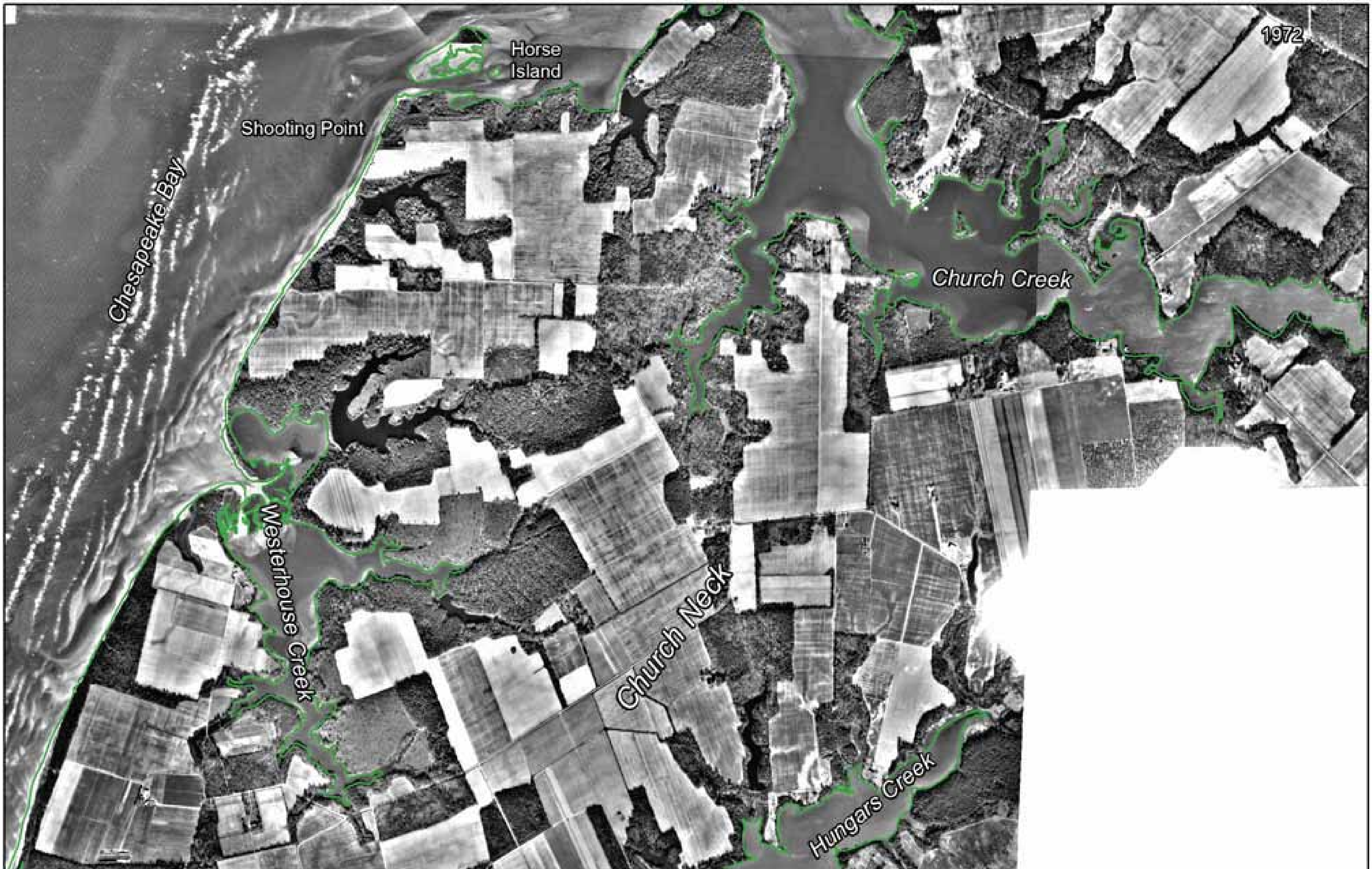
0 2,000 4,000

Feet

# Northampton County, Virginia
## Plate 5



Shoreline Studies Program
VIMS




Legend

1972 Shoreline

N W E S

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 5

Shoreline Studies Program VIMS


Legend

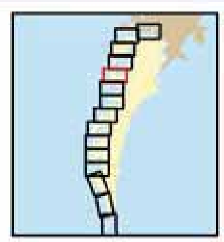
1994 Shoreline

N
W E
S

0 2,000 4,000

Feet

# Northampton County, Virginia
## Plate 5



Shoreline Studies Program VIMS

B-28

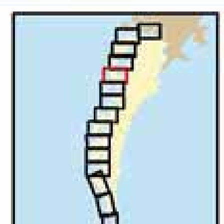

**Legend**

2002 Shoreline

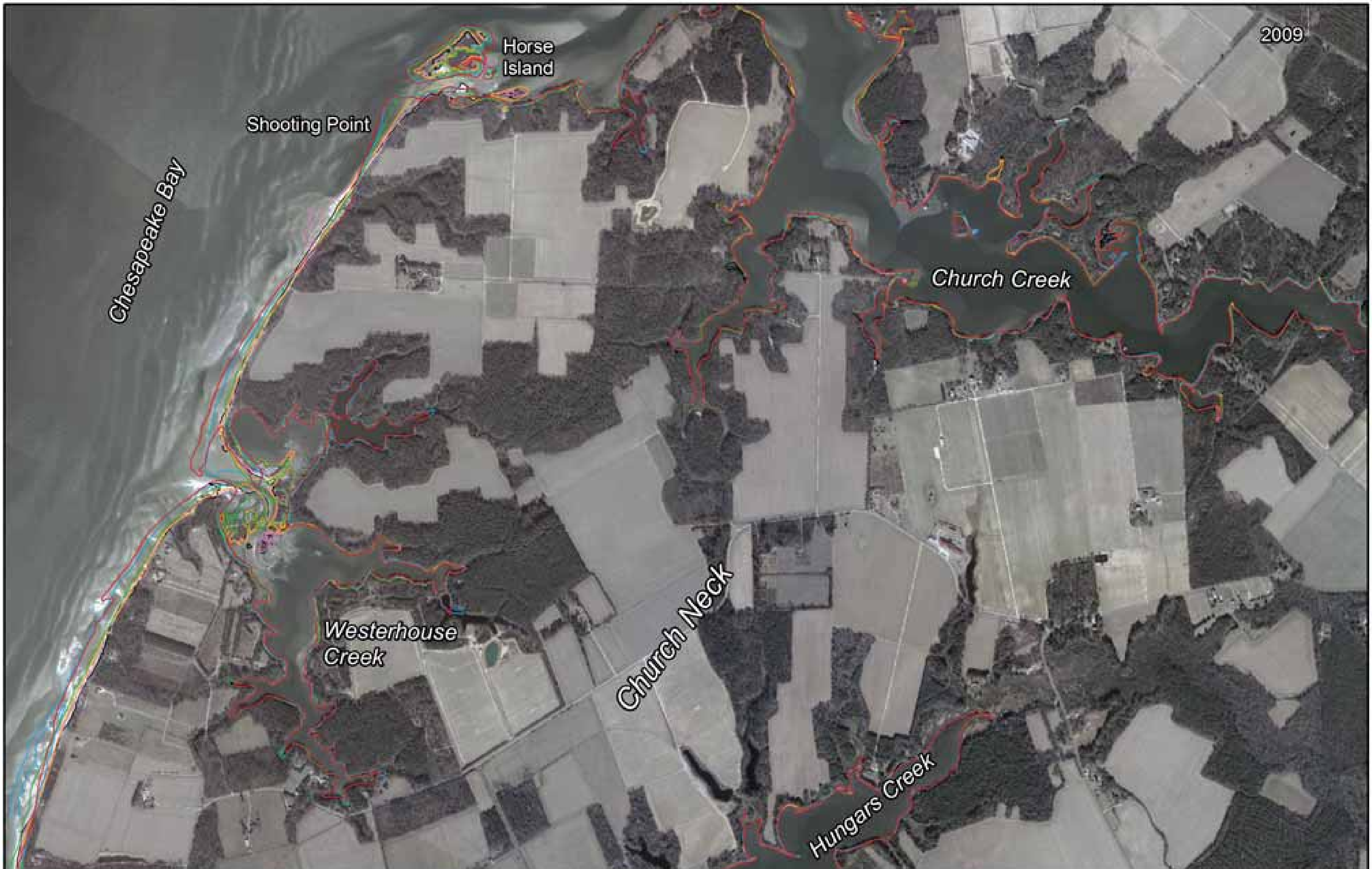
N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
# Plate 5



Shoreline Studies Program
VIMS




**Legend**

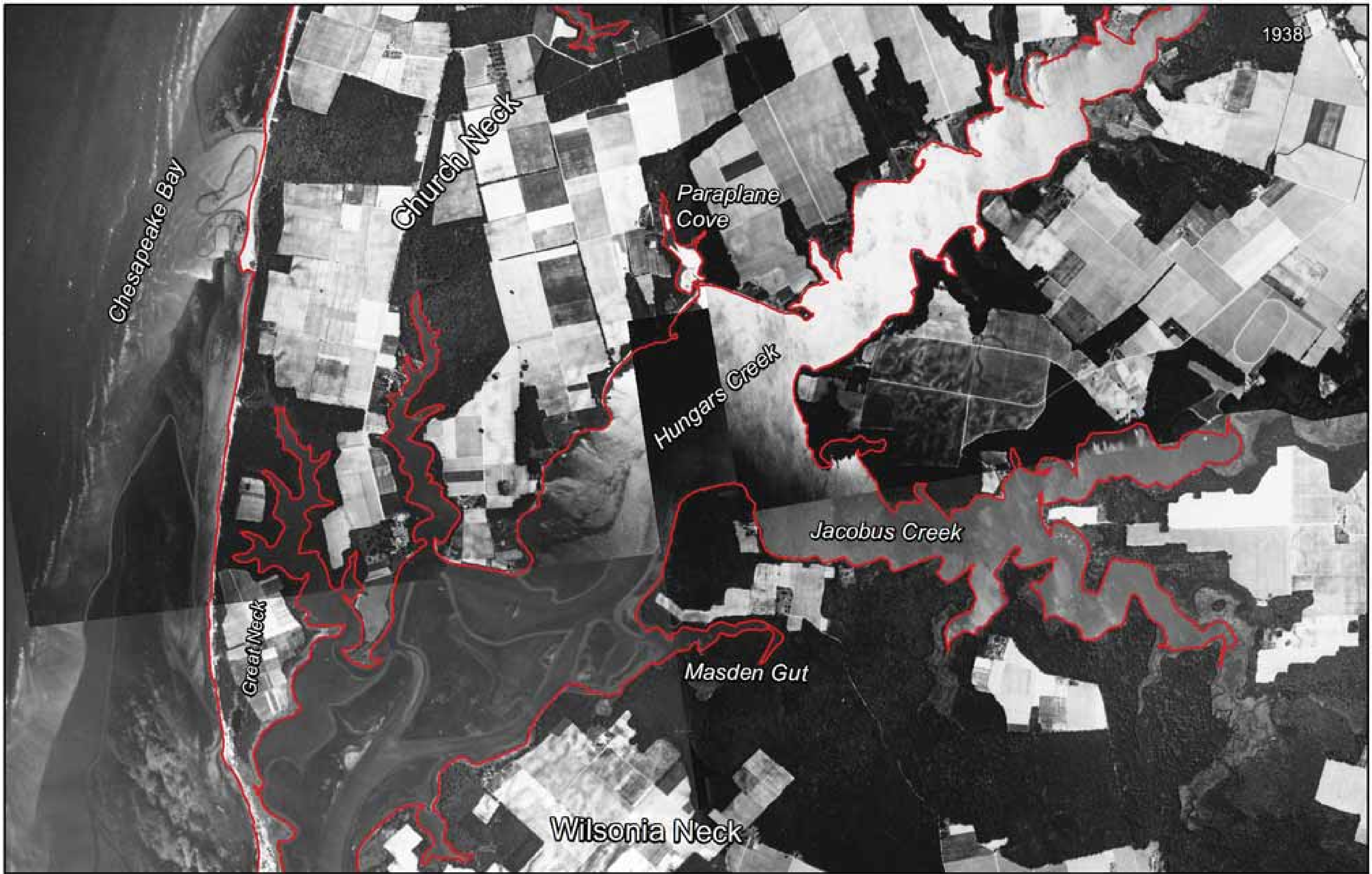
1938 Shoreline
1949 Shoreline
1972 Shoreline
1994 Shoreline
2002 Shoreline
2009 Shoreline

## Northampton County, Virginia
## Plate 5

0 2,000 4,000 Feet

N S E W

Shoreline Studies Program VIMS




Legend
1938 Shoreline

0 2,000 4,000 Feet

**Northampton County, Virginia**
**Plate 6**


**Legend**

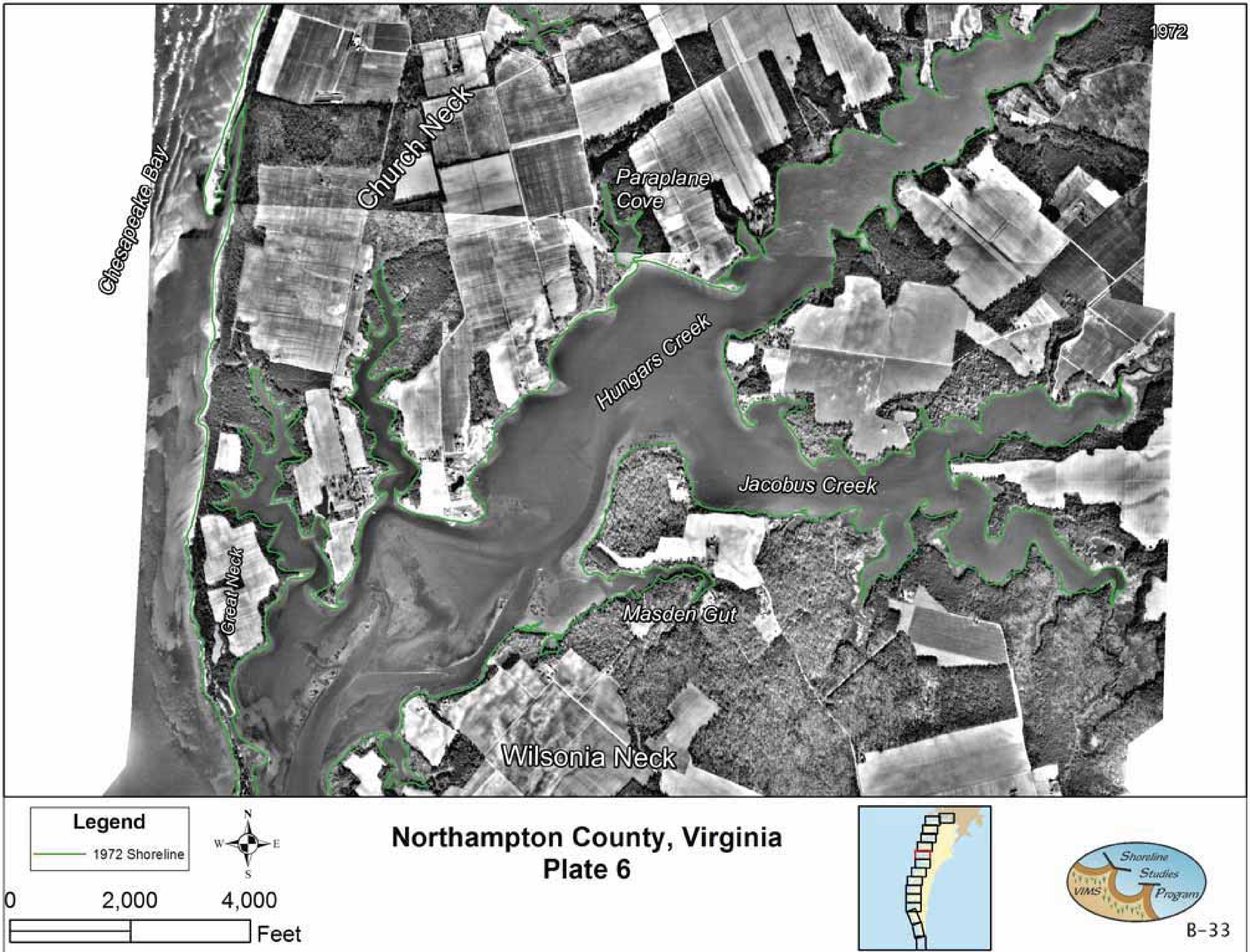
1949 Shoreline

N W E S

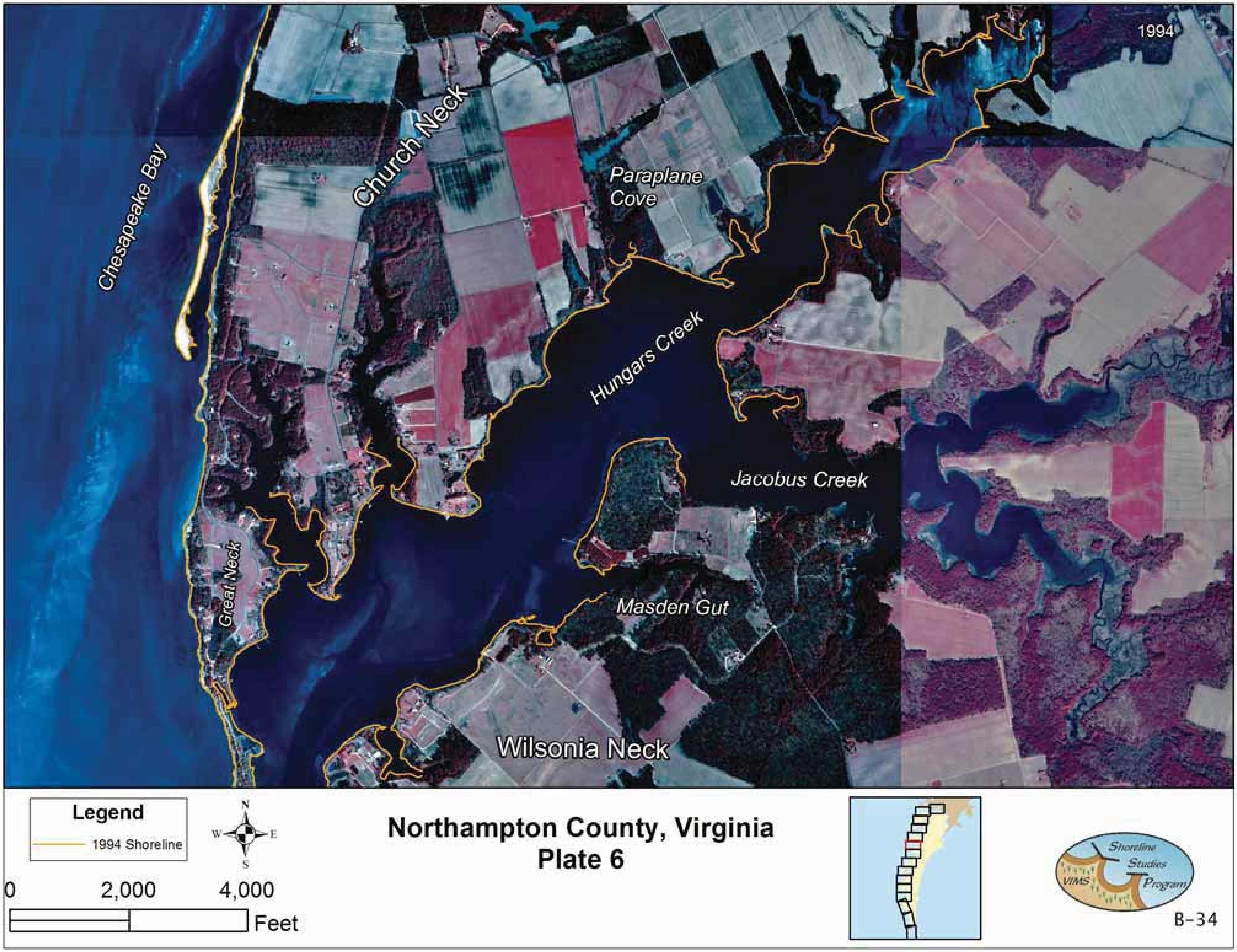
0 2,000 4,000 Feet

# Northampton County, Virginia
# Plate 6

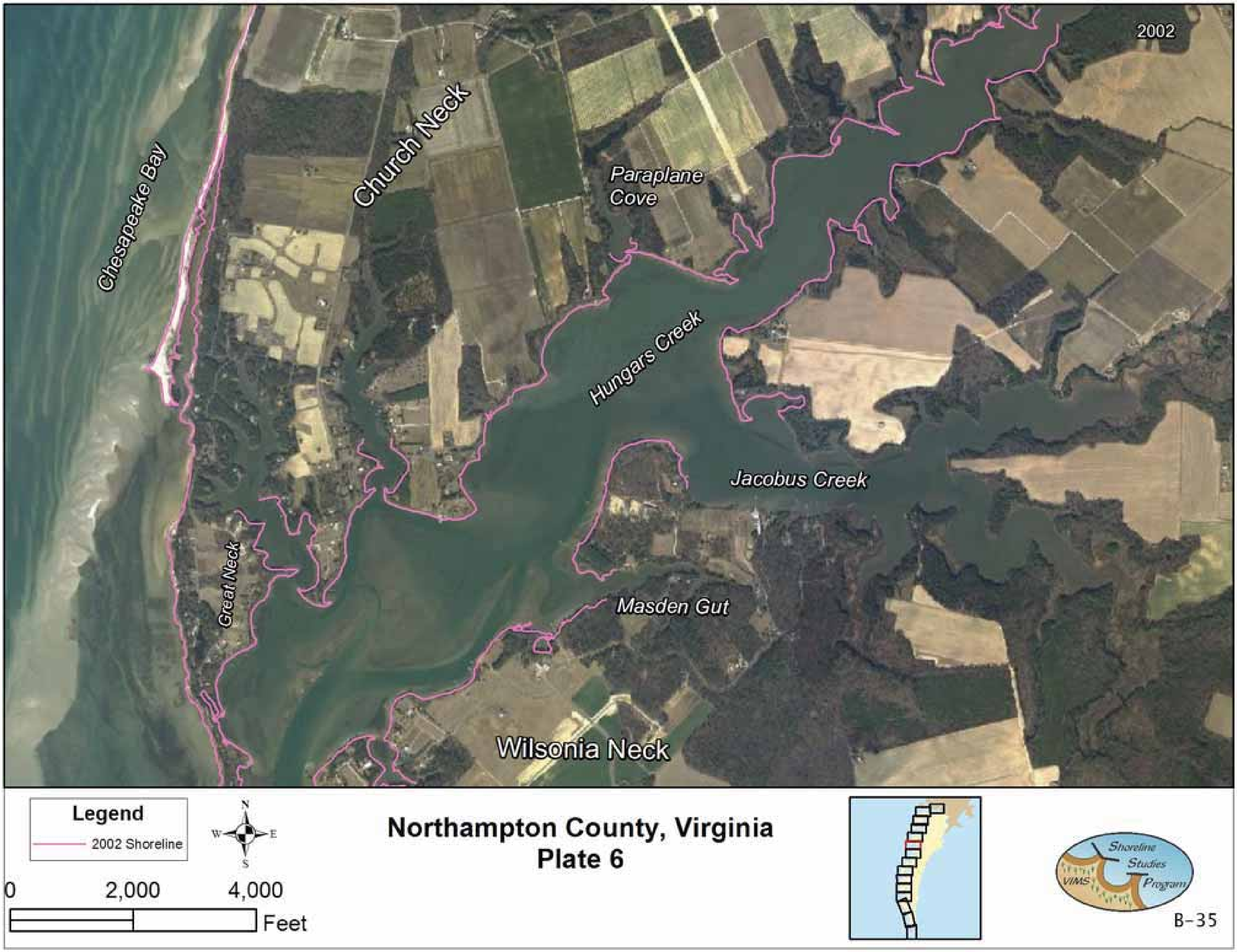
Shoreline Studies Program VIMS




**Northampton County, Virginia**
**Plate 6**




**Northampton County, Virginia**
**Plate 6**




**Northampton County, Virginia**
**Plate 6**


## Legend

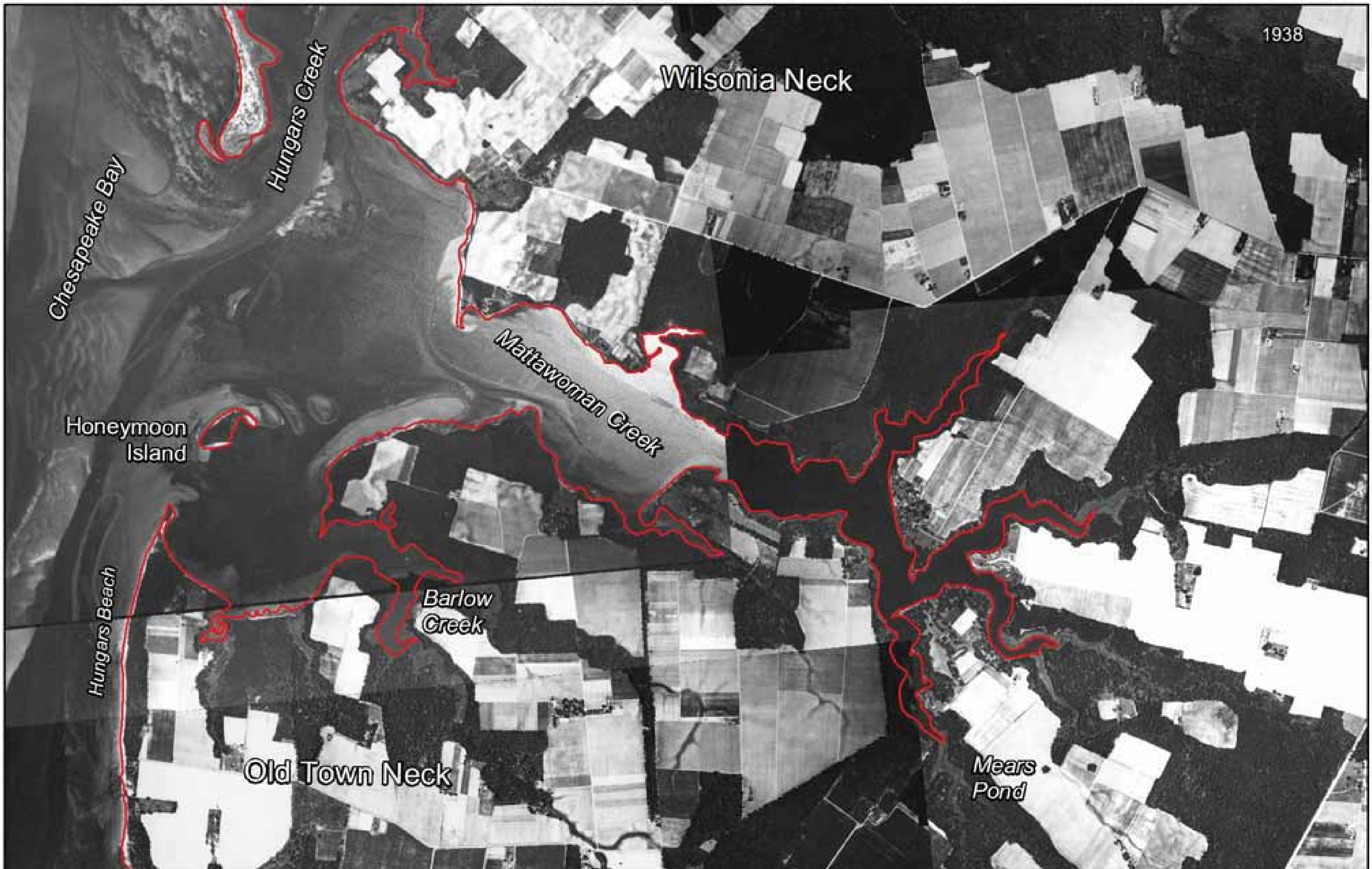
| | |
|---|---|
| 1938 Shoreline | 1994 Shoreline |
| 1949 Shoreline | 2002 Shoreline |
| 1972 Shoreline | 2009 Shoreline |

# Northampton County, Virginia
# Plate 6

0 2,000 4,000 Feet

N S W E

Shoreline Studies Program VIMS

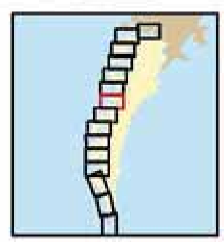



**Legend**

1938 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 7




Legend

1949 Shoreline

N W E S

0 2,000 4,000

Feet

**Northampton County, Virginia**
**Plate 7**

Shoreline Studies Program VIMS

B-38

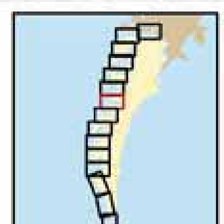

**Legend**

1972 Shoreline

N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
## Plate 7



Shoreline Studies Program
VIMS

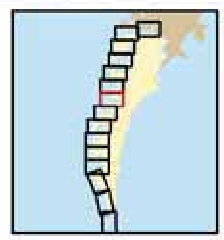

**Legend**

1994 Shoreline

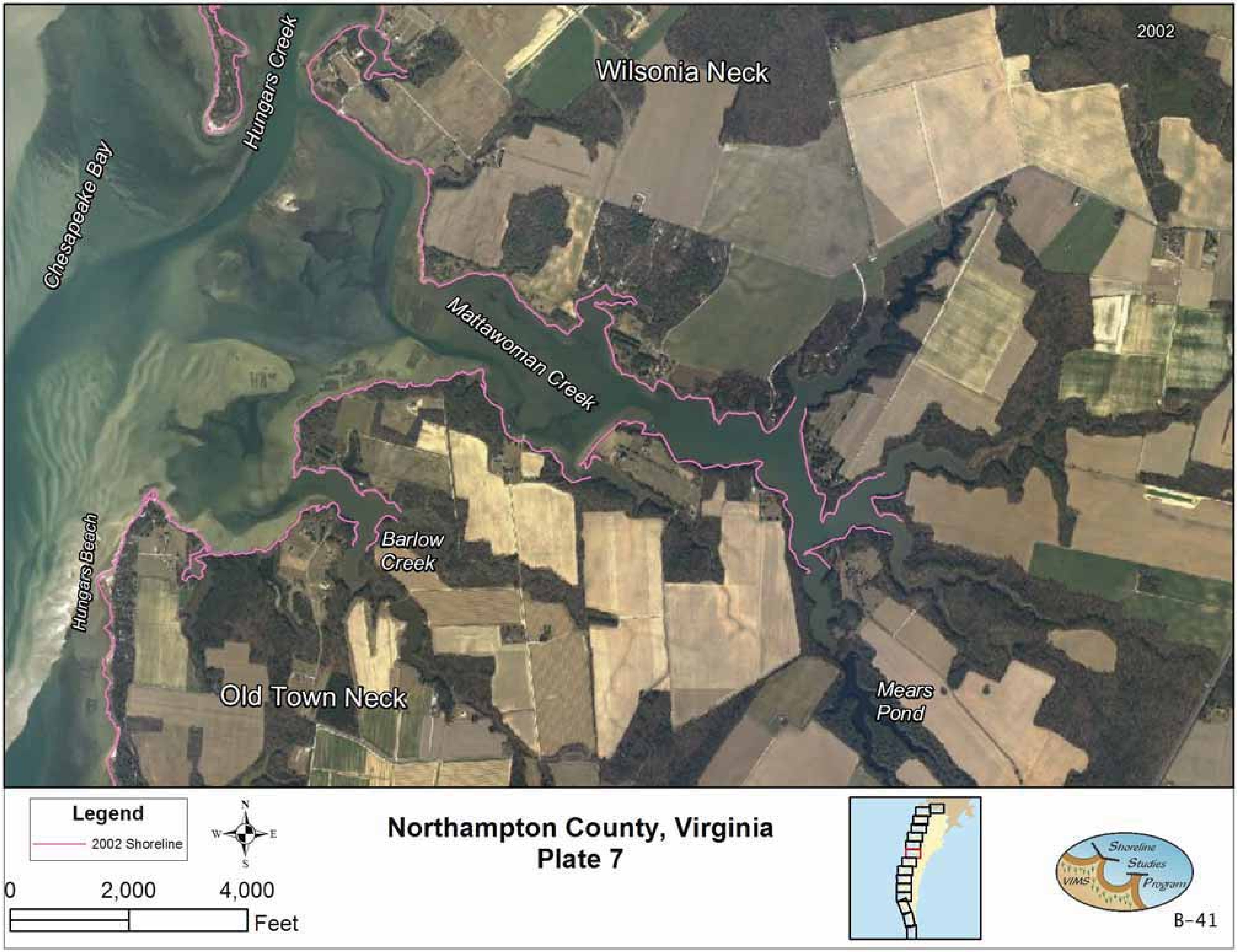
N
W E
S

0 2,000 4,000
Feet

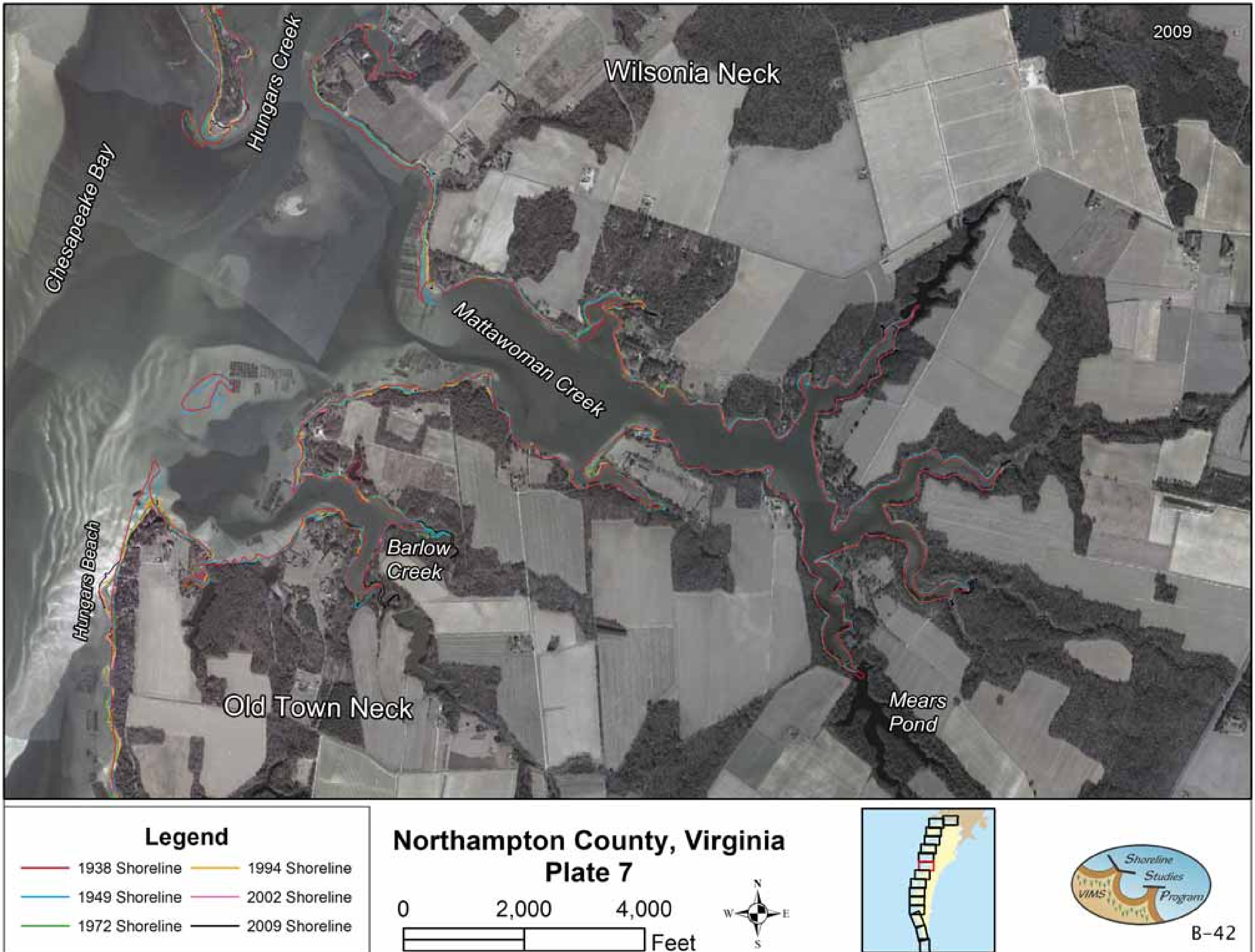
## Northampton County, Virginia
## Plate 7

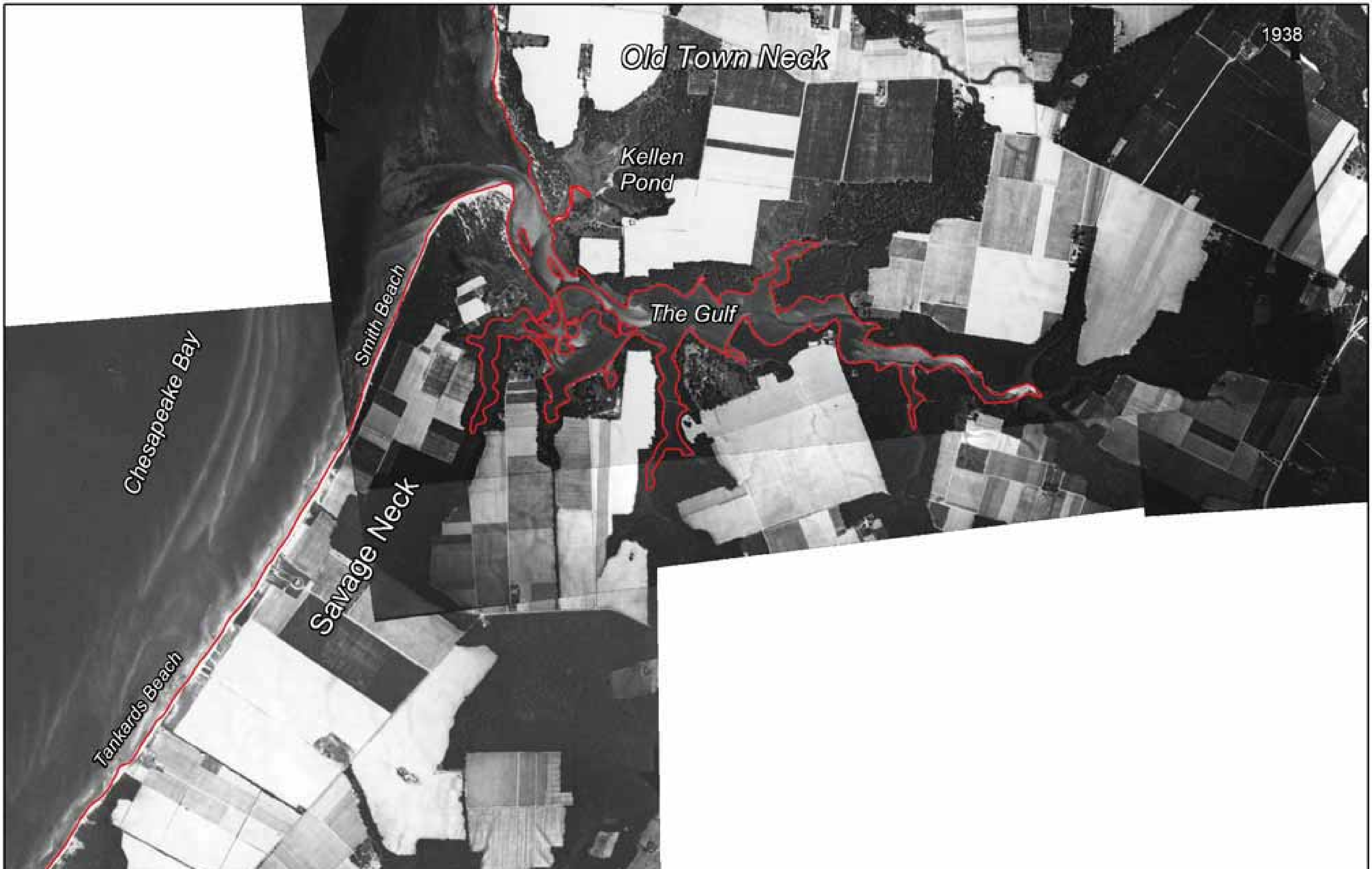


Shoreline Studies Program VIMS




## Northampton County, Virginia
## Plate 7


2009
Wilsonia Neck
Hungars Creek
Chesapeake Bay
Mattawoman Creek
Barlow Creek
Hungars Beach
Old Town Neck
Mears Pond
Legend
1938 Shoreline
1994 Shoreline
1949 Shoreline
2002 Shoreline
1972 Shoreline
2009 Shoreline
Northampton County, Virginia
Plate 7
0
2,000
4,000
Feet
N
W
E
S
Shoreline Studies Program
VIMS




Legend

1938 Shoreline

N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
## Plate 8

Shoreline Studies Program
VIMS


Legend

1949 Shoreline

N W E S

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 8

Shoreline Studies Program VIMS


Legend

1972 Shoreline

N
W E
S

0 2,000 4,000

Feet

# Northampton County, Virginia
# Plate 8

Shoreline Studies Program
VIMS

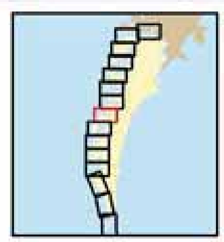

**Legend**

1994 Shoreline

N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
## Plate 8



B-46

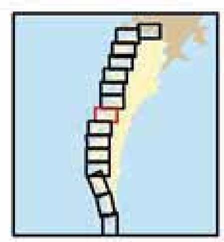

**Legend**

2002 Shoreline

N
W E
S

0 2,000 4,000
Feet

## Northampton County, Virginia
## Plate 8



Shoreline Studies Program VIMS


**Legend**

1938 Shoreline
1949 Shoreline
1972 Shoreline
1994 Shoreline
2002 Shoreline
2009 Shoreline

# Northampton County, Virginia
## Plate 8

0 2,000 4,000 Feet

N E S W

Shoreline Studies Program VIMS

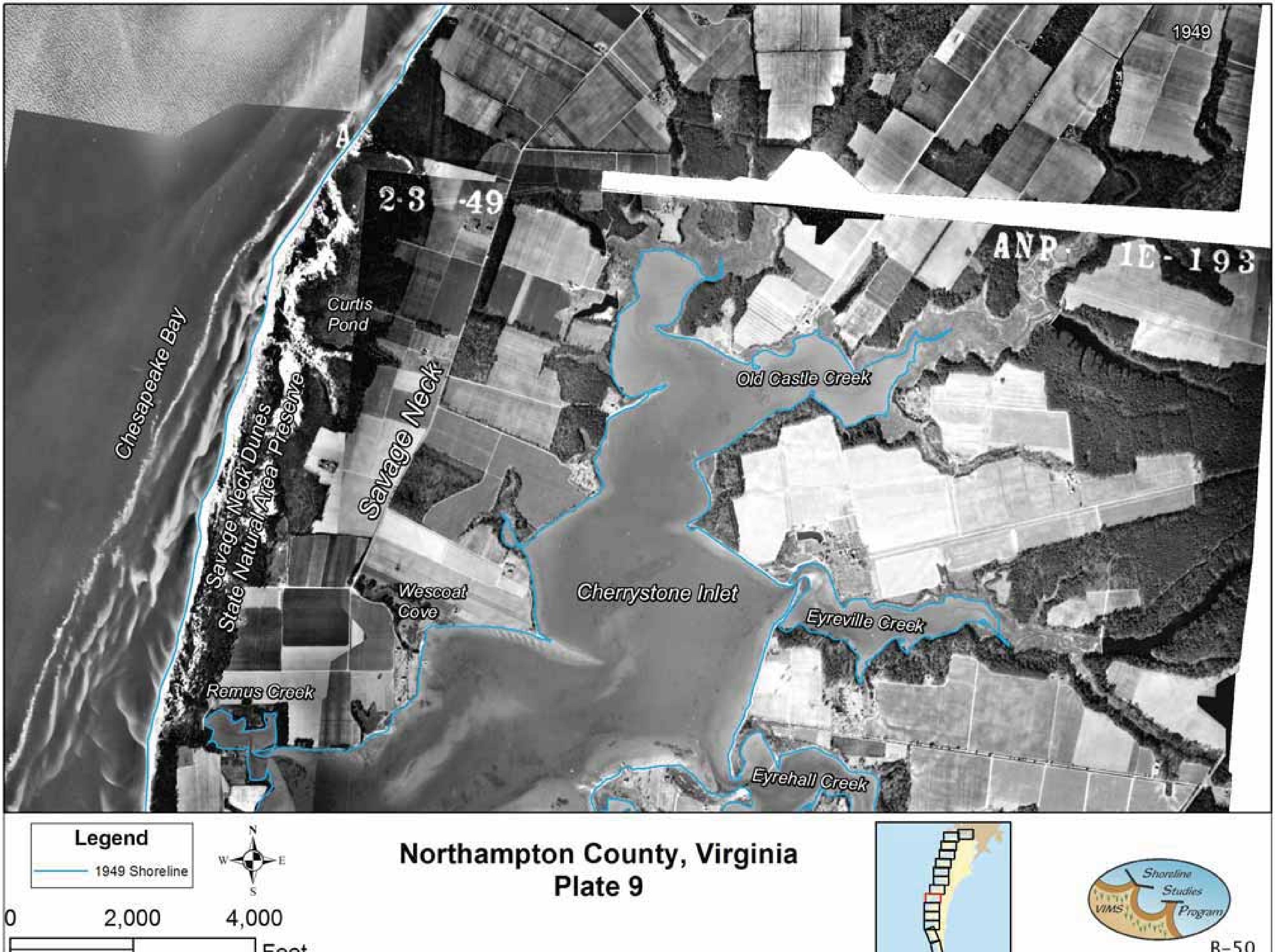

Legend
1938 Shoreline

N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
## Plate 9

Shoreline Studies Program
VIMS




# Northampton County, Virginia
## Plate 9


Legend

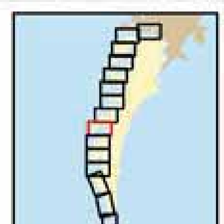
1972 Shoreline

N
W E
S

0 2,000 4,000

Feet

**Northampton County, Virginia**
**Plate 9**



Shoreline Studies Program VIMS


Legend

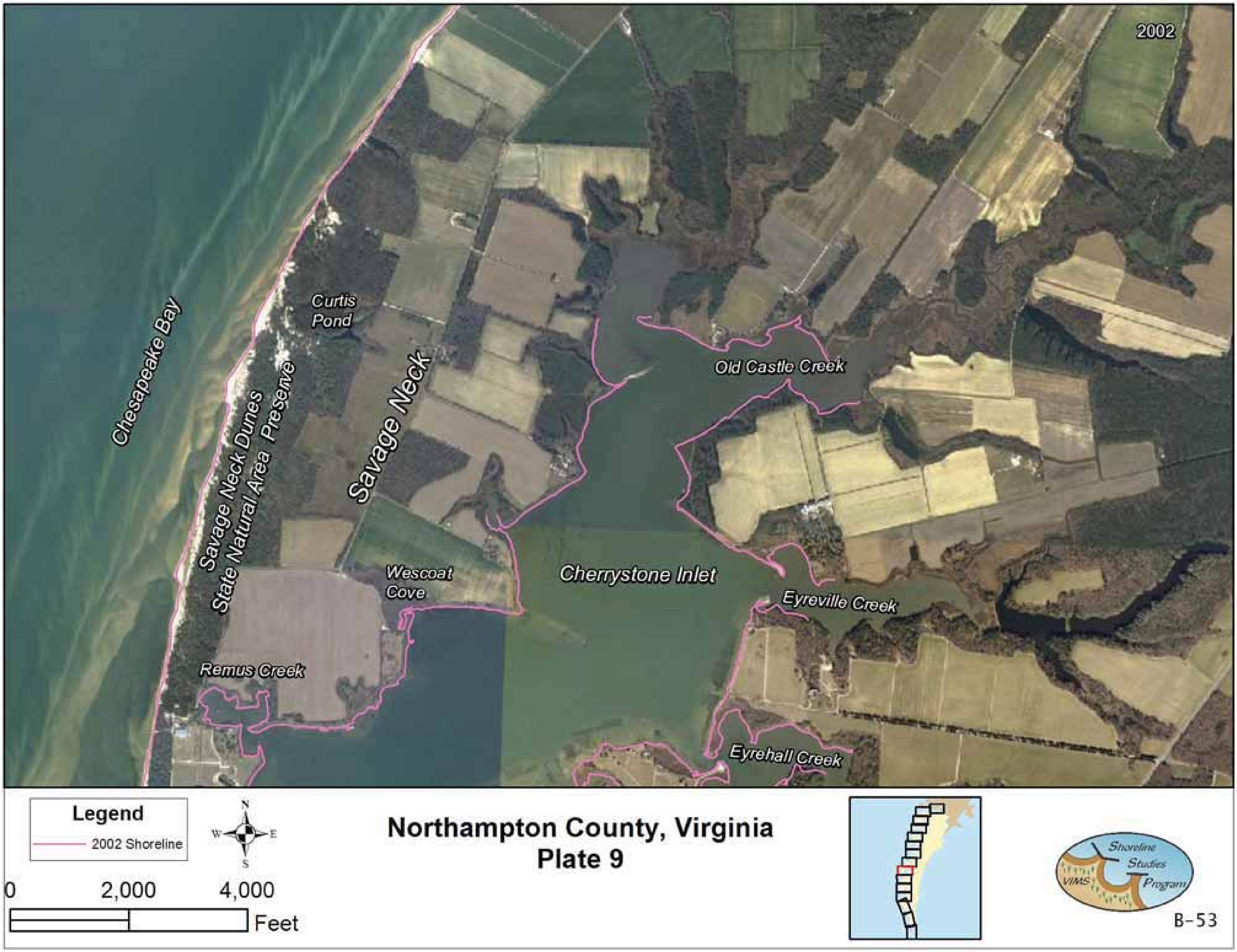
1994 Shoreline

N W E S

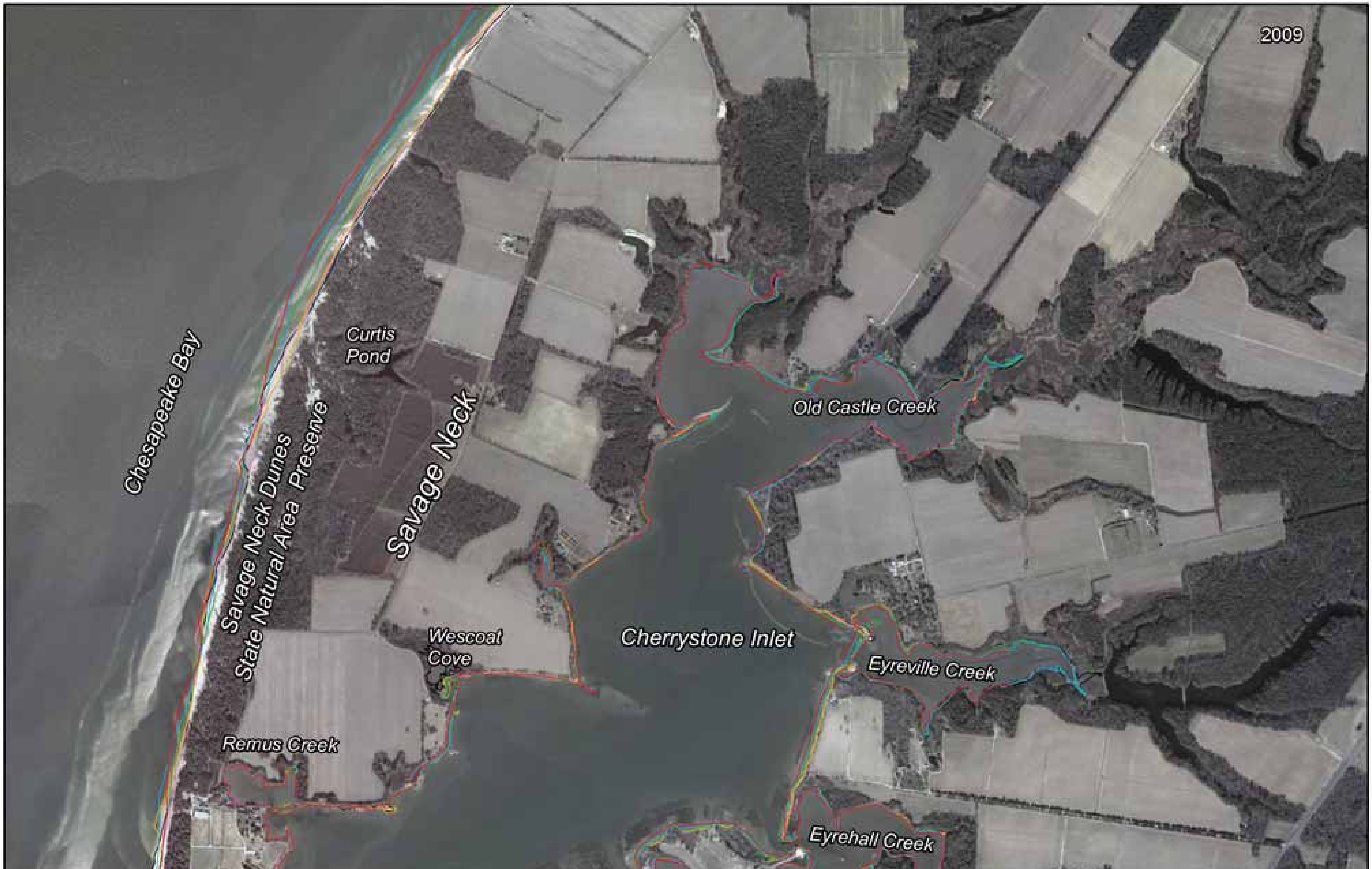
0 2,000 4,000 Feet

# Northampton County, Virginia
# Plate 9

Shoreline Studies Program VIMS




**Northampton County, Virginia**
**Plate 9**



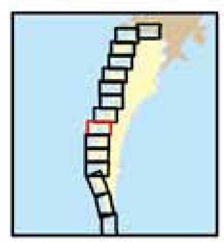

**Legend**

| | |
|---|---|
| 1938 Shoreline | 1994 Shoreline |
| 1949 Shoreline | 2002 Shoreline |
| 1972 Shoreline | 2009 Shoreline |

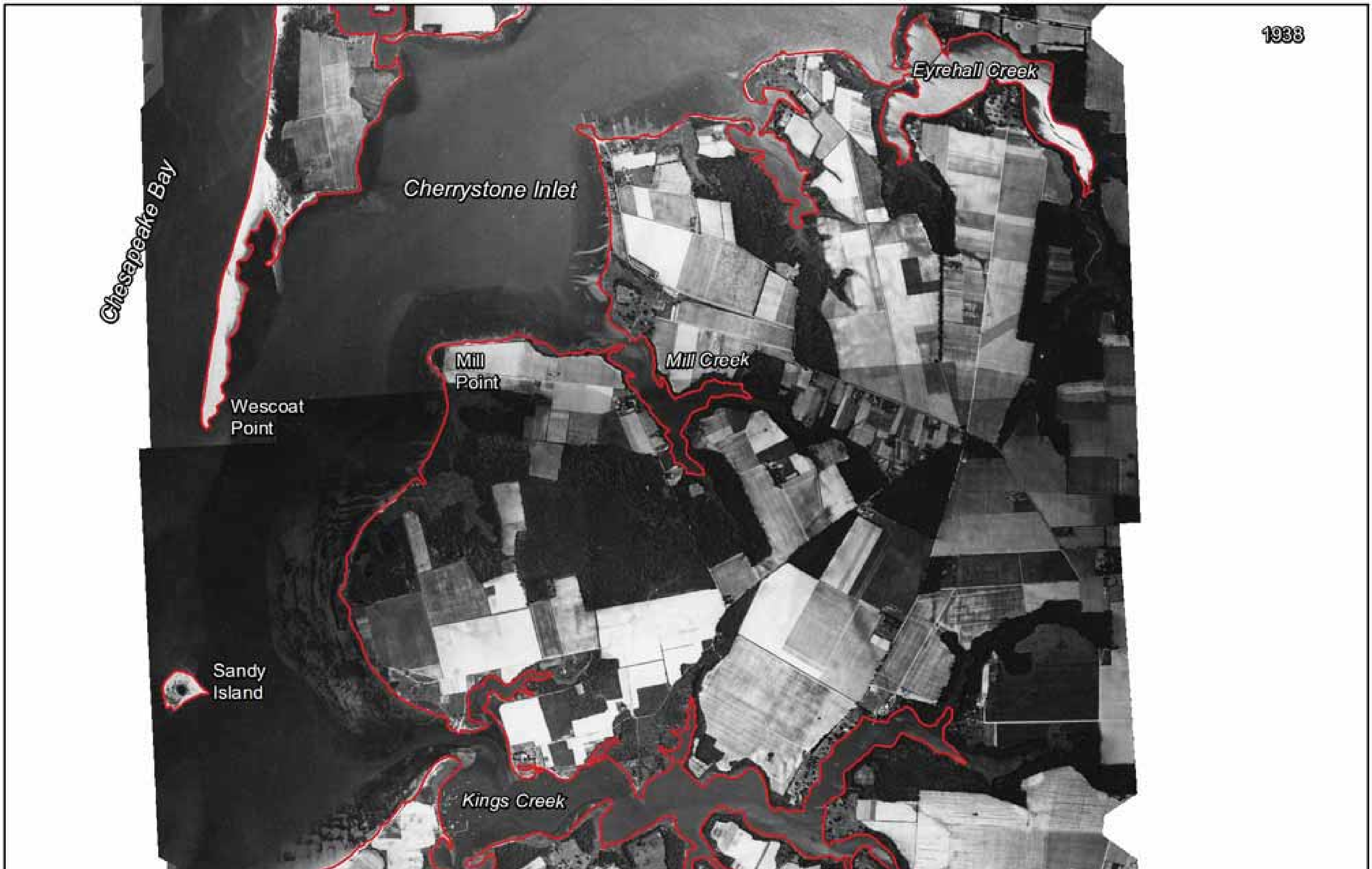
# Northampton County, Virginia
## Plate 9

0 2,000 4,000
Feet

N W E S



Shoreline Studies Program VIMS




**Legend**

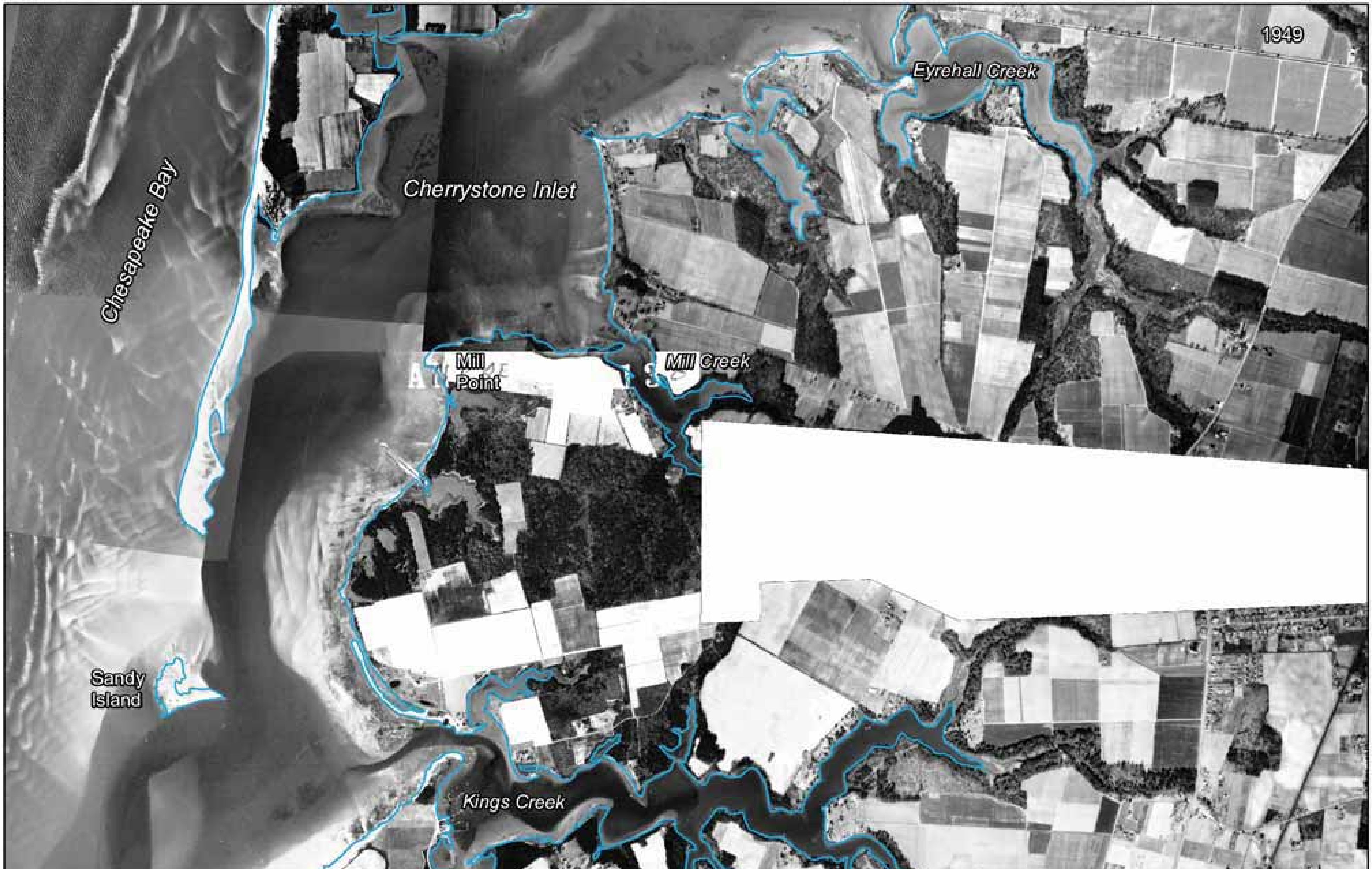
1938 Shoreline

N W E S

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 10

Shoreline Studies Program VIMS




Legend

1949 Shoreline

N
W E
S

0 2,000 4,000
Feet

# Northampton County, Virginia
## Plate 10

Shoreline Studies Program
VIMS


Legend

1972 Shoreline

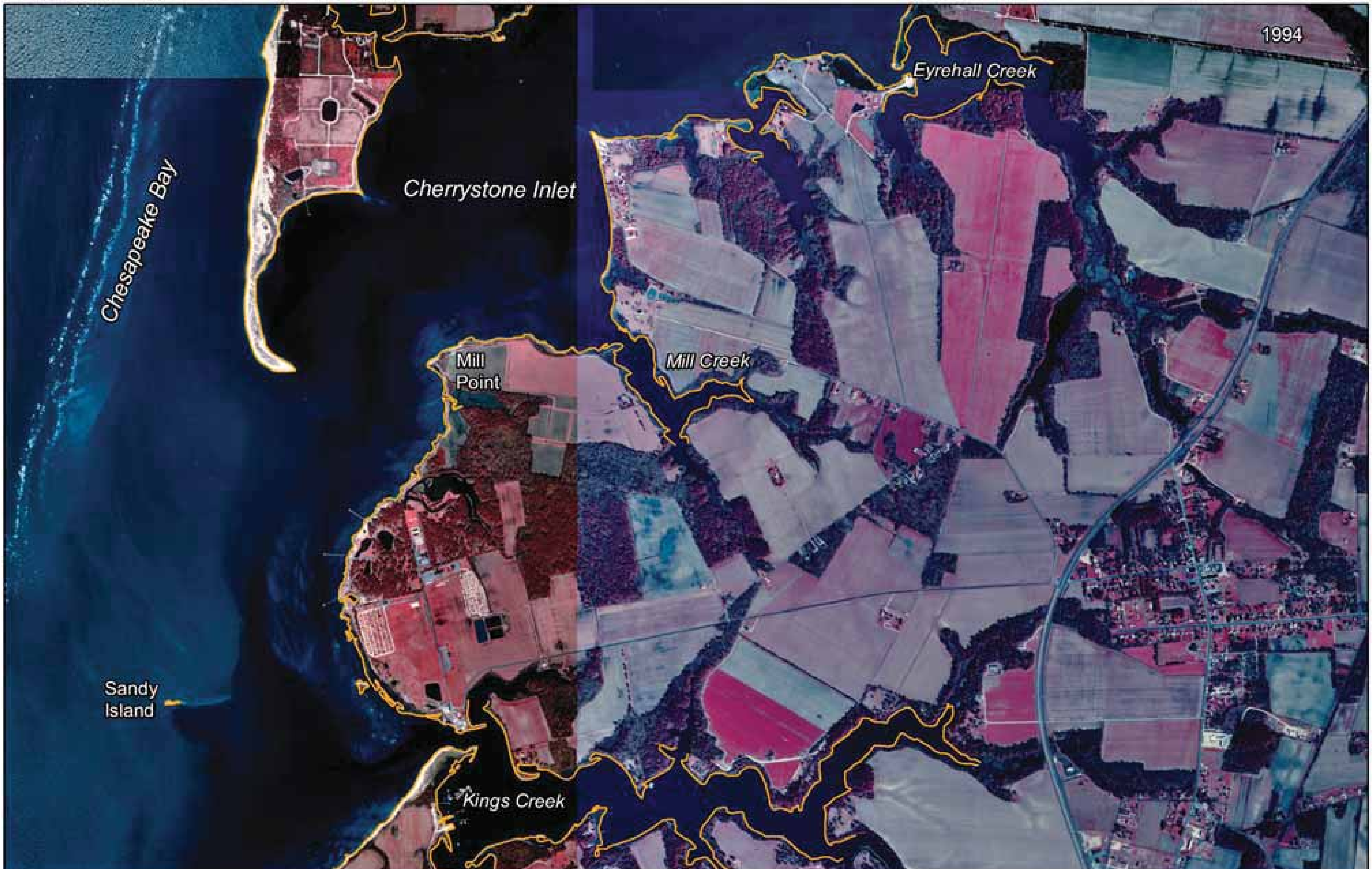
N
W E
S

0 2,000 4,000

Feet

**Northampton County, Virginia**
**Plate 10**

Shoreline Studies Program
VIMS




Legend

1994 Shoreline

0 2,000 4,000

Feet

# Northampton County, Virginia
## Plate 10

Shoreline Studies Program VIMS


Legend

2002 Shoreline

N
W E
S

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 10

Shoreline Studies Program VIMS


Legend

- 1938 Shoreline
- 1949 Shoreline
- 1972 Shoreline
- 1994 Shoreline
- 2002 Shoreline
- 2009 Shoreline

**Northampton County, Virginia**
**Plate 10**

0 2,000 4,000 Feet

N S W E

Shoreline Studies Program VIMS

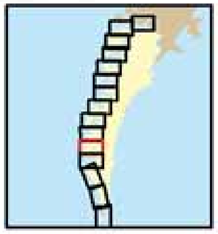

Legend

1938 Shoreline

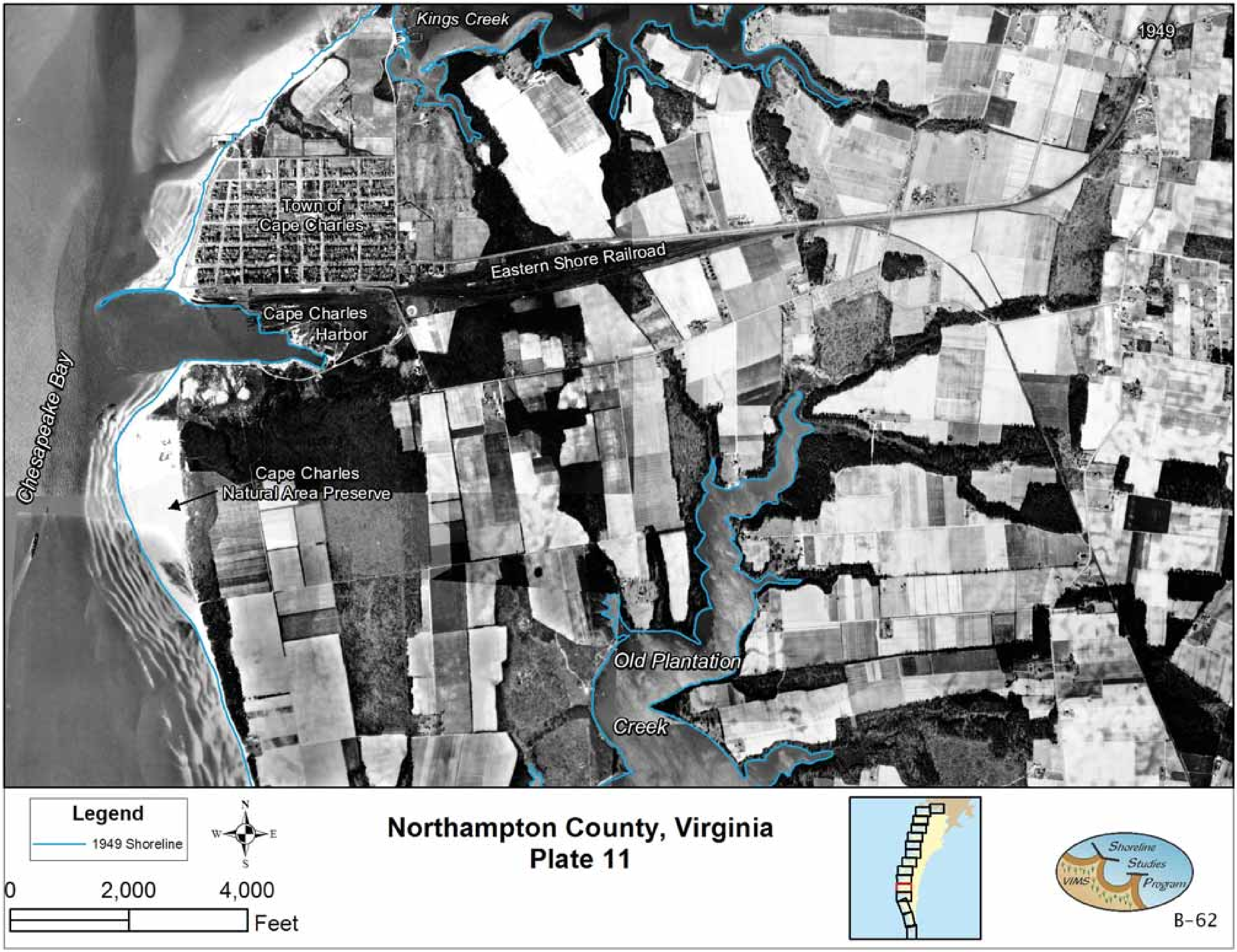
N
W E
S

0 2,000 4,000
Feet

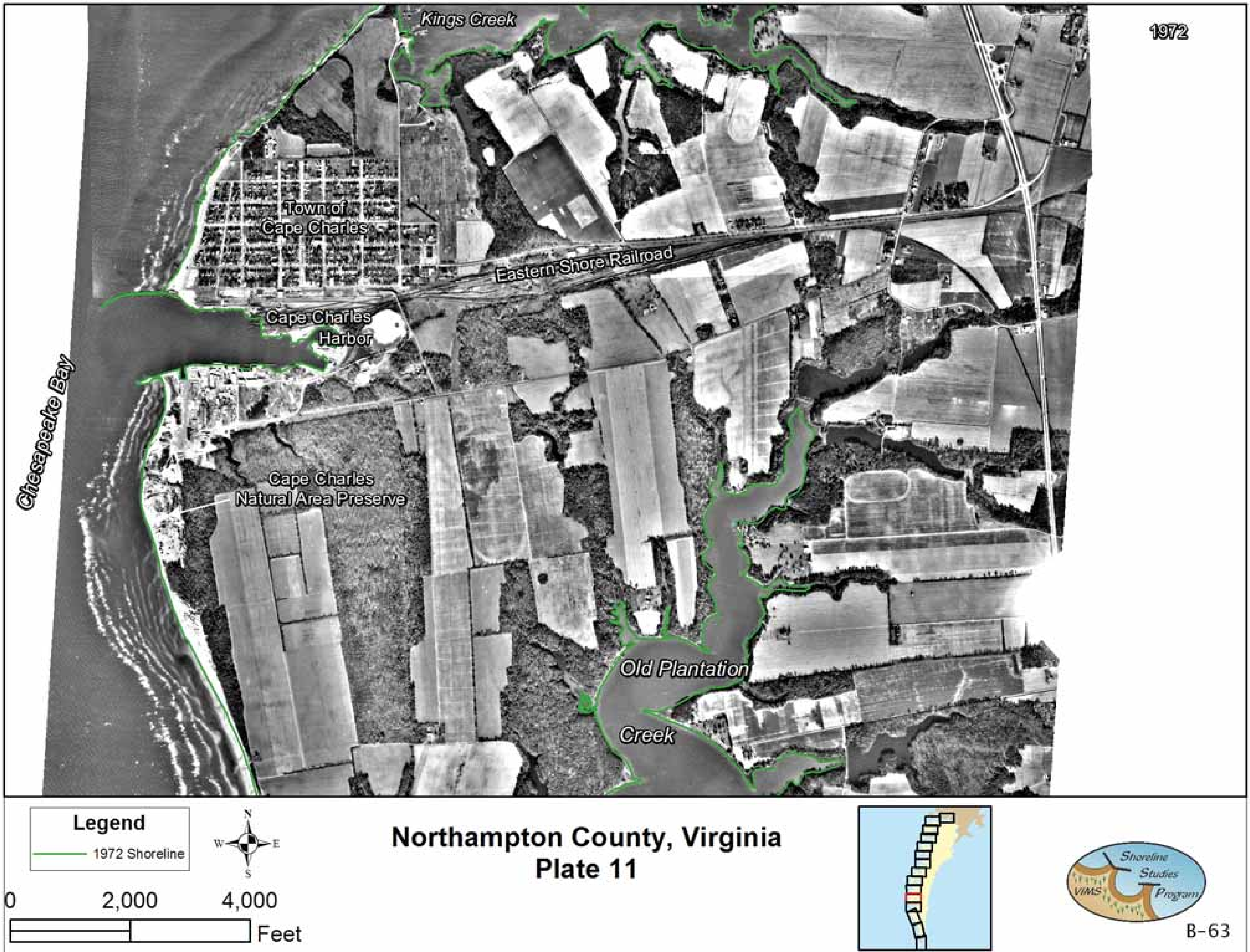
# Northampton County, Virginia
## Plate 11



Shoreline Studies Program
VIMS




**Northampton County, Virginia**
**Plate 11**




**Northampton County, Virginia**
**Plate 11**

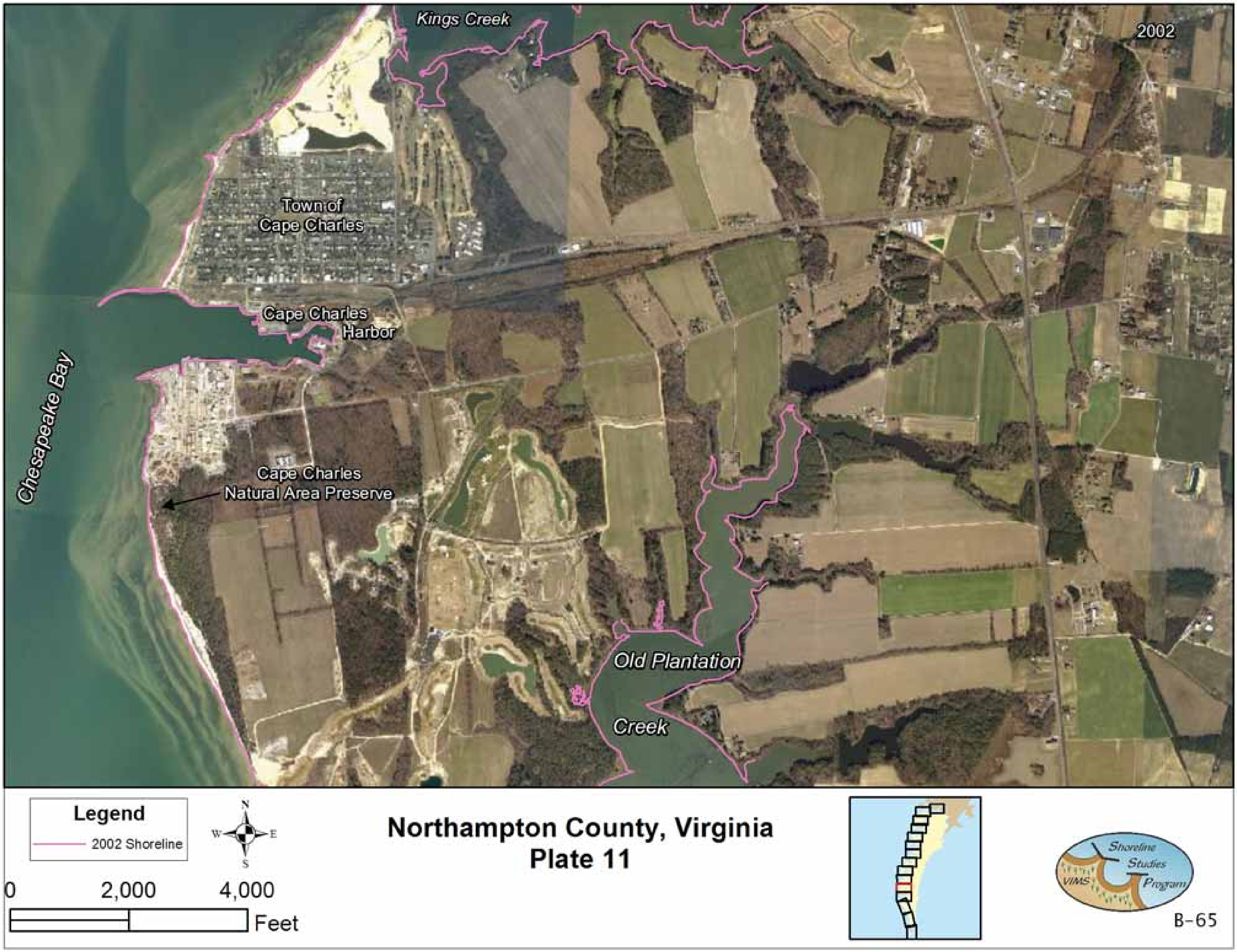

Legend

1994 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 11

Shoreline Studies Program VIMS




**Northampton County, Virginia**
**Plate 11**

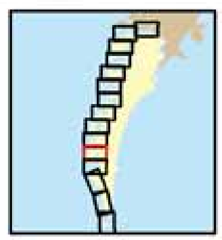

**Legend**

1938 Shoreline
1994 Shoreline
1949 Shoreline
2002 Shoreline
1972 Shoreline
2009 Shoreline

# Northampton County, Virginia
# Plate 11

0 2,000 4,000 Feet

N W E S



Shoreline Studies Program VIMS


Legend

1938 Shoreline

N W E S

0 2,000 4,000 Feet

**Northampton County, Virginia**
**Plate 12**

Shoreline Studies Program VIMS


Legend

1949 Shoreline

N
W E
S

0 2,000 4,000
Feet

**Northampton County, Virginia**
**Plate 12**

Shoreline Studies Program VIMS

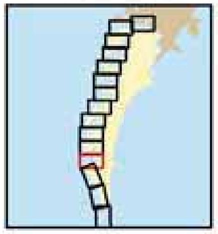

Legend

1972 Shoreline

N W E S

0 2,000 4,000 Feet

**Northampton County, Virginia**
**Plate 12**



Shoreline Studies Program VIMS


**Legend**

1994 Shoreline

N W E S

0 2,000 4,000 Feet

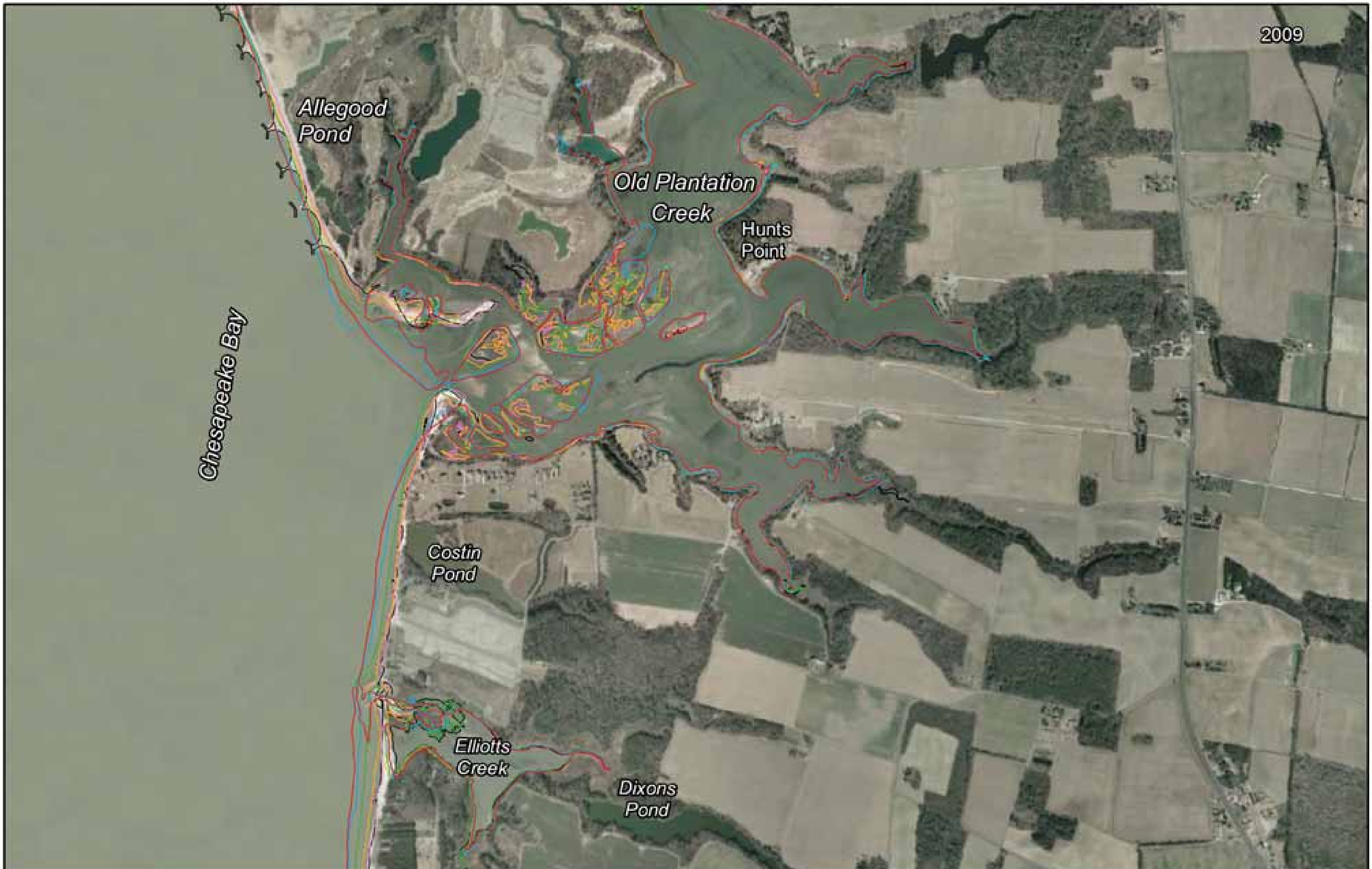
# Northampton County, Virginia
## Plate 12

Shoreline Studies Program VIMS


Legend
2002 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 12



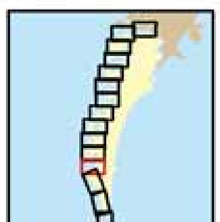

## Legend

- 1938 Shoreline
- 1949 Shoreline
- 1972 Shoreline
- 1994 Shoreline
- 2002 Shoreline
- 2009 Shoreline

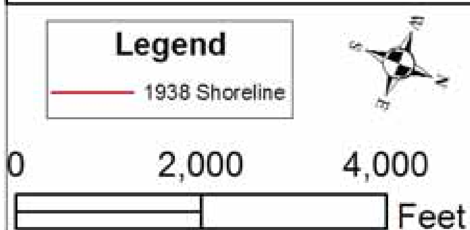
# Northampton County, Virginia
# Plate 12

0 2,000 4,000 Feet

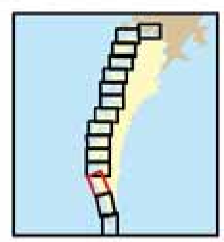
N W E S



Shoreline Studies Program VIMS


**Northampton County, Virginia**
**Plate 13**




Legend

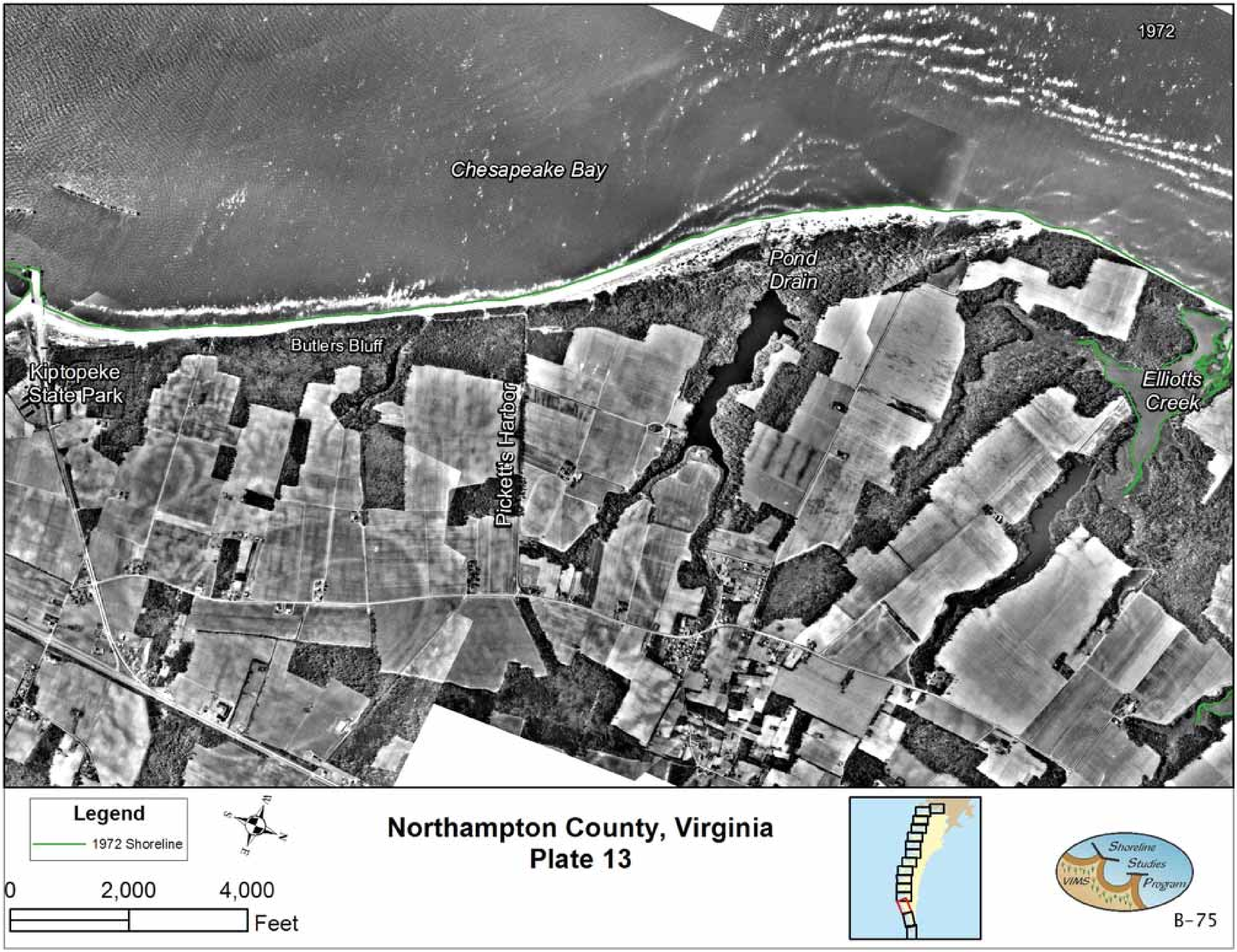
1949 Shoreline

0 2,000 4,000

Feet

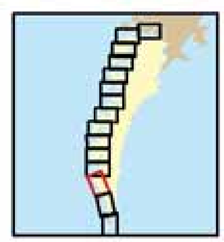
**Northampton County, Virginia**
**Plate 13**

Shoreline Studies Program VIMS




**Northampton County, Virginia**
**Plate 13**


## Northampton County, Virginia
## Plate 13




**Legend**

2002 Shoreline

0 2,000 4,000 Feet

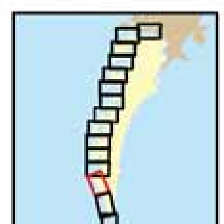
# Northampton County, Virginia
## Plate 13


## Legend

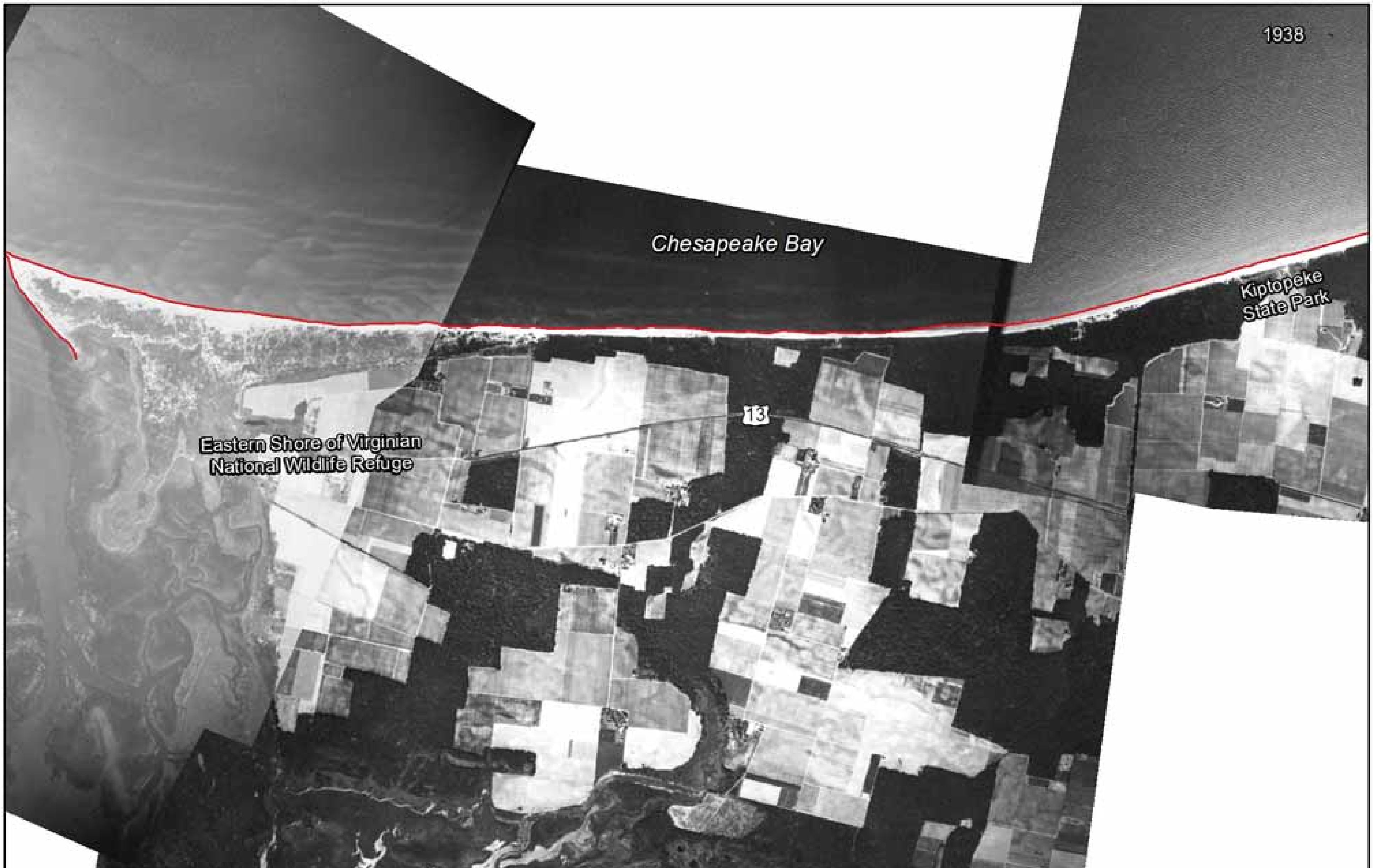
| | |
|---|---|
| 1938 Shoreline | 1994 Shoreline |
| 1949 Shoreline | 2002 Shoreline |
| 1972 Shoreline | 2009 Shoreline |

# Northampton County, Virginia
## Plate 13

0 2,000 4,000 Feet



Shoreline Studies Program VIMS



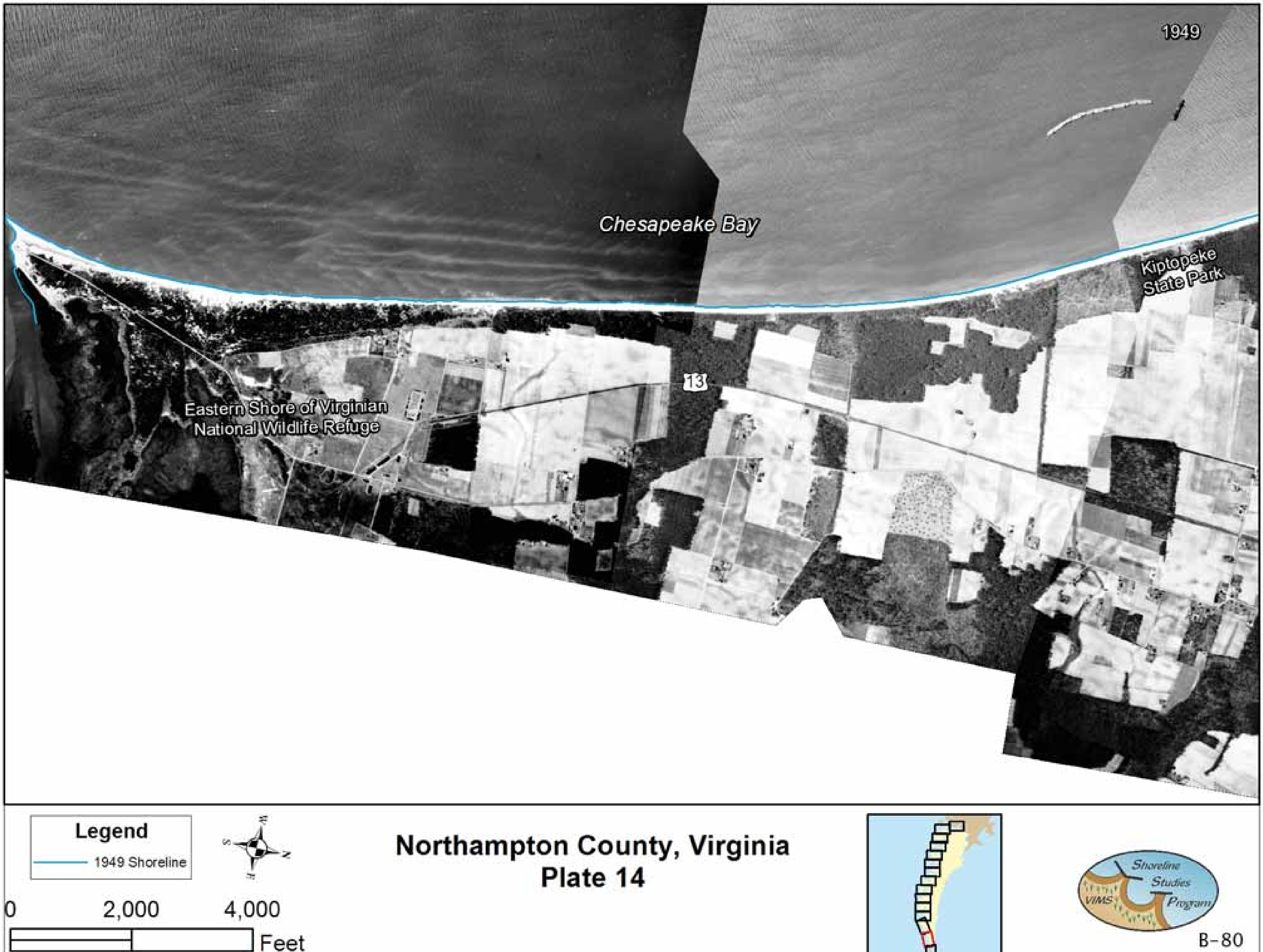

**Legend**

1938 Shoreline

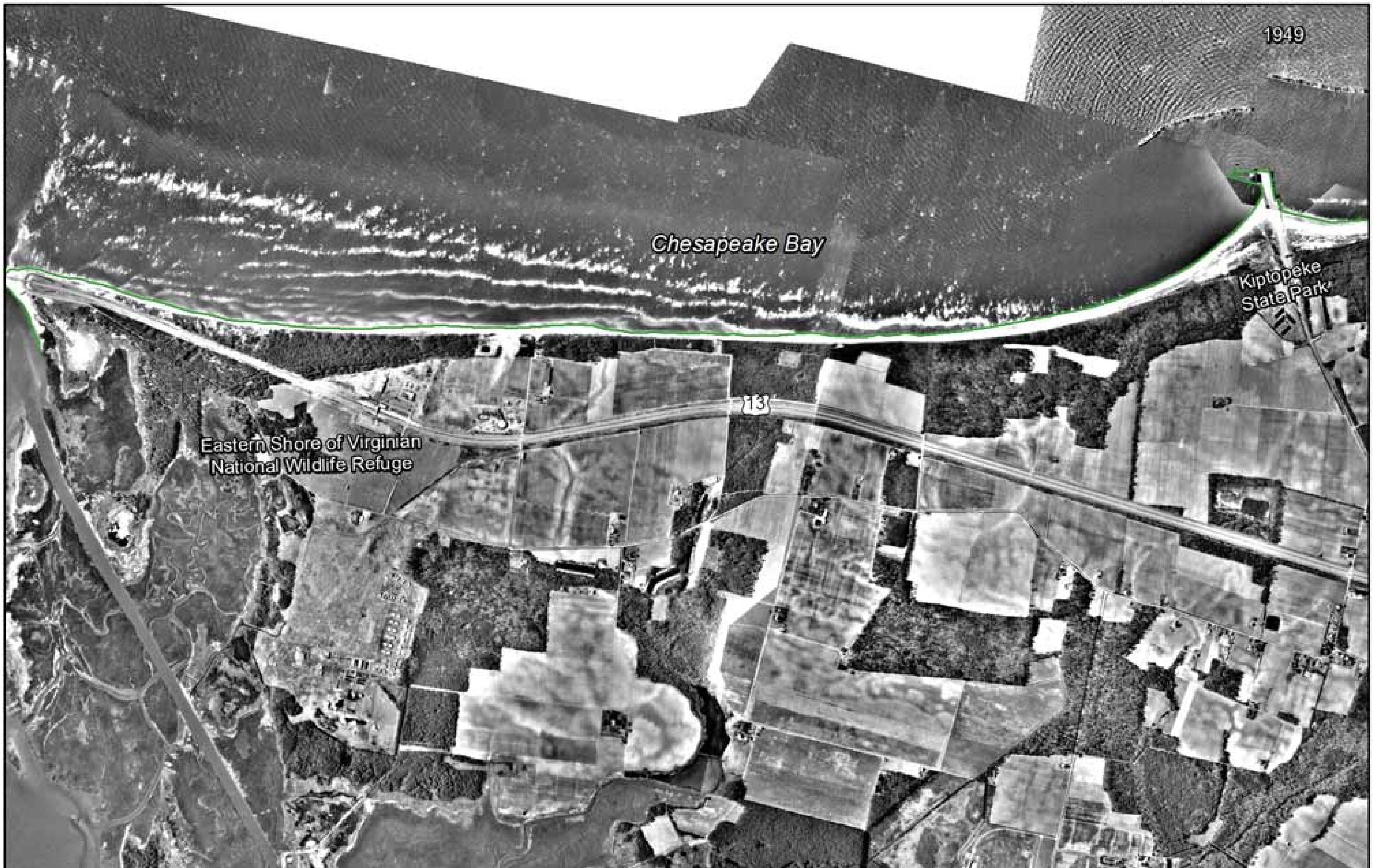
0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 14

Shoreline Studies Program VIMS




**Northampton County, Virginia**
**Plate 14**




Legend

1972 Shoreline

0 2,000 4,000 Feet

**Northampton County, Virginia**
**Plate 14**

Shoreline Studies Program
VIMS

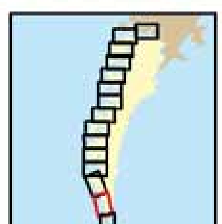

Legend

1994 Shoreline

0 2,000 4,000

Feet

**Northampton County, Virginia**
**Plate 14**



Shoreline Studies Program
VIMS


Legend

2002 Shoreline

0 2,000 4,000

Feet

# Northampton County, Virginia
## Plate 14

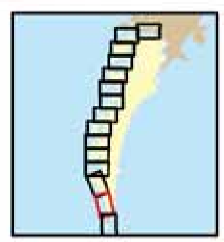
Shoreline Studies Program VIMS


**Legend**

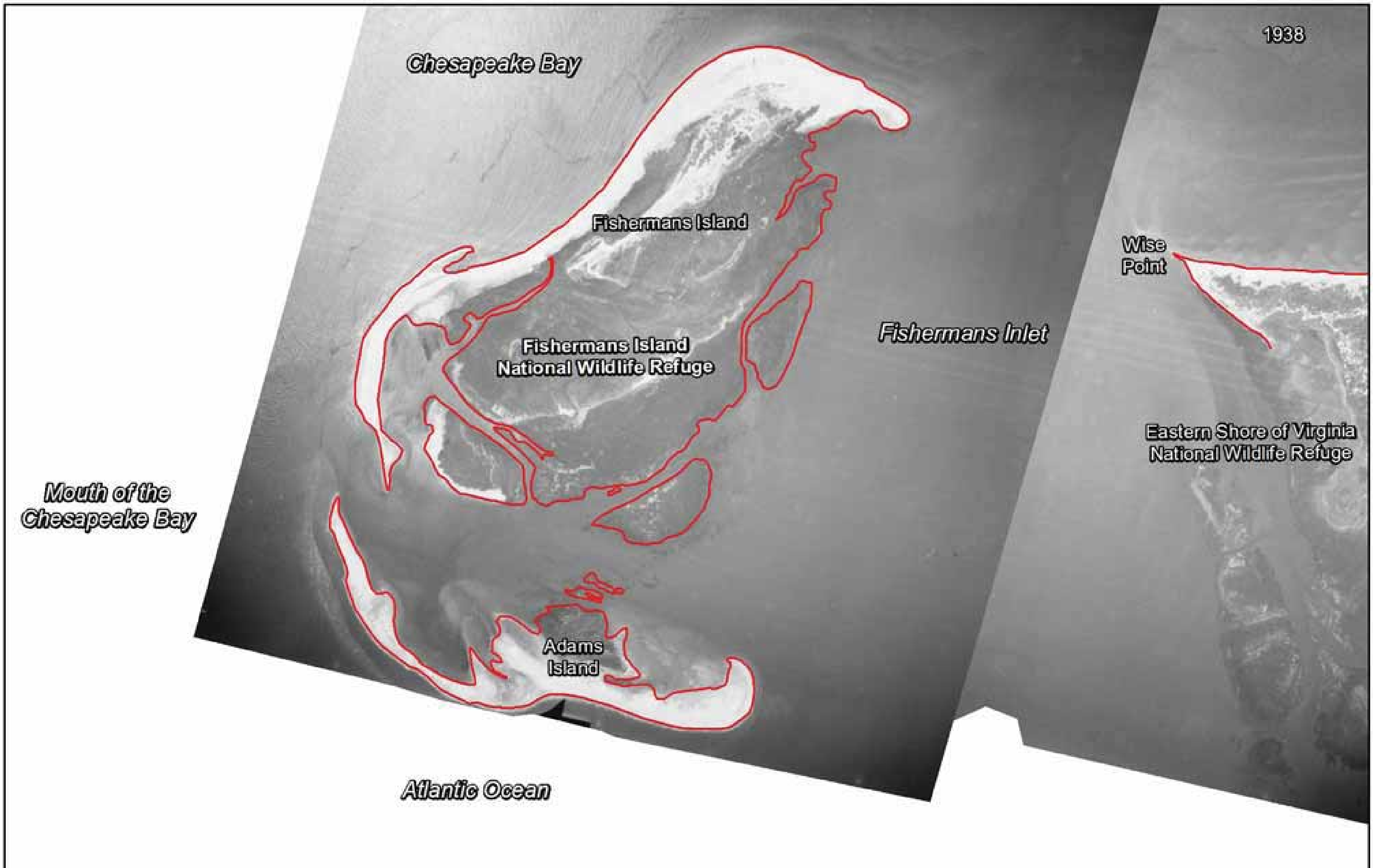
1938 Shoreline
1949 Shoreline
1972 Shoreline
1994 Shoreline
2002 Shoreline
2009 Shoreline

# Northampton County, Virginia
## Plate 14

0 2,000 4,000 Feet



Shoreline Studies Program VIMS



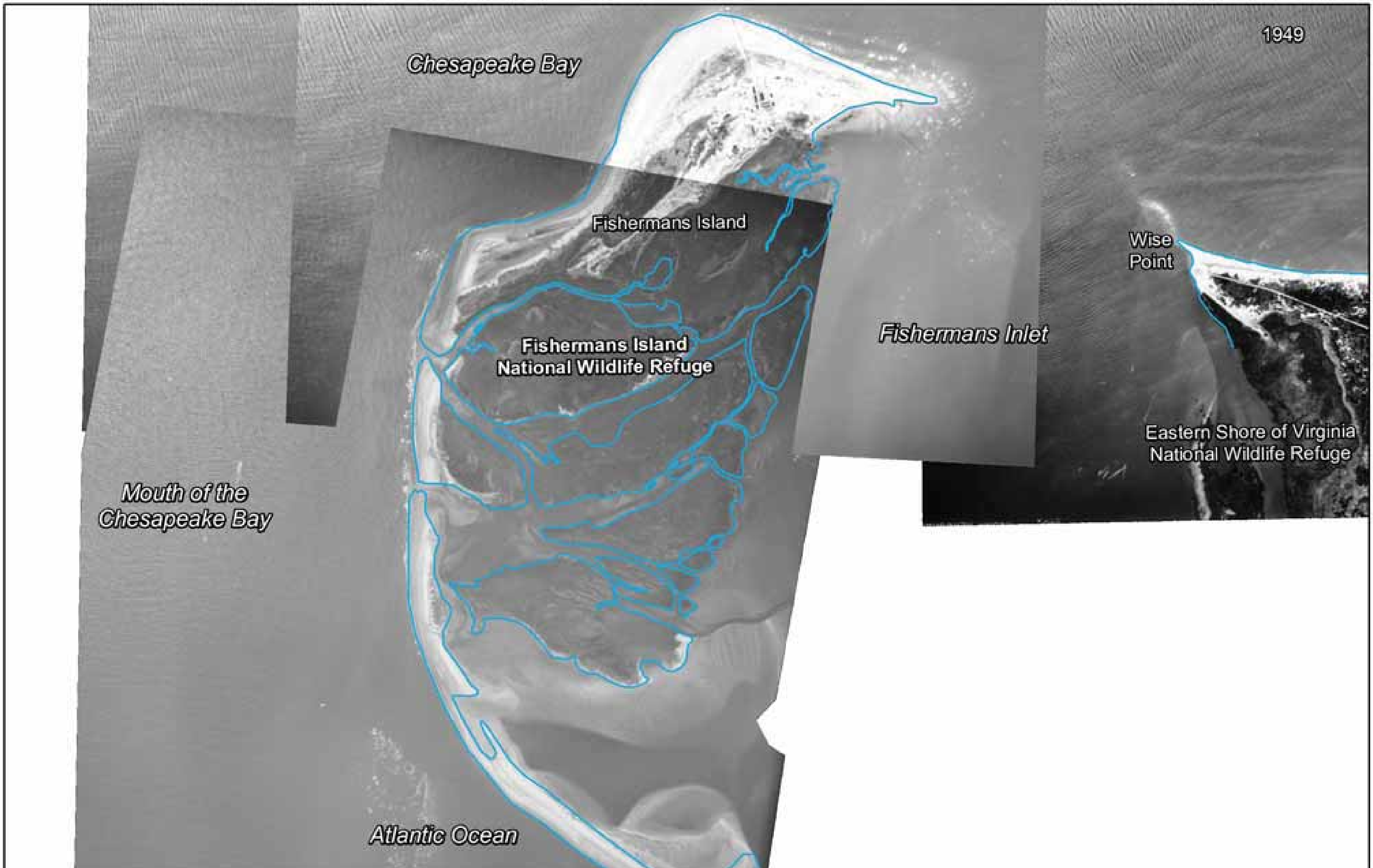

Legend
1938 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 15

Shoreline Studies Program VIMS

B-85

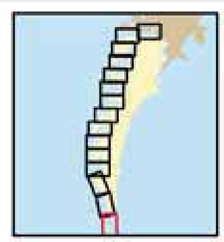



**Legend**

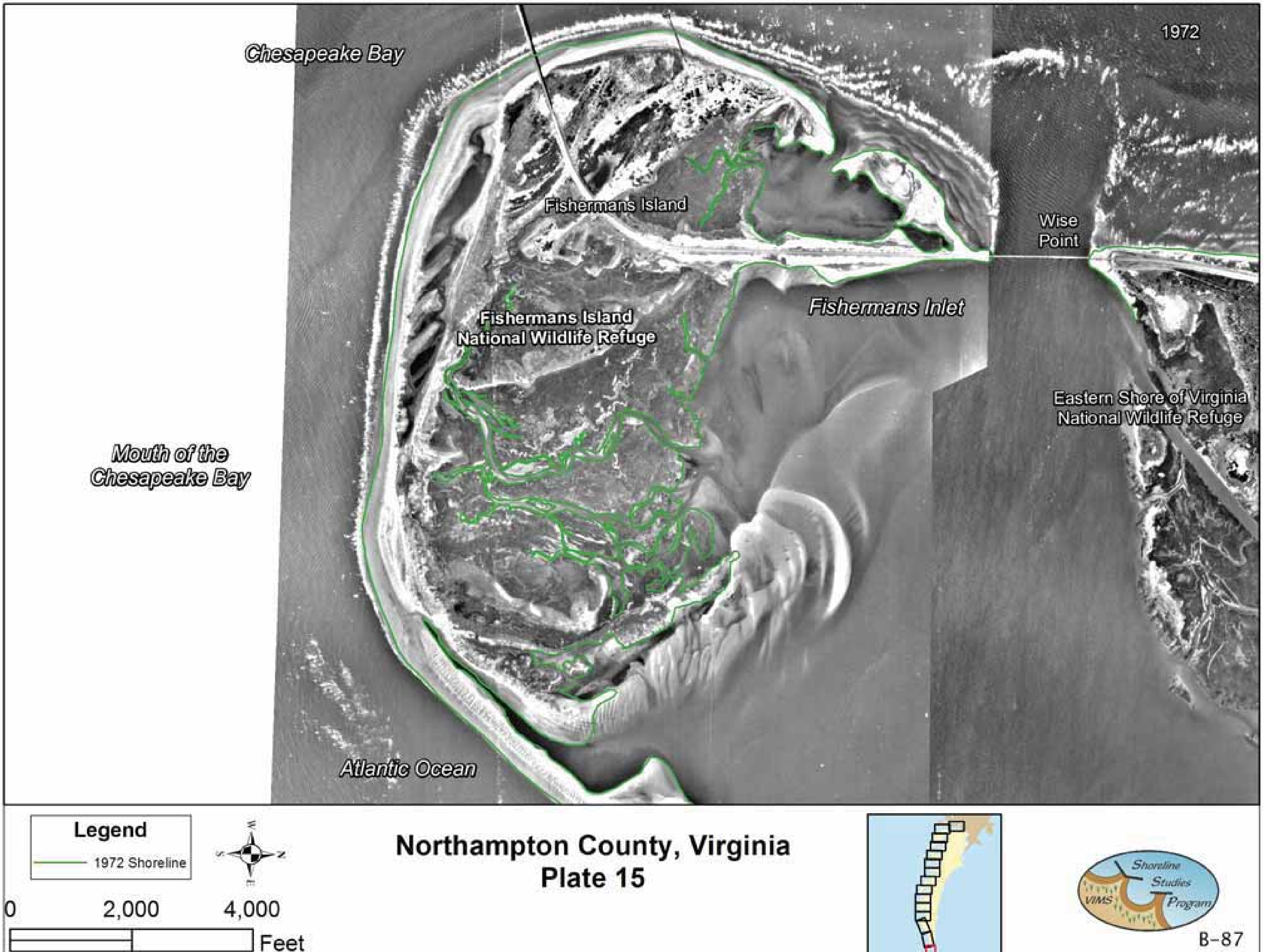
1949 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 15

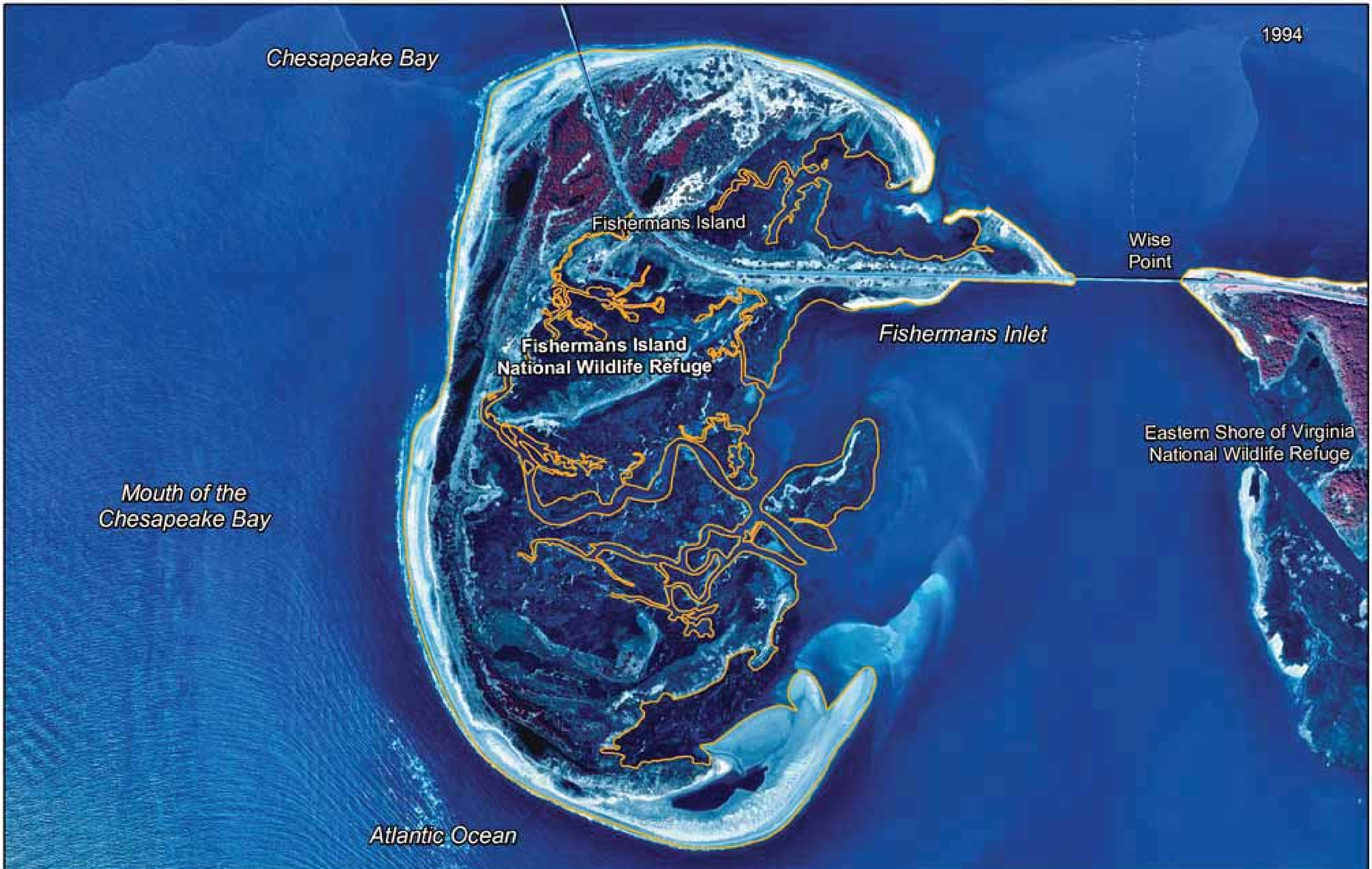


VIMS Shoreline Studies Program




# Northampton County, Virginia
## Plate 15

Shoreline Studies Program
VIMS

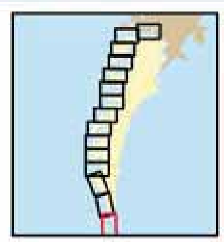



**Legend**

1994 Shoreline

0 2,000 4,000 Feet

## Northampton County, Virginia
## Plate 15



Shoreline Studies Program VIMS


Legend

2002 Shoreline

0 2,000 4,000 Feet

# Northampton County, Virginia
## Plate 15

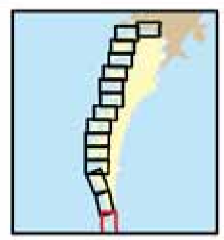
Shoreline Studies Program VIMS


**Legend**

1938 Shoreline
1949 Shoreline
1972 Shoreline
1994 Shoreline
2002 Shoreline
2009 Shoreline

## Northampton County, Virginia
## Plate 15

0 2,000 4,000 Feet



Shoreline Studies Program VIMS

B-90