Developing Watershed Priorities for Mapping Indigenous Cultural Landscapes of the Greater Chesapeake Bay

Prepared By:
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Prepared For:
National Park Service Chesapeake Bay
The Chesapeake Conservancy

St. Mary's College of Maryland
St. Mary's City, Maryland
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EXECUTIVE SUMMARY

The purpose of this project was to develop a prioritized list for modeling Indigenous Cultural Landscapes for the tidal Chesapeake. The project was undertaken as an initiative of the National Park Service Chesapeake Bay office, which supports and manages the Captain John Smith Chesapeake National Historic Trail. One of the goals of the trail is to interpret Native life in the Middle Atlantic in the early years of colonization by Europeans. The Indigenous Cultural Landscape (ICL) concept, developed as an important tool for identifying Native landscapes, has been incorporated into the Smith Trail's Comprehensive Management Plan in an effort to identify Native communities along the trail as they existed in the early 17th-century and as they exist today. Identifying ICLs along the Smith Trail serves land and cultural conservation, education, historic preservation, and economic development goals. Identifying ICLs further empowers descendant indigenous communities to participate fully in achieving these goals. Previous ICL studies have taken place in the Nanticoke watershed on the Delmarva Peninsula, the Mattawoman and Nanjemoy Creeks in southern Maryland, and the Susquehanna River at the head of the Bay.

While the project focused on the tidal Chesapeake, the project area included a 10-mile radius area extending from tidal shores to include as much of the landscape as possible. The project area consists of approximately 17,170 square miles of water and land, extending from the mouth of the Bay to the Susquehanna River. From east to west, the project extends from within the Delmarva Peninsula to the Fall Line, or to Richmond, Virginia. This region has a human history stretching back thousands of years and was a well populated region during Captain John Smith's voyages to explore and map the Chesapeake in 1608. Following the arrival of European settlers in the early 17th century, the region remained a largely indigenous landscape until later in the century, when English encroachment created serious challenges for the Native people residing in the region. Despite displacement through the end of the 17th and 18th centuries, descendants of the Native occupants remain throughout the region to this day.

The primary goal of this project was to develop a priority list for modeling future ICLs in that part of the Chesapeake Bay associated with Smith's voyages. This goal was addressed through the development of a sensitivity model reflecting settlement activity during the Late Woodland period (ca. 900-1600 AD) through the early 17th century. By examining relationships between known archaeological resources and their surrounding environment, landscape variables correlating to site presence were used to develop a model of settlement for the greater Bay landscape. Analysis of this model demonstrates that it can successfully identify 77% of known archaeological sites of the focus periods on 27% of the total land area. The model, while generated on a relatively large regional scale, both compares well and contrasts with Smith's own observations in 1608. Where Smith's map and the sensitivity model differ suggests ways in which Smith's map might be interpreted. For example, Smith shows sparse settlement along wide water bodies, such as the Chesapeake shoreline, but dense settlement along more narrow rivers and tributaries. The absence of settlements in certain areas, then, could be a function of distance visibility, impacting Smith's ability to fully record settlements that may have in fact existed.

In collaboration with staff from the National Park Service Chesapeake Bay office, other variables for identifying priority areas for examination were identified. These variables included the presence of active indigenous communities, areas threatened by development and/or climate change, and areas of potential archaeological and historical significance. Using these variables and variables previously identified for modeling ICLs, recommendations for future ICL studies throughout the tidal Chesapeake were developed based on a synthesis of the available data. Watershed regions with active indigenous communities, areas of archaeological sensitivity, areas of dense settlement activity as denoted by Smith, and potentially threatened areas have been deemed the highest priority for further study. Fourteen specific watersheds have been identified and ranked using these criteria. Of these fourteen specific watersheds, the Nanticoke and Rappahannock rivers have already been or will be the subject of ICL studies. These two areas have been removed from the priority list. Also previously completed was a project focused on the Nanjemoy and Mattawoman creeks, a portion of Priority Number 8, the Potomac River from Washington D.C. to Port Tobacco. The twelve Priority Watershed Areas recommended for future ICL studies include the following:

1. York River (river's mouth to West Point);
2. Pamunkey River;
3. Mattaponi River ;
4. James River (Chickahominy River to river's mouth);
5. James River (Richmond to and including the Chickahominy River);
6. Patuxent River;
7. Potomac River (Port Tobacco to Point Lookout);
8. Potomac River (from Washington DC to Port Tobacco, including the Anacostia River);
9. Chester River;
10. Choptank River;
11. Pocomoke River;
12. Wicomico River (Eastern Shore).

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Any errors in fact or interpretation are the responsibility of the authors.

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I. Introduction

This project was undertaken as an initiative of the National Park Service Chesapeake Bay Office, which supports and manages the Captain John Smith Chesapeake National Historic Trail (NHT). The Captain John Smith NHT was Congressionally-established in 2006 to commemorate the then upcoming 400th anniversary of Smith's exploration of the Chesapeake Bay (1607-1609). As Smith sailed up the Bay and into its tributaries, he encountered hundreds of hamlets, towns, and territories populated by nations whose histories extended back centuries and even millennia. Smith's visit looms large in the modern national consciousness because of the extraordinary map and report he created trying to make sense of the Native cultures and polities he saw, all part of an effort to send information about the promise of colonization in this region back to investors in England. Despite Smith's biases and incomplete understandings of what he and his crew observed, his map and report are considered foundational documents in American history, revealing the extent of indigenous occupation in a land Europeans would nonetheless go on to characterize as "uncultivated," vacant, and ready for appropriation.

The Indigenous Cultural Landscape (ICL) concept (Beacham 2012, 2015) is a key component of the Captain John Smith Chesapeake National Historic Trail Comprehensive Management Plan (CMP). According to the CMP, ICLs represent "the contexts of the American Indian peoples in the Chesapeake Bay and their interaction with the landscape" (National Park Service 2010:4.22). ICLs are areas either containing or with a high potential for containing pre- and post-Contact Native American archaeological sites within large and relatively undisturbed surrounding landscapes. These landscapes should accurately reflect the culture and lifeways of the communities who lived within them (and often still do). ICLs are dynamic landscapes, with broad and diverse areas used in different ways across seasons and over considerable time periods. These landscapes may be in "proximity to known American Indian communities" and may be "part of a descendant community's past known through tribal history, oral history, or archaeology." Therefore, areas important to living indigenous descendant groups that are of more recent history are also part of ICLs.

Previous ICL studies in support of the CMP have focused on river drainages as both manageable and meaningful units of study. Studies to date include the Nanticoke River watershed on Maryland's Eastern Shore (Sullivan, Chambers, and Barbery 2013), the Nanjemoy/Mattawoman Creek watersheds on Maryland's Western Shore (Strickland, Busby, and King 2015), and the Susquehanna River watershed at the head of the bay (the latter underway as of the writing of this report). The focus on these areas was driven by several timely and converging factors, including landscapes considered potentially threatened (either by development or rising sea level), the contemporary presence of indigenous communities, documented archaeological resources, unusually rich documentary records, and the presence of landscapes considered evocative of the ICL.

These previous studies also provided an opportunity for refining both the criteria and the methodology used to identify ICLs associated with the John Smith Trail. In addition to a refined list of criteria, project management considerations have revealed the value of a focus on watersheds, first suggested by Sullivan, Chambers, and Barbery (2013:1) in their study of the Nanticoke ICL. This recommendation acknowledges that the greater Chesapeake Bay watershed is highly variable and that the Native groups who occupied this region beginning some 12,000 years ago both shaped and were influenced by these local environments and ecologies. Strickland, Busby, and King (2015:62) found that watersheds generally align with the home territories of Native groups although the fit is not always perfect. Still, watersheds can serve as initial organizing domains, but should also be approached on a case-by-case basis.

Accepting that watershed (and sub-watershed) analysis provides the most efficient framework for identifying and representing ICLs in the Chesapeake Bay drainage, this project aimed to identify those watersheds with a high potential for containing ICLs and prioritize their future mapping based on archaeological, historical, ecological, and environmental significance, the presence of active contemporary indigenous communities, and potential threats presented by development and/or climate change. By undertaking a systematic and more global examination of the entire length of the Chesapeake Bay, including the Captain John Smith Chesapeake National Historic Trail, this project used criteria defined and subsequently refined by the National Park Service for the identification of ICLs. This project also examined existing land uses and land use change in the Bay's watershed in relation to potential ICL areas in an effort to prioritize those landscapes at greatest risk for loss.

This report describes the results of this greater study of the Smith NHT and the Chesapeake Bay watershed. The study used practical GIS applications of modeling archaeological sensitivity, environmental variables, land use, and the presence of contemporary communities to create a priority list of landscapes in the Chesapeake Bay watershed for more detailed future study. The project area included portions of the watershed in Maryland, Pennsylvania, Virginia, and Washington, D.C. Unfortunately, archaeological spatial data from Delaware could not be included in this study because of time constraints accessing the data. The portions of the project area within the state, however, are minimal and the absence of data from Delaware does not have a significant impact on the findings presented in this report. As these data become available, they will be included in any addendum to these findings.

II. The Indigenous Cultural Landscape Concept

A set of basic criteria for identifying landscapes found within an ICL was devised in 2011 by the National Park Service. An additional set of criteria was created and tailored for the Nanjemoy/ Mattawoman (Potomac River) watershed study to make the concept meaningful locally. These criteria emerged from comments and suggestions made by project stakeholders, including the state-recognized Piscataway groups. Through discussions with National Park Service staff, the criteria for ICLs was adjusted to reflect the additions and changes developed through the Nanjemoy/Mattawoman watershed study and are presented as followed:

- Good agricultural soil (fine sandy loam, 1-2% grade);
- Fresh water source (river or creek water may be brackish);
- Transportation tributary adjacent;
- Landing place (confluence of tributaries optimal);
- Marshes nearby (for waterfowl, shellfish, reeds, tubes, muskrat, turtles);
- Brushy areas (for small games, berries);
- Primary or mixed deciduous forest (for larger game, nuts, bark, firewood);
- Uplands that could support hunting activities (and a variety of wildlife);
- Proximity to known American Indian communities (documented through ethno-history or archaeology; may be post-Contact);
- Protection from wind;
- High terrace landform;
- Areas associated with living communities/families;
- Areas associated with indigenous use in the past, including archaeological significant sites and historical areas with considerable time depth;
- Burial sites and spiritually significant areas/sites;
- Places known through historical documentation such as John Smith’s maps and writings, colonial land records, known paths, house sits, town sites, and reservation land;
- Threatened landscapes where preservation is still possible;
- Places suitable for land-based visitor experiences and interpretation of indigenous culture and history, especially those places evocative of past landscapes.

Other kinds of criteria that might be regionally relevant to an ICL include:

- Areas of recurrent use for food or medicine acquisition (shell middens, plant gathering sites);
- Areas of recurrent use for tool acquisition (quarries, clay sources);
- Places with high probability for ceremonial or spiritual use (even if not documented), or known by descendant community to have been used for ceremony;
- Trails used as footpaths (usually became Colonial roads, sometimes are today’s highways and local roads).
- Parcels that can be interpreted as supporting activities of Indian community sustainability, such as trading places or meeting places;
- Places associated with ancestors, or part of a descendent community’s past known through tribal history, ethno-history, or archaeology.

For the present project, which seeks to identify and prioritize potential ICL identification at a macro level (i.e., the entire tidal Chesapeake Bay), five criteria were found to be especially useful for predicting high probability or sensitivity areas. These criteria included soils, freshwater sources, marshes/wetlands, slope, and proximity to Native communities, both in the past (archaeological sites) and in the present (contemporary Native communities). Other variables used to develop the ranking for priority landscapes included archaeological and historical significance and land use change, such as residential and commercial development, linear infrastructure (road construction), or climate change.

The data necessary to identify and measure these variables and their relationships came from a wide variety of sources, including readily available online databases. Archaeological and historical significance derives from a general consensus about what constitutes events important in American history as well as an area’s potential for containing historic properties (archaeological sites and landscapes listed in or considered eligible for the National Register of Historic Places). Together, these variables served to identify potential ICL areas and provide information for prioritizing their mapping.

III. Project Area

The spatial extent of this project consists of a ten-mile buffer along the tidal extents of the Chesapeake Bay watershed and includes water bodies presumably accessible by Captain John Smith in 1608 (Figure 1). A ten-mile buffer ensures ample land coverage for archaeological site sampling while keeping the project area manageable for analysis and computing requirements. The project area includes approximately 17,170 square miles, or about 25% of the Bay's watershed.

The project area lies almost entirely within the Coastal Plain, reaching the Piedmont in only a few cases along its northern and western boundaries. At the time of Smith's voyages, the native groups present consisted primarily of Algonquian speaking peoples. Iroquoian peoples were present in the region at the headwaters of the bay and Siouan speaking groups in the Piedmont. The project area represents all waterways and tributaries visited by Smith, including the many towns Smith recorded (Figure 2; readers are cautioned that Smith's map, while impressively accurate, is not accurate enough to tie depicted towns with archaeological sites except in a few cases. The map shown in Figure 2 should therefore be used with extreme caution). A few Native settlements shown on Smith's Map, however, are beyond the ten-mile buffer project area. These settlements lie beyond areas marked by Smith as the extent of his exploration, and he describes learning about these towns "by relation" or from Native informants.

The project's chronological boundaries range from about 900 AD through the 20th-century (archaeologically, the Late Woodland and Contact/post-Contact periods). The beginning date – 900 A.D. – is based on archaeological studies in the Chesapeake Bay watershed suggesting increased sedentism and political complexity as reflected in archaeological evidence. Domesticated plants had become an important resource, although groups continued to rely on foraging and hunting for subsistence and seasonal movement is evident in the archaeological record. The end date chosen, the 20th century, coincides with Native revitalization efforts following decades of governmental efforts to eradicate Indian identity, exacerbated by the nation's Jim Crow laws. Comprising more than a thousand years, there is considerable variability within this time frame and its use in this case is solely for the purpose of identifying priority landscape areas for future, more detailed study.

The Chesapeake Bay is one of the most important estuaries in the world and the largest in the United States; its shoreline stretches for nearly 12,000 miles. The Chesapeake Bay is relatively young in the landscape, formed by melting glacial waters beginning in the Holocene. In fact, people were in the Bay's watershed for several thousand years before the Bay achieved a form its modern inhabitants (including Smith) would have recognized. It is fed by dozens of major streams and rivers, and the valleys along which these rivers traveled became important transportation routes in prehistory and remain so into the present day. The Bay is a veritable protein factory, with an estimated 3,600 plant and animal species in the watershed.

Although people had been in the Bay's watershed for at least 12,000 years, it wasn't until ca. 1300 AD that population growth dramatically increased, evidenced by a growing number of settlements and a growing number of individual households within these settlements. Domesticated crops, including corn (an import from Mexico), an astonishing indigenous mobility, and centralizing political authority are evident in the archaeological record and the limited oral history record. When Smith and the other Virginia colonists arrived in the Chesapeake Bay in 1607, they encountered an indigenous landscape of centuries-old and diverse nations taking full advantage of the Bay's resources.

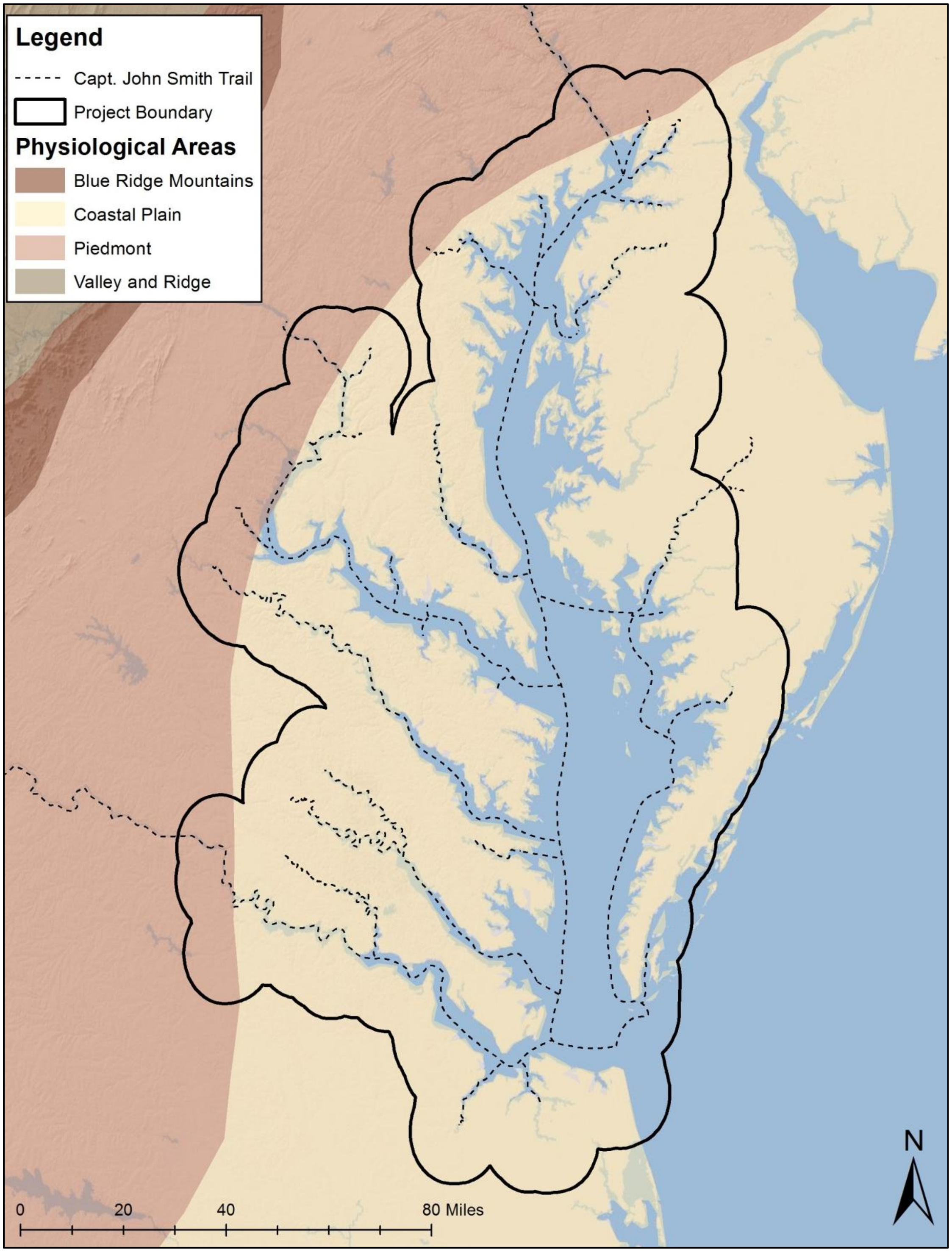

Figure 1. Project Area[1] with physiological regions.

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[1] The project area consists of a 10 mile buffer from waterways of the trail. Though the Captain John Smith Chesapeake National Historic Trail extends along the Potomac and the James beyond the bounds the project area, these portions are located well into the Piedmont region. Portions of the Nanticoke lie beyond tidal waters, which terminate roughly where the river intersects US Route 50.

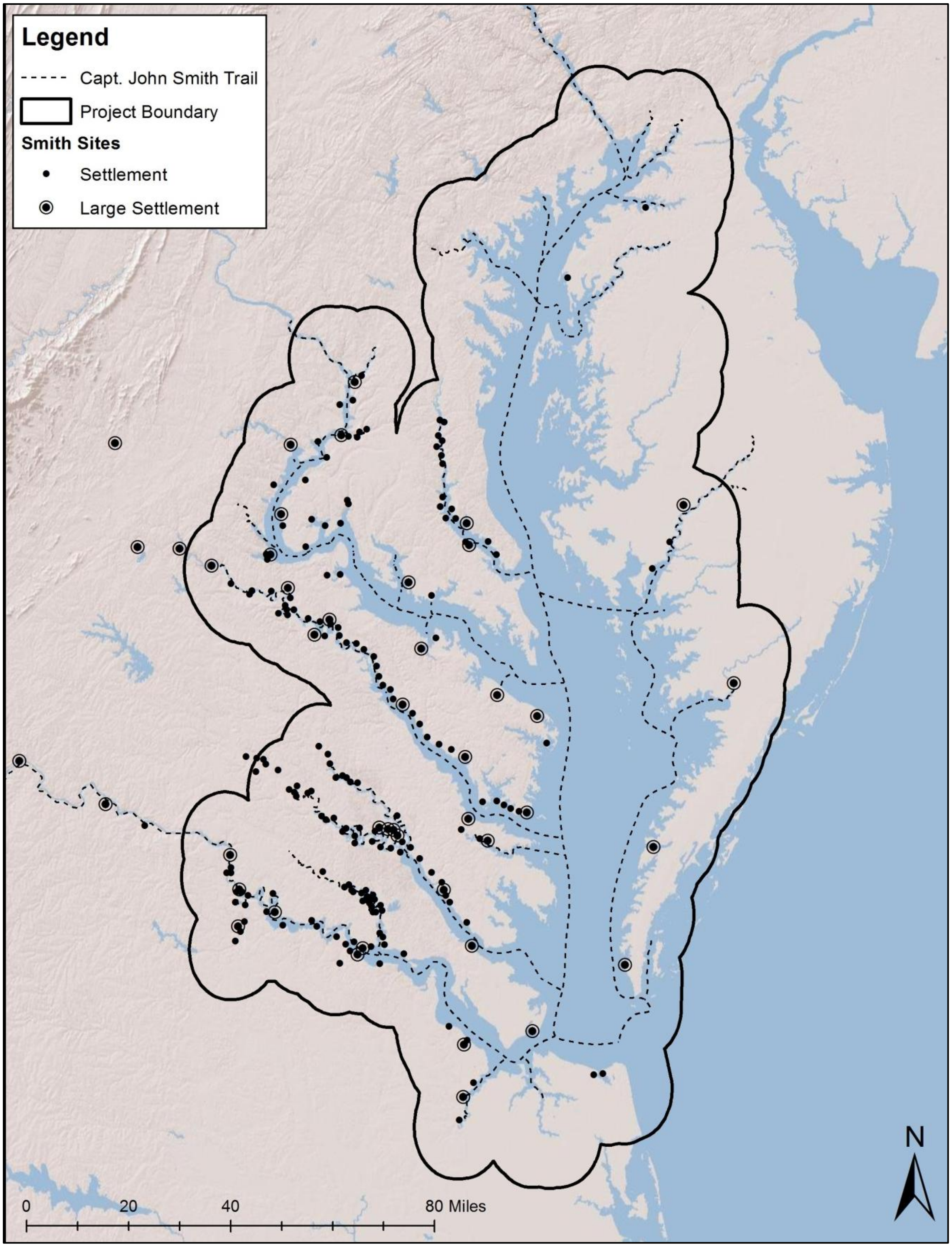

Figure 2. Settlements identified by Captain John Smith; this map should be used with caution.

IV. Indigenous Settlement Models of the Chesapeake Bay Region: Previous Research

There have been a number of ways by which researchers have attempted to model the settlement of people in the Chesapeake and other Algonquian-speaking regions. Studies of the Middle Woodland (500 BC-900 AD) and early Late Woodland (900 AD-1200AD) periods in both Maryland and Virginia have shown that these centuries were a transitional period of increasing sedentism (living in one place for periods at a time), population growth, and the emergence of larger group territories, economies, and polities. These changes may have been spurred by better access to reliable food sources, including domesticated plants (Sperling 2008:24). A growing dependence on domesticated foods requires different structures for ensuring adequate food supplies, including the ability to store resources for future use in subsurface pits, ceramic pots, or above-ground granaries. Availability of resources appears to be the major contributing factor in this transition and many archaeologists saw an important shift ca. 900 AD, with Native communities entering a different phase of development known as the Late Woodland.

Archaeologist Martin Gallivan (2002) has challenged the common understanding that there was a sudden and dramatic shift toward greater sedentariness in the early part of the Late Woodland. Gallivan argues that sedentary practice at the beginning of the Late Woodland period differed only slightly from the end of the Middle Woodland period. Examining site population density and duration of occupation through an examination of ceramic discard, Gallivan found that it was only after 1200 AD (and not after 900 AD) that more permanent and substantial settlements appear in the archaeological record, at least in the James River valley and surrounding environs.

Gallivan's observations accord with shifts seen in the archaeological record in the Potomac River valley, with support for these shifts provided by an unusual oral history account. Prior to about 1300 AD, the predominant ceramic type in the Coastal Plain Potomac was Townsend ware, shell-tempered ceramics produced from about 950 AD through the late 17th and early 18th centuries. Beginning about 1300 AD, however, grit- and/or sand-tempered ceramics, including Potomac Creek and, later, Moyaone ware types, also appear in the river valley's archaeological record.

A number of archaeologists have pointed out that, at about the time grit-tempered Potomac Creek ceramics began to appear in the inner coastal plain, palisaded towns in the Piedmont on both sides of the Potomac River were being abandoned; the inhabitants of these towns made and used a crushed quartz-tempered ceramic analogous to Potomac Creek types. As these towns were being abandoned, others in the piedmont were being established by people producing predominantly limestone-tempered ceramics. Archaeologists infer that the appearance of Potomac Creek ceramics in the Middle Potomac valley may reflect migrations from the Piedmont into the Coastal Plain, possibly spurred by migrations into the Piedmont from the west.

The radiocarbon dates associated with the earliest appearance of Potomac Creek ceramics (ca. 1300 AD) in the lower Potomac valley roughly correspond with the date suggested by an unusual surviving Piscataway oral history (ca. 1270-1400 AD). This oral history, recorded in 1660 by the colonial Maryland government, described an ancestor of the Piscataway coming from the Eastern Shore to rule over the Piscataway, Patawomeck, and Susquehannock nations. Researchers have noted that the oral history refers to a leader coming from the east while the archaeological evidence suggests migrants from the west. The evidence is complicated by the late anthropologist Paul Cissna's (1986:31; 41-48) analysis of a surviving Piscataway translation of the Ten Commandments (housed at Georgetown University's Lauinger Library) suggesting strong affinities with the language spoken by both the Powhatan and the Delaware and not with western groups. A study of ossuaries from throughout the Maryland coastal plain suggests that ossuary burials appeared first on the Eastern Shore and slightly later on the western shore (Curry 1999), a phenomenon which could be interpreted as possibly reflecting some kind of movement from the east.

Archaeologist Stephen Potter (1993:138) argues that these variable sources of evidence are not necessarily mutually exclusive and may indicate an “intergroup alliance” forged by a leader who had indeed come from the Eastern Shore and seated himself at Moyaone (Potter 1993:138; Merrell 1979:550). Whether Potter’s interpretation is right or not, the point is that, oral historical, linguistic, and archaeological evidence indicate what appear to be major shifts in population in the Potomac River valley beginning ca. 1300 AD. Combined with Gallivan’s findings for the James River valley, 1300 AD appears to be an important date in regional Native history in terms of economic, social, and political development.

Gallivan also found that, at least in Virginia between 1500 and 1607, there was an apparent *decline* in sedentariness, caused perhaps by political instability, an extended dry period (as revealed by tree ring evidence), or both (Gallivan 2002:549-552). The standard argument for this decline has been indigenous populations stricken with disease brought by earlier European explorations. Such explorations would have included the failed Spanish Jesuit Ajacán Mission of 1570 (probably on the York River) and earlier expeditions by Lucas Vázquez de Ayllón in 1525 and Ángel de Villafañe in 1561 (Loker 2010; Potter 1993:161-164). Populations in parts of New England in the early 17th century were apparently decimated by European diseases before permanent English settlement took place in that region (Marr and Cathey 2010). European-borne diseases could have conceivably had an impact on populations in the Chesapeake, leading, for example, to the destruction of populations at Shenks Ferry in the Susquehanna Valley (Pendergast 1991:45)

Other researchers, however, contend that there is little archaeological evidence, at least in the Potomac, to support the notion that 16th-century European contact had brought any epidemics to the Native population (Potter 1993:165). Studies of Late Woodland populations in the Potomac drainage in particular suggest that there was actually an increase in population size (Ubelaker 1974:68), and the abandonment of major settlements may date more recently, to the first decades of the 17th century; in some cases, these settlements moved inland along creeks or less exposed waterways. In order to fully resolve questions about the impact of European-borne epidemics in the 16th century, further study is clearly needed (Potter 1993:166).

Potter (1993:102) noted a shift in archaeological site types and their distributions from the earlier part of the Late Woodland to the later part in the Northern Neck of Virginia. Sites of “intermediate” size distributed across river necklands were generally supplanted by a single large site containing dispersed residential settlements. During the later Late Woodland, the chief’s residence came to form a “core settlement” within the larger, dispersed village. Clusters of houses as well as hunting and gathering camps would be located within a 2-km range of the core (Potter 1993:88-89).

Potter’s systematic study provides an estimate of the size of what could reasonably be called a catchment area for a community and provides a robust starting point for defining Smith-era ICLs. Similar work on the dynamic nature of Late Woodland regional indigenous landscapes can be found in the work of E. Randolph Turner III (1976) and Helen Rountree (1989). These communities, while essentially “permanent” and centered around river drainages, often shifted throughout the landscape in response to resource availability (good soil, firewood), climate and weather, trading relations, and unfriendly neighbors.

Jay Custer and Daniel Griffith (1986) examined Late Woodland settlement patterns on the Delmarva Peninsula (the eastern shore of the Chesapeake, including Delaware, Maryland, and Virginia), through a focus on the seasonal mobility of macro- and micro-band base camps. Custer and Griffith developed five models of seasonally-based settlement patterns on the peninsula (Table 1). They found that macro-band base camps are typically found in floodplains along the major drainages of the Delmarva Peninsula, close to marshes on land between saltwater and freshwater environments. A minority of macro-band settlements, however, are found on bluffs overlooking drainage sections with low terraces

Model	Winter	Spring	Summer	Fall
1	Micro-band base camp; interior	Micro-band base camp; mid-drainage	Micro-band base camp; coastal	Micro-band base camp; mid-drainage
2	Macro-band base camp; interior	Macro-band base camp; mid-drainage	Macro-band base camp; coastal	Macro-band base camp; interior
3	Macro-band base camp; interior	Macro-band base camp; coastal		Macro-band base camp; interior
4	Macro-band base camp; mid-drainage		Micro-band base camp; coastal	Macro-band base camp; mid-drainage
5	Macro-band base camp; mid-drainage			

Table 1. Five models of Late Woodland Settlement on the Delmarva Peninsula (Source: Custer and Griffith 1986).

and marshes. Conversely, micro-band base camps are noted as appearing along marshes, lagoons, and bays as well as in the floodplains of major drainages.

Sites classified as procurement sites or short-term camps have more subtle distribution patterns. These sites are found in poorly drained woodlands along small sand ridges near low-order ephemeral streams. There are also regional differences, as small procurement sites appear along both major drainages (adjacent to swamps and marshes) and small bays and drainages (adjacent to barrier islands along the Atlantic coasts and the Chesapeake shoreline). These sites are presumably located in areas good for hunting, gathering, and shellfish collecting (Clark 1976; Custer and Griffith 1986).

Evidence from Virginia's piedmont communities reveals the great variation that existed in the Native landscape (Hantman 1993). Piedmont groups exhibited dispersed communities and isolated homesites away from the major river drainages. Late Woodland settlement patterns on the Delmarva Peninsula ranged from diffuse to concentrated (Thomas et al. 1975; Custer 1989). Busby's (2010) recent examination of Nanticoke settlements on Maryland's Eastern Shore showed a nucleated "core settlement" with smaller sites across a broad 3-km-plus area during the later Late Woodland giving way to more dispersed linear settlements along secondary drainages in the early Contact period. The point is, even within this relatively constricted area of the Chesapeake drainage on the Eastern Shore, variation in expression of communities across the landscape existed.

GIS-Based Approaches

GIS-based approaches to human settlement have emerged as a powerful tool for understanding the relationship of settlement locations to the environment and other natural, social, and cultural factors. GIS technology allows a far greater amount of data to be collected, processed, and analyzed, with models based on a more rigorous foundation than earlier efforts, leading to strengthened interpretations. A number of different GIS-based studies have been undertaken throughout the Chesapeake, although not on a broad, Chesapeake-wide scale. Nonetheless, these growing numbers of studies have served to inform researchers about variables correlating (or not) with Native settlement in the broader Chesapeake region.

Strickland (2012) examined the nature of Native settlement on the lower and middle Potomac's north shore, using archaeological site typologies defined by the Maryland Historical Trust (MHT). Not surprisingly, these typologies can be problematic, especially for those sites identified as "short-term camps" and "procurement sites." These types of sites appear with the largest frequency in MHT's archaeological site inventories, and the label appears to function as a catch-all term for indigenous sites with as-yet-unknown settlement activity. Nonetheless, Strickland's analysis revealed statistically significant correlations of Late Woodland sites with proximity to wetland areas such as the Potomac River and inland waterways. He also found that there was a range of correlations between site types, agriculturally productive soils, elevation, and slope. Strickland was able to identify four types of Native settlement on Maryland’s lower western shore and the attributes of each type. A summary of the results and interpretation of the statistical correlative studies of typologies can be found in Table 2. A proposed settlement model based on this data can be found in Figure 3.

Typology	**Attributes**
Villages/Towns	1.) Strong association with proximity to shore
	2.) Low elevations
	3.) High potential crop yields
	4.) Within close proximity to the most productive soils for corn
Base Camps	1.) Close proximity to shore but with a longer range
	2.) Range of elevations for its shore proximity
	3.) No observed correlations to tested soil attributes
Hamlets	1.) Close proximity to the shore
	2.) Higher elevations than villages, but not a longer range
	3.) Range of different soil productivity attributes
	4.) Close proximity to villages and base camps
Short-term Camps/ Procurement	1.) Close proximity to shore but with a longer range
	2.) Range of elevations for its shore proximity
	3.) Slight association with agriculturally productive soil types
	4.) Range of travel times from villages and base camps, but still clustered with them

Table 2. Lower Potomac Late Woodland settlement attributes by type (adapted from Strickland 2012).

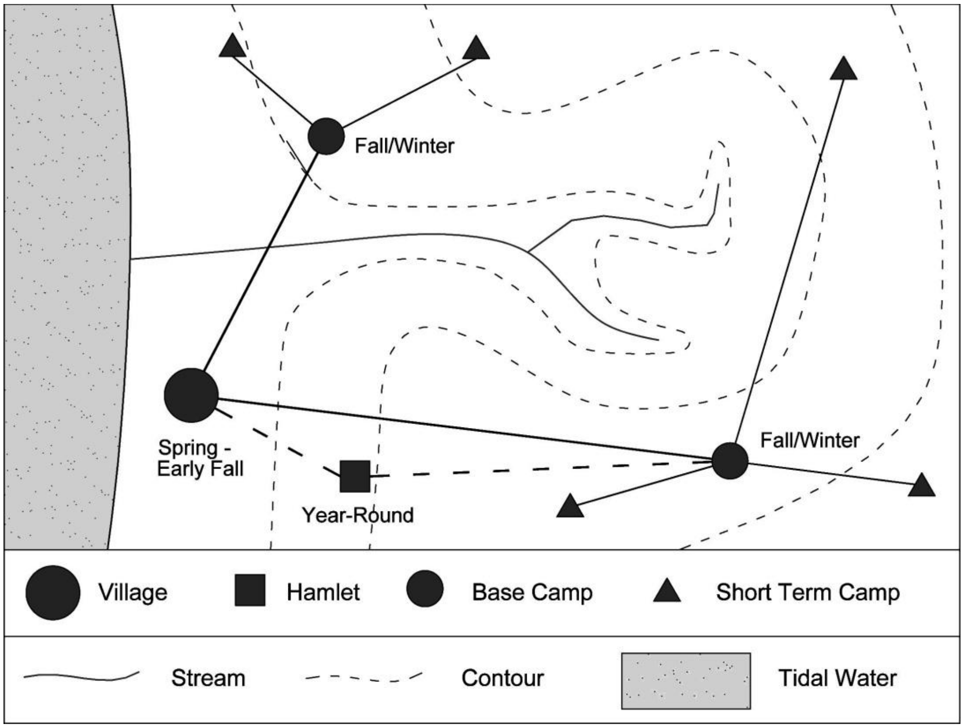

Figure 3. Lower Potomac Late Woodland settlement model (adapted from Strickland 2012).

Archaeologists with Washington College have used a GIS-based approach to model settlement on a micro-regional level along the Chester River in Kent and Queen Anne counties in Maryland (Seidel et al. 2004). While previous researchers had focused on the settlement patterns of Late Woodland populations (Custer and Griffith 1986), archaeologist John Seidel, building on previous work by Darrin Lowery (1997), has developed a predictive model for settlement in three different chronological categories: prehistoric, 17th through the 18th century, and 19th through the early 20th century.

Lowery (1997) had previously defined what he termed "focal landscapes," including:

1) Point Focus: settlement on points of well-drained land, usually surrounded by water;
2) Cove Focus: settlement around small estuarine coves or creeks;
3) Converging Stream Focus: settlement on knolls or terraces above the confluence of freshwater streams;
4) Springhead Focus: settlement around active freshwater spring;
5) Interior Stream Focus: settlement on ridges or terraces along freshwater drainage systems;
6) Sand Ridge Focus: settlement along well-drained sandy ridges, usually Aeolian in origin;
7) Bay Basin Focus: settlement along well-drained rims surrounding shallow, poorly drained depressions;
8) Estuarine Wetland Focus: settlement on knolls or ridges adjacent to or within broad marshes; and
9) Rivershore Focus: settlement on high ground along the major tributaries of the Chesapeake Bay.

Seidel (2004:38-39) then took a GIS-based approach to Lowery's classifications, identifying four variables of importance for defining potential site locations, including soil type (well-drained, poorly drained, sandy, silty); slope (steep or shallow); proximity to water (streams, creeks, wetlands); and water type (fresh, brackish, salty) (Seidel 2004:37). Modeling the relationships between these variables, Seidel was able to define landscapes as areas of Very High, High, and Moderate probability for containing archaeological sites.

Seidel's predictive model was largely based on soil survey maps for the two counties in his project area. Soil types can be used to define areas where water from precipitation, runoff, or flooding is most easily absorbed. Soil types can also serve as a proxy for the types of plants available in an environment and, in turn, the types of animals exploiting these plants. Settlement choices are also influenced by the desire to dwell on well-drained, level, and dry ground. Not surprisingly, Seidel found that sites are generally found on slopes between 2 and 10 percent and within close proximity to freshwater (Seidel et al. 2004:37-38).

The work done on the Chester River mirrors similar approaches used by cultural resource management firms and the Federal Government for planning and mitigation purposes. In the Chesapeake region, predictive models have been developed for Aberdeen Proving Ground, NASA Goddard Spaceflight Center, and the Patuxent River Naval Air Station, all Federal facilities located on Maryland's western shore.

The US Army's Aberdeen Proving Ground facility (APG) consists of 39,000 acres located near the head of the Chesapeake Bay in Harford County, Maryland. Archaeologists Konnie Westcott and James Kuiper (2000) developed a model for the facility based on an analysis of 572 recorded pre-Contact archaeological sites in the Upper Chesapeake Bay.

The following variables were considered in the development of the Aberdeen model:

1) Proximity to nearest water;

2) Proximity to nearest brackish water;
3) Type of nearest water;
4) Soil type;
5) Elevation;
6) Slope; and
7) Aspect.

Distance to water (ft)	Water type	Elevation (ft)	Topography
0-500 >500	Brackish Fresh	0-20 >20	Terrace/Bluff Floodplain/Flat

Table 3. Attribute classifications for Aberdeen Proving Ground predictive model.

To develop final model calculations for the Aberdeen Proving Ground facility, unique combinations of environmental attributes using the variable categories shown in Table 3 were developed. The frequency of observed sites located on each unique landscape combination was tabulated. Based on the percentage of sites found on each landscape combination, a level of site potential was assigned as High, Medium, or Low/No Potential. Those with site percentages of over 20% were classified as High, between 6.25% and 20% as Medium, and less than 6.25% as Low/No Potential.

The resulting model was tested for efficacy using Kvamme's Gain Statistic, calculated using the equation *1-[percent area / percent known sites*] (Kvamme 1989). The closer the resulting statistic is to 1, the more perfect the model is. Any model with a gain statistic over 0.5 is considered a positive prediction. The Gain Statistic for areas designated as High Potential at Aberdeen was 0.79, with nearly 91 percent of targeted sites located in an area comprising approximately 19 percent of the land area. If sites were distributed randomly, a Gain Statistic closer to 0 would be expected. A random distribution of points along the same high probability area should account for an occurrence of only 19%, therefore the Aberdeen model demonstrates that the gain is 4.78 times what could be expected from a random distribution.

Many of the methods used to develop the predictive model at APG were also used to develop models at the Patuxent River Naval Air Station in St. Mary's County, Maryland and at the Naval Surface Warfare Center Indian Head in Charles County, Maryland. While using the same variables, where the methodologies converge is on the treatment of the final model. At Patuxent River, arbitrary values were assigned to different classifications of the environmental variables. This was done in consultation with a number of partners, including the Maryland Historical Trust, where the value of each variable was debated in order of perceived importance (Eagan, McAllister Associates, Inc. 2003).

Preliminary modeling of the NASA Goddard Spaceflight Center in Prince George's County, Maryland, used similar variables. This model, developed by archaeologist Bill Dickenson (2004), used what were dubbed primary and secondary variables derived using a number of remote sensing techniques. Primary variables consisted of topography, vegetation, and degrees of modern disturbance. Secondary variables included soil, distance to water, slope, and aspect. Correlations were assigned arbitrary values equaling 2 or -2 on their respective raster maps. A value of 2 indicated correlation with archaeological sites and -2 as no correlation. The sum of these variables over the landscape was used to designate areas of archaeological sensitivity. This model accounted for degrees of modern disturbance differently, assigning values between 0 and 5 for different land use types (from most disturbed to least disturbed, respectively). The simplicity and effectiveness of this model served as a guide for this project.

Most recently, the William and Mary Center for Archaeological Research (WMCAR) incorporated themes relevant to the study of ICLs in a National Register nomination prepared for the Captain John Smith Chesapeake National Historic Trail Keystone Segment (lower James River) (WMCAR 2015). Using a GIS-based approach to define the nomination's contributing and non-contributing resources, archaeologist David Lewes identified high-productivity marshes, including large freshwater wetlands capable of harboring important food resources, as a key factor in the development of the nomination. WMCAR also incorporated theoretical settlement locations depicted on Smith's 1612 map as well as Smith's voyage routes and stops, ethnohistorically-defined tribal territories for the Chickahominy, Paspahegh, Quiyoughcohannock, Warraskoyack settlements, and archaeological sites representing the Late Woodland as well as Contact-era European and Native sites from the early 17th century.

All of the efforts described above demonstrate that sensitivity and other forms of predictive modeling based on more than one variable and relatively large datasets can be used to predict Native settlements in the Chesapeake coastal plain. The results of these efforts inform the present project.

V. Methodology

The methodology for the present project draws on the methodologies used in earlier GIS-based approaches as well as the methodology developed by the National Park Service (NPS) and the University of Maryland for the Nanticoke ICL and by NPS and St. Mary's College of Maryland for the Nanjemoy/ Mattawoman ICL. Because of the far larger geographical scope of the present project and time and funding limitations, the project's chronological focus was restricted to identifying sensitivity areas for places occupied during the Late Woodland and Contact periods.

This analysis revealed that soil type, slope, and elevation as well as proximity to fresh water, marshes, other food resource-rich wetlands, and transportation tributaries are especially important variables for defining ICLs at a macro-scale. These variables along with use by indigenous communities in the past and in the present (archaeological sites and existing communities) provide excellent indicators of potential ICLs, providing an important guide to decision-makers for future mapping projects.

Digital datasets approximating the environmental and cultural factors described above are available from a number of sources, some with restrictions in access and/or use. Data themes approximating important ICL variables included archaeological data and environmental data (soils, wetlands, hydrography, digital elevation models, and land use). These data sources are listed in Table 4.

Data Sources: Archaeological Sites

Archaeological site data was acquired via data licensing agreements from the Maryland Historical Trust (MHT), the Virginia Department of Historic Resources (VA DHR), the Washington D.C. Historic Preservation Office (DCSHPO), and the Pennsylvania Bureau of Historic Preservation (PA BHP). Unfortunately, despite registering with the Delaware Division of Historical and Cultural Affairs, data from Delaware was not forthcoming in the short time allotted for the completion of this project.

Data	**Source**
VA Archaeology	Virginia Department of Historic Resources
MD Archaeology	Maryland Historical Trust
DC Archaeology	DC Historic Preservation Office
PA Archaeology	Pennsylvania Bureau of Historic Preservation
Soils	USDA Natural Resource Conservation Service
Wetlands	National Wetland Inventory Survey
Land Use	USGS National Land Cover Dataset
Hydrography	USGS National Hydrography Dataset
Elevation	USGS 3D Elevation Program

Table 4. Data themes and sources.

While each jurisdiction's dataset varied in the number of attributes recorded for each archaeological site, chronological periods assigned to each site were considered most critical for the present project. Happily, this basic data was included in all datasets, although terminology varied. The attribute "Contact" within MHT and VA DHR datasets, for example, was analogous to "Protohistoric" with PA BHP.

Not surprisingly, the majority of the project area lies within Maryland and Virginia. Washington, D.C. is a small jurisdiction to begin with, although important trends are evident in the D.C. data as discussed below. In the case of Pennsylvania, the project area extends into the state by only about two miles. Within that small area only two sites within the chronological focus of this study were identified. The lack of data from Delaware, while unfortunate, does not appear to have had a great impact on the overall study. While parts of the project area do extend into Delaware, the distance is only seven miles at its greatest extent (New Castle County), making up only 1.8% of the total project area.

DCSHPO archaeologist Ruth Trocolli (personal communication) pointed out that the District is today composed predominantly of urban and suburban development, making analysis of sites in relation to environmental variables (such as soils) challenging when compared with similar analyses in the overall project area. The Washington, D.C. landscape itself has changed dramatically since the early 18th and 19th centuries, with many sites from those periods located under several meters of fill. The DCSHPO has undertaken efforts to digitally reconstruct now diverted and entirely subterranean waterways and tributaries within the urban area.

The majority of the sites of interest in the District were identified prior to 1960 by researchers from or affiliated with the Smithsonian Institution. Survey techniques were not systematic and indigenous settlement was poorly understood. Many of the collections from these sites have never been fully catalogued, with Native occupations classified as either “unidentified prehistoric” or, if Native ceramics are present, “unidentified Woodland.” Further, the locations of many of these sites have not been confirmed since they were first recorded and they have not been assigned site numbers. Many of the “unidentified prehistoric” sites may very well date to the period of interest for this project but the state of the records makes it difficult to determine at this time (Trocolli, personal communication).

Because of the problems with the D.C. data, they were not included in the broad spatial analysis but were instead examined separately. Notably, data from Baltimore City is also lacking, with only three recorded sites matching the chronological scope of this project. These sites are located in the northern, less developed, areas of the city.

Each archaeological dataset consisted of vector polygon shapefiles (site size and orientation were not considerations for this project). Each site was converted to a point vector shapefile in order to analyze the distributions of sites in bulk in relation to environmental resources. This required the calculation of the centroid or center point of each polygon shape using GIS. All points from all jurisdictions were projected from their varied state plane coordinate systems to North American Datum 1983 UTM Zone 18 North (meters) to ensure cross-compatibility in order to analyze the data as a whole.

Each site was analyzed by its on-site environmental characteristics (soils, slope, and elevation) and its proximity to other resources (freshwater, wetlands, marshes, and transportation tributaries). The methodology employed for each of the two types of resource relationships will be discussed in the following subsections.

Online Data Sources: Environmental and Ecological Data

Soil data were acquired through the US Department of Agriculture’s Natural Resource Conservation Service. This data is available in two forms, including the Soil Survey Geographic Database (SSURGO) and the State Soil Geographic Database (STATSGO). Each dataset includes both spatial (polygon shapefiles) and tabular (Microsoft Access) data. SSURGO data consists of detailed soil surveys that are compiled for each individual county. STATSGO is a broadly generalized state-wide soil classification, which consists of only very basic classifications with little tabular data. Given the aims of granularity of this project, only the SSURGO data was included in the analysis.

The SSURGO spatial data consists of two key attribute fields, termed MUSYM and MUKEY. The MUSYM field consists of the three-letter abbreviation of each soil type. These abbreviations are assigned per county and often conflict when the same abbreviation is used for different soil types in other counties. Conversely, the same soil type may be classified and abbreviated differently in neighboring counties. Fortunately, the MUKEY field consists of a unique numerical identifier code that does not conflict across counties. This field was used to compute correlative statistics between sites.

Quantile Class	Elevation Range
1	0-1.3
2	1.3-4.0
3	4.0-8.5
4	8.5-13.9
5	13.9-19.3
6	19.3-25.7
7	25.7-34.7
8	34.7-45.5
9	45.5-64.4
10	64.4-178.9

Table 5. Elevation range quantile classes.

Digital elevation data was acquired through the US Geological Survey's National Elevation Dataset. This data is available at three resolutions: 1 arc second (approximately 30 meters), 1/3 arc second (approximately 10 meters), and 1/9 arc second (approximately 3 meters). Given the large scope of this project the 1/3 arc second data was chosen for use in this project. At this resolution, the data provides relative accuracy over the large project area and is much more manageable in terms of computing resources and the need for long-term data storage. The data was acquired in a series of raster tiles forming a mosaic over the entire project area. The mosaic dataset was combined into a single raster dataset and clipped to the project area prior to analysis. Slope was calculated and derived directly from this dataset. Within these raster datasets, each cell (or pixel) was given a numerical value corresponding to the elevation or slope at that particular point. Only land areas were included. The classification for each cell or pixel was based on 10 quantile classes (Table 5). Reclassifying data in this way creates a series of classes of roughly equal land areas rather than arbitrary classes at equal intervals (such as 5 percent slope intervals). This better reflects the overall landscape.

Marsh and other wetlands datasets were acquired from the National Wetland Inventory Survey (NWIS) and the National Hydrography Dataset, both from the US Geological Survey. For this project, transportation tributaries were defined by those watercourses that are named. This was done in lieu of a complex analysis of water depth, breadth, and length. Tributaries that are named are generally the most substantial of the region's waterways.

Euclidean distance raster models were created emanating from proximity resources (marshes, wetlands, and transportation tributaries), with the resources serving as seeds or node points from which distances were calculated. The Euclidean distance raster represents the distance from each resource if measured directly in a straight line. Cost distance functions (such as walking time) could have been calculated as a function of slope but was not done as part of this analysis in order to quickly process and manage the data. This follows the approach used to develop the predictive model for the Aberdeen Proving Ground (Westcott and Kuiper 2000). As with the elevation and slope data, the Euclidean distance raster datasets were clipped to the land area and reclassified according to 10 quantile classes. The resulting dataset represents ordinal classes of roughly equal land area emanating from the tested resources.

Online Data Sources: Land Use Data

Land use data was taken from the US Geological Survey at a resolution of 30 meters. This data consists of a raster dataset for each state in the project area with cell values represented by an arbitrary coding system. Each code corresponds with a different type of land use or land class, such as urban, suburban, and so on (Table 6). Land use data is available for the years 2001, 2006, and 2011 (all amended in 2014). The data from 2001 and 2011 was used to give a span of a decade of land use change over time. To model types of land that are considered most damaging to ICLs (Codes 21-24), the rate of change (as a percent) was calculated for the land area of each county within the project area.

This was calculated two ways: for the land area of each entire county included in the project area and for the land area within watershed boundaries. Watershed boundaries were defined by the USGS Watershed Boundary Dataset from their 10-digit hydrologic unit dataset (HU10). Hydrologic units are broken down into units (2, 4, 6, 8, 10, and 12) representing classes of watersheds that include region, sub-region, basin, sub-basin, watershed, and sub-watersheds. The HU10 dataset represents the watershed class of hydrologic units with an average size of about 227 square miles.

There are several steps involved in the preparation of raw land use data for statistical analysis. Each dataset came is organized by state and by chronological snapshot, which as noted include a wider area than is covered within the scope of this project. First, the mosaic of the raster data from each year was combined and clipped to the project area. Second, a unique identifying code or designation was located for the vector shapefiles of the land area for each county and watershed.

The land use data then had to be prepared for calculating zonal statistics. Zonal statistics calculate the raster values within designated raster zones. The aforementioned county and watershed boundaries with unique identifier codes represent these different zones. The combined land use raster was then reclassified, with codes 21-24 given a value of 1 and all other codes being given a value of 0. The reclassified land use raster (with values between 0 and 1) serves as the variable to examine within each zone. By applying binary values for areas of pervious and impervious surface, the mean of these values within a zone/site will give you the percentage of a site that is impacted by impervious surface area.

Code	Land Cover Type
11	Open Water
12	Perennial Ice/Snow
21	Developed, Open Space
22	Developed, Low Intensity
23	Developed, Medium Intensity
24	Developed, High Intensity
31	Barren Land
41	Deciduous Forest
42	Evergreen Forest
43	Mixed Forest
51	Dwarf Scrub
52	Shrub/Scrub
71	Grassland
72	Sedge
73	Lichens
74	Moss
81	Pasture
82	Cultivated Crops
90	Woody Wetlands
95	Emergent Herbaceous Wetlands

Table 6. Land use code classifications.

Statistical Testing

The datasets described above were created with two forms of data: nominal and ordinal. Nominal datasets used in this project included only soil type classifications. Nominal variables are sometimes called categorical variables and consist of two or more categories with no inherent ranking order (sex and ethnicity are nominal variables). Ordinal variables represent a ranked class of variables. Nominal and ordinal datasets typically require different sets of statistical tools in order to analyze relationships between datasets. For this project, nominal data was tested for correlations using a chi-square test. Chi-square tests can be useful for determining if distributions of nominal or categorical data are random or exhibit an association or correlation. Ordinal data was tested using a Kolmogorov-Smirnov test. This test was used to compare the cumulative percentages of observed points against the land area of each rank order quantile class.

Before analysis could be undertaken, the raster values for each data theme had to be extracted to the archaeological site points and summarized. For example, if a site lies within the first quantile class denoting distance to shore, that site would get a value of 1. Likewise, if it were in the fifth quantile class, it would get a value of 5. Soil data existed as vector polygons, and as such the unique identifier code for each soil type was joined to the site points based on way the two dataset overlay.

Statistical tests examining correlations were performed on soils, slope, aspect (direction), elevation, wetland proximity, and transportation tributary proximity. All of the tested variables had a demonstrated statistical correlation with archaeological sites with the exception of aspect. Archaeological sites were more often than not located in areas with such little slope that an aspect could not be properly inferred. As a result, aspect as a variable was not included in the final model.

The results of the statistical testing only indicate whether there is a significant deviation from what would be expected from a random sample. The tests do not, however, describe or interpret this relationship. In order to interpret the results of the test, each variable was examined for differences between what was observed (O) and what would be expected (E) within each variable's land area. By subtracting E from O (O-E), the result gives a simple indication of how the sites correlate to their surrounding environment. For example, a positive result for the first 5 wetland proximity quantile classes would indicate that the correlation between sites and wetland proximity is explained by a desire to be closer to these resources as opposed to further away.

The slope, elevation, wetland proximity, and transportation tributary proximity quantile classes were reclassified from 10 classes each down to 2 classes each. This was done in order to better handle and narrow the focus of the final model. The same was done for the predictive model developed for Aberdeen Proving Ground. Values were given to each class according to their demonstrated site correlation (Table 7). Following the example of the wetland proximity quantile classes, the first 5 classes were given a value of 2, while classes 6 through 10 were given a value of -2.

Quantile Class	Slope Range (%)	Wetland Prox. (m)	Trans. Tributary Prox. (m)
1	0	0	0 - 79.3
2	0 - 1.2	0 - 52.8	79.3 - 198.2
3	1.2 - 2.5	52.8 - 105.7	198.2 - 317.2
4	2.5 - 3.7	105.7 - 158.5	317.2 - 436.1
5	3.7 - 6.2	158.5 - 228.9	436.1 - 594.7
6	6.2 - 8.7	228.9 - 299.4	594.7 - 753.3
7	8.7 - 11.2	299.4 - 387.4	753.3 - 951.5
8	11.2 - 14.9	387.4 - 510.7	951.5 - 1229.1
9	14.9 - 21.1	510.7 - 739.7	1229.1 - 1665.2
10	21.1 - 316.1	739.7 - 4490.9	1665.2 - 10110.2

Table 7. Soil, wetland proximity, and transportation tributary proximity quantile classes.

Because soil data exists as nominal data, classified only by each soil type's unique identifier code, the assignment of values was handled differently. Soil types were assigned a value based on preferences inferred from the distribution of archaeological sites. Soil values were calculated by comparing differences in the observed number of archaeological sites on any given soil type with the expected number of sites on that soil type if sites were distributed randomly. Soil types with a positive difference above ½-standard deviation were assigned a value of 2; soil types with a difference between 0 and a (positive) ½-standard deviation were assigned a value of 1; those types with a difference between 0 and a (negative) ½ standard deviation were assigned a value of -1; and types with a negative value greater than (negative) ½-standard deviation were assigned a value of -2.

All the subsequent classified raster maps were summed together to produce a raster ranging in value between -7 and 10. The highest value of 10 represents areas where all 5 of the most positive variables overlay each other (with each of the highest variable values set at 2). For this project, areas considered for the sensitivity model areas have a value equal to or greater than 4. Areas with a value of 4 would represent an area where at least two of the tested variables were represented. These areas were further broken down into two categories, including areas of High and of Moderate Sensitivity. Values between 4 and 6 were categorized as Moderate Sensitivity, while values between 7 and 10 were categorized as High Sensitivity. The values for High Sensitivity were determined specifically so that it would encompass areas that would have been affected by the assigned values of the soil data. The justification for this and the limitations of the soil data are discussed in the chapter immediately following.

The Case of Washington, D.C.

The urban environment of Washington, D.C. makes statistical approaches used for the overall project area somewhat problematic when applied to the District. The landscape of the city, especially its hydrography, has changed considerably since its founding, impacting the types of environmental and ecological information available for statistical analysis. The city's intensively developed urban environment has also meant that only 40 Late Woodland and Contact-era sites have been identified and all of them have been found in the relatively limited areas of open space.

Fortunately, the DCSHPO has undertaken efforts to reconstruct and model historic shorelines, with this work demonstrating the earlier presence of rich marshlands and attractive landing places near the confluence of the Anacostia River with the Potomac. The known 40 Native archaeological sites are located along the banks of the Potomac and Anacostia rivers, and a “prehistoric village” has been reported for nearby Theodore Roosevelt Island. The documentary record, including Smith’s map and journals and later documents describe the Nacotchtank, an important Native polity located in this area.

Because of Washington, D.C.’s potential for containing traces of an earlier ICL, analysis consisted principally of a visual inspection of materials provided by the DCSHPO in context with the analysis undertaken for the greater project area.

VI. Sensitivity Model for the Greater Chesapeake Bay Watershed

The sensitivity model developed as a result of this analysis identified a large number of areas designated as High Sensitivity for ICLs. A description of the distribution of High Sensitivity areas within each of the major tributaries of the Bay is discussed below; the areas are shown in Figures 4-9:

Maryland Western Shore (Figs. 4, 6, 7)

- *Susquehanna River*: Near the mouth of the Susquehanna River and southwest, particularly in Aberdeen.
- *Gunpowder River*: Around Aberdeen Proving Ground and low-lying areas south and east of I-95.
- *Patapsco River*: Although highly urbanized, potential areas are found at the mouth of the river, particularly on the less developed south bank from Gibson Island to Curtis Creek.
- *Severn River*: Along the minor tributaries of the river near the mouth of the Severn and further upriver north and east of Crownsville and in the vicinity of Severna Park.
- *South River*: On both banks, principally the mouth of the river to Riva.
- *Patuxent River*: On both banks, stretching from the mouth as far north as Bowie and Crofton.
- *Chesapeake Shoreline*: Notable lack of high sensitivity areas from the mouth of the Patuxent to Chesapeake Beach. High sensitivity areas stretch from North Beach to the South River.
- *Potomac River*: Lowlands stretching from Piscataway Creek to the mouth of the Potomac, including inland swamps such as Mattawoman Creek, the western branch of Nanjemoy Creek, Port Tobacco Creek, St. Clements and Breton Bays, and St. Mary's River (Nanjemoy and Mattawoman have been previously mapped).

Virginia Western Shore (Figs. 5-9)

- *Rappahannock River*: on the north bank, from the mouth of the river to Fones Cliffs, west of Fones Cliffs toward Fredericksburg; on the south bank, generally less expansive high sensitivity areas along the bank. They are found from Fredericksburg to Center Cross. Comparatively fewer high sensitivity areas from Center Cross to Waterview. High sensitivity areas extend from Waterview to the mouth of the Piankatank.
- *Piankatank River*: Inland from the mouth and up Dragon Swamp towards Dragon Run State Forest.
- *York River (including Mobjack Bay, Mattaponi, & Pamunkey)*: Much of Mobjack Bay, and from the mouth of the York to West Point. All along the Mattaponi and Pamunkey throughout the project area boundary.
- *James River*: Includes low-lying undeveloped areas along the Nansemond and Elizabeth rivers and tributaries. Along the north bank west of Hampton towards Richmond, including the Chickahominy River, areas near Charles City to Fourmile and Bailey creeks and into low lying undeveloped areas of Richmond City. Along the south bank from Richmond city to Upper Chippokes Creek, including Wards Creek, Flowerdew Hundred, Powell Creek, Chappell Creek, Bailey Creek, and low-lying undeveloped areas of the Appomattox River. Notably less dense from Upper Chippokes to Smithfield.
- *Potomac River*: Lowlands from the mouth of the river to Nomini Bay. Scattered areas from Popes Creek to Occoquan, including Mattox Creek/Monroe Bay, Upper Machodoc and Dahlgren, Chotank Creek, lower portions of Potomac and Aquia Creeks, and tributaries around the base at Quantico.

Eastern Shore/Delmarva (Figs. 4-5)

- *Elk River*: Notable lack of areas but those present are found primarily along Little Elk and Big Elk creeks and low-lying points of land to the mouth of the river, including along the Bohemia River and tributaries.
- *Sassafras River*: Notable lack of areas but are found primarily along low-lying points of land and at intersections of minor tributaries.
- *Chester River*: Dense coverage of areas throughout the course of the River and its many tributaries.
- *Choptank River*: Dense coverage of areas throughout the course of the River and its many tributaries.
- *Nanticoke River*: Dense coverage of areas throughout the course of the River and its many tributaries. Notably less in areas inundated by marsh (previously mapped).
- *Wicomico River*: Dense coverage of areas throughout the course of the River and its many tributaries. Notably less in areas inundated by marsh.
- *Pocomoke River*: Dense coverage of areas throughout the course of the River and its many tributaries. Notably less in areas inundated by marsh.

Washington, D.C. (Fig. 6)

- *Anacostia River and Theodore Roosevelt Island*: Despite an urbanized landscape, documentary and limited archaeological evidence suggest the potential for an ICL in the southwest portion of the District.

Sensitivity Model Assessment

The goal of any sensitivity or probability model is to maximize site prediction ability while maintaining minimal land area coverage. This makes sense from a cultural resource management and mitigation perspective. While a model could easily account for 100% of sites by covering 100% of the land area, this would negate the usefulness of the model itself. Ideally, the goal of this project would be to develop a model that can account for 80% (or more) of sites while maintaining land surface area coverage at 25% (or less). As previously stated, the performance of the model can be tested using a gain statistic (*1-[land area percent / sites percent]*) comparing the total land area against the total number of sites predicted. Gain statistic values between 0.5 and 1 represent models that have positive results, while those below 0.5 are considered negative. By meeting or exceeding the project goal of 80% predicted sites to 25% surveyed area, the Gain statistic value should meet or exceed 0.69.

The percentage of sites lying within areas of Moderate and High Sensitivity were then tested using the gain statistic. The total land area coverage for these sensitivity areas was estimated at 32%. A total of 77% of sites were observed in this area. This produced a gain statistic of 0.58. While not meeting the goal of 0.69, it is considered a positive result. The total land area coverage is within 7% of the goal, while site prediction is within 3% of the goal.

To refine this model, further consideration was given to current land use, particularly wetlands. While wetland proximity is an important variable used in the final model, wetland environments themselves are poorly suited for any type of settlement. Areas of marsh were initially included in the calculation of land coverage. To eliminate these areas unlikely to yield any archaeological sites, the model was clipped to exclude them. This brought down the total land coverage to 27%, close to the goal of 25%. The final gain statistic of the moderate and high sensitivity areas was refined to 0.65, much closer to the goal of 0.69. The final mapping of archaeological sensitivity was reflected in Figures 4-9.

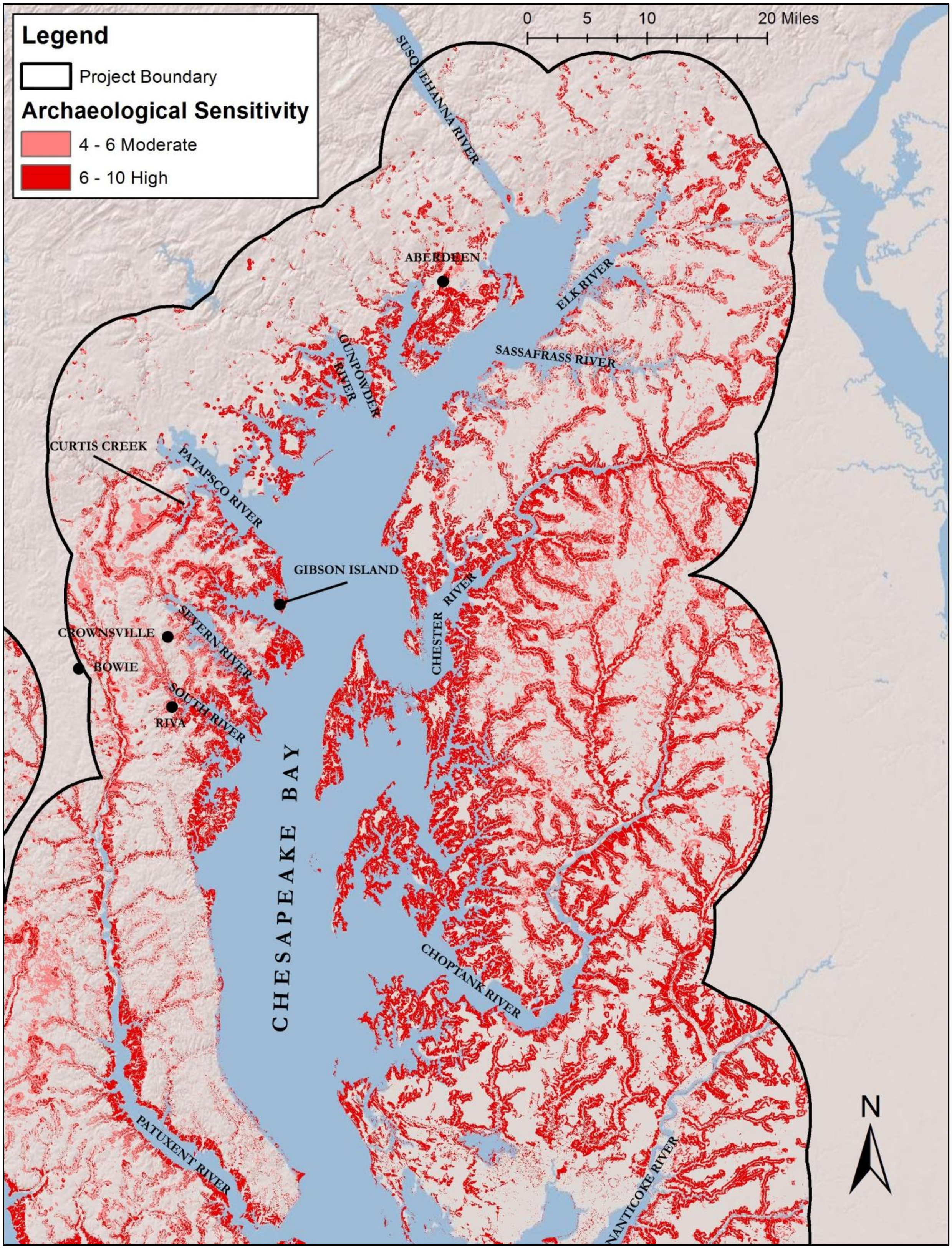

Figure 4. Sensitivity model results: Northern Chesapeake Bay.

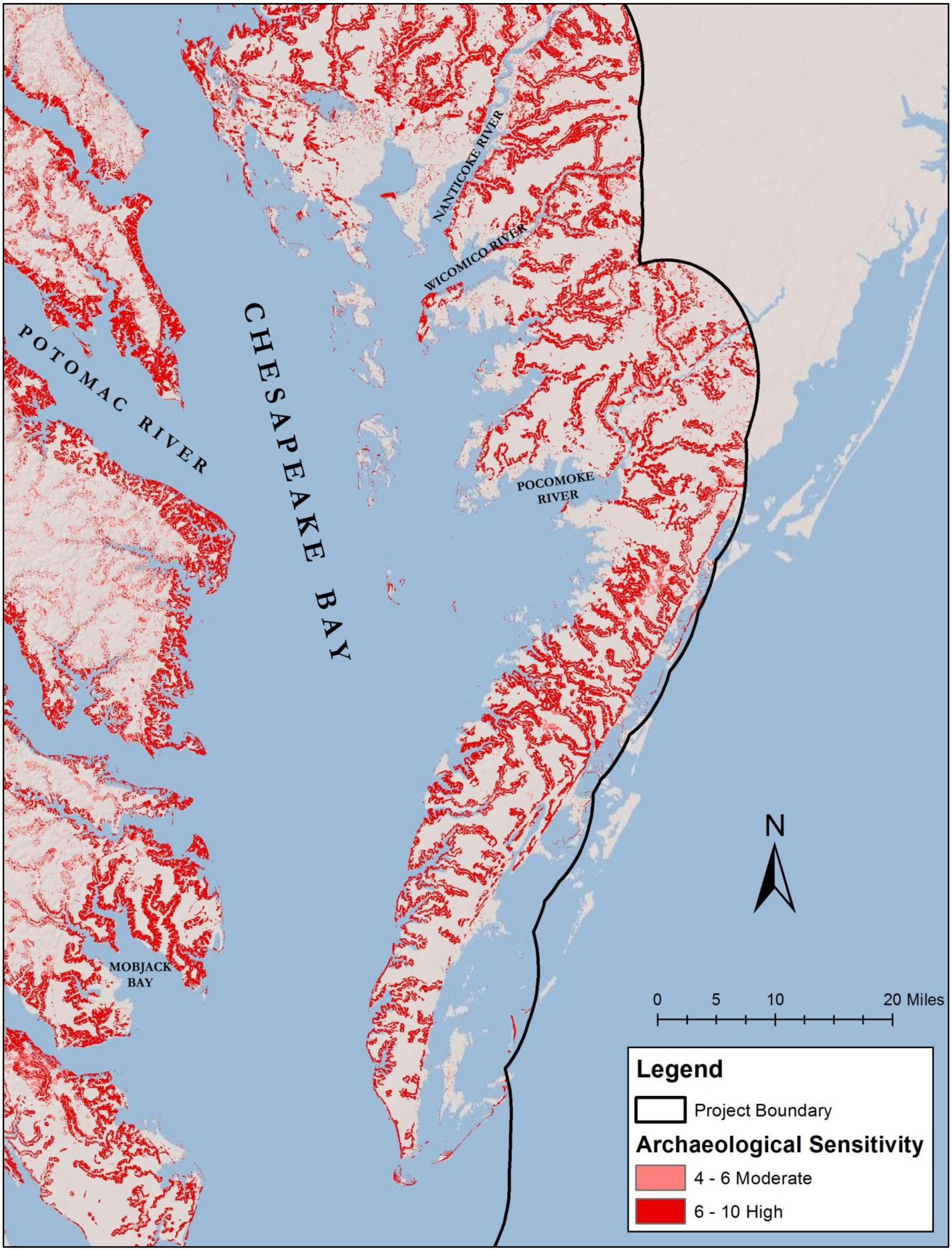

Figure 5. Sensitivity model results: Lower Chesapeake Bay.

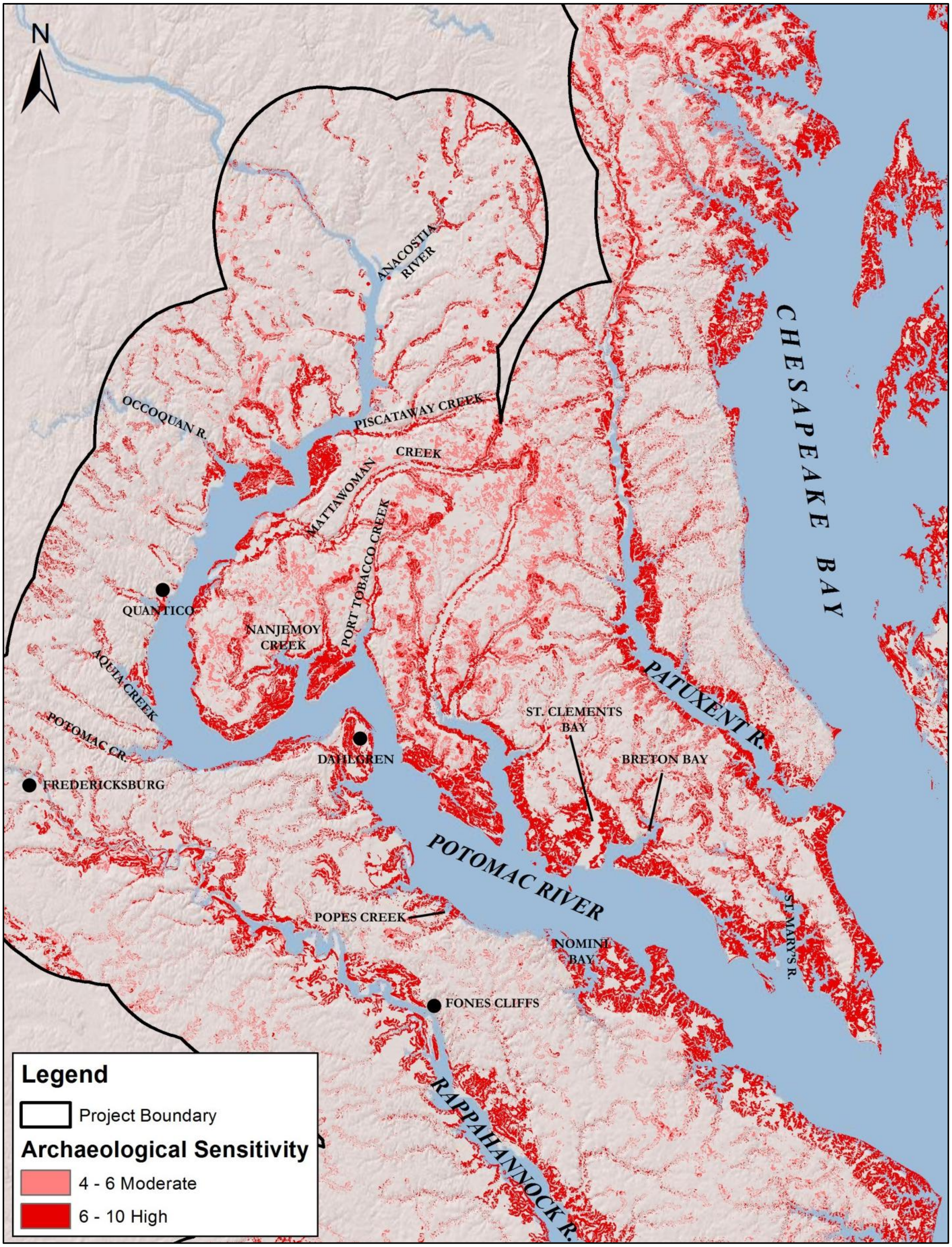

Figure 6. Sensitivity model results: Potomac and Patuxent rivers.

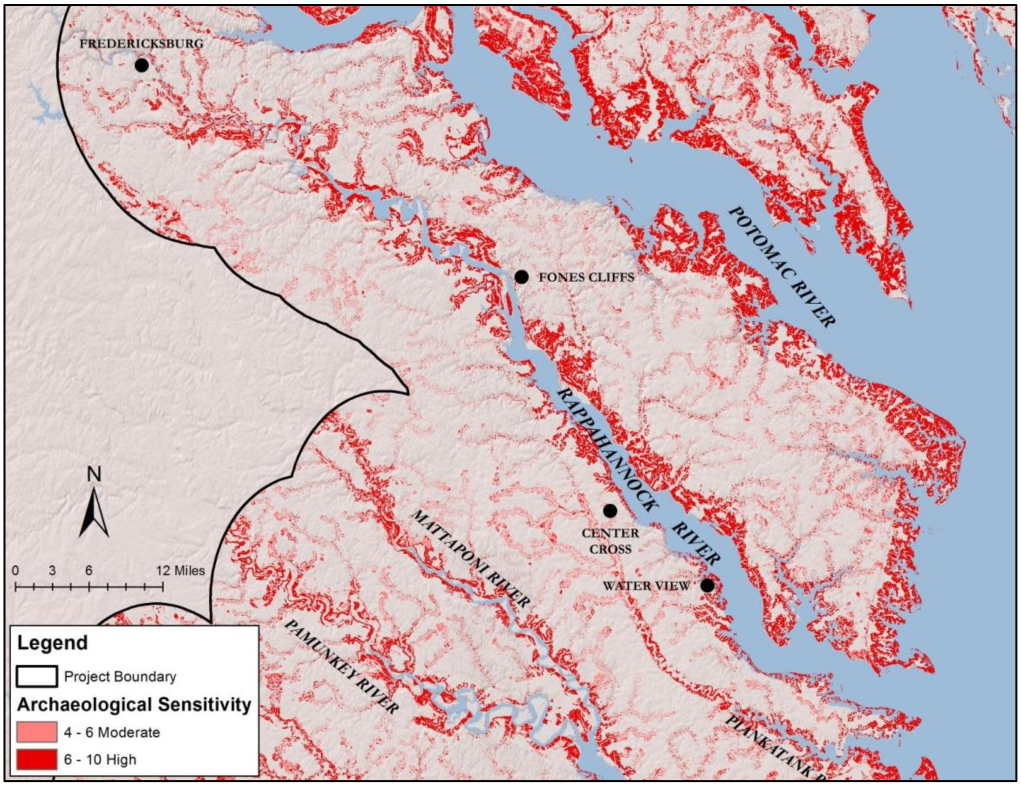

Figure 7. Sensitivity model results: Rappahannock River.

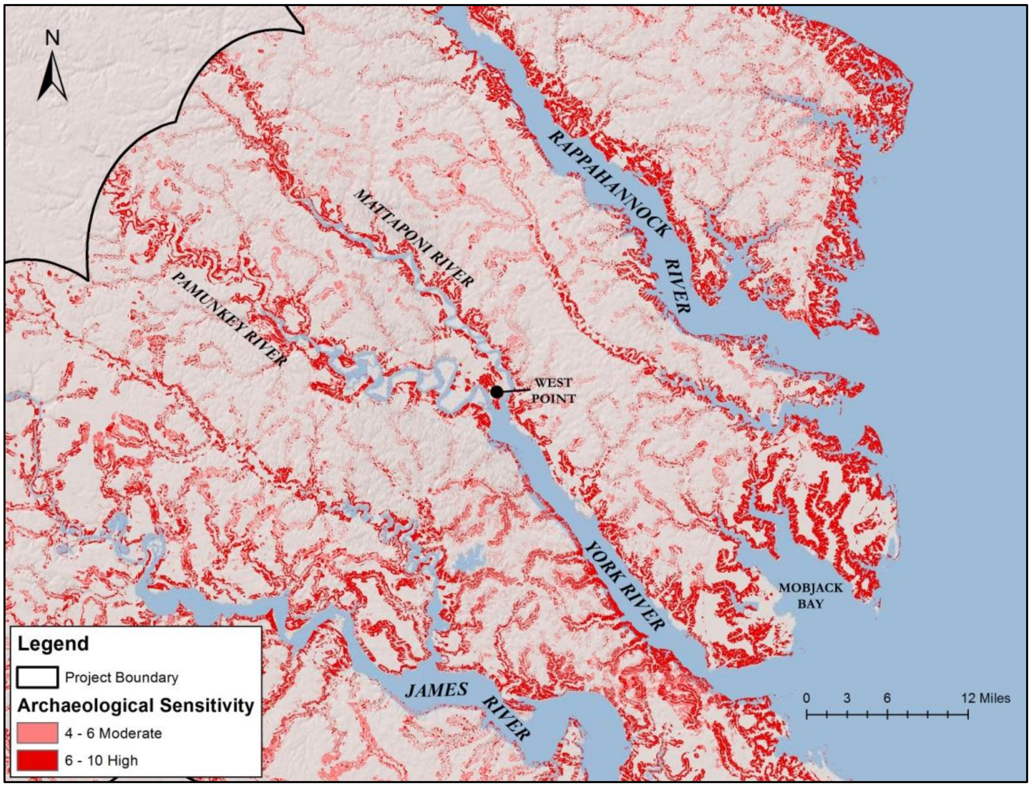

Figure 8. Sensitivity model results: York, Mattaponi, and Pamunkey rivers.

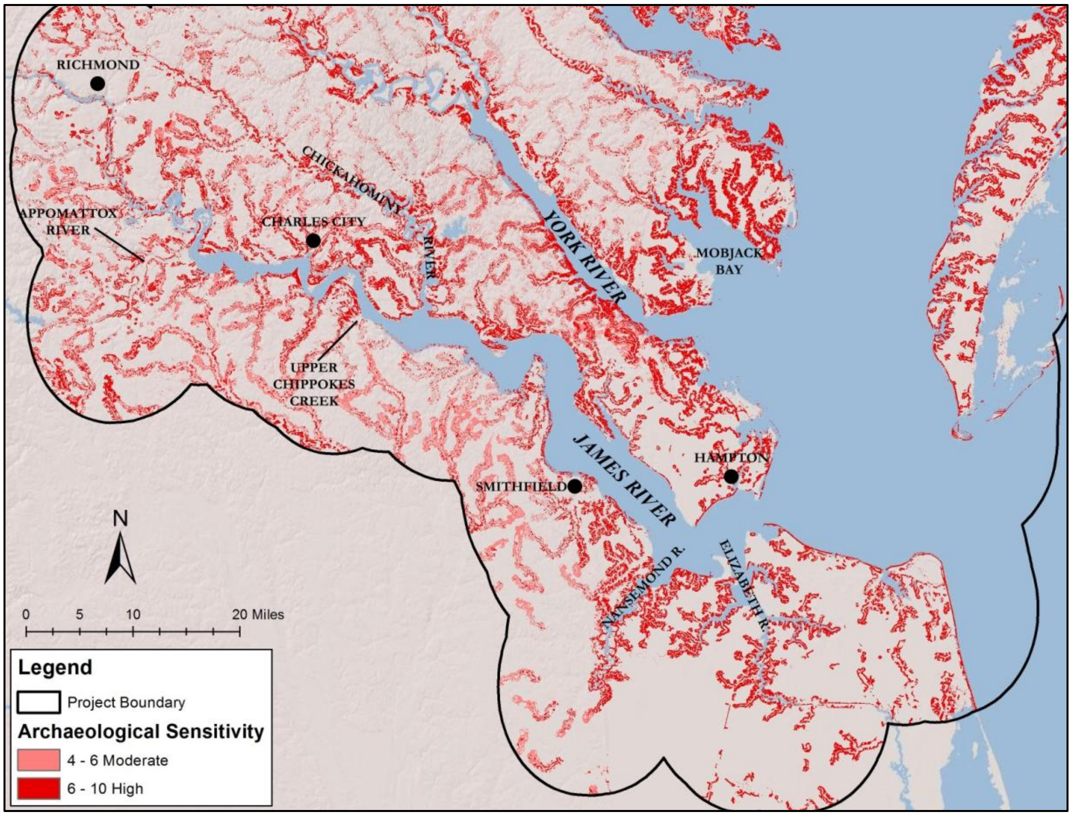

Figure 9. Sensitivity model results: James River.

The sensitivity model as presented is based on a number of assumptions. A major assumption involves treating the data as if people throughout the landscape settled in more or less a similar fashion. Depending on the environment in any given region, adaptability manifests itself in fundamentally different ways. For instance, the Eastern Shore of Maryland and Virginia consists almost entirely of flat, low-lying, and oft-flooded land with expansive marshes. Marshes and wetlands tend to have many more resources of use to human groups than non-wetland environments. Nonetheless, overall ecological diversity is greater on the western shore, especially the further north and west one travels. The western shore is also characterized by better drained soils when compared with those found on the Eastern Shore, an important consideration for wild and domesticated crops. Patterns of subsistence on the two shores of the Chesapeake Bay, then, were probably significantly different, something the model at this broad level cannot account for.

An important factor that impacts most modeling projects concerns the level of archaeological survey on which the model is built. Site representation varies across counties, and this variation appears closely linked to levels of archaeological survey. Most archaeological sites found in the various jurisdictions' inventories have been identified as a result of surveys driven by the requirements of the National Historic Preservation Act (NHPA). Many of the region's defense installations, for example, have completed "fence-to-fence" surveys in compliance with Section 110 of the NHPA. Other areas have been surveyed in response to Section 106 of the NHPA. Active archaeological programs at Anne Arundel County's Lost Towns Project, The Colonial Williamsburg Foundation, Historic St. Mary's City, and Jamestowne Rediscovery as well as work undertaken by the region's academic institutions has resulted in the generation of surveys in selected areas. The work in these areas and the higher number of archaeological sites identified as a result can inadvertently create a biased representation of settlement in these areas.

Additional considerations when interpreting this model concern issues with scale. The methods used to develop the model are typically used on smaller scales, particularly at either county-level or a property specific scale. For example; the study performed along the Chester River is an example of a county-level type study. The data compiled was specific to the counties bordering the Chester River and variables analyzed thusly. At the Aberdeen Proving Ground facility, the model was generated on a specific property, while analyzing archaeological and environmental data from the immediate surrounding areas. While achieving similar results in terms of number of sites predicted in the model versus the percent land area the high sensitivity area covers, issues of scale persist. The environmental variability within the study area warrants further inquiry at a more micro-regional level.

Given these limitations, the variables used to build the model represent basic needs for settlement. Soil types serve as a proxy for the availability of resources useful to humans (although soil data from areas with little survey – places such as the Rappahannock River drainage, for example – can be missed in the statistical analysis). Waterways are important regardless of location throughout the project area, as they served a dual function of providing subsistence resources (albeit varied depending on location) and transportation routes. Slope serves to identify flat areas more amenable to settlement.

It should be noted that the model produced as part of this project is to demonstrate the wide distribution of archaeological potential throughout the Chesapeake. It should not be taken as a source for the application of any policy or land use planning. Models are more efficient when using a wide sample of data (as was done here) but applied on micro-regional scales. What can be gleaned from the results of this data are that it depicts areas that may have been suitable for settlement during the Late Woodland and Contact periods, not that these areas represent where sites should necessarily be expected to be found. Statistical analysis revealed a correlation between observed archaeological sites and several environmental variables. Sites were found to correlate close to shores of waterways used for transportation, near to wetlands and marshes that provided essential food sources, on gently sloping land allowing for unproblematic settlement activity, and on low floodplain elevations with rich soil deposits. Perhaps more difficult to identify are seasonal hunting grounds and trapping areas which may leave significantly smaller signatures.

The overall distribution of high archaeological sensitivity throughout the landscape appears very daunting. From the perspective of identifying specific places for future ICL study, it becomes necessary to narrow where the largest concentrations of high sensitivity areas are found in the landscape. To do this a Hot-Spot analysis was performed on the percent coverage of high sensitivity areas within a 1-km grid over the entire study area. Hot-Spot analysis examines clusters within study blocks or geographically delineated areas. The most statistically significant hotspots are depicted in Figure 10. These areas include much of the Delmarva peninsula, northern portions of the western Chesapeake shore of Maryland, the lower Patuxent, the lower Potomac, Virginia's western Chesapeake shore, much of the north bank of the Rappahannock, portions of the York River, the lower Pamunkey, the lower Mattaponi, the north bank of the James River, the Chickahominy River, and the Nansemond River.

It should be reiterated that this is no replacement for micro-regional models which can be used to tell more about the specific region of a particular people, as there is no doubt considerable cultural variation and adaptation taking place throughout the Chesapeake.

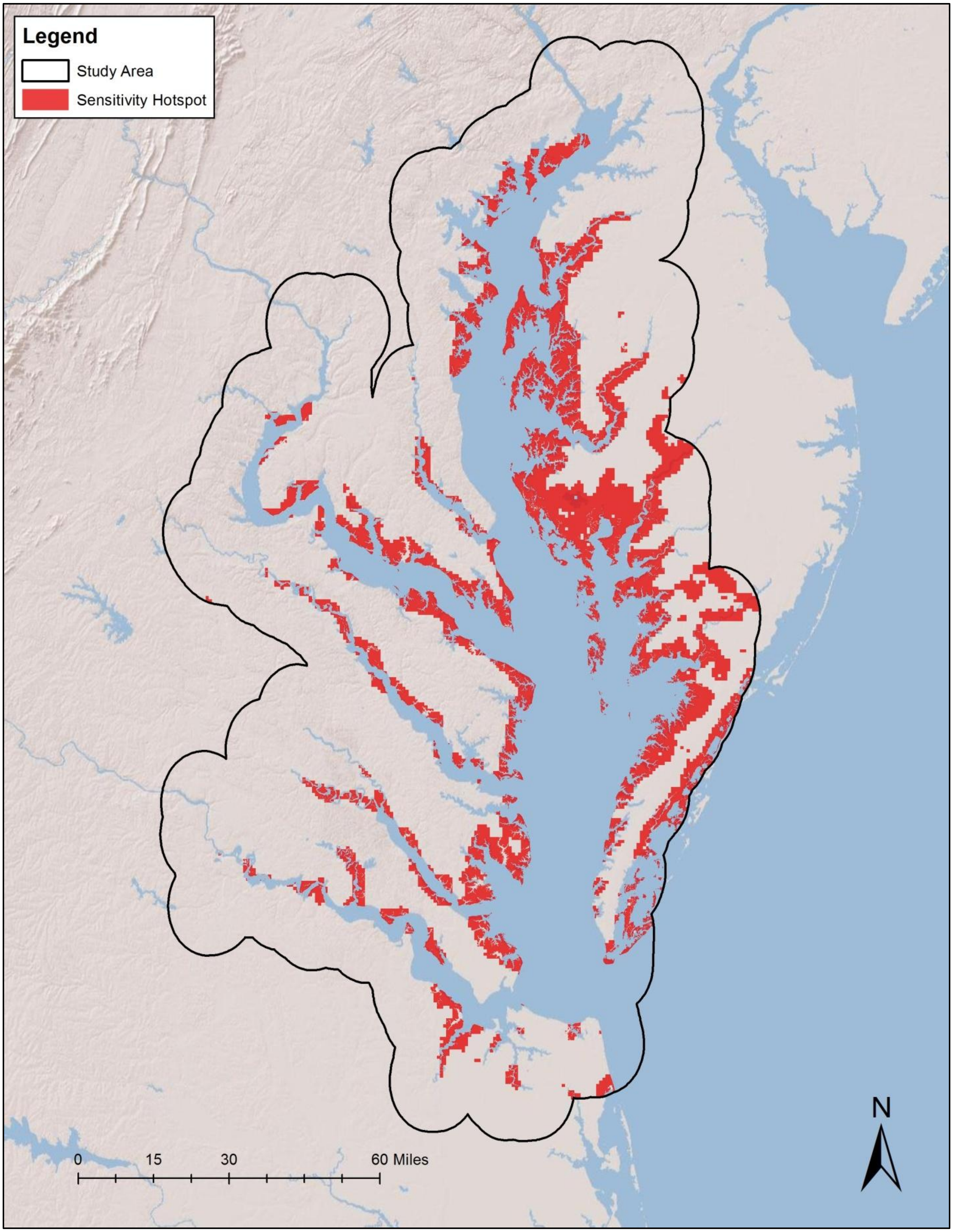

Figure 10. Sensitivity Area hotspots.

VII. Priority Watershed Areas

The purpose of this project was to develop Priority Watershed Areas for future study as Indigenous Cultural Landscapes associated with the Captain John Smith Chesapeake National Historic Trail. In consultation with NPS staff, the following criteria were considered especially important for identifying ICL areas of high potential and priority, including (1) the presence of contemporary Native communities; (2) known archaeological resources; (3) environmental and ecological resources of value to Late Woodland Native communities; (4) settlements depicted on the 1612 Smith Map; (5) archaeological and historical significance; and (6) identification of landscapes facing land use change through development and/or climate change.

The sensitivity model was developed to predict settlement locations through the early Contact-period based on two of these criteria, including (2) known archaeological resources and (3) environmental and ecological resources of value to Late Woodland Native communities.

Not surprisingly, almost every river drainage in the Chesapeake Bay watershed contains environmental and ecological resources that would have been attractive to human communities in the past, with archaeological evidence confirming these choices in many areas of the watershed. Based on the archaeological potential alone, the study of nearly any of these major waterways would make an important contribution to the study of ICLs. These areas include several dozen watersheds which could be further sub-divided. Given limited resources, however, NPS sought the development of Priority Watershed Areas to guide decision-making while targeting limited resources for maximum value.

To assist the National Park Service with prioritizing river drainages and watersheds for future study, the four remaining criteria are considered critical for informed decision-making. These include (using the numbering system above) (1) the presence of contemporary Native communities; (4) approximate locations of towns and other settlements depicted on the 1612 Smith Map; (5) archaeological and historical significance; and (6) identification of threatened landscapes (including rural versus urbanized landscapes). Each one of these criteria is described below.

Contemporary Native Communities

As previously noted, there are a number of organized and active Native communities throughout the Chesapeake Bay watershed. At present, there are 15 tribes that are considered partners of the National Park Service. This includes seven tribes in Virginia, six in Maryland, and two in Delaware. While there are no tribal partners located in Pennsylvania, the Lenape of Delware are active in the eastern part of that state. The names, locations, and associated watersheds of these communities are listed in Table 8 and conjectured in Figure 11.

Indigenous communities are found in association with all of the region’s major river drainages, including the Potomac, Wicomico, Choptank, Nanticoke, Pocomoke, Rappahannock, York, Mattaponi, Pamunkey, James, and Chickahominy rivers (see Figure 11).

While the number of Native communities found throughout the project area is impressively extensive given the realities of colonialism, there are areas that are nonetheless under-represented in the watershed, particularly in urbanized areas. For example, while the contemporary Piscataway are focused on southern Maryland, their ancestral territory could include Washington, D.C. Indeed, a number of Piscataway members live and work in the immediate D.C. Metro area. Washington, D.C. is also home to the National Museum of the American Indian, an important center for documenting and sharing stories of the indigenous people throughout the US, including the Piscataway. The name of the museum’s cafeteria, Mitsitam, at the museum is taken from a Piscataway Algonquian phrase for “let’s eat.”

Tribal Group	Location	Nearby Major Watershed
Virginia		
Chickahominy	Charles City and New Kent counties	James, York, and Chickahominy rivers
Eastern Chickahominy	New Kent County	James/Chickahominy
Mattaponi	King William County/ Banks of Mattaponi	York/Mattaponi rivers
Nansemond	Cities of Suffolk and Chesapeake	James River
Pamunkey	King William County/ Banks of Pamunkey	York/Pamunkey rivers
Rappahannock	King and Queen County/ Indian Neck	Rappahannock River
Upper Mattaponi	King William County	York/Mattaponi rivers
Maryland		
Accohannock	Somerset County/ Marion Station	Pocomoke/Big Annemessex rivers, Chesapeake Bay
Assateague	Worcester County	Chincoteague Bay rivers
Nause-Waiwash	Dorchester County/ City of Cambridge	Nanticoke/Choptank rivers
Piscataway Conoy Tribe of MD & Associated Tribes	Southern Maryland	Potomac/Wicomico rivers
Piscataway Indian Nation	Southern Maryland	Potomac/Wicomico rivers
Pocomoke Indian Nation	Somerset, Worcester, and Accomack counties	Pocomoke/Big Annemessex rivers, Chesapeake Bay
Delaware		
Nanticoke Indian Assoc.	Sussex County	Nanticoke River/Rehoboth Bay
Lenape Indian Tribe	Kent County, Cheswold	Chester/Leipsic rivers

Table 8. Contemporary tribal groups within project area.

Territorial boundaries drawn by contemporary tribes approximate but are not always (if ever) perfect matches with ancient boundaries. This is not unexpected given that territorial boundaries shift and change in response to many factors, including both natural and cultural drivers. Colonialism also shaped the boundaries of Native territories. In many ways, identifying and representing the ICL for a particular community serves to provide a narrative grounded in historical evidence that not only reveals the changing boundaries of earlier territories but explores reasons for those changes. For example, the sensitivity model confirms the observations Smith made in 1608 along the Rappahannock, placing major towns along the river’s north bank. Today, the political center of the Rappahannock is located on the river’s south bank, revealing how adaptations to not only colonial structures but modern life have reshaped the territorial limits of contemporary Native communities.

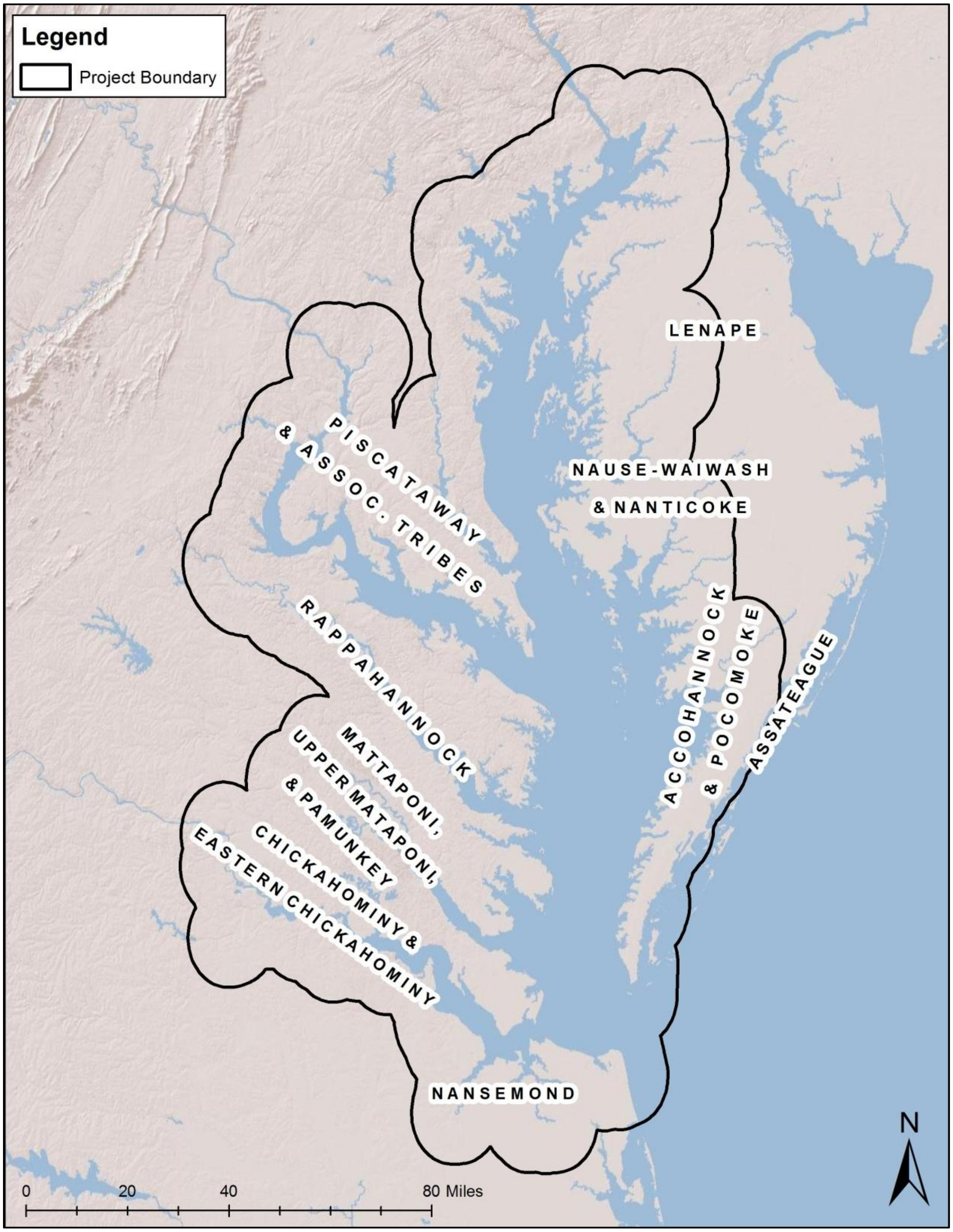

Figure 11. Existing tribal communities map.

Settlements Represented on the 1612 Smith Map

Although colonizers would go on to represent the Chesapeake region as an uncultivated and uninhabited wilderness, Smith's 1612 map, with its representation of a rich and extensive indigenous landscape, gives the lie to that justification. To be sure, Smith's famous map is a problematic representation that must always be approached cautiously, but it is nonetheless one of the very few documents surviving from a period of first encounters, at least on the part of the English invaders and the Chesapeake nations that stood in their way.

Although Smith may have recognized the extent of Native occupation in the region, he intended for the map to be used by the Crown to promote colonization, and it was: in its description of Lord Baltimore's patent, Charles I's 1632 Charter of Maryland clearly refers to landmarks depicted on the Smith map. While the Smith Map cannot be taken at face value (no historical document can be), it does have some relationship to a past reality and can provide insight, albeit limited, into an important point in American history.

For example, the Smith Map depicts towns in greater or lesser density within the whole, suggesting the explorer made an effort to accurately represent the landscape as he saw it (contrast this with Augustine Herman's 1670 [1673] Map of Maryland and Virginia, which depicts 17th-century colonial settlements evenly across the landscape, a representation that has not been borne out by historical and archaeological research). This variation could be real or it could be due in part to something as pragmatic as a waterway's width and what Smith and his men could see from their ships (see below).

An important example of the settlement variability Smith reports observing concerns the representation of towns along the north bank of the Rappahannock River. This observation is, in fact, borne out by the sensitivity model. Smith's map depicts a much larger number of settlements along the Rappahannock's north bank than he does along the south bank. Native settlements shown on the map on the river's south bank begin only at present day Port Royal.

The absence of towns on the Rappahannock's south side has been used to demonstrate the power of the Powhatan polity; presumably, by locating on the river's north bank, the communities along the Rappahannock kept Powhatan at bay. The sensitivity model, however, suggests an economic motivation for this pattern. A greater number of marshes and low-lying adjacent flat land are found on the river's north bank while, on the south side, the landscape consists of high terraces and steep slopes. The sensitivity model not only confirms an observation made by Smith, it suggests an economic reason for the variation.

Modeling the variations in settlement density depicted on the Smith Map is not hard to do. Point density calculations provide a method for measuring the magnitude of settlement in any given locale based on the number of "points" (or settlements) present. In this case, points were assigned to each individual settlement depicted by Smith on his map. Results of these calculations give a visual interpretation of the density of points and from this density of settlement can be inferred (Figure 12). Significantly, no large clusters are evident on the Eastern Shore of the Bay. The densest areas of settlement as suggested by the Smith Map are instead seen on the western shore along the Patuxent, middle Potomac, Rappahannock, York, Pamunkey, Mattaponi, James, and Chickahominy rivers.

Along the Patuxent these high density areas are found from the mouth of the river to Pig Point. In the middle Potomac, higher densities are observed from the Port Tobacco River to Piscataway Creek (on the Maryland side) and along the Occoquan River (on the Virginia side). There are two areas of higher density in the Rappahannock River watershed, including an area from Fleets Bay to Urbanna and a second area from Belle Isle State Park to Fredericksburg. The area from Fleets Bay to Urbanna also includes portions of the Piankatank River and Dragon Swamp. The areas from Belle Isle State Park to Fredericksburg and from Dogue to west of Fones Cliffs are especially dense with settlement.

Within the York River valley, Smith shows settlement most dense from the Williamsburg vicinity north to the confluence of the Mattaponi and Pamunkey rivers. Settlement density along the Mattaponi and Pamunkey continued northwest and was especially dense in the West Point vicinity. Density along

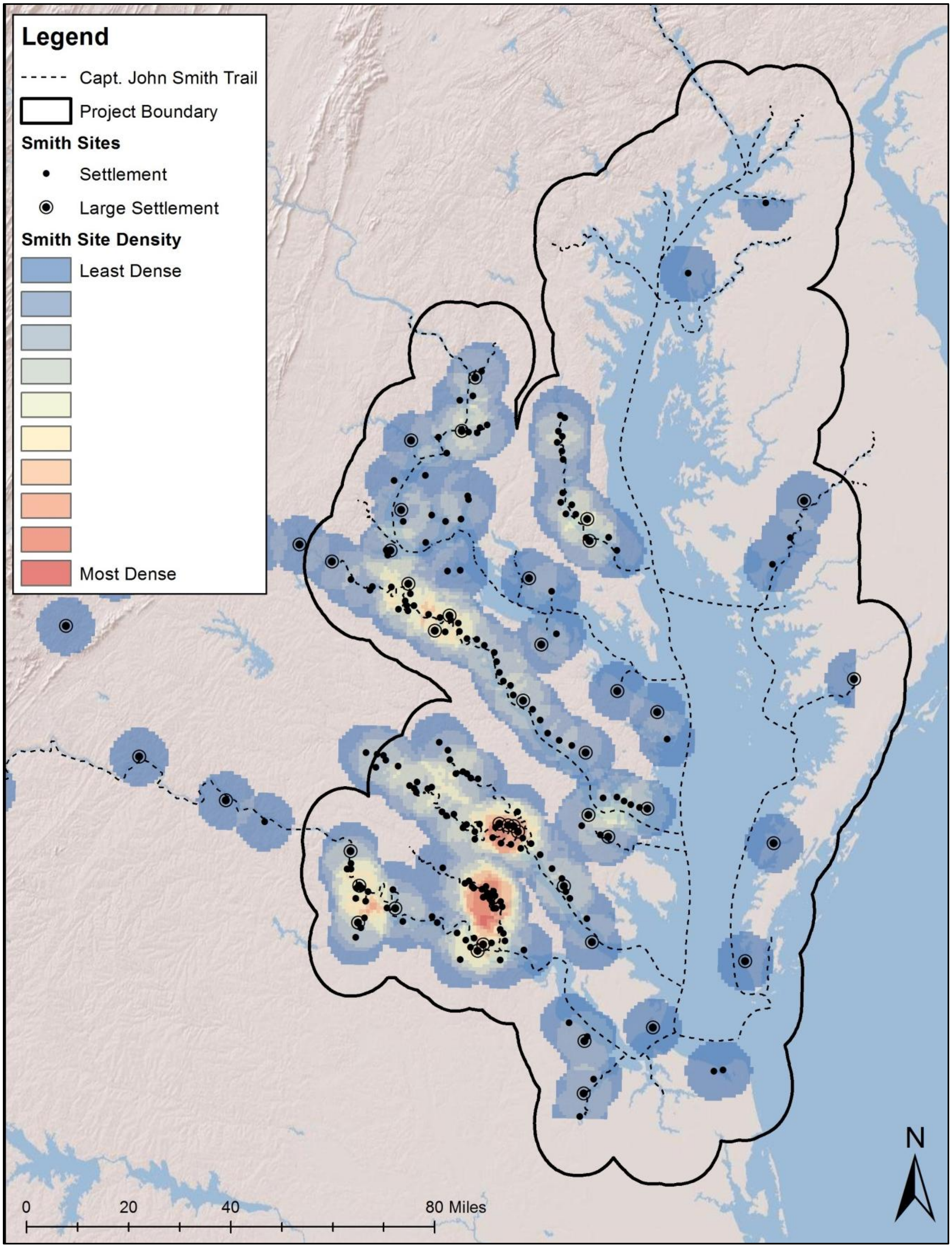

Figure 12. Density of Smith settlements.

the James began at about Jamestown Island and moved north toward Richmond. Density is greatest along the Chickahominy near its confluence with the James and particularly so in the area north of the

Chickahominy Wildlife Management Area. This area is considered the most densely clustered grouping of settlements depicted anywhere on Smith's map.

Interpreting the Smith Map using this method should be approached critically and cautiously. While Smith's map is a fair representation of the region in general, its depiction of settlements is not without concern. Not only were Smith's depictions of settlements understood through the lens of a European explorer, Smith and his men spent more or less time in various localities, and Smith was not averse to using information he had been given by relation. Indeed, Smith was careful to note when his map showed places known only by relation, but it is entirely possible that his work in the areas he presumably went was also infused by accounts and reports from others.

Finally, Smith may not have seen everything present in the landscapes he did visit. For example, although Smith does not record many settlements along shores directly on the Chesapeake Bay, modeling efforts indicate that it is likely people were living in these areas. Smith observed greater numbers of settlements on comparatively narrow rivers. Perhaps Smith's closer proximity to either shore in these smaller drainages made it easier to visually spot and investigate these settlements. Making similarly close observations in the main stem of the Bay would have been difficult. The widest river explored by Smith was the Potomac, where Smith observed most of the river's settlements further upstream where the river is considerably narrower (it is also possible that this variation represents indigenous reality).

Archaeological and Historical Significance

Archaeological and historical significance were prioritized based on a general consensus of the importance of particular events in American history and on criteria used to determine eligibility for the National Register of Historic Places. For example, events involving Natives and English colonists in the lower James and York rivers during the early 17th century are considered very significant and formative to American history. Archaeological sites and their associated landscapes must also possess integrity and authenticity, meaning sites must have been dated using standard methods and must retain a high degree of preservation.

Threatened Landscapes

Previous research in the Chesapeake watershed has identified two serious and growing threats to both land and archaeological site conservation: residential and commercial development and climate change. Both threats constitute serious challenges for the region's 21st-century residents, as both development and climate change can have a negative impact on archaeological sites and viewsheds. The following sections describe both types of threats and where they are having the greatest negative impact in the Bay's watershed. Threatened landscapes are important criteria for identifying priority areas for documenting ICLs.

Development Pressure

As previously noted, land use data from 2001 and 2011 was compared in an effort to calculate the rate of land development in the watershed. These data were analyzed in two ways, including by county and by watershed. The change in developed land area was expressed as a percent increase for both the county and watershed boundaries and is shown in Figures 13 and 14.

The percent change by county ranged from 0 percent (almost no change) to about 24 percent. Counties with a change in land development of greater than 10 percent were noted as potentially at risk for the impacts that negatively affect cultural resources associated with ICLs. Along the James and York rivers, these counties include the growing suburbs west of Norfolk, around Williamsburg, and east of Richmond. Along the Potomac, these areas include Fredericksburg and its suburbs north along the

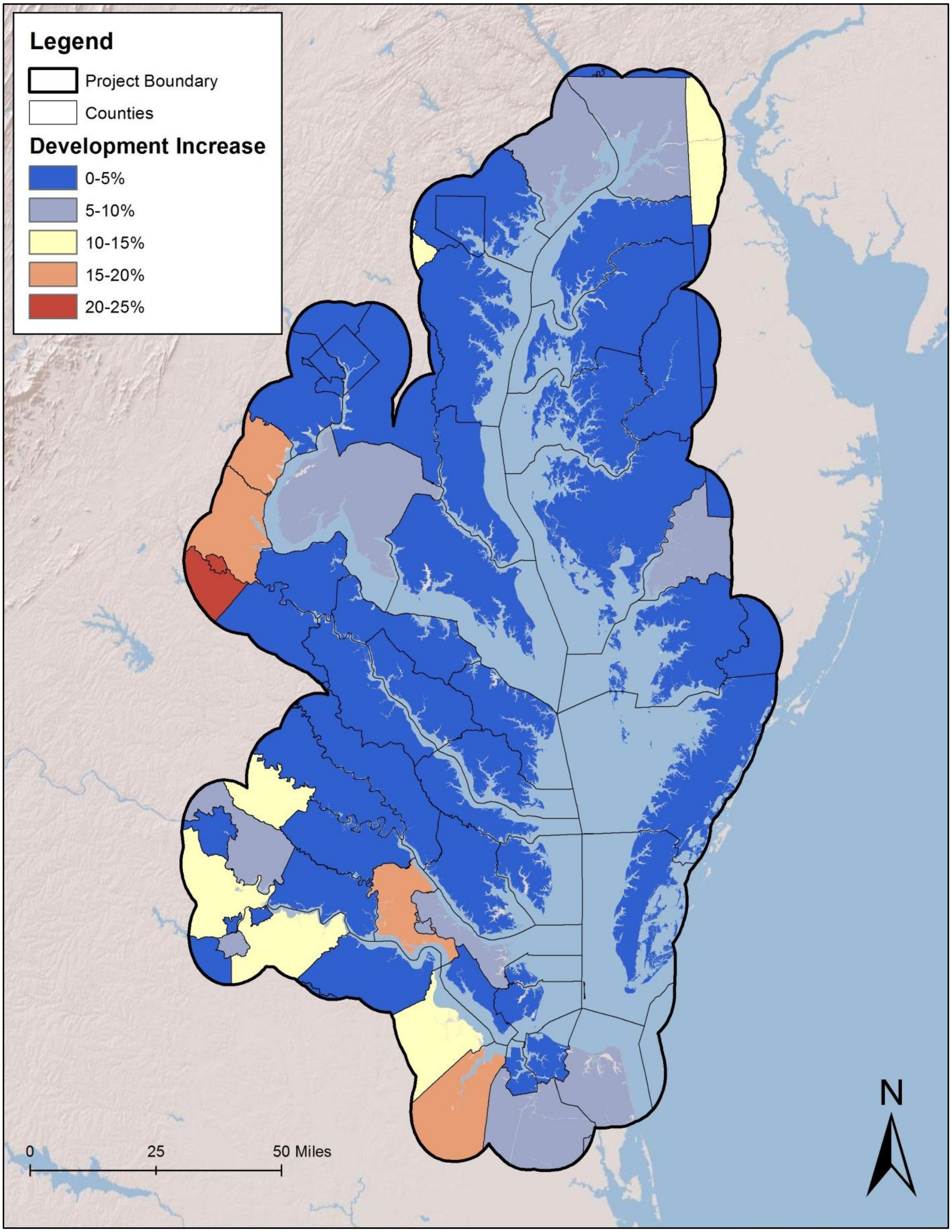

Figure 13. Developed land cover change from 2001 to 2011 by county.

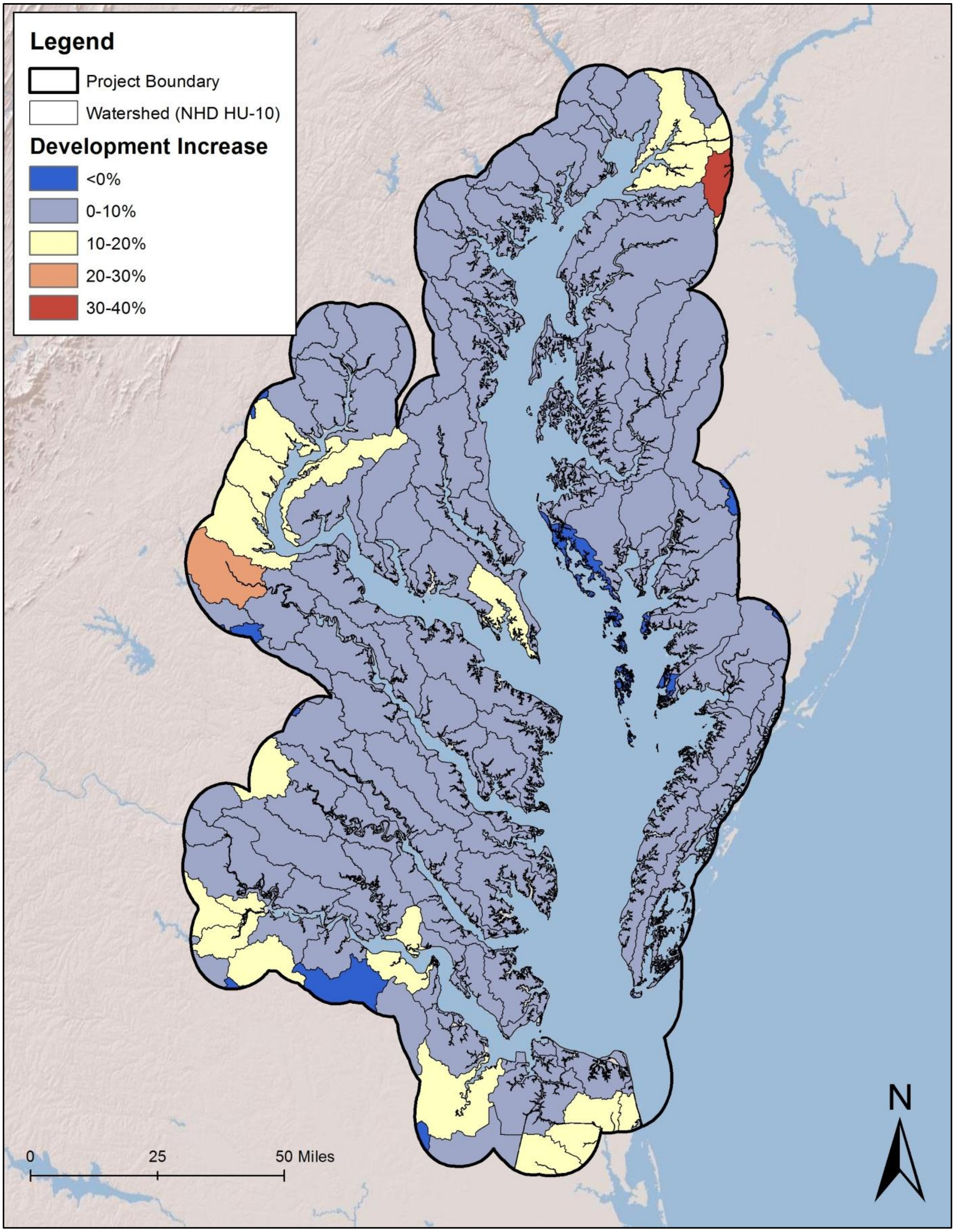

Figure 14. Developed land cover change from 2001 to 2011 by watershed.

Interstate 95 corridor to the Marine base at Quantico. Portions of Howard County in Maryland (containing suburbs of Baltimore) have also seen an increase in developed land area within the small portion that falls within the bounds of the project area. In Delaware, New Castle County has seen an increase in developed land area, likely due to suburban sprawl around Newark and Wilmington.

While examining the rate of change by county is useful, the data is at a level at which it cannot account for specific at-risk watersheds. County-level examination only serves a broad focus, whereas ICL studies are chosen based on watershed regions and boundaries. The percent change in developed land area by watershed between 2001 and 2011 ranges from 0 to just over 30 percent. Again, any watershed area with a change of over 10 percent was considered threatened.

At the head of the bay, at-risk watersheds include the Elk River, Red Lion Creek, and Delware/ Appoquinimink river watersheds. On the western shore of the bay along the Potomac, at-risk watersheds include the Occoquan (also Pomonkey Creek), Quantico/Mattawoman (combined as one), Potomac Creek, and St. Mary's River watersheds. Along the Rappahannock, at-risk areas include the Massaponax Creek watershed and portions of the Rappahannock watershed near Fredericksburg.

Increased development in the York River valley is evident in the Upper Pamunkey River watershed. For the upper James River valley, the watersheds of Swift Creek, Ashton Creek, Appomattox River, and Blackwater Swamp have seen more than a 10 percent increase in developed land. Within the tidal James River valley the Powhatan Creek and Nansemond River valleys are at risk. The low-lying coastal areas in the vicinity of the Great Dismal Swamp are also at risk and include the Northwest River, North Landing River, and Currituck Sound watersheds.

Climate Change

Aside from the effects of development, other forces are at play in terms of impacting the integrity of the landscape. A more predictable threat to the landscape is the threat of climate change. The Maryland Climate Change Commission climate models and projections estimate that, by the year 2050, the rise in relative sea level in the state will be between 0.9 and 2.1 feet, with a best estimate of 1.4 feet (Figure 15).

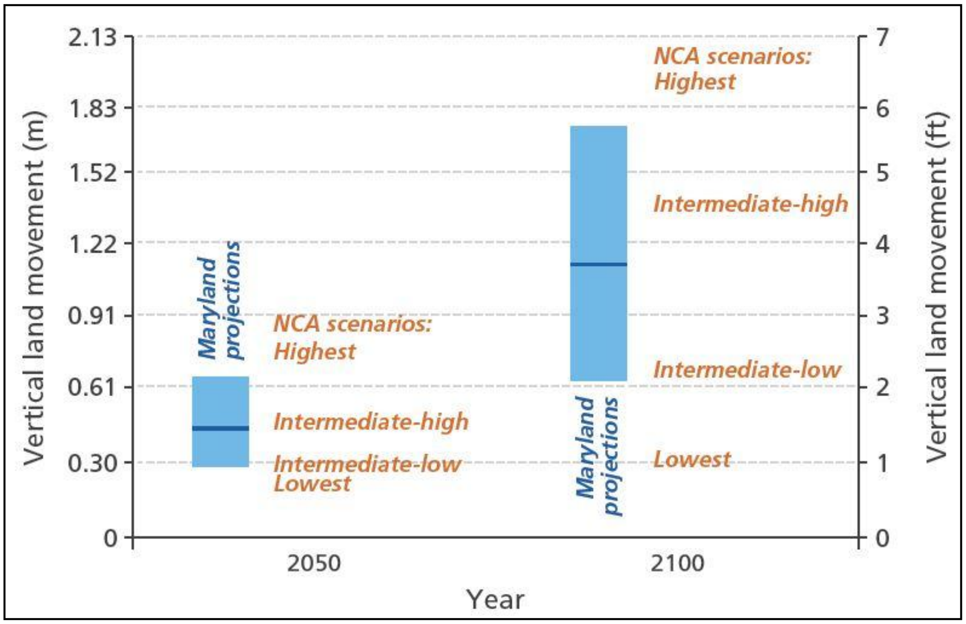

Figure 15. Sea level rise predictions for Maryland (Source: Boesch et al. 2013).

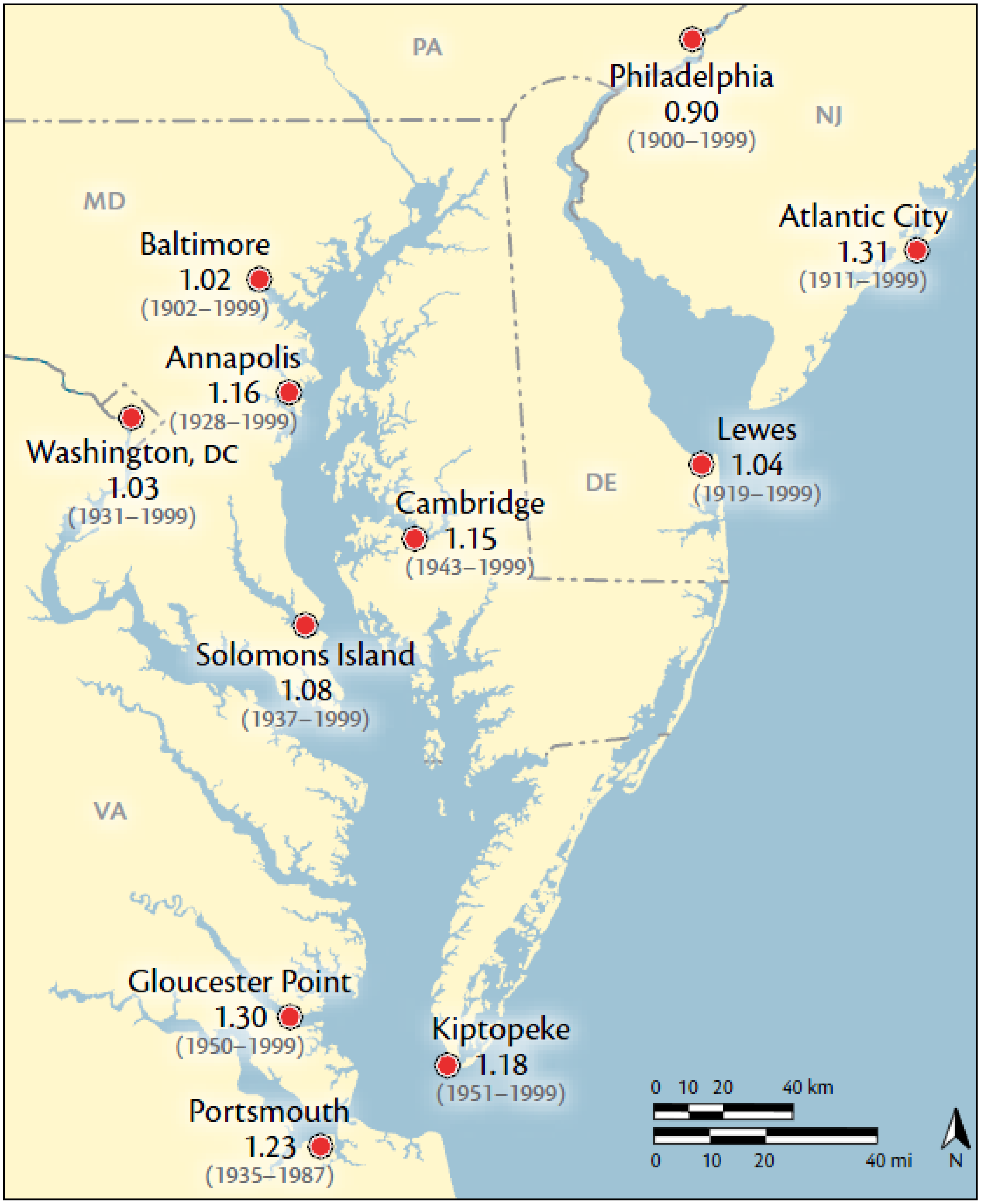

Figure 16. Rates of sea level rise in the Chesapeake (Source: MCCC 2008).

By the year 2100, the projected range is between 2.1 and 5.7 feet, with a best estimate of 3.7 feet. These projections are based on multiple data sources, including CO^2 emissions projections, global temperature monitoring, and local studies on tidal changes and rates. Indeed, tidal gauges installed throughout the Chesapeake (Figure 16) have shown sea level over the past century has risen more than a foot.

Sea-level rise is a consequence of both rising average surface temperatures across the planet and land subsidence due to the effects of the Chesapeake Bay bolide (Boesch et al. 2013). The impact of the bolide, which hit the Hampton Roads vicinity, created a crater filled with breccias of broken rock that, 35 million years later, continue to settle as they consolidate. The crater, discovered by geologists searching for untapped oil reserves, extends fully under the Eastern Shore and along the eastern edges of the western shore and is a principal cause of the land subsidence experienced in those areas (USGS 2014).

Land subsidence rates within the Chesapeake region have been estimated to be anywhere from around 0.39 to 1.31 feet per century (MCCC 2008). The highest rates of subsidence have been measured on the Eastern Shore of the Chesapeake, especially closer to Delaware Bay. Along the western shore, these rates are greatest near the Great Dismal Swamp, the James River valley, and the York River valley near its intersection with the Pamunkey and Mattaponi rivers.

The effects of sea-level rise and land subsidence have put most of the Bay's Eastern Shore at risk for flooding and future inundation, potentially erasing these landscapes forever. This area consists of expansive marshes and low-lying flat lands and has greater exposure during hurricanes and Nor'easters. The western shore of the bay also includes marshes and low-lying land, although not in as high proportions as seen on the Eastern Shore. The western shore benefits by having a more diversified landscape consisting of flat lowlands, bluffs, hills, and the foothills of the Appalachian Mountains.

From a climate change perspective, then, priority should be given to the threatened landscapes of the Eastern Shore or Delmarva Peninsula. Already recently-inhabited islands in the Bay have been lost and others, including Smith and Tangier islands, are directly threatened. What was once dry land on the Eastern Shore is now marsh, and the trend in this direction is continuing.

Discussion

This study revealed a number of watershed landscapes with a high sensitivity for having been occupied by Native people at the time Captain John Smith embarked on his mapping expedition in 1608. By modeling the correlations between soil types, marshes, wetlands, transportation tributaries, and areas where Late Woodland (900 AD-1600 AD) and Contact (1600 AD+) period archaeological sites have been found, it is possible to identify similar landscapes that have not, as yet, been documented. This exercise has confirmed what Smith's map suggests: the Chesapeake Bay region was a relatively dense setting for many thriving Indian communities and nations on the eve of Contact with Europeans. Indigenous Cultural Landscapes with varying intensities of settlement existed in many river and creek drainages from the Bay's southern end to its northern end.

Prioritizing these many potential landscapes involved assessing them against additional criteria, including the presence of contemporary Native communities, and two criteria developed specifically for this project. These two new criteria included a comparison with the Smith map and with the potential for land use changes driven by development, climate change, or both. An additional criterion of early contact interface/Anglo-Native interaction was also included to delineate watersheds of exceptional historical significance. More specifically, these watersheds locations where early intensified contact with Europeans took place, such as in the James and York rivers (including their tributaries) with the establishment of Jamestown and related settlements beginning in 1607, and the Potomac and Patuxent rivers with the establishment of St. Mary's City and related settlements beginning in 1634.

Table 9 and Figure 17 list and depict the general watershed areas along with findings from the abovementioned set of criteria. Further, Table 10 lists the top watersheds with notes of their most immediate threats. The ranking system used in Table 10 was based on the sum of arbitrary values given to the responses given for each of the criteria shown in Table 9. The arbitrary values for each response were developed in consultation with National Park Service staff. The rankings themselves are split into four groups on a scale of 0 to 3. The rank of 0 was assigned only to watersheds that have already had ICL

Watershed	**Contemp. Community**	**Smith Map**	**Rural**	**Develop. Rate %**	**Climate Change**	**Early Contact Interface**
Susquehanna River	*No*	*Sparse*	*Yes*	*0-10*	*Low*	*No*
Gunpowder River	No	Sparse	No	0-10	Low	No
Patapsco River	No	Sparse	No	0-10	Moderate	No
Severn River	No	Sparse	No	0-10	Moderate	No
South River	No	Sparse	No	0-10	Moderate	No
Patuxent River	**Yes**	**Dense**	**Yes**	**0-10**	**High**	**Yes**
Potomac River I: Washington DC to Port Tobacco including Anacostia	**Yes**	**Dense**	**Partially**	**0-20**	**Moderate**	**Yes**
Potomac River II: Port Tobacco to Point Lookout	**Yes**	**Sparse**	**Yes**	**0-20**	**High**	**Yes**
Western Chesapeake Shore: Annapolis to Point Lookout	No	Sparse	Partially	0-10	High	No
Rappahannock I: Fredericksburg to Tappahannock	**Yes**	**Dense**	**Partially**	**0-30**	**Moderate**	**No**
Rappahannock II: Tappahannock to mouth	No	Dense	Yes	0-10	High	No
Piankatank River	No	Dense	Yes	0-10	High	No
York River: Mouth to West Point	**Yes**	**Dense**	**Partially**	**0-10**	**High**	**Yes**
Pamunkey River	**Yes**	**Dense**	**Yes**	**0-20**	**Moderate**	**Yes**
Mattaponi River	**Yes**	**Dense**	**Yes**	**0-10**	**Moderate**	**Yes**
James River I: Richmond to and including the Chickahominy	**Yes**	**Dense**	**Partially**	**0-20**	**Moderate**	**Yes**
James River II: Chickahominy to Mouth and including Nansemond	**Yes**	**Dense**	**No**	**0-20**	**High**	**Yes**
Elk River	No	Sparse	Yes	10-20	Moderate	No
Sassafras River	No	Sparse	Yes	0-10	Moderate	No
Chester River	**Yes**	**Sparse**	**Yes**	**0-10**	**High**	**No**
Choptank River	**Yes**	**Sparse**	**Yes**	**0-10**	**Very High**	**No**
Nanticoke River	***Yes***	***Sparse***	***Yes***	***0-10***	***Very High***	***No***
Wicomico River (Eastern Shore)	**Yes**	**Sparse**	**Yes**	**0-10**	**Very High**	**No**
Pocomoke River	**Yes**	**Sparse**	**Yes**	**0-10**	**Very High**	**No**

Table 9. Watershed observation summary within tidal Chesapeake area (Recommended future ICL study areas are represented in bold type; Previous ICL studies are italicized).

studies prepared or are planned in the immediate future. The remaining watersheds are ranked 1 through 3, with 1 being of the Highest priority, and 3 being of Moderately High priority. Ranks 1 through 3 were assigned by the combined scores for each criteria response value, but are shown listed in alphabetical order within each rank class.

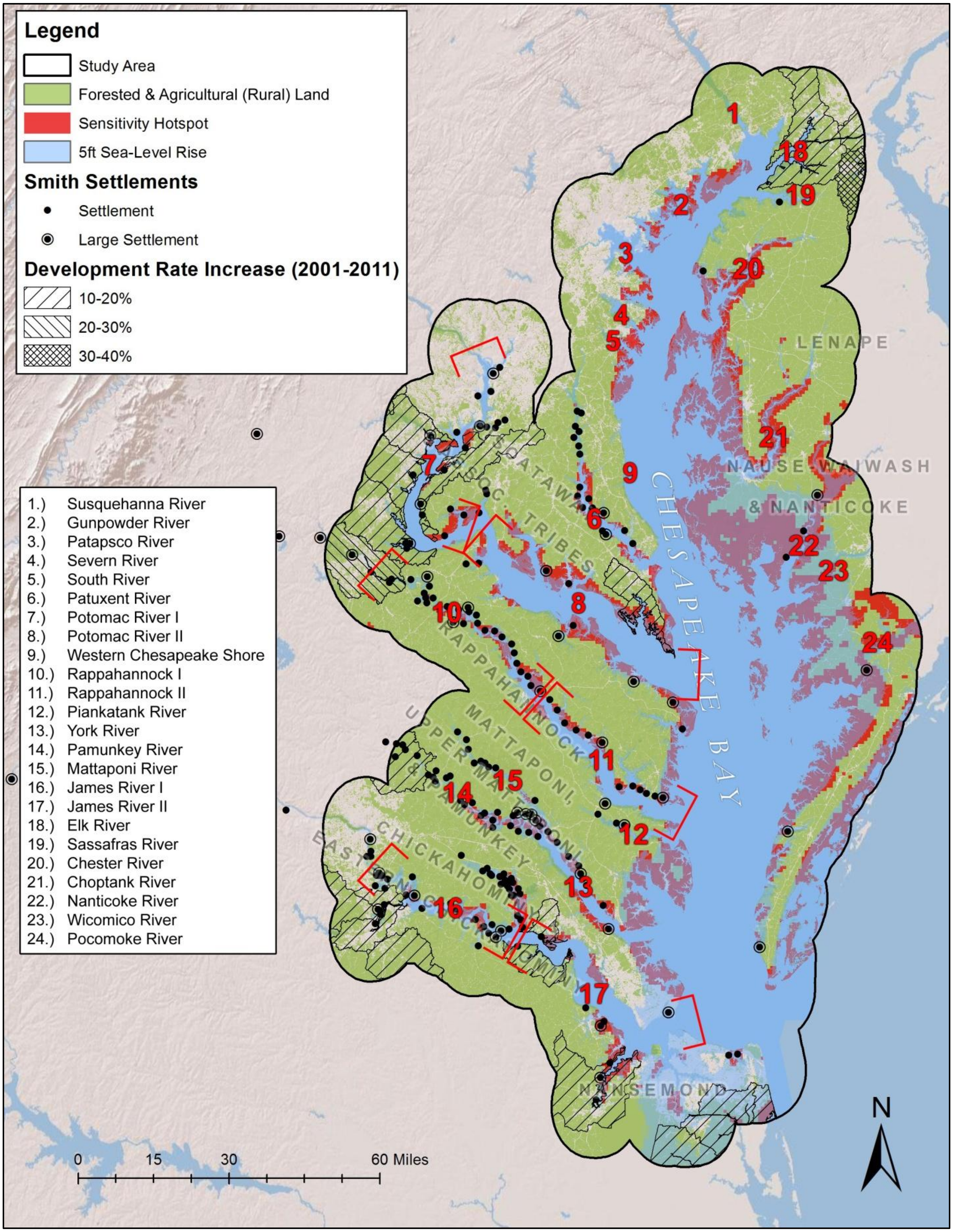

Figure 17. Map of watershed observations within the project area; red lines bracket areas mentioned in this report.

Priority Ranking	**Watershed**	**Threats**
0	***Nanticoke River***	*Sea Level Rise/Erosion*
0	***Rappahannock:*** *Fredericksburg to Tappahannock*	*Suburban sprawl around Fredericksburg, VA.*
1	**James River:** Richmond to and including Chickahominy	Suburban sprawl east of Richmond
1	**James River:** Chickahominy to Mouth and including Nansemond	Suburban sprawl west of Norfolk, sea level rise/erosion
1	**Mattaponi River**	Minor development
1	**Pamunkey River**	Development
1	**York River:** Mouth to West Point	Sea Level Rise/Erosion
2	**Patuxent River**	Sea Level Rise/Erosion
2	**Potomac River:** Port Tobacco to Point Lookout	Sea Level Rise/Erosion, Sprawl along St. Mary's River
2	**Potomac River:** From Washington DC to Port Tobacco including Anacostia[2]	Urban developed land in Washington DC. Suburban sprawl around Waldorf, MD and Quantico, VA.
3	**Chester River**	Sea Level Rise/Erosion
3	**Choptank River**	Sea Level Rise/Erosion
3	**Pocomoke River**	Sea Level Rise/Erosion
3	**Wicomico River** (Eastern Shore)	Sea Level Rise/Erosion

Table 10. Priority Watershed Areas for further evaluation[3]; 0=watersheds for which an ICL study was completed; 1=Highest Priority; 2= High Priority; 3=Moderately High Priority.

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[2] While the Potomac River watershed is an important interface between indigenous peoples and the English beginning in 1634, the previous study of the Nanjemoy and Mattawoman Creek watersheds covered a good portion of this region. However, the Anacostia River does have great potential despite its urban landscape.

[3] The Susquehanna River drainage was not included in this list as a majority of that watershed was beyond the scope of this project. Preliminary work similar to the Nanjemoy/Mattawoman and Nanticoke ICL studies is underway in this region.

VIII. Conclusion

Results of the sensitivity model generated for this report demonstrate that much of the Chesapeake region shares environmental characteristics associated with indigenous settlement in the Late Woodland and Contact periods. Due to issues with scale, defining future ICL studies based on the generation of the sensitivity model alone does not reveal the significant differences throughout the landscape that existed within specific watersheds. The results of this generalized model can be used, however, in the interpretation of Captain John Smith's map of the Chesapeake. Along the Rappahannock River, for example, the model shows larger and more expansive areas of high sensitivity along much of its north bank, coinciding with Smith's observations of a majority of settlements along this bank. In contrast, Smith's map shows very sparse settlement along the Chesapeake Bay shoreline. It should be noted that where Smith does show settlements in great number, the overall width of the river is much narrower. This is evident in nearly all tributaries that were explored. The wide open waterways like that of the Bay would have allowed for navigation further from the coast, making settlement observations increasingly difficult.

Analyzing the Smith map further, the density of sites within the tributary rivers of the Bay reveal where hotspots of settlement activity were observed by Smith. The densest clusters of settlements are observed along portions of the Rappahannock, Mattaponi, Pamunkey, James, and Chickahominy rivers in Virginia. As previously stated, the width of the waterway appears to correlate with the number of settlements observed. This is true in the case of the Potomac River, the widest of the tributaries, where few settlements are observed until the river narrows the further upstream from its mouth. The same can be said for the Rappahannock, York, and James river valleys as well.

The archaeological record suggests that settlement during the Late Woodland and Contact periods was not restricted in the way Smith portrays it in his map. Where Smith's map limits, the sensitivity model can serve as a supplement for identifying indigenous landscapes of the period. However, archaeological data is not without its own sampling bias.

Past work with ICLs by the National Park Service within the Chesapeake has taken a watershed-based approach on a much more detailed micro-regional level. These studies could not have been completed without the involvement of existing active indigenous communities. Various indigenous communities are found throughout the Chesapeake, with active groups in Maryland, Delaware, and Virginia. Highest priority areas should include watersheds associated with or in close proximity to these groups as previously mapped in Figure 11.

Targeting watersheds potentially threatened by development, particularly large proposed residential communities, suburban sprawl, and linear infrastructure projects (roadways, pipelines) can provide impetus for protecting natural and cultural landscape features from adverse effects by documenting why these places are significant. One of the National Park Service Chesapeake Bay Office's stated goals is the protection of these landscapes so intimately tied to the American historical experience and raising awareness and education through experiences and interpretations of the Captain John Smith Chesapeake National Historic Trail.

Recommendations

By synthesizing all data compiled as part of this project, fourteen specific watersheds have been identified as being of particular interest and potential for yielding important information in regards to indigenous landscapes. Of these fourteen watersheds, the Nanticoke has already had an ICL study done (Sullivan, Chambers, and Barbery 2013) and the Potomac has had a portion completed (Nanjemoy-Mattawoman) (Strickland, Busby, and King 2015), while the Rappahannock study is currently pending as of the writing of this report. All fourteen of these High to Highest Priority watersheds include most or all of the following criteria:

1. Expansive and notable areas of archaeological sensitivity;
2. Active indigenous communities;
3. Dense settlement activity on Smith's map;
4. Predominantly rural land use;
5. Potentially threatened by development and climate change; and
6. Rivers/watersheds of historical importance to early contact interfaces and exchanges.

The remaining twelve landscapes that meet the above criteria as seen in Table 10 include segments of the James, Mattaponi, Pamunkey, York, Patuxent, Potomac, Chester Choptank, Pocomoke, and Wicomico Rivers. Sea level rise and erosion due to climate change were immediate threats to eight of the twelve identified watersheds. Development was observed as being a concern for six of the twelve watersheds. All of these watersheds have active indigenous communities along their banks or within very close proximity.

Previous ICL studies have already covered two of these watersheds, or large portions thereof. A study on the Nanticoke River watershed has already been completed. The study of the Nanjemoy and Mattawoman Creek watersheds covered much of the Maryland side of the portion of the Potomac River stretching from Washington DC to Port Tobacco. Planned ICL studies are for the portion of the Rappahannock River stretching from east of Fredericksburg to Tappahannock, which will include the area known as Fones Cliffs, an important trail feature that is under development pressure.

It is further recommended that the approach taken as part of this study be applied to the Susquehanna River portion of the Captain John Smith Chesapeake National Historic Trail. This northern reach of the trail has a drastically different landscape than that of the tidal Chesapeake, which is better served by separate effort to analyze the spatial relationships of archaeological and historical resources to their environment.

This report is intended to guide and further target identification of indigenous cultural landscapes in the Chesapeake Bay. While much of the Bay has potential for yielding new and important insights into indigenous life throughout the centuries, the NPS and partners can focus limited resources on documenting places where landscape integrity and meaning is most threatened, and prioritize interpretation and conservation activities where descendent communities can play a substantive role in protection.

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William and Mary Center for Archaeological Research [WMCAR]
2015 *Captain John Smith Chesapeake National Historic Trail, Keystone Segment, Historic District*. National Register of Historic Places Inventory/Nomination Form.

Appendix I. Professional Qualifications

SCOTT M. STRICKLAND

EDUCATION

Master of Science (Distinction) 2012
Archaeological Computing – Spatial Technologies
University of Southampton, Southampton, United Kingdom

Bachelor of Arts 2008
Sociology/Anthropology
St. Mary's College of Maryland, St. Mary's City, Maryland

Associates Degree 2006
Social Sciences
College of Southern Maryland, La Plata, Maryland

ARCHAEOLOGICAL AND RELATED EXPERIENCE AND EMPLOYMENT

Project Researcher/GIS Manager (NPS - Nanjemoy Indigenous Cultural Landscapes) March 2015-Present
St. Mary's College of Maryland, St. Mary's City, Maryand

Contract Archaeologist (Maryland Historical Trust CLG grant) Jan. 2015 - Present
St. Mary's County Department of Land Use & Growth Management, Leonardtown, Maryland
St. Mary's College of Maryland, St. Mary's City, Maryland

Project Archaeologist (NEH – Colonial Encounters, Potomac)/Adjunct Instructor Jan. 2013 – May 2015
St. Mary's College of Maryland, St. Mary's City, Maryland

GIS Technician July 2014-Oct. 2014
Duke Cultural Resource Management, Rancho Santa Margarita, California

Archaeological/Records Consultant 2012-Present
Self-Employed, Lexington Park/California, Maryland

Historical Researcher/Project Archaeologist (Zekiah Archaeological Survey) 2009-2012
Smallwood Foundation, Waldorf, Maryland

Historical Researcher/Archaeologist (Zekiah Archaeological Survey) 2008-2009
Wetherburn Associates LLC., Waldorf, Maryland

Field Supervisor 2008
St. Mary's College of Maryland, St. Mary's City, Maryland

Survey/CAD Technician 2003-2008
Offenbacher Land Surveying, Lexington Park, Maryland

TEACHING EXPERIENCE

GIS: Humans and their Environment 2015
Department of Anthropology/Environmental Studies – St. Mary's College of Maryland

GIS for the Social Sciences 2013-2014
Department of Anthropology – St. Mary's College of Maryland

SELECTED REPORTS

- **<u>2015</u>** Strickland, Scott M.
  Archaeological Assessment and Review of St. Mary's County, Maryland's Cultural Resources. Report prepared for the St. Mary's County Historic Preservation Commission and the Maryland Historical Trust. Report to be completed in June, 2015.
- **<u>2012</u>** Strickland, Scott M.
  A GIS Approach to Late Woodland Settlement Patterns along Maryland's Lower Potomac River. [Thesis] Department of Archaeology, University of Southampton. Southampton, United Kingdom.
- **<u>2012</u>** Flick, Alex J., Skylar A. Bauer, Scott M. Strickland, D. Brad Hatch, and Julia A. King
  "a place now known unto them" The Search for Zekiah Fort. Report prepared for Michael & Virginia Besche, Mr. & Mrs. Don Eckel, Mr. & Mrs. Gaylord Hogue, Mr. & Mrs. Michael J. Sullivan, and Mrs. D.H. Steffens. Report on file, Maryland Archaeological Conservation Laboratory, Jefferson Patterson Park and Museum
- **<u>2011</u>** Strickland, Scott M., and Julia A. King
  An Archaeological Survey of the Charleston Property: Josias Fendall's Dwelling Plantation. Report prepared for Mark & Barbara Hoy, James & Betty Jackson, and The Smallwood Foundation. Report on file, Maryland Archaeological Conservation Laboratory, Jefferson Patterson Park and Museum

JULIA ANN KING

EDUCATION:

Ph.D., 1990, Historical Archaeology, University of Pennsylvania, Philadelphia.
M.A., 1981, Anthropology, Florida State University, Tallahassee.
B.A., 1978, College of William and Mary, Williamsburg, Virginia.

TEACHING EXPERIENCE:

2013-present, Professor of Anthropology, St. Mary's College of Maryland, St. Mary's City, Maryland, 20686.
2006-2013, Associate Professor of Anthropology, SMCM.
2008-2012, Coordinator, Museum Studies Program, SMCM.

PROFESSIONAL EXPERIENCE:

1996 to 2006: Director, Maryland Archaeological Conservation Laboratory, Maryland Historical Trust, St. Leonard, Maryland, 20685.
1987 to 1996: Director of Research, Jefferson Patterson Park and Museum, St. Leonard, MD.
1978-1986: Numerous field crew and field supervisor positions, including Flowerdew Hundred, Governor's Land, St. Augustine, St. Mary's City.

OTHER POSITIONS:

2003 President, Society for Historical Archaeology (www.sha.org).
2003-2011 Member, President's Advisory Council on Historic Preservation (www.achp.gov).

GRANTS, AWARDS, and FELLOWSHIPS:

2013-2014 Maryland Historical Trust, *An Archaeological Survey of Piscataway Landscapes.*
2012-2014 National Endowment for the Humanities, Division of Collaborative Research, *The Lower Potomac River Valley at Contact, 1550-1720.*
2005-2007 National Endowment for the Humanities, Division of Preservation and Access. : *Developing a Records Database for the State of Maryland's Archaeological Collections*.
2002-2005 National Endowment for the Humanities, Division of Collaborative Research. *A Comparative Archaeological Study of Colonial Chesapeake Culture*.
2002 Research Fellow, Henry Francis duPont Winterthur Museum, Winterthur, Delaware.
2001-2003 National Endowment for the Humanities, Division of Preservation and Access. *Developing a Digital Catalog for the State of Maryland's Archaeological Collections*.
2000 Andrew Mellon Fellow, Virginia Historical Society, Richmond.
1999 Research Associate, The Colonial Williamsburg Foundation, Williamsburg, Va.
1994 Fellow in Landscape Architecture Studies, Dumbarton Oaks, Washington, D.C.

PROFESSIONAL MEMBERSHIPS and SERVICE:

Society for Historical Archaeology, Member, Director (1997-2000), President (2003)
Society for American Archaeology, Member
Council for Northeast Historical Archaeology, Member, Director (1991-94, 1995-98)
Southeastern Archaeological Conference, Life Member
Register of Professional Archaeologists, Member
American Anthropological Association, Member

PEER-REVIEWED PUBLICATIONS:

2012 *Archaeology, Landscape, and the Politics of the Past: The View from Southern Maryland*. University of Tennessee Press, Knoxville.

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