Accomack County

Blue & Green Infrastructure Project

Accomack County Literature Review and Data Assessment Report

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Accomack County Literature Review and Data Assessment Report

Introduction

The Accomack County Literature Review and Data Assessment Report was prepared by the Green Infrastructure Center and Accomack County staff as Phase I of the Accomack County Blue & Green Infrastructure Project. The purpose of the Literature Review and Data Assessment Report is to document data collected for use in development of the Accomack County Blue & Green Infrastructure Study, which is Phase II of this project. The Literature Review and Data Assessment Report includes the following:

Green Infrastructure Center Memorandum The Green Infrastructure Memorandum explains the contents of the following attachments. The Memorandum was written in October 2009 and documents project progress to date. After this memo was written and during Phase II of the project, further refinements were made to the information for inclusion in the Accomack County Blue & Green Infrastructure Study.

Attachment A – GIS Information Summary The GIS Information Summary documents the geographic information system (GIS) mapping data compiled from a wide variety of local, state, and federal sources. Of particular value was the data obtained from the Virginia Coastal Zone Management Program's Coastal GEMS website, an online GIS program available at: http://www.deq.state.va.us/coastal/coastalgems.html

Attachment B – Literature Review The Literature Review documents studies and reports relevant to blue and green infrastructure resource planning and conservation in Accomack County.

Attachment C – Literature Review Resource Spreadsheet The Literature Review Resource Spreadsheet list the studies and reports in the Literature review and will be updated periodically by Accomack County as a research tool.

Attachment D – Stakeholder Interviews Summary The Stakeholder Interviews Summary outlines the key issues identified by local, regional, and statewide participants, including the Accomack County Board of Supervisors.

Green Infrastructure Center Inc.

This project made possible by:

MEMORANDUM

DATE: October 16, 2009

TO: Accomack County
Larry Forbes, *Economic Development Director*
Jim McGowan, *Planning Director*
Tom Brockenbrough, *GIS Coordinator*

FROM: Sarah Malpass, Karen Firehock

RE: Accomack Data Assessment

ATTACHED: A – GIS Information Summary
B – Literature Review Summary
C – Literature Review Resource Spreadsheet
D – Stakeholder Interviews Summary

Introduction

The purpose of this memo is to provide Accomack County with an overview of the data assessment conducted by the Green Infrastructure Center (GIC) as part of the Accomack County Green Infrastructure Research Study. The data assessment included a GIS information summary, a literature review and a series of stakeholder interviews.

GIS Information Summary

The first task was to compile and analyze available Geographic Information Systems (GIS) mapping data to create a series of themed maps in partnership with the Accomack County GIS Coordinator. The themes and preliminary base maps are provided as Attachment A. The initial map set includes:

- Virginia Natural Landscape Assessment
- Water Resources: Feature Types
- Water Resources: Watersheds, Groundwater Recharge, Floodplains
- Recreational Resources
- Working Lands: Prime Agricultural Soils
- Working Lands: Parcel Distribution for Sustainable Timber Management
- Fishery Related Resources
- Wildlife Habitat Resources
- Landscape Types
- Resource Protection

- Land Use: Zoning
- Land Use: Future Land Use

Literature Review

The second task was to conduct a literature review of studies and reports regarding the quality, quantity, impacts to, or trends in species, ecosystems or habitat on the Eastern Shore. The full literature review is provided as Attachment B. A spreadsheet of the included resources is provided as attachment C. Key recommendations from the literature with further implications for mapping and analysis include:

- Reduce nutrient quantities applied to agricultural fields and filter the nutrients that are applied.
- Increase the connectivity of riparian systems.
- Protect the continuity of interior habitat along the coastline.
- Isolate low-quality habitat patches including smaller patches and those containing invasive species.
- Rebuild coastal habitats lost to erosion and inundation.
- Protect groundwater recharge zone, initiate drinking water conservation programs and re-use systems for irrigation purposes.
- Enhance dunes for shoreline protection and habitat expansion for birds and beetle species currently in decline.

Stakeholder Interviews Summary

The third task was to conduct interviews with local and regional individuals and organizations. These interviews were conducted August 18 – 22, 2009. A summary of the stakeholder interviews and their implications for asset mapping is provided in Attachment D. Key considerations include:

- Development patterns and infrastructure demands
- Water quality and wastewater management
- Conserving natural resources
- Identification of places with locally recognized environmental value
- Disagreement over the existence and implications of sea level rise
- Agriculture-related pollution
- Access to recreation
- Characterization of closed shellfish beds

Additionally, information gathered during the literature review indicated some significant progress in restoring Submerged Aquatic Vegetation (SAV) beds after broadcasting seeds and observing successful germination. Stakeholder interviews provided additional levels of detail, namely that sea grass restoration on the seaside has been very successful while restoration on the bayside has not met with as much success.

Next Steps

After review by Accomack County, the GIC will finalize the data assessment and move forward with the asset mapping phase of the research study. Next steps will include:

Finalize Data Assessment

The GIC will acquire additional data as needed based on comments from the data assessment review. Relevant spatial and conceptual data from the Literature Review and stakeholder interviews will be incorporated.

Research on other models, either existing or nearly completed, for inclusion in the project will be completed. Potential additional maps may include threatened species, erosion and accretion, and special resources based on expert local knowledge.

Transition to Asset Mapping

Based on data assessment and the county's goals, the GIC will develop a methodology for creating asset maps and overlays of local priority landscapes (per workplan). The GIC project team will focus on developing the green infrastructure network base map (prioritized, high value resources) and will coordinate with the county to develop the thematic overlays.

Attachment A: GIS Information Summary

Introduction

In coordination with Accomack County, the GIC project team conducted a data assessment of available GIS data for possible use in the study's green infrastructure asset and opportunity mapping tasks. Due to the amount of readily available data, inventory base maps were divided into themes. An inventory of available data by theme is included on the following page; data excluded after evaluation is also included in the table. The inventory base maps will be updated as requested datasets become available. Base maps follow the table of base map inventory themes.

Considerations

Landscape types and topography could be important considerations in identifying and prioritizing the county's green infrastructure assets. The Virginia Natural Landscape Assessment was developed by the Virginia Department of Conservation and Recreation Natural Heritage Program for identifying, prioritizing, and linking natural lands in Virginia (see map on page 4). Large intact natural lands – or cores – are an important green infrastructure asset. Characterizing these cores by landscape type and ecological function will be an important component of developing a green infrastructure network and identifying assets at risk. Landscape types may include developed areas, submerged aquatic vegetation, dune systems, forest cover and wetlands. Ecological functions may include providing water filtration, storm surge protection, biodiversity support, and corridors for animal movement.

Topography is another important consideration in coastal environments where natural events such as storms or changes in landforms could significantly impact natural resources. While course contour information can be interpolated from other data sources, a finer scale (< 5 foot intervals) would be ideal for this analysis. The project team is currently researching alternative data sources. Sea level rise, storm surge prediction, or other similar models may contain base information that could be used as a proxy for elevation.

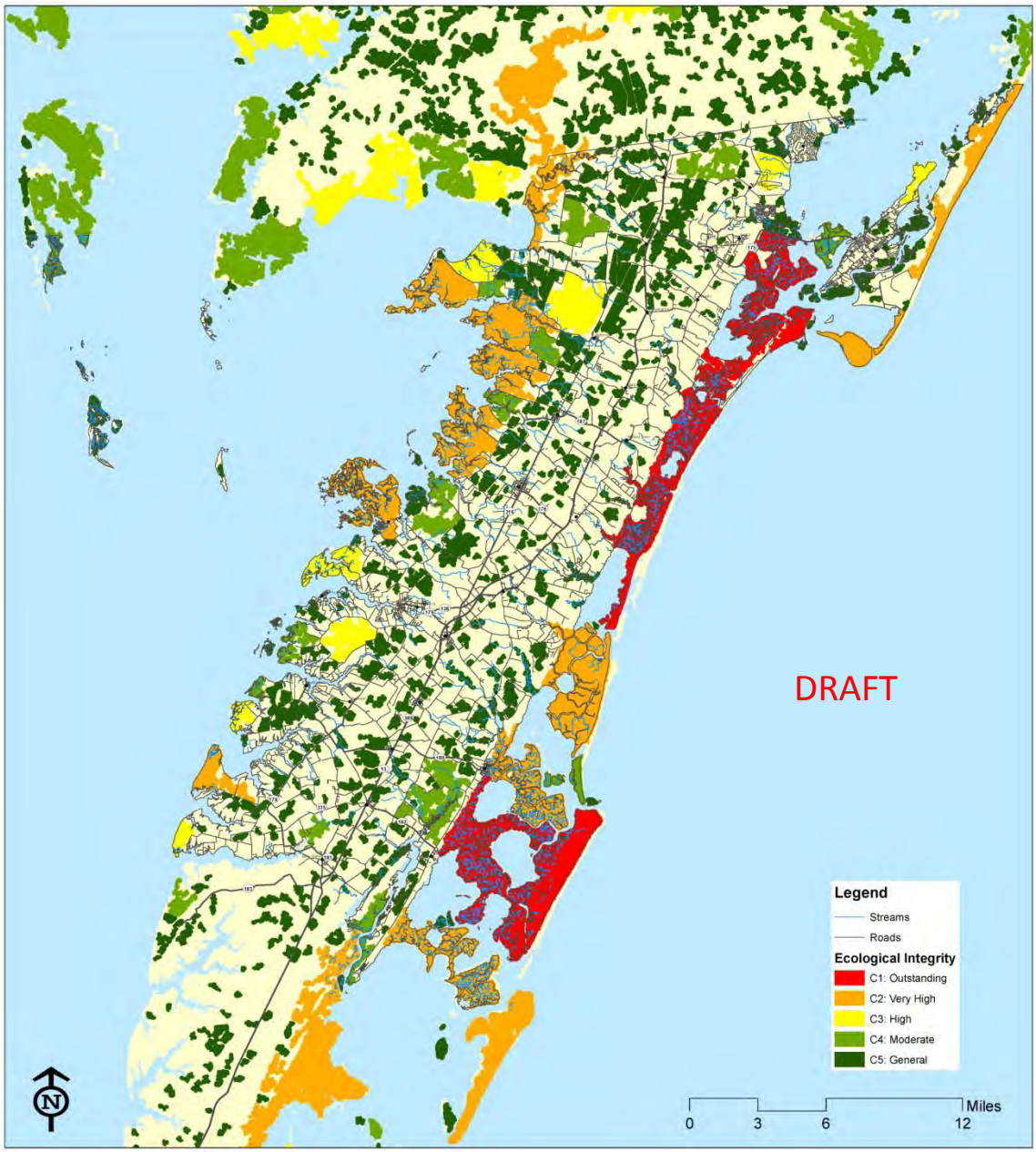
Additional spatial information from the Literature Review and models currently being developed by other state agencies will also be evaluated for possible use in developing the asset maps.

Accomack County Base Map Inventory by Theme

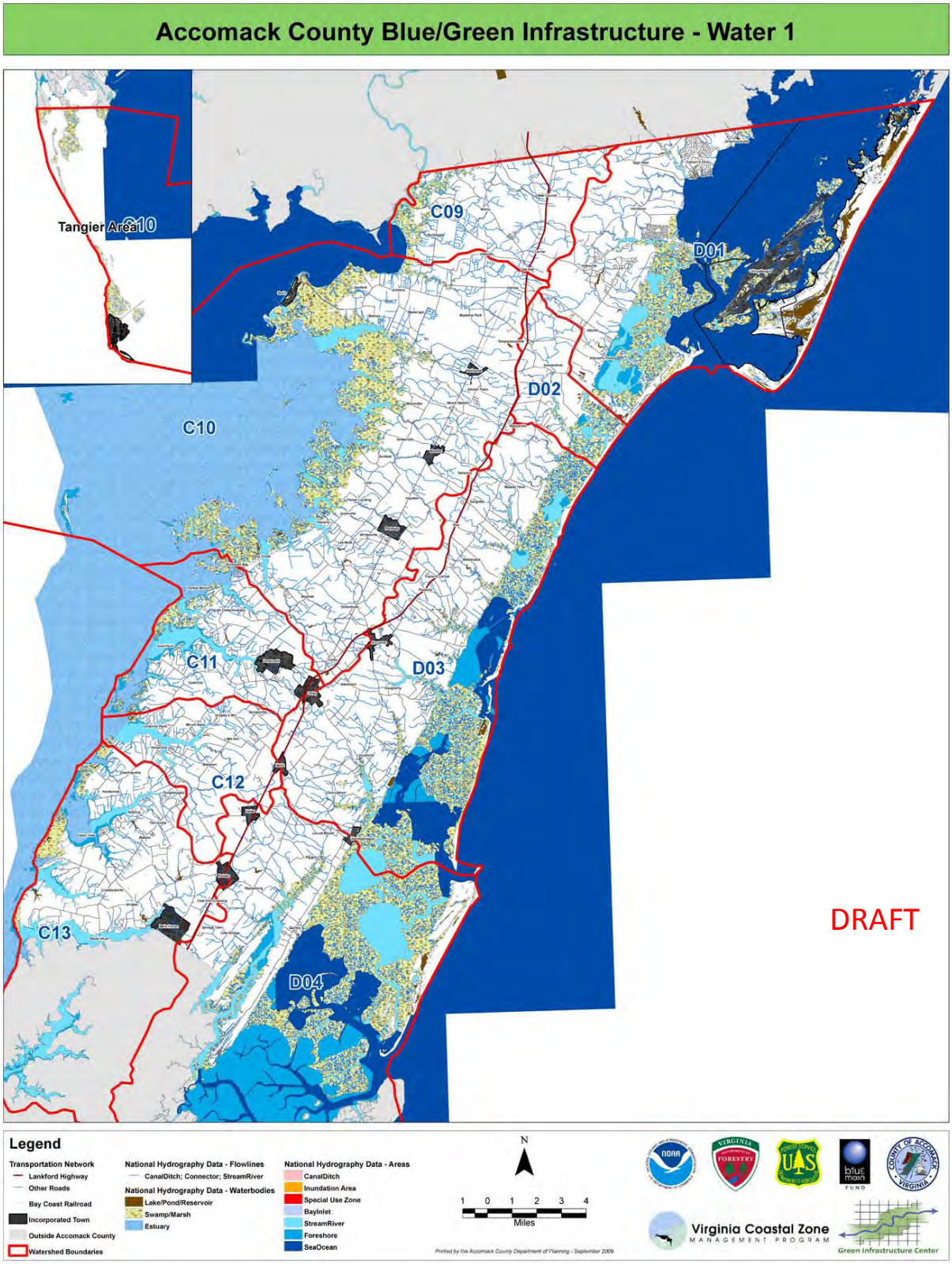
Map Theme	Layer to include	Source	Notes*
Water			
	Watershed Boundaries (HUC)	AC or NHD	detailed subunits might not be available
	Flood Zones	AC (FEMA)	
	Wetlands	AC (NWI)	
	Healthy Streams	GEMS	Requested
	Streams	NHD/VGIN	
	Tidal Wetlands	NWI	
	Groundwater Recharge	AC	
	Community Wells and Intakes	VDH	
Recreation			
natural-resource based recreation (exclude playfields, etc.)	County Boat Ramps	AC	
	Waters Worthy of Scenic Rivers Designation	AC (DCR)	
	Seaside Eastern Shore Water Trail	GEMS	
	Birding & Wildlife Sites	DGIF	
	Birding & Wildlife Trails	DGIF	
	Conservation Lands	DCR	w/ public access
	Blueways	DCR	exclude - Eastern Shore Water Trail only Blueway
	Trails	DCR (others)	researching possible sources
	Boating Public Access Sites	AC	
	Campgrounds		exclude - RV related
	County Parks	AC	
Working Lands			
ag and forest lands	Forest Cover	DOF	2006 most current available
	Parcels >25 - <100 acres	AC	
	Parcels >100 acres	AC	
	Prime Ag Soils	SURGO	Class I-II (include III if limited coverage)
	Ag. & Forestal District Lands	AC	
	Common Land Units	USDA	researching possible sources
Heritage			
	Historic Register Sites	DHR	include state and national register sites
	Potentially Eligible Historic Sites	DHR	request from DHR
	Historic Districts	DHR	
	Civil War Battlefields		exclude - no data
	County Significant Resources		exclude - no data
	American Indian Lands		exclude - no data
	Trails / Routes		exclude - no data
	Highway Markers	DHR	request from DHR
Fisheries			
	Fisheries Management Areas	GEMS	Requested
	Baylor Grounds (Public Oyster Grounds)	GEMS	Requested
	Private Oyster Leases	GEMS	Requested
	State Constructed Oyster Reefs	GEMS	Requested
	Commercial Shellfish Aquaculture Sites	GEMS	Requested
	Oyster Gardening Sites	GEMS	Requested
	Restricted/Condemned Shellfish Areas	AC	Health Department
Wildlife			
may need a terrestrial map and aquatic species map	Natural Heritage Screening Coverage	DCR DNH	
	Essential Wildlife Habitat	VDGIF	Tier 1-2
	Important Bird Areas	GEMS	Audubon data
	Migratory Songbird Stopover Habitat	GEMS	Requested
	Threatened & Endangered Species Waters	GEMS	Requested
Landscape Types			
	Forest Cover Types	DOF	Hardwood, coniferous
	Submerged Aquatic Vegetation (SAV)	VIMS	
	Developed Areas	DOF	
	Wetlands	NWI	Tidal and Nontidal (fresh, brackish, salt)
	Dune Systems	GEMS	Requested
Resource Protection			
use a gradient to designate level of protection	Chesapeake Bay Act Areas	AC	RPA and RMA
	Conservation Lands	DCR	
	Easements	AC	
	Coastal Barrier Resource Areas	AC	Additional data might be avialable from TNC
Land Use			
	Zoning	AC	
	Future Lands	AC	
Base information			
information to include on all maps, if possible	Roads	AC	
	County Boundary	AC	
	Surrounding Counties	AC	
	Incorporated Towns	AC	

Virginia Natural Landscape Assessment (VaNLA)

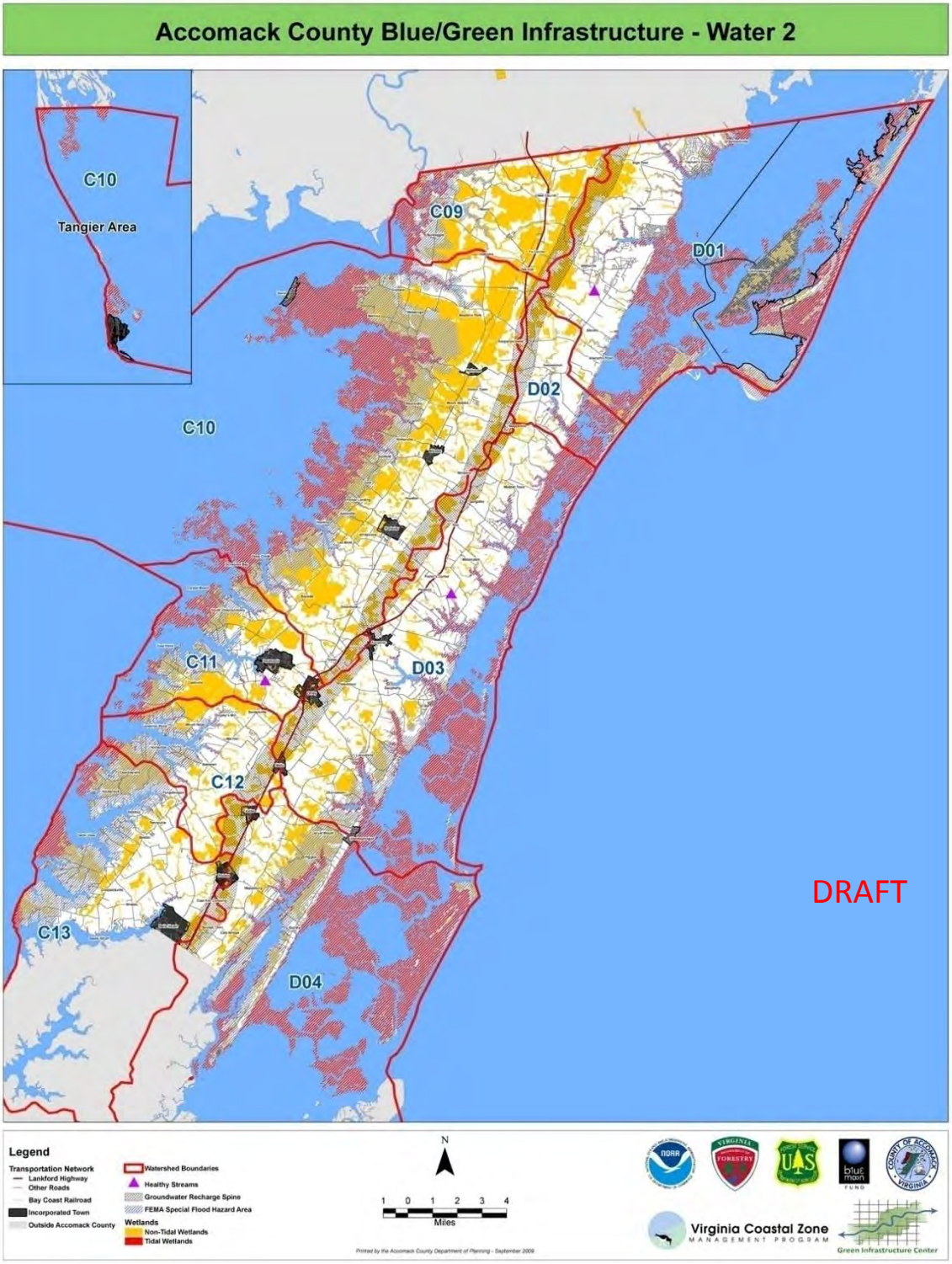
The VaNLA identifies natural lands, or cores, ranked by ecological integrity. Cores can include intact forests, large wetlands, and dune systems. In general, higher scores are given to those areas that are more biologically diverse, part of a larger complex of natural lands, and contribute to water quality enhancement. In Accomack County, cores with outstanding or very high ecological integrity are primarily wetland or marsh areas located along the bayside and seaside.



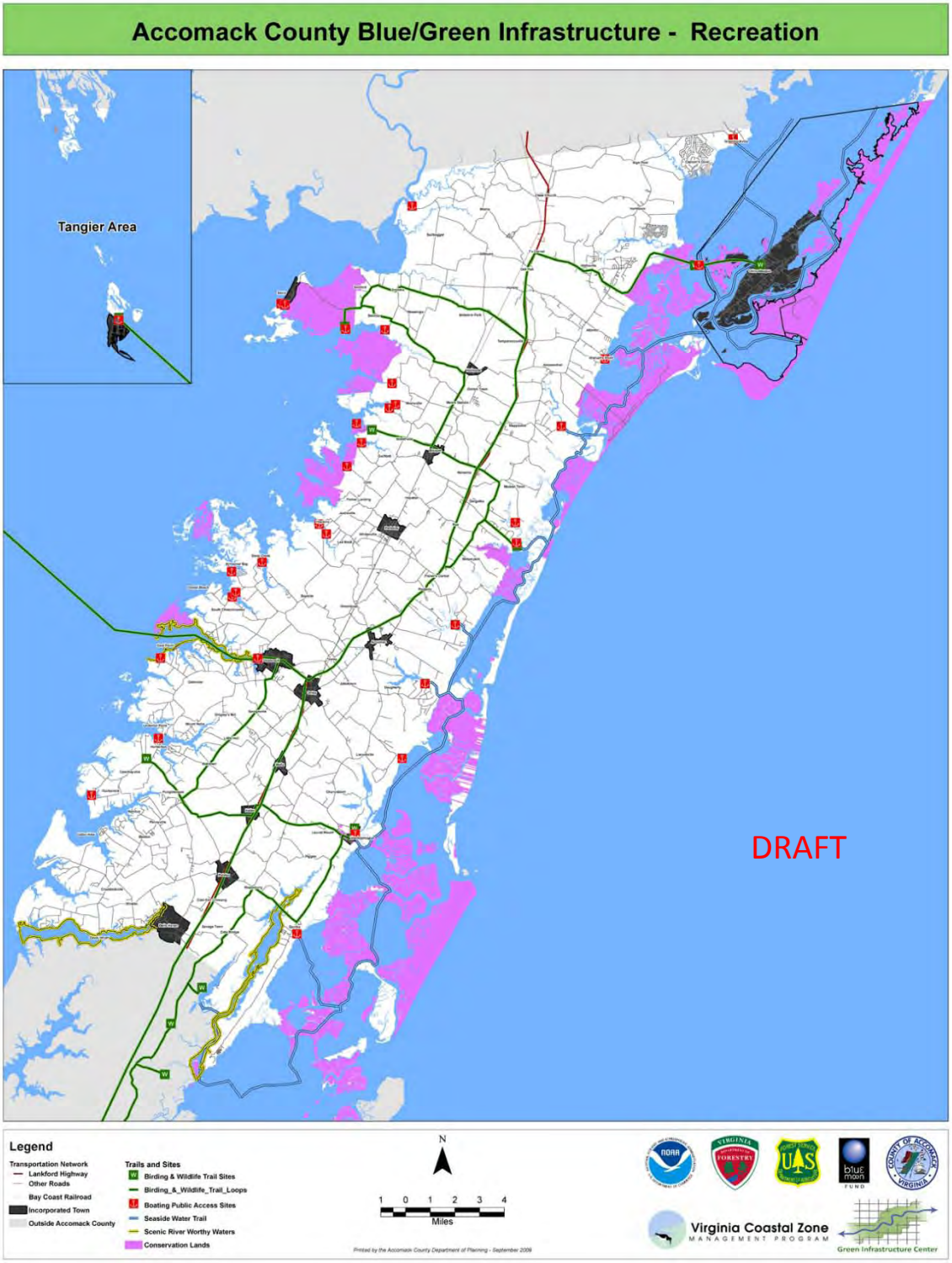
Water Resources – feature types



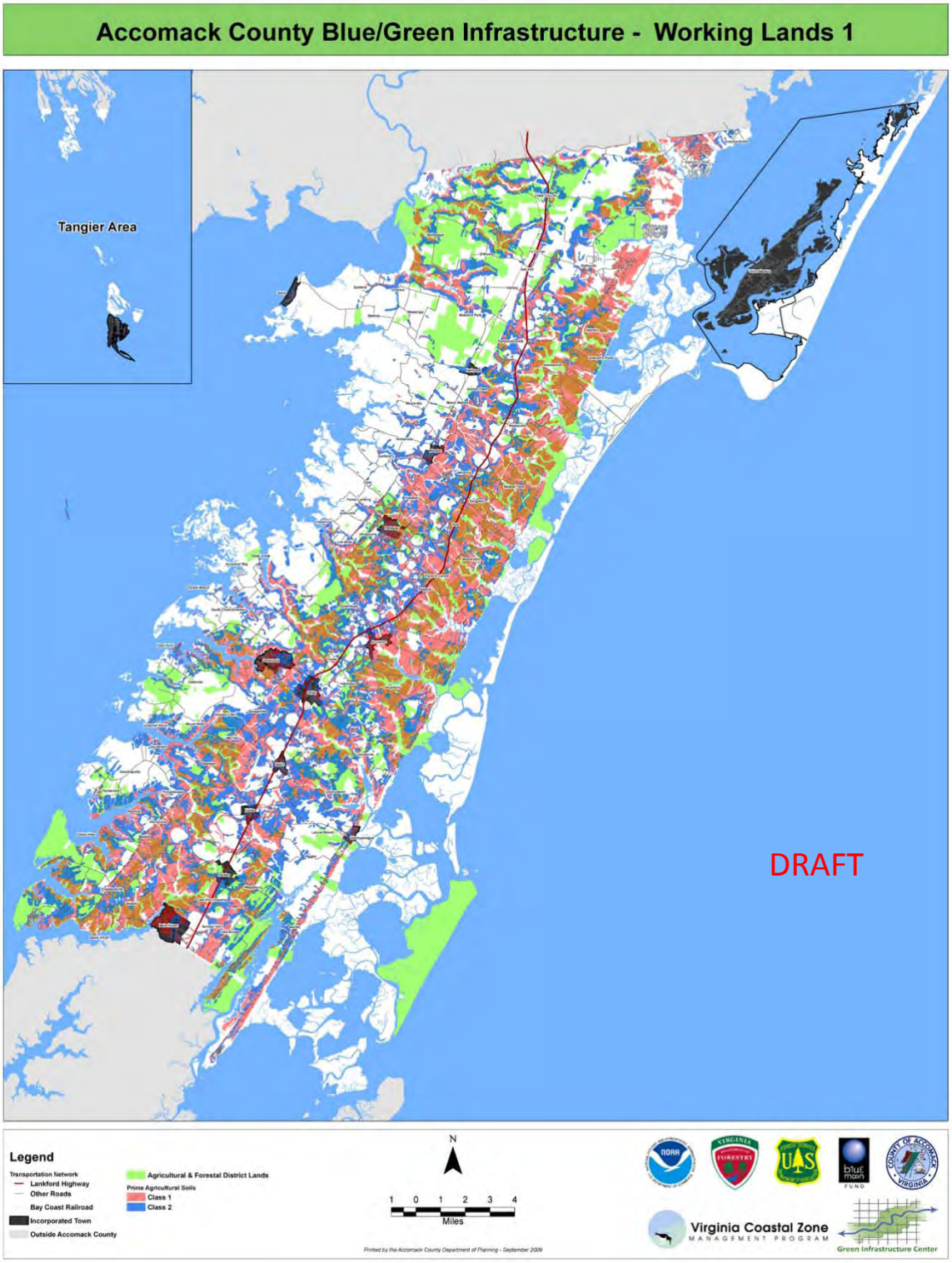
Water Resources – watersheds, groundwater recharge, floodplains



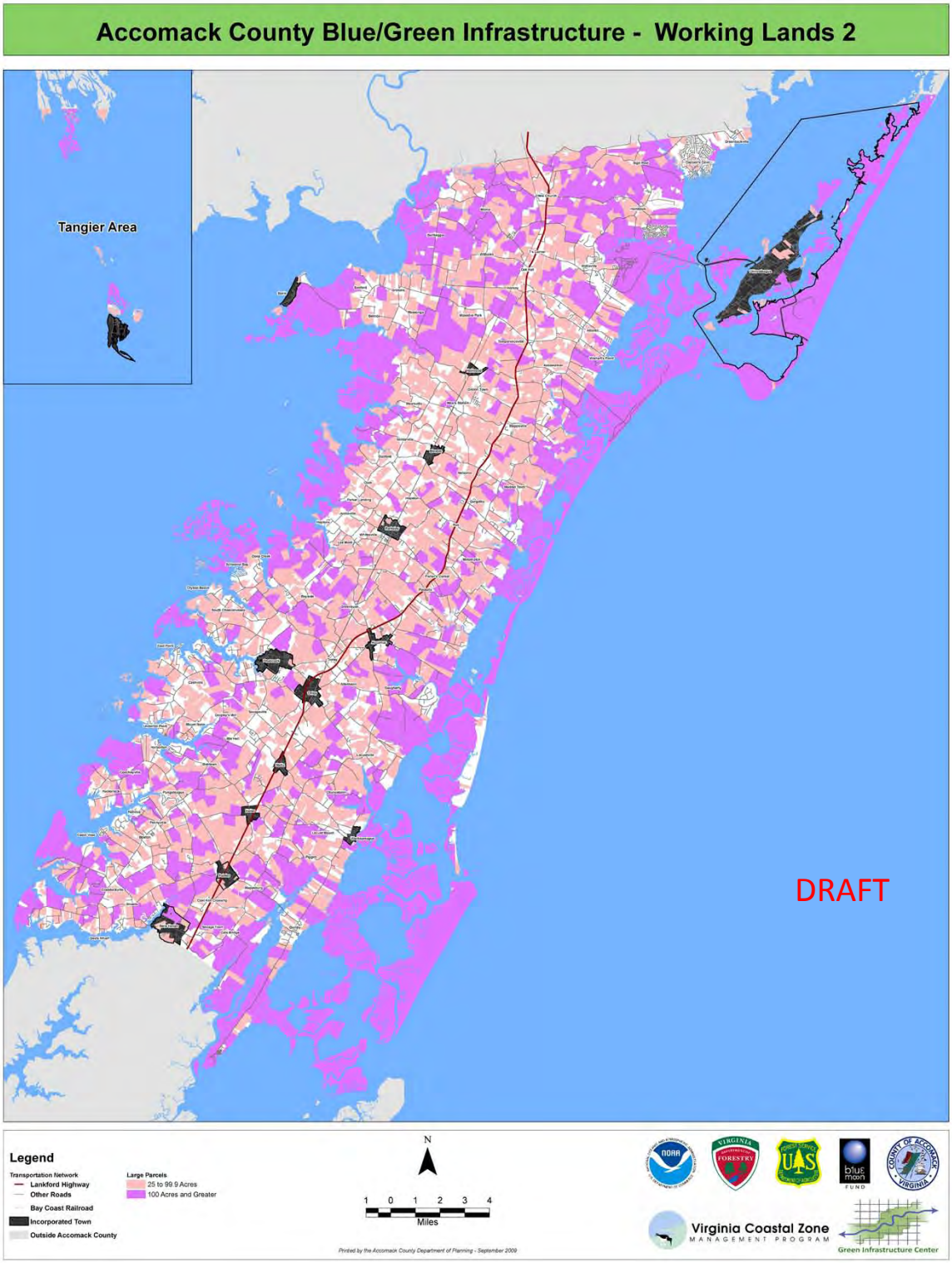
Recreation Resources



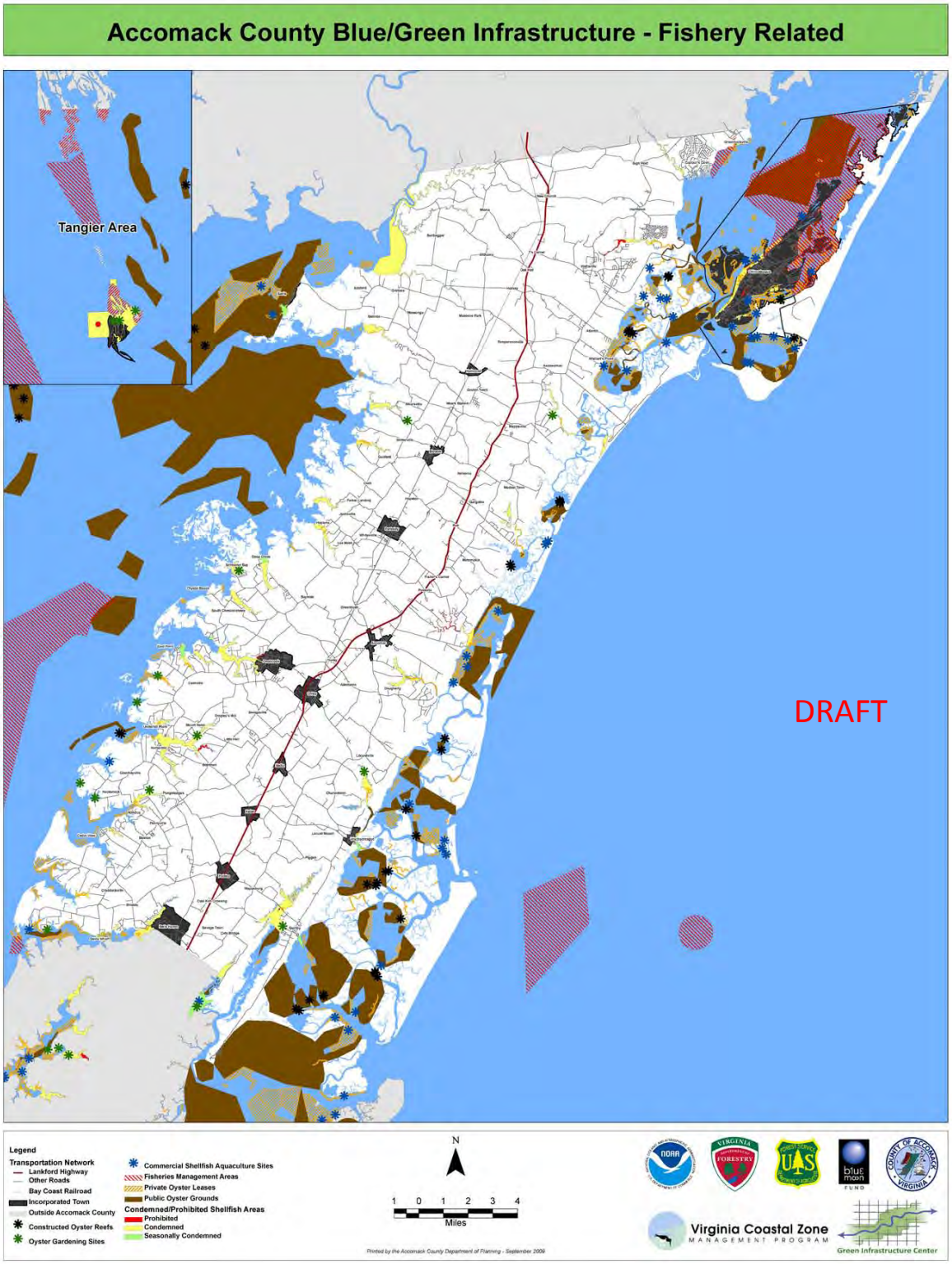
Working Lands – Prime Agricultural Soils



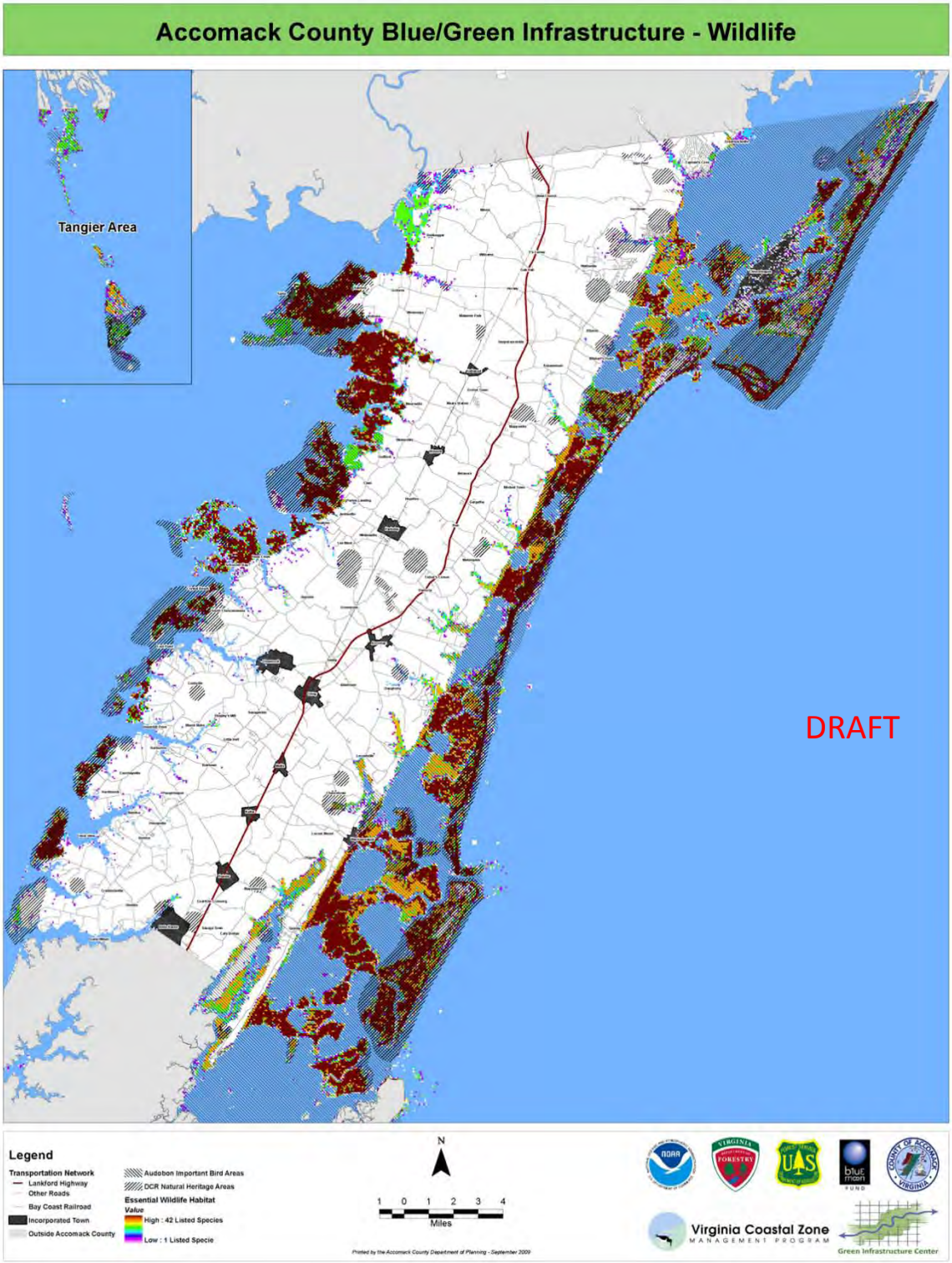
Working Lands – Parcel Distribution for Sustainable Timber Management



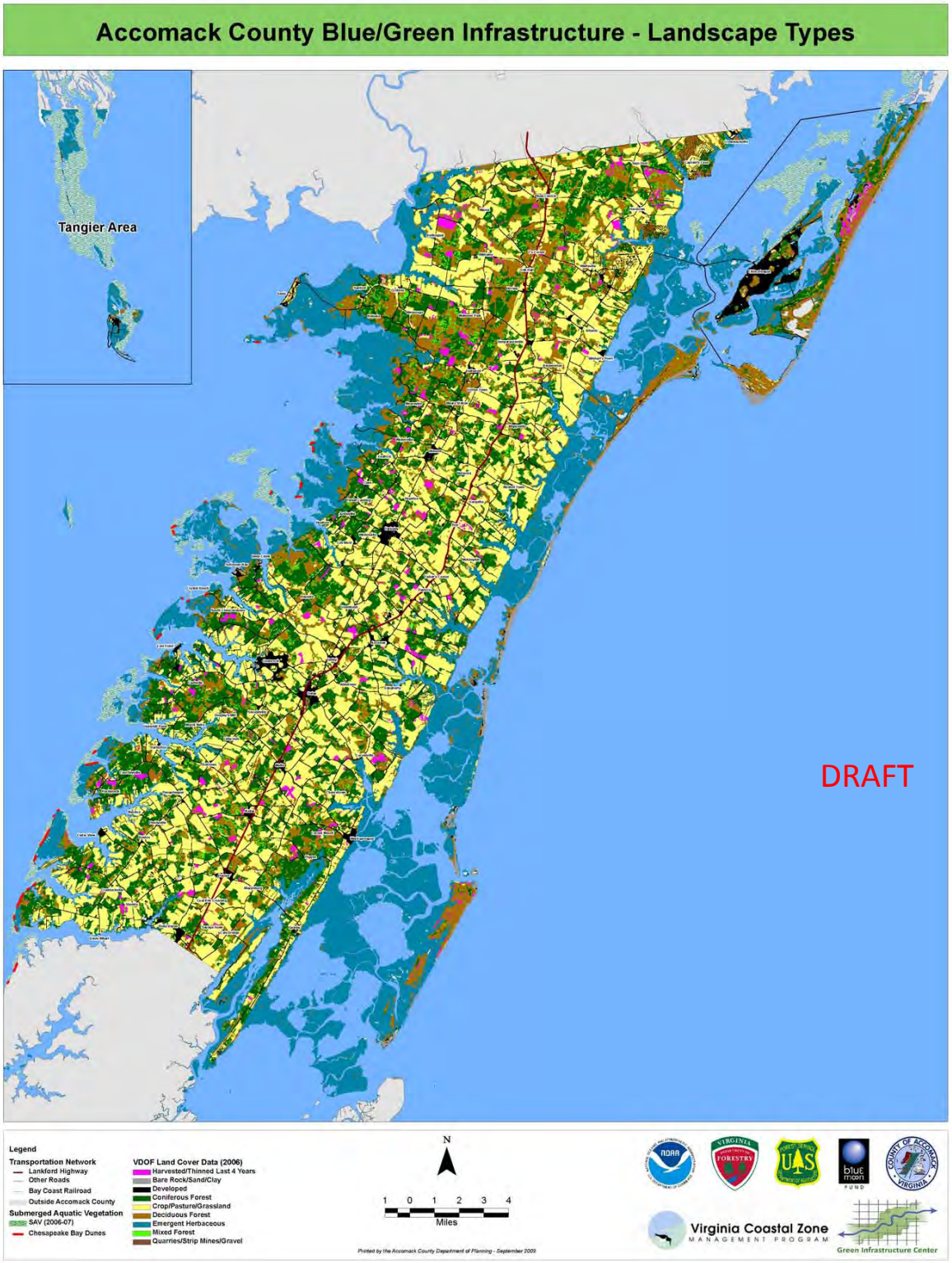
Fishery-Related Resources



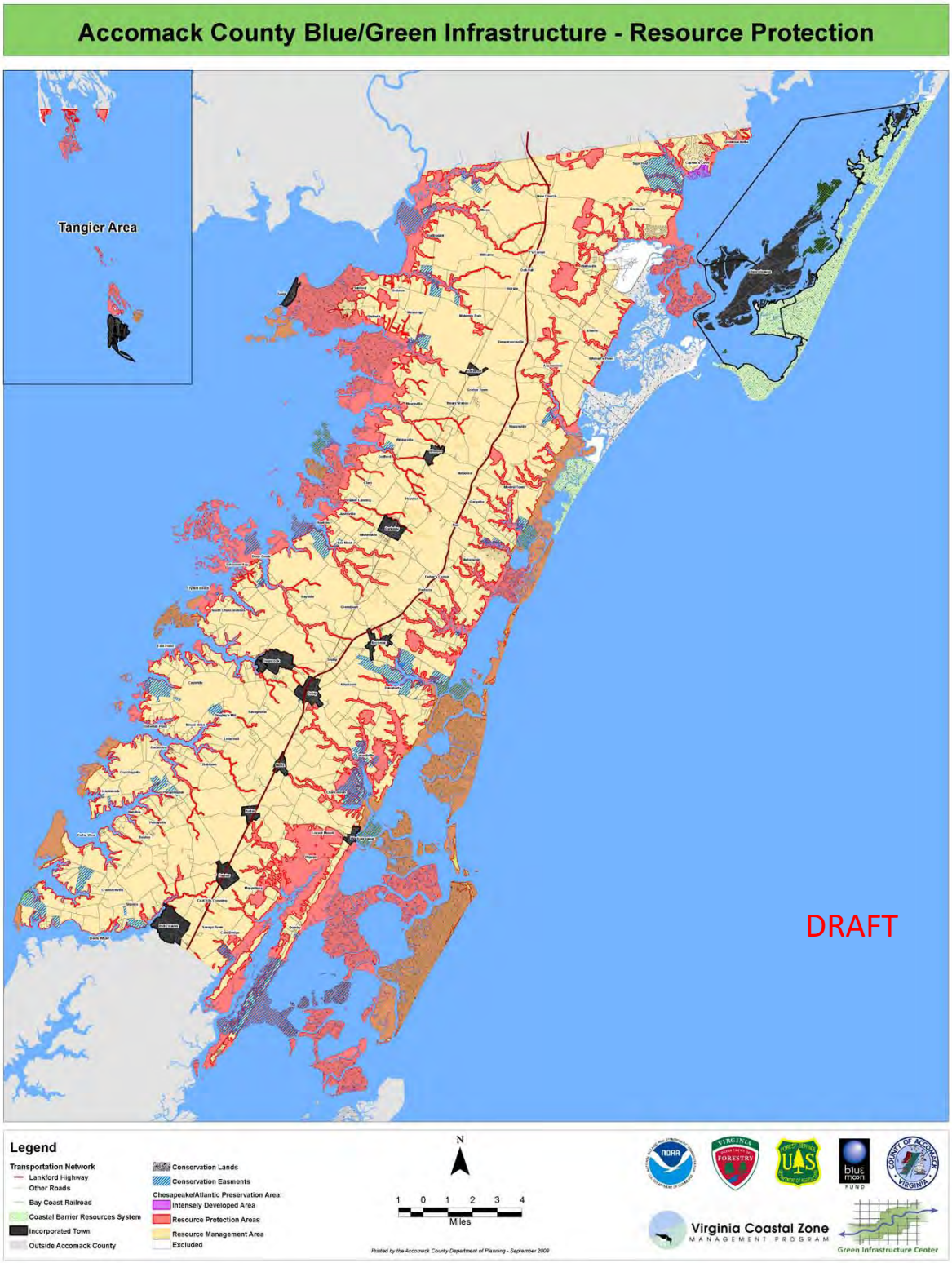
Wildlife Habitat Resources



Landscape Types



Resource Protection



Land Use

Zoning

Future Land Use

Attachment B: Accomack Literature Review

K. Hill, October 2009

Overview

Many planning agencies can benefit from an up-to-date review of the existing scientific literature on topics that might be relevant to contemporary public policy decisions. The Green Infrastructure Center (GIC) is assisting Accomack County on in developing a strategy for conserving biodiversity and cultural resources in the County. This literature review is intended to be a resource to both the County and the GIC as they consider how to develop strategies for the County in relation to its biodiversity resources.

This review is organized into three sections. The first is a brief categorization that identifies the author type and content type of each of the studies reviewed. The second identifies particularly useful studies that provide information about assets, risks, and recommendations for Accomack County. The third section contains a comparison of the issues raised by the Accomack County planning staff, noted by the GIC, and the available literature (providing a research gap assessment).

I examined 108 references provided by the Green Infrastructure Center that were listed in the electronic document "Accomack Literature Review Draft, 6-30-09 ag_clc.xls." I also included 12 additional documents, which contain information from Federal agencies and non-profit organizations that may be of use to the GIC and Accomack County. The primary goal of the review was to assess whether there is an existing literature base that can be useful to Accomack County planning staff. Since effective planning generally relies on a standard that is often described as "best available science," this review distinguishes between research studies that have been subjected to blind peer-review and studies that may have been peer-reviewed in other ways, or that were probably not subjected to peer-review at all. While the information available in any of these types of studies may be valuable, peer-reviewed scientific research is the most defensible basis on which to draw generalizable conclusions about dynamics that may affect resources, ecosystems and species before weighing public policy decisions. However, non-peer reviewed work has been included because much of the research in the county has been conducted by scientists who have many years of field experience and who are conducting these studies as part of their normal professional work.

Those three categories provided a framework for assessing the literature in this review. Most of the literature reviewed here has been published in peer-reviewed journals (44%). The next largest group of studies was published by government agencies (34%), which often involve internal peer review. The final group was published by non-governmental organizations or by academic research institutions with funding from government agencies, but no peer review appears to have been applied to them (22%).

In addition to the question of whether a study was peer-reviewed or not, it is useful to know whether the research consists of a description of the status of a population or resource at a single moment in time, or whether it assesses changes in that resource or population over time. This distinction is important because studies that ask questions about change over time are more useful to planning efforts that must project the future status of a valued resource or species in order to advise policymakers about how to sustain those resources or populations. In this study, 51% of the studies reviewed were descriptive assessments of the status of a landform, ecosystem, or species. 54% of the studies included information about either (1) change over time, (2) causal links related to these changes,

or (3) strategic recommendations for managers. About 8% of the studies reviewed here contained analyses that attempt to predict future trends.

In addition to studies of change over time, some studies tested hypotheses using statistical methods. These are particularly important because they provide the most defensible context for making inferences about whether the observations made in a specific study can reasonably be generalized to other locations and instances. Approximately 8% of the studies reviewed here included statistical tests of hypotheses. These 8 studies examined the factors that influence nest sites for birds on barrier islands (Rounds et al, 2004); land use factors that might influence estuary health (Rodriguez et al, 2007); the influence of nitrogen on the decline of native marsh grasses (Day et al, 2004); the influence of flooding on insect diversity (Brust et al 2005); fire history and recurrence intervals on the Delmarva Peninsula (Kirwan and Shugart, 2000); the ways in which gaps in shrub vegetation on barrier islands contribute to diversity in those ecosystems (Crawford and Young 1998); the rates at which saltmarshes assimilate carbon (Kathilankal et al 2008); and the impact of predation as a significant cause of decline in bird populations on barrier islands, rather than habitat loss alone (Wilson et al 2007). [1]

Of the trends identified in the literature, several are likely to be of paramount importance to future spatial planning efforts. Over the near term, avian and mammalian predator influences on population declines of shore birds seem to be of high importance, since the Accomack County shoreline is of such significance to these species on a continental scale as a breeding or stop-over location. Invasion of native marshes by *Phragmites* grasses is also a very important near-term concern, since it eliminates high-quality habitat areas and can be managed if landowners choose to do so (Virginia Dept. of Conservation and Recreation 2009). Beach erosion seems to also be a problem for species of federal conservation concern, such as plovers (see Watts et al 1996, for example) and Northeastern beach tiger beetles (Fenster et al 2006), a negative trend that may be addressed through beach nourishment. In addition, nitrogen moving from the farmland on the eastern shore of Accomack County into the near shore environment is clearly an issue for management of fisheries and ecosystems associated with Chesapeake Bay (see the State of Virginia's Tributary Strategy for the Eastern Shore, published in 2005, for a comprehensive review of this issue). On the positive side, loggerhead sea turtles appear to increasingly select nest sites on Assateague Island and other Eastern Shore locations, which are in what has been considered the northernmost part of this species' range. Artificial egg relocation efforts as well as more northerly dispersal by females have affected this positive trend (Boettcher et al 2007).

Over the medium and longer term of 50 to 100 years, conservation of groundwater resources is likely to become a more significant issue. Data show that the rate of sea level rise is increasing, and various predictive models suggest that this increase in rate could be dramatic over a 75 to 100 year timeframe (Gutierrez et al/USGS 2007). Rising sea levels will likely lead to increased problems with saltwater intrusion in groundwater supplies, given the current depths to saline water (Nowroozi et al. 1999). This trend will also affect infrastructure situated near the shoreline, particularly transportation routes. In addition, sea level rise will have very significant repercussions for coastal habitat conservation, since the

[1] The Nature Conservancy (TNC) has implemented a successful predator control program in the past few years which has dramatically restored the bird population of the barrier islands managed by TNC. Results of this program have not yet been published but a poster summarizing the results may be obtained from TNC: Erwin, RM, A Wilke, B Truitt, R Dueser, R Boettcher, A Daisey, P Denmon, J Porter and N Moncrief. "Changing Distributions of Colonial Waterbirds and Mesopredators on the Virginia Coast Reserve Barrier Islands." To be presented Nov. 4-7, 2009 at the Waterbird Society Meeting in Cape May, NJ.

predicted levels of inundation are likely to cause a large-scale loss of natural barrier islands and wetlands along both the seaside and the bayside of the Eastern Shore (Titus et al., 2009).

SECTION I. Categorization of research literature

Since effective planning generally relies on a standard that is often described as "best available science," this review distinguishes between research studies that have been subjected to blind peer-review and studies that may have been peer-reviewed in other ways, or that were probably not subjected to peer-review at all. While the information available in any of these types of studies may be valuable, peer-reviewed scientific research is the most defensible basis on which to draw generalizable conclusions about dynamics that may affect resources, ecosystems and species before weighing public policy decisions.

In addition to the question of whether a study was peer-reviewed or not, it is useful to know whether the research consists of a description of the status of a population or resource at a single moment in time, or whether it assesses changes in that resource or population over time. This distinction is important because studies that ask questions about change over time are more useful to planning efforts that must project the future status of a valued resource or species in order to advise policymakers about how to sustain those resources or populations.

Table 1. Classification of the literature by author and type of study. (Individual studies are typically included in only 1 "author" category but in more than 1 "type" category.)

Author categories	*Number of studies*
Government documents, not externally peer reviewed:	36
NGO/academic studies, not peer reviewed:	23
Peer reviewed scientific studies:	47
Types of studies	
Descriptive status assessments:	54
Change over time assessments:	18
Causal link assessments:	19
Hypothesis testing studies:	8
Predictive studies:	8
Studies that include strategic recommendations:	19
TOTAL NUMBER reviewed:	**106**

This categorization reveals that there are only a small number of studies that could potentially provide the most defensible and generalizable type of causal evidence for the purpose of developing public policy (i.e., the 8% that test hypotheses using inferential statistics). Fortunately, the literature is dominated by peer-reviewed publications, which provide the next highest level of defensibility. In addition, 44 studies address either change over time, causal linkages, or predictions of future system states. These should be most helpful to planners, who must project trends into the future in order to make strategic decisions.

A significant number of studies reviewed here (23) were performed by faculty and graduate students at institutions such as the Virginia Institute of Marine Sciences (VIMS), or William and Mary's Institute for Conservation Biology, with support from the Coastal Zone Management Program and the National Oceanic and Atmospheric Administration, or by non-profit groups who play an important role in assessing biological resources in the Chesapeake Bay. These contain important information, but – depending on the rigor of the methods used and the training of the people who participated – the quality of that information may be limited, or the interests of advocacy groups may cast doubt on their objectivity. These should be examined on a case-by-case basis, and concurrence with other sources of information should be sought.

SECTION II. Identification of key research studies

This section uses a set of sub-headings that are intended to represent Accomack County's most significant natural assets. The studies listed under each may describe, test hypotheses about causal links, or otherwise investigate the distribution in space and/or time of these resources. They also identify risks to the persistence of these resources, so the section is titled "Assets and risks." Sub-headings are meant to break out components of the most important natural resources and ecosystems for individual attention. Brief summaries or characterizations are provided for the literature that is relevant to each significant asset or risk.

A. Assets and Risks

Shoreline areas, biodiversity, and freshwater resources

The following sub-headings of this review address the major components of these dynamic shoreline systems one at a time.

Dune systems

Dune ecosystems are very significant as breeding areas for threatened species, such as plovers, sea turtles, and beach tiger beetles. In addition to their value for biodiversity, dunes play a very important role in preventing inundation of coastal areas by storms. Natural erosion processes cause these features to be dynamic, but as long as the transportation of sand along the nearshore zone continues and the

dunes are allowed to migrate both along the shoreline and inland as sea levels rise, there is potential for these systems to persist over the long-term on the Eastern Shore.

Recreational development of the Maryland coast of the Delmarva Peninsula has limited the longshore transport of sand that would naturally re-supply dunes on the Eastern Shore for decades, and some authors note that Assateague Island and other barrier islands off Accomack County experience significantly accelerated rates of erosion as a result of these coastal interventions to the north. Assawoman Island also shows exceptionally high rates of erosion.

The best article for understanding the biodiversity impacts and linkages of these dynamic dune systems is:

> Wilson, M. D., B. D. Watts, and J. E. LecLerc. 2007. Assessing habitat stability for disturbance-prone species by evaluating landscape dynamics along the Virginia barrier islands. Center for Conservation Biology Technical Report Series, CCBTR-07-06. College of William and Mary, Williamsburg, VA.

The best review of the history of the Virginia dunes in relation to land use and regulations is Varnell and Hardaway 2007, but it is important to note that this file also contains a basic overview of dune geomorphology and ecology that is specific to Virginia's Eastern Shore and very helpful to planners who wish to understand the way that dunes and their associated ecosystems change over time.

> Varnell, Lyle, and C. Scott Hardaway, 2007. "The Coastal Primary Sand Dune and Beach Act: Recommendations to Update the Act and Complete the Oversight of Virginia Tidal Shorelines," Virginia Institute of Marine Sciences.

Map-based surveys have been completed of the Accomack dune systems by researchers at VIMS. They have summarized their maps and observations in the following two documents:

> Hardaway, C. Scott, Jr, Donna A. Milligan, Lyle M. Varnell, Christine Wilcox, George R. Thomas, 2006. "Dune Evolution in Accomack County, Virginia, Chesapeake Bay Shorelines," Shoreline Studies Program, Department of Physical Sciences and Office of Research and Advisory Services, Virginia Institute of Marine Science College of William & Mary, Gloucester Point, Virginia.
>
> Hardaway, C. Scott, Jr, Donna A. Milligan, Lyle M. Varnell, Christine Wilcox, George R. Thomas, Linda M. Meneghini, Thomas A. Barnard, 2004. "Accomack County Dune Inventory," Shoreline Studies Program, Department of Physical Sciences and Wetlands Program, Center for Coastal Resources Management, Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia.

Wetlands

Wetland ecosystems are significant sinks for nutrients such as nitrogen, which is taken up by marsh plants. They also play a major role in supporting aquatic and terrestrial biodiversity, since many species of birds, amphibians, insects, and other forms of life depend on marsh areas for food or refuge.

Wetlands also provide significant storm surge buffering, by acting as a sort of bowl or sponge that provides space for floodwaters that originate either on land, driven by rainfall events, or from the sea, driven by wind and tides.

Wetlands are being inundated and eroded in Accomack County, on both the Bay side and the sea side of the Eastern Shore. Rates of sea level rise, storm frequencies, changes in the volume of sediment supplies from rivers or offshore sand bars, and shoreline hardening by property owners all have an effect on the rate at which marshes can accumulate height, and be sustained as the land subsides and relative sea levels continue to rise.

(NOTE: More studies of wetland ecosystems in Accomack County or the region are included under the biodiversity section of this review, because their primary purpose was to study marsh systems in relation to particular birds or other species.)

The Virginia DCR study of wetland restoration potential includes 3 sites in Accomack County proposed for wetland restoration:

> Virginia Department of Conservation and Recreation, Division of Natural Heritage, 2008. "Wetland Restoration Catalog."

The spatial issues and landuse management challenges associated with the invasion of native marsh areas by *Phragmites* grasses are best addressed by this study, which contains the most recent maps of *Phragmites* distribution along the Accomack seaside:

> Myers, R.K., K.E. Heffernan, P.A. Clarke, and D.P. Field. 2009. "Management and education to control Phragmites on the Seaside of Virginia's Eastern Shore." Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. Final report for Year Six of the Seaside Heritage Program submitted to USDC National Oceanic and Atmospheric Administration. Natural Heritage Technical Report # 09-05.

Consequences for avian biodiversity are addressed in Paxton, 2006 (below), with links to maps of specific locations online. These maps should be useful for reviewing other assessments of the biodiversity value of specific patches, since patches that are already invaded by *Phragmites* should be considered of lesser habitat value:

> Paxton, B. J. 2006. "Potential Impact of Common Reed Expansion on Threatened High-marsh Bird Communities on the Seaside: Assessment of *Phragmites* Invasion of High Marsh Habitats**."** Center for Conservation Biology Technical Report Series, CCBTR-06-17. College of William and Mary, Williamsburg, VA.

Relevant to the subject of how and why *Phragmites* replaces native marsh grasses, this study (Day et al 2004) observes that increasing nutrient loads (N) seems to reduce the competitiveness of *Spartina* saltmarsh grasses:

> DAY, F.P.; CONN, C.; CRAWFORD, E., and STEVENSON, M., 2004. Long-term effects of nitrogen

fertilization on plant community structure on a coastal barrier island dune chronosequence. *Journal of Coastal Research,* 20(3), 722–730.

Submerged Aquatic Vegetation (SAV) beds

Submerged aquatic vegetation beds are the nursery and refuge for many aquatic species during some phase of their lives, including molting blue crabs. These sub-tidal seagrass meadows were once extensive and continuous around the margins of Chesapeake Bay. Reductions in water quality (specifically in the amount of light that can penetrate the water column due to increased amounts of suspended sediments) and erosive storm events such as hurricanes and nor-easter's are major drivers of loss for SAV beds.

Efforts are being made to restore SAV beds in the Bay, with some significant results after simply broadcasting seeds and observing successful germination. There are other limits to the success of these restoration efforts, however, since more rapid rates of sea level rise and shoreline erosion will likely increase turbidity and make it harder to restore these ecosystems to the Bay.

The study noted below by Moore (2006) is a powerpoint presentation that summarizes the issues relating sea level rise to losses of SAV beds.

Moore, K., 2006. "How global warming and climate change may be accelerating losses of Chesapeake Bay seagrasses." The Virginia Institute of Marine Science, School of Marine Science, College of William and Mary, Gloucester Point, VA.

Orth et al (2002) includes a very good overview of the causes of SAV bed loss, although the geographic area studied is a bit northwest of Accomack County.

Orth, R., K. Moore, J. Fishman, D. Wilcox, L Karrh and T. Parham, 2002. "Causes of Submerged Aquatic Vegetation Declines in Tangier Sound, Chesapeake Bay." Report prepared for the Chesapeake Bay Program. Virginia Institute of Marine Science, College of William and Mary, Gloucester point, VA.

Halka (2005) provides the best overview of the sedimentation issues that are linked to SAV decline.

Halka, J., 2005. "Sediment in the Chesapeake Bay and Management Issues: Tidal erosion processes," Tidal Sediment Task Force of the Sediment Workgroup under the Chesapeake Bay Program, Nutrient Subcommittee, CBP-TRS276-05, May.

Shrublands

Although ecologists and others recognize shrub ecosystems as important, particularly on barrier islands where they may provide cover for shorebird nests, very little recent research on this ecosystem type was identified for this review. The one piece on the subject is by Crawford and Young (1998), and the introduction provides a valuable overview of the role played by shrub thickets in sustaining biodiversity on Accomack County's islands.

Crawford, E., and D. Young, 1998. "Comparison of gaps and intact shrub thickets on an Atlantic Coast barrier island," Am. Midl. Nat. 140:68-77.

Fauna/flora (biodiversity)

Virginia's State Wildlife Action Plan, specifically, "Chapter 4. Virginia's Coastal Plain," has the best descriptions of species life histories and locations where they occur. This is the best single resource for information about the species that Accomack County staff has identified as of interest to them. Other Tier I, II, III and IV species are included as well.

In summary, these Accomack County species are considered "Tier I," and their habitat needs are primarily in marshes, grasslands, and barrier islands. Predation by mammals and gulls, and disturbance by humans during nesting season (April 1 – July 31, collectively) are considered leading causes of their population declines.

Table 2. Habitat needs of Tier I species in Accomack County. For all of these species, sites in Accomack County are considered very important for reproduction or refuge.

Tier I species	**Habitat needs**
Loggerhead sea turtle	Seaside beaches above high tide
Piping plover	Seaside barrier islands
Wilson's plover	Seaside barrier islands
Peregrine falcon	Coastal bridges, towers, nest platforms
Henslow's sparrow	Bayside grasslands and marshes
Gull-billed tern	Nests in marshes or barrier island beaches, mammalian nest predators a big problem
Black rail	High salt marshes (*Phragmites* invasion a big problem)

A multi-agency map has been produced that shows the typical habitats of shorebirds of concern, and the ownership pattern of coastal land that is important to these birds.

Virginia Department of Environmental Quality, Coastal Management Program; National Oceanic and Atmospheric Administration; Virginia Department of Game & Inland Fisheries; Wildlife Restoration; U.S. Fish and Wildlife Service; Virginia Department of Conservation & Recreation; The Nature Conservancy. 2005. "Barrier Island Bird Nesting Habitats."

A draft introduction to an EIS that was done to study the possible effects of introducing a non-native oyster provides an excellent overview of the biodiversity issues in Chesapeake Bay.

Seltzer, Craig. 2008. Draft Programmatic Environmental Impact Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster. Produced for the Army Corps of Engineers, Norfolk District.

There are many studies related to the status and life history of individual species. The best overview of shorebird issues is:

Watts, B. and B. Truitt, 2000. "Abundance of Shorebirds along the Virginia Barrier Islands During Spring Migration," Vol 71, No 2, The Raven.

The best (and only) reference on the federally-threatened beach tiger beetle is here (note relationship to beach nourishment, which seems to benefit this species):

FENSTER, M.S.; KNISLEY, C.B., and REED, C.T., 2006. Habitat preference and the effects of beach nourishment on the federally threatened northeastern beach tiger beetle, *Cicindela dorsalis dorsalis*: Western Shore, Chesapeake Bay, Virginia. *Journal of Coastal Research,* 22(5), 1133–1144.

Hildebrand et al (2007) is the most useful reference to Delmarva Fox Squirrel population dynamics in relation to change over time in landscape patterns, below.

Hildebrand, R., R. Gardner, M. Ratnaswamy, C. Keller, 2007. "Evaluating population persistence of Delmarva fox squirrels and potential impacts of climate change," Biological Conservation 137:70-77.

The actual surveys of squirrel population size are summarized here:

US Fish and Wildlife Service, 2007. "Delmarva Peninsula Fox Squirrel, 5 year Review: Summary and Evaluation," Chesapeake Bay Field Office, Annapolis, Maryland.

Discussions of reintroducing the fox squirrel to additional areas in Accomack County have been initiated by the VA Dept. of Game and Inland Fisheries, below.

"The Delmarva Squirrel Reintroduction Program on Virginia's Eastern Shore," Prepared by the Department of Game and Inland Fisheries, Wachapreague, VA and Terwilliger Consulting, Inc., Locustville, VA 23404, March 2008.

Finally, Kirwan and Shigart (2000) discuss fire frequency and vegetation patterns in relation to increasing drought periods that may be driven by climate change. These dynamics could have a significant impact on the Delmarva Fox Squirrel, as the authors point out, by reducing the extent of suitable vegetation for this mammalian species.

Kirwan, J., and H. H. Shugart 2000. "Vegetation and Two Indices of Fire on the Delmarva Peninsula," Journal of the Torrey Botanical Society, Vol. 127, No. 1 (Jan. - Mar.), pp. 44-50.

Shellfish resources

The best resources on oyster and clam habitat in Accomack County are located on a VIMS website:

http://ccrm.vims.edu/resources/index.html

The best concise overview of the issues is in this VMRC statement to the US House of Representatives:

> Wesson, J., "Testimony by the Virginia Marine Resources Commission Division of Fisheries Management, Department of Conservation and Replenishment," U. S. House of Representatives Committee on Resources Subcommittee on Fisheries Conservation, Wildlife and Oceans, Oversight Hearings on the Efforts to Introduce Non-Native Oyster Species to the Chesapeake Bay, October 14, 2003.

The best maps of Accomack County's potential oyster beds, and the risks to their sustained health, are in a document prepared by VIMS for the VA CZM program:

Center for Coastal Zone Management, Virginia Institute of Marine Science at the College of William and Mary. "Shellfish Aquaculture Vulnerability Model." Final report to Virginia Coastal Zone Management Program, Virginia Department of Environmental Quality. November 2007.

Spatial integrity of protected coastal zones

A multi-agency map has been produced that shows the typical habitats of shorebirds of concern, and the ownership pattern of coastal land that is important to these birds. This file is named "nestingmapbarrierislands.pdf" in the literature files that accompany this review.

In addition, one study of landscape dynamics and fragmentation exists which is useful for understanding both the spatial/temporal patterns and their links to biodiversity along the seaside of Accomack County:

> Wilson, M. D., B. D. Watts, and J. E. LecLerc. 2007. Assessing habitat stability for disturbance-prone species by evaluating landscape dynamics along the Virginia barrier islands. Center for Conservation Biology Technical Report Series, CCBTR-07-06. College of William and Mary, Williamsburg, VA.

Groundwater

Groundwater is a significant asset both for the County's drinking water supply and for agricultural irrigation purposes. It is at risk of contamination by fertilizers applied to farm fields and residential lawns, as well as aging septic fields that no longer absorb pathogens or nutrients, and from saltwater intrusion due to excessive pumping and an increasing relative sea level.

A major study of this asset exists from 1992:

"Groundwater Supply Protection and Management Plan for the Eastern Shore of Virginia," Prepared by Horsley Witten Hegemann, Inc., May 5, 1992.

This report contains a very important map of groundwater recharge zones, and 23 specific recommendations on how to best protect and understand changes in the peninsula's groundwater resources. The recharge zones were proposed as overlay zones, in three levels of protection: (1) very strong protections for areas within 200 ft. of wellheads, (2) strong protections for a 5,000 ft wide spine of the major deep-aquifer recharge zone that runs north-south along the high ground of the peninsula, whose width was determined using a 1992 estimate for the volume of water needed in the peninsula, and (3) careful observations and planning for water withdrawals and new land uses within several large wellhead protection zones, that together cover most of the peninsula. In overlay zone 3, the report states that increasing withdrawal rates could alter the spatial pattern of the recharge zone itself, putting the water resources at risk. This report also notes that saltwater intrusion was probably already occurring in 1992, but that screening of the wells was likely diluting the salt content. This is of concern as withdrawal rates, the number of wells, and relative sea level have probably all increased since 1992. It is not clear from this literature review whether Accomack County ever adopted the 23 recommendations of this report, established strong protective zones, or monitored the threats of future groundwater contamination. The 1992 report was based primarily on a literature review and rule-of-thumb estimates rather than field data or monitoring of water usage or contamination processes, so no truly thorough baseline study of actual conditions exists in the literature. It's possible that this report over-estimated or under-estimated a wide range of rates, resource availability, and threats, and if no follow-up monitoring has occurred in the intervening decades, the County may not have sufficiently accurate information to protect its water resources.

In addition, a report exists that considers the actual and potential saltwater intrusion into Accomack's freshwater resources (Nowroozi et al 1999). This issue will become increasingly important, economically and spatially, as sea level rise accelerates and salt water gets closer to the surface under the Eastern Shore. The actual study, however, is limited in its usefulness by the low resolution of the maps included in the publication.

Nowroozi, A., S. Horrocks, P. Henderson, 1999. "Saltwater intrusion into the freshwater aquifer in the easter shore of Virginia: a reconnaissance electrical resistivity study," Journal of Applied Geophysics 42:1-22.

Sea Level Rise

Finally, it seems wise to note that resources exist which comprehensively discuss shoreline trends and challenges for the medium and long-term in the Accomack region. There are two new federal resources specific to coastal areas that comprehensively incorporate new scientific evidence behind climate change predictions and provide tools and guidance for adapting to climate change trends. The Environmental Protection Agency's (EPA) coastal toolkit is one example, which includes advice on adaptation planning, identifies data resources, and organizes the best available science relevant to climate change predictions:

http://www.epa.gov/CRE/toolkit.html

In addition, a major new report was released in January of 2009 by the EPA as part of the federal government's climate change science program. That report details the likely impacts and policy choices facing coastal areas in the US Mid-Atlantic region, including Virginia's Eastern Shore. It is quite comprehensive, and the chapters on vulnerable species, land use and infrastructure, public recreational resources, and adaptation strategies are very useful for planning and conservation purposes. They detail some of the most vulnerable ecosystems and built systems, and provide a very helpful overview of the spatial distribution of valuable coastal systems that appears to be rare in the existing literature. That new report is titled:

> Titus, J., et al., "Coastal Sensitivity to Sea-Level Rise: A focus on the mid-Atlantic region," US Climate Change Science Program, Synthesis and Assessment Product 4.1, January, 2009.

More specific local shoreline surveys have been conducted by researchers at VIMS. In particular, researchers and graduate students have conducted a visual survey from boats of shoreline conditions throughout Accomack County. This is a rapid assessment technique which does not involve extensive field work, but provides a useful approximation of the conditions found along the entire shoreline of the county.

> Berman, Marcia; Harry Berquist, Sharon Dewing, Julie Glover, Carl Hershner, Tamia Rudnicky, Dan Schatt, 2002. "Accomack County Shoreline Situation Report," Special Report in Applied Marine Science and Ocean Engineering No. 374 of the Virginia Institute of Marine Science.

The review noted below by the National Wildlife Federation has useful maps and species-level assessments, but the federal study cited above has superseded it since the information contained in that federal publication is more recent.

> Glick, P.; J. Clough; B. Nunley, 2008. "Sea level rise and coastal habitats in the Chesapeake Bay region," National Wildlife Federation, Technical Report.

The increasing rate of sea level rise in the Virginia area is the subject of a report by the USGS, published in 2007. This study provides maps of vulnerability that are coarse, but do show meaningful differences along the Eastern Shore.

> Gutierrez, B.T., Williams, S.J., and Thieler, E.R., 2007. "Potential for shoreline changes due to sea-level rise along the U.S. Mid-Atlantic region." U.S. Geological Survey Open-File Report 2007-1278. Web only, available at http://pubs.usgs.gov/of/2007/1278.

Finally, this somewhat older study documents the validity of Bruun's Rule for the Chesapeake Bay shoreline of Accomack County. Bruun's Rule states that for every increment of sea level rise, the profile of a beach will move inland by a factor of 80-100 times the increment of sea level rise. In other words, if sea level rises by 1 meter over the next 100 years, beach profiles will move inland 80 to 100 meters, due to the dynamic equilibrium established by wave action and sediment transport. This is an important consideration as planners try to estimate the impacts of accelerated sea level rise on coastal areas in Accomack County.

> Rosen, P. S., 1978. A regional test of the Bruun Rule on shoreline erosion. Marine Geology 26,

Letters Section, M7-M16.

B. Recommendations

The recommendations in this section were made by the authors of publications that were included in this review, not by the Green Infrastructure Center.

1. Reduce nutrient quantities applied to agricultural fields, and filter the nutrients that are applied:

Murphy, T., 2005. "Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for Virginia's Eastern Shore," Department of Natural Resources, Commonwealth of Virginia, Richmond, VA.

2. Increase the spatial continuity of riparian systems:

Murphy, T., 2005. "Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for Virginia's Eastern Shore," Department of Natural Resources, Commonwealth of Virginia, Richmond, VA.

3. Protect spatial continuity of coastal habitats:

A multi-agency map has been produced that shows the typical habitats of shorebirds of concern, and the ownership pattern of coastal land that is important to these birds.

Virginia Department of Environmental Quality, Coastal Management Program; National Oceanic and Atmospheric Administration; Virginia Department of Game & Inland Fisheries; Wildlife Restoration; U.S. Fish and Wildlife Service; Virginia Department of Conservation & Recreation; The Nature Conservancy. 2005. "Barrier Island Bird Nesting Habitats."

The most significant medium and long-term risk to the spatial continuity of coastal ecosystems is an accelerated rate of relative sea level rise, which is predicted for the 21st century and is already being observed. The USGS has produced a useful overview of the spatial distribution of this problem in the mid-Atlantic region of the United States, below:

Gutierrez, B.T., Williams, S.J., and Thieler, E.R., 2007. "Potential for shoreline changes due to sea-level rise along the U.S. Mid-Atlantic region." U.S. Geological Survey Open-File Report 2007-1278. Web only, available at http://pubs.usgs.gov/of/2007/1278.

A comprehensive summary of the risks to coastal ecosystem assets, along with recommendations for adaptation, are presented by this new federal study of the mid-Atlantic region:

Titus, J., et al., "Coastal Sensitivity to Sea-Level Rise: A focus on the mid-Atlantic region," US Climate Change Science Program, Synthesis and Assessment Product 4.1, January, 2009.

4. Isolate low-quality habitat patches (*Phragmites* patches, etc.)

Myers et a (2009) contains the most recent maps of *Phragmites* distribution along the Accomack seaside.

Myers, R.K., K.E. Heffernan, P.A. Clarke, and D.P. Field. 2009. "Management and education to control Phragmites on the Seaside of Virginia's Eastern Shore." Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. Final report for Year Six of the Seaside Heritage Program submitted to USDC National Oceanic and Atmospheric Administration. Natural Heritage Technical Report # 09-05.

Paxton, B. J. 2006. "Potential Impact of Common Reed Expansion on Threatened High-marsh Bird Communities on the Seaside: Assessment of *Phragmites* Invasion of High Marsh Habitats**."** Center for Conservation Biology Technical Report Series, CCBTR-06-17. College of William and Mary, Williamsburg, VA.

5. Replace coastal habitats lost to erosion and inundation

Glick, P.; J. Clough; B. Nunley, 2008. "Sea level rise and coastal habitats in the Chesapeake Bay region," National Wildlife Federation, Technical Report.

Titus, J., et al., "Coastal Sensitivity to Sea-Level Rise: A focus on the mid-Atlantic region," US Climate Change Science Program, Synthesis and Assessment Product 4.1, January, 2009.

6. Protect groundwater recharge zone, initiate drinking water conservation programs and re-use systems for irrigation purposes

The County has probably already made plans to protect its groundwater recharge zones. The study below, by Nowroozi et al (1998), emphasizes the importance of this as salt water levels rise in relation to the Delmarva Peninsula – and specifically, Virginia's Eastern Shore. This study is now 10 years old, and it would seem to be a high priority for the County to have an updated study that reflects the current position of relative sea level and projects a future position in the medium term, based on observed rates of sea level rise from recent data.

Nowroozi, A., S. Horrocks, P. Henderson, 1999. "Saltwater intrusion into the freshwater aquifer in the easter shore of Virginia: a reconnaissance electrical resistivity study," Journal of Applied Geophysics 42:1-22.

7. Enhance dunes for shoreline protection and habitat expansion for bird and beetle species currently in decline

The three studies listed below discuss different perspectives on dune and wetland systems in relation to flood protection, nutrient retention, and biodiversity values. All of them imply that careful programs of beach nourishment could benefit shorebirds, the northeastern beach tiger beetle, and even loggerhead sea turtles.

> Varnell, Lyle, and C. Scott Hardaway, 2007. "The Coastal Primary Sand Dune and Beach Act: Recommendations to Update the Act and Complete the Oversight of Virginia Tidal Shorelines," Virginia Institute of Marine Sciences.
>
> Erwin, R. M., M. Haramis, M. Perry, B Watts, 2007. "Waterbirds of the Chesapeake Region: An Introduction," Waterbirds 30 (Special Publication 1): 1-3.
>
> FENSTER, M.S.; KNISLEY, C.B., and REED, C.T., 2006. Habitat preference and the effects of beach nourishment on the federally threatened northeastern beach tiger beetle, *Cicindela dorsalis dorsalis*: Western Shore, Chesapeake Bay, Virginia. *Journal of Coastal Research,* 22(5), 1133–1144.

SECTION III. Research "gap assessment"

Each of the issues raised by planners in Accomack County is represented in the literature reviewed here. Notably, several species or groups of species are not commonly studied, including clams, Loggerhead Sea Turtles, American Black Ducks, migratory songbirds, the Northeastern Beach Tiger Beetle, Black-bellied Plovers, and Whimbrels.

Oysters are well-studied by government scientists and institutions working under government contracts, but there are no studies of oyster dynamics that were published in the peer-reviewed scientific literature that was included here. This is a significant gap, particularly since oyster population dynamics are expected to have major impacts on the Bay's ecosystem over time.

Upland scrub-shrub vegetation is not represented in the literature reviewed for this study, although there is one study of shrub patterns and biodiversity implications on barrier islands.

Table 3. Number of studies that address topics raised by planners in Accomack Comprehensive Plan or staff from the Nature Conservancy.

Animal species	**Number of relevant studies**
Oysters	9
Clams	1 (VIMS CCRM 2007)
Loggerhead Sea Turtle	1 (Boettcher et al 2007)
American Black Duck	1 (Costanzo and Hindman, 2007)
Delmarva Fox Squirrel	4
Migratory Songbirds	1 (Paxton and Watts, 1999)
Northeastern Tiger Beetle	1 (Fenster, Knisley and Reed, 2006)
American Oystercatcher	8
Black Skimmer	6
Five species of nesting terns	8
Piping Plovers	5
Wilson's Plovers	4
Black-bellied plovers	2
Red Knot	3
Whimbrel	2
Vegetation communities	
Mixed hardwood and pine forests	5
Salt marsh grasses	8
Eelgrass / SAV	4
Upland scrub/shrub communities	1 coastal shrub ref. (Crawford and Young, 1998)

Attachment C – Literature Review Resources Spreadsheet

Summary

The following spreadsheet provides a list of the resources that were collected during the course of the GIC's data assessment and literature review. Additional resources may be added throughout the course of the project, and a copy of the active database will be provided to Accomack County for ongoing research tracking related to the County's environmental resources. This database is intended to be a tool that will ensure that the County stays abreast of local and regional research.

Accomack County Green
Infrastructure Research Study
Literature Review List (draft)

Methodology to the Organization of the Accomack Research Spreadsheet

The Accomack Research workbook is organized to follow the research methodology that was used when searching for resources. The Reports worksheet includes the list of resources that were identified, and is organized into **Key Resources, Secondary Resources, and Additional Resources**. Key Resources are listed first on the worksheet, and include reports that include spatial data as well as information about a topic that was highlighted in the Accomack County Comprehensive Plan or during interviews with County staff. The Key Resources are also divided into groups based on the topics listed in the Categories worksheet, if applicable. The Secondary Resources included on the Reports worksheet provide a list of additional reports that may be useful, but did not have spatial data and did not include information about specific topics from the Categories spreadsheet. The Additional Documents include reports that may or may not have general information about topics from the Categories spreadsheet and/or spatial data, or is considered outdated based on the research methodology.

The Organizations worksheet includes a list of organizations and Web sites that were researched. Any relevant reports found on the Web sites were appropriately categorized on the Reports worksheet. Additional notes about resources that are available on the Web sites are noted in the worksheet.

Title	Topics / Keywords / Report Type	Researchers / Authors	Synopsis / Abstract	Spatial Data (Y / N)	Format of Data / Report	Useful for GI Report (Y, N, Maybe)	Department Available From	Agency / Organization	Date Published (or Collected)	Contact Information	Notes	File Name	General Category
Key Resources													
Water Quality and Quantity													
Tidal Flushing Characteristics in Virginia's Tidal Embayments	water quality tidal flushing	Julie Herman, Jian Shen, Jie Huang	This project evaluated water bodies in the Virginia coastal zone using several water quality models to calculate residence times. Results were grouped into tidal flushing categories (quickly, intermediately, and slowly flushed) that reflect a relative time frame in which a water body is flushed.	yes	PDF	Yes	Center for Coastal Resources Management VIMS	VIMS College of William and Mary	2007	http://ccrm.vims.edu/research/water_column_quality/tidal_flushing/TidFlush_final.pdf http://ccrm.vims.edu/research/water_column_quality/index.html Maps: http://ccrm.vims.edu/research/water_column_quality/tidal_flushing/tidal_flushing_maps.html	GIS Data available	Herman J, Et Al. VIMS 2007	General - Other
Eastern Shore Ground Water Supply Protection and Management Plan (Chapter 2 Water Resources)	Water Resources ground water farm ponds	Horsely Witten Hegemann, Inc	Water resources - topography, soil, surface water (farm ponds, wetlands), ground water, water use - report made for Accomack County	Yes - Simple	PDF	Yes		Horsley Witten Hegemann, Inc (Consultants in Water Resources and	1992	http://www.a-npdc.org/groundwater/Ch1-Ch2.pdf http://www.a-npdc.org/groundwater/publications.html	Study commissioned by Accomack County	Horsely Witten Hegemann, Inc 1992	General - Other
Ambient Toxicity and Chemical Characterization of Four Bayside Creeks of the Eastern Shore	onancock creek toxicity	Morris Roberts Jr, Mark Luckenbach, Michael Unger	Purpose: Characterize selected bayside creeks on Virginia's Eastern Shore with respect to chemistry and toxicity. Studied Onancock Creek in Accomack County.	yes	PDF	Yes	Chesapeake Bay Program, VIMS	EPA, VIMS W&M	2001	EPA (Using UVA's Virgo)		Roberts M, Et Al. VIMS 2001	General - Other
Saltwater intrusion into the freshwater aquifer in the eastern shore of Virginia: a reconnaissance electrical resistivity survey	saltwater freshwater geology	Ali A. Nowroozi, Stephen B. Horrocks, Peter Henderson	Contrasts between apparent high resistivity of the saturated freshwater zones and apparent low resistivity of the saturated saltwater zone are recorded on 111 Schlumberger sounding field curves	yes	PDF	Yes	Department of Ocean, Earth and Atmospheric Sciences	Old Dominion University	1999	Journal of Applied Geophysics (Using UVA's Virgo)	Contains maps with geology of the eastern shore	Nowroozi A, Et Al. ODU 1999	General - Other
Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for Virginia's Eastern Shore	Excess Nutrients Sediments	Virginia Secretary of Natural Resources	Analysis and strategy on the excess amounts of nitrogen, phosphorus and sediment flow into the bay and its tributaries from the land, from the air, from wastewater treatment plants and from industrial facilities. These nutrients and sediment foul our waters and harm the finfish, shellfish, aquatic plants and other organisms that make up the bay's	No	PDF	Yes	Virginia Secretary of Natural Resources	Virginia Secretary of Natural Resources	2005	http://www.naturalresources.virginia.gov/Initiatives/WaterQuality/ http://www.naturalresources.virginia.gov/Initiatives/WaterQuality/FinalizedTribStrats/easternShore.pdf		Virginia Secretary of Natural Resources 2005	General - Other
Erosion Control / Sea Level Rise													
A REGIONAL TEST OF THE BRUUN RULE ON SHORELINE EROSION	shoreline erosion	Peter Rosen	Sea-level rise has been quantitatively related to shoreline retreat by the Bruun Rule. This relationship was verified on a field scale along the 336-km shoreline on the Virginia Chesapeake Bay. Relative sea level rise in this area is as high as 5.43 mm/yr, and mean longterm shore retreat is 0.98 m/yr. The model was applied individually to 146 beach units in the area, and the results were compiled regionally. This long-term, regional setting where seasonal or local variations in process are averaged out, is believed to be the context in which the model has physical meaning. The erosion rate predicted by the Bruun Rule fits the long-term measured rate with a 3% error. The fit of the Bruun Rule for the Virginia Chesapeake Bay shoreline system demonstrates that sea-level rise can account for all shore retreat in the system	No	PDF	Yes	Atlantic Geoscience Centre	Bedford Institute of Oceanography, Dartmouth, N.S. (Canada)	1977		Rosen, P. S., 1978. A regional test of the Bruun Rule on shoreline erosion. Mar. Oeol., 26 M7-M16.	Rosen, P. AGC Bruun Rule. 1977.	General - Other
Impact of Sea Level Rise on Virginia's Coast	sea level rise coast	Skip Stiles	Showing risk and impact of sea level rise on the Chesapeake Bay	Yes	PDF	Yes	Wetlands Watch	Wetlands Watch	2007			Stiles, S. SLR Wetlands Watch. 2007.	General - Other
Global Warming and VIRGINIA	global warming	National Wildlife Federation	Quick report on the impact of global warming on Virginia and possible policies that could help.	No	PDF	Yes	National Wildlife Federation	National Wildlife Federation	2009			NWF VA Global Warming. 2009.	General - Other
Increasing Vulnerability to Hurricanes: GlobalWarming'sWake-Up Call for the U.S. Gulf and Atlantic Coasts	global warming	National Wildlife Federation	Report on the impact of hurricanes on the Atlantic Coast and US Gulf and how to prepare for change in weather patterns.	No	PDF	Yes	National Wildlife Federation	National Wildlife Federation	2008			NWF Atlantic Hurricanes. 2008.	General - Other
Sea-Level Rise and Coastal Habitats in the Chesapeake Bay Region	seal level rise coast habitats	Patty Glick. Jonathan Clough, Brad Nunley	High quality report on the impacts of sea level rise to Chesapeake Bay Area using modeling system.	Yes	PDF	Yes	National Wildlife Federation	National Wildlife Federation	2008			Glick, P. et al. Sea Level Rise NWF. 2008.	General - Other
Potential for Shoreline Changes Due to Sea-Level Rise Along the U.S. Mid-Atlantic Region	sea level Rise shoreline	Benjamin T. Gutierrez, S. Jeffress Williams, and E. Robert Thieler	Thirteen scientists convened for a two-day meeting to exchange information and develop a consensus opinion on potential future coastal changes for the mid-Atlantic coast in response to sea-level rise. Using criteria defined in past work, the mid-Atlantic coast was divided into four geomorphic compartments: spits, headlands, wave-dominated barriers, and mixed-energy barriers. A range of potential coastal responses was identified for each compartment based on four sea-level rise scenarios.	Yes	PDF	Yes	USGS	USGS	2007			Gutierrez, et al. USGS. 2007.	General - Other

Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region	Sea Level Rise Coast	James G. Titus Lead Authors: K. Eric Anderson, Donald R. Cahoon, Dean B. Gesch, Stephen K. Gill, Benjamin T. Gutierrez, E. Robert Thieler, and S. Jeffress Williams	This Synthesis and Assessment Product (SAP) examines potential effects of sea-level rise from climate change during the twenty-first century, with a focus on the mid-Atlantic coast of the United States. Using scientific literature and policy-related documents, the SAP describes the physical environments; potential changes to coastal environments, wetlands, and vulnerable species; societal impacts and implications of sea-level rise; decisions that may be sensitive to sea-level rise; opportunities for adaptation; and institutional barriers to adaptation. Finally, this SAP discusses ways natural and social science research can improve understanding and prediction of potential impactsto aid planning and decision making.	Yes	PDF	Yes	U.S. Climate Change Science Program	U.S. Climate Change Science Program	2009		CCSP, 2009: Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [James G. Titus Coordinating Lead Author), K. Eric Anderson, Donald R. Cahoon, Dean B. Gesch, Stephen K. Gill, Benjamin T. Gutierrez, E. Robert Thieler, and S. Jeffress Williams (Lead Authors)]. U.S. Environmental Protection Agency, Washington D.C., USA, 320 pp.	Titus, J. et al. CCSP. 2009.	General - Other
SEDIMENT IN THE CHESAPEAKE BAY AND MANAGEMENT ISSUES: TIDAL EROSION PROCESSES	erosion sediment chesapeake bay	Chesapeakee Bay Program Tidal Sediment Task Force	This document addresses six important questions and provides regional contacts and resources for further study and information. It provides useful background information on sediment processes and data that can help tributary teams determine the effects of tidal sediment in their watershed and help assess whether reductions in tidal sediment input may be effective in meeting the sediment allocation cap loads.	Yes	PDF	Yes	Chesapeake Bay Program, Nutrient Subcommittee	Chesapeake Bay Program, Nutrient Subcommittee	2005			Chesapeake Bay Program, Tidal Erosion. 2005.	General - Other
The Coastal Primary Sand Dune and Beach Act	sand dunes beach	Lyle M. Varnell C. Scott Hardaway	Identifies primary and secondary sand dunes, sand dune plant.	Yes	PDF	Yes	VIMS	VIMS College of William and Mary	2007	http://web.vims.edu/physical/research/shoreline/Accomack%20County%20%20Full%20Reports.html http://web.vims.edu/physical/research/shoreline/docs/Dune&BeachAct_Recommend_Final.pdf		Varnell L, Et Al. VIMS 2007	General - Other
OCCOHANNOCK CREEK Shoreline Erosion Assessment and Living Shoreline Options Report	shoreline erosion	C. Scott Hardaway, Marcia Berman	Occohannock Creek was chosen for this demonstration shoreline assessment because increasing productive marsh and reducing shoreline erosion here will benefit the environment and the residents of both counties. The resulting document presents shoreline management strategies keyed to each of these segments. The recommendations are based on physical and hydrodynamic characteristics such as fetch,	Yes	PDF	Yes	VIMS Shoreline Studies Program Dept of Physical Science, Center for Coastal	VIMS College of William and Mary	2008	http://web.vims.edu/physical/research/shoreline/Accomack%20County%20%20Full%20Reports.html http://web.vims.edu/physical/research/shoreline/docs/OccohannockCreek/OccohannockCreek.pdf		Hardaway C S, Et Al. VIMS 2008	General - Other
Accomack County Dune Inventory	sand dunes beach	C. Scott Hardaway, Jr., Donna A. Milligan, Lyle M. Varnell, George R. Thomas, Walter I. Priest, Linda M. Meneghini, Thomas A.	A total of 33 dune sites were identified along Accomack's shoreline in 1999 and 2000. The report discusses dune classification and site characteristics.	Yes	PDF	Yes	VIMS Shoreline Studies Program Dept of Physical Science, Center for Coastal	VIMS College of William and Mary	2004	http://web.vims.edu/physical/research/shoreline/Accomack%20County%20%20Full%20Reports.html http://web.vims.edu/physical/research/shoreline/docs/locality/Accomack/Accomack_County_Dune_Inventory.pdf		Hardaway C S, Et Al. VIMS Dune Inventory 2004	General - Other
Dune Evolution Accomack County, Virginia Chesapeake Bay Shorelines	shore dunes evolution	C. Scott Hardaway, Jr. Donna A. Milligan Lyle M. Varnell Christine Wilcox George R. Thomas	The purpose of this report is to document how the dunes on Chesapeake Bay shores of Accomack have evolved since 1938. Aerial imagery was taken for most of the Bay region beginning that year, and it is this imagery that allows one to assess the geomorphic nature of shore change. Aerial imagery shows how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers	Yes	PDF	Yes	VIMS Shoreline Studies Program Dept of Physical Science, Center for Coastal	VIMS College of William and Mary	2006	http://web.vims.edu/physical/research/shoreline/Accomack%20County%20%20Full%20Reports.html http://web.vims.edu/physical/research/shoreline/docs/dune_evolution/Accomack/AC_Evo_FinalReport.pdf		Hardaway C S, Et Al. VIMS Dune Evolution 2006	General - Other
Invasive Species													
Potential Impact of Common Reed Expansion on Threatened High-marsh Bird Communities on the Seaside: Assessment of Phragmites Invasion of High Marsh Habitats	Phragmites Invasive Species	Barton J. Paxton	A GIS layer of high marsh patches was produced by digitizing high marsh patch boundaries from Virginia 2002 basemap imagery. This layer was compared to a layer of P. australis patches to determine the extent and degree of P. australis invasion into the high marsh. A total of 264 high marsh patches were identified totaling 1719 hectares. P. australis had invaded 123 of these high marsh patches to some degree, and 141 were free of any P. australis. Of the 114 patches, totaling 1137 ha, that had been invaded by P. australis, at a level of greater that 1%, 327 ha or 28.7% of their area was affected. High marsh patches within northern most and southern most latitudinal classes showed a significantly higher rate of invasion than patches within the middle latitudinal classes.	yes (separate GIS data)	PDF	Yes	CCB	College of William and Mary	2006	http://www.deq.virginia.gov/coastal/description/2004projects/11-02-04.html	Paxton, B. J. 2006. Potential Impact of Common Reed Expansion on Threatened High-marsh Bird Communities on the Seaside: Assessment of Phragmites Invasion of High Marsh Habitats. Center for Conservation Biology Technical Report Series, CCBTR-06-17. College of William and Mary, Williamsburg, VA. 9pp.	Paxton B. CCB Phragmites 2006	plants
Potential Impact of Common Reed Expansion on Threatened High-marsh Bird Communities on the Seaside: Breeding Bird Surveys of Selected High-marsh Patches	Common Reed, Wetland Birds	Barton J. Paxton	Survey. Birds are at risk from invasive Phragmites. The most commonly detected bird species were Red-winged Blackbirds, Willets, Seaside Sparrows, Common Yellowthroats, and Sharp-tailed Sparrows. Two of these species, the Seaside Sparrow and Sharp-tailed Sparrow, are species of high conservation concern. Seaside and Sharp-tailed Sparrows were found in significant numbers within large high-marsh patches on the northern portion of Virginia Delmarva Peninsula, regardless of P. australis presence. However these species rarely, if ever, utilized P. australis, and still required large patches of high-marsh	Yes	PDF	Yes	CCB	College of William and Mary	2007	http://www.deq.state.va.us/coastal/documents/task9-02-05.pdf	Paxton, B. J. 2007. Potential Impact of Common Reed Expansion on Threatened Highmarsh Bird Communities on the Seaside: Breeding Bird Surveys of Selected High-marsh Patches. Center for Conservation Biology Technical Report Series, CCBTR-07-03. College of William and Mary, Williamsburg, VA. 19pp.	Paxton B. Common Reed CCB 2007	Birds
Phragmites on the Eastern Shore	Phragmites, Invasive Species		Maps showing distribution and abundance of Phragmites on the Eastern Shore Seaside of Virginia	Yes	PDF	Yes	Seaside Heritage Program		2005	http://www.deq.state.va.us/coastal/vshp/documents/phragsurvey.pdf http://www.deq.state.va.us/coastal/vshp/goals.html#phrageducation	Text unavailable - scroll through PDF to find maps	N/A - see link	Plants
Management and Education to Control Phragmites on the Seaside of Virginia's Eastern Shore AND Management Plan for Phragmites australis on the Seaside of Virginia's Eastern Shore	Phragmites, Invasive Species	Rick K. Myers	GPS census of Phragmites occurrences on the Seaside, analyze data, and report trends and changes in Phragmites abundance and distribution since 2004. Received CZM funding. Background information, Maps, and Management Plan.	yes	PDF	Yes	VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION	VA Natural Heritage	2009	http://www.deq.virginia.gov/coastal/documents/task10-03-07b.pdf http://www.deq.virginia.gov/coastal/description/2007projects/10-03-07.html http://www.deq.virginia.gov/coastal/documents/task10-03-07c.pdf	Myers, R.K., K.E. Heffernan, P.A. Clarke, and D.P. Field. 2009. Management and education to control Phragmites on the Seaside of Virginia's Eastern Shore. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. Final report for Year Six of the Seaside Heritage Program submitted to USDC National Oceanic and	Myers R. DCR Study 2009 and Myers R. DCR Plan 2009	Plants
Potential Impact of Common Reed Expansion on Threatened High-marsh Bird Communities on the Seaside: Wintering Bird Surveys of Selected High-marsh Patches	wintering birds, common reed	Barton J. Paxton	Four species of high conservation concern; Sharp-tailed Sparrow, Marsh Wrens, Sedge Wrens and Seaside Sparrows, were found in significant numbers within marsh study sites. Sharp-tailed Sparrows, Marsh Wrens, and Sedge Wrens were detected along the entire gradient of the large marsh patches in the northern portion of the Virginia Delmarva Peninsula to the smaller marsh patches in the southern portion of the Virginia Delmarva Peninsula, regardless of P. australis presence. However, while these species were detected within P. australis, they were most often detected within marsh grass	yes	PDF	yes	CCB	College of William and Mary	2008	http://www.deq.virginia.gov/coastal/documents/task10-02-06b.pdf http://www.deq.virginia.gov/coastal/description/2006projects/10-02-06.html	Paxton, B. J. 2007. Potential Impact of Common Reed Expansion on Threatened High-marsh Bird Communities on the Seaside: Wintering Bird Surveys of Selected High-marsh Patches. Center for Conservation Biology Technical Report Series, CCBTR-07-13. College of William and Mary, Williamsburg, VA. 21pp.	Paxton B. Common Reed CCB 2008	Birds
Habitats													

Ecosystem Effects of Oyster Restoration in Virginia Habitat and Lease Areas: A Report to the Maryland Dept of Natural Resources	oyster restoration ecosystem	Carl Cerco, Mark Noel	This report is the third in a series in which the Chesapeake Bay Environmental Model Package was used to assess the environmental benefits of oyster restoration in Chesapeake Bay. Here, the effects of oyster restoration to all potential Virginia oyster habitat were investigated. Three scenarios were completed with oyster mortality rates corresponding to 1994 base rates, to rates which allow a ten-fold biomass increase in regions that presently support oysters, and to rates consistent with 1920-1970 biomass in regions that presently support oysters. Benefits of establishing oysters in new areas were negligible for 1994 base mortality rates. Maximum benefits were computed for mortality rates consistent with 1920-1970 population levels. The maximum benefits from restoration to all potential Virginia habitat, compared to existing habitat, included: 0.44 µg/L reduction in summer-average surface chlorophyll, 0.04 mg/L increase in summer-average deep-water (d > 12.9 m) dissolved oxygen, 0.06 /m reduction in summer-average light attenuation, 687 tonnes C (11%) additional SAV, and 5301 kg/d nitrogen removal.	Yes	PDF	Yes	US Army Engineer Research and Development Center	US Army Engineer Research and Development Center	2006			Cerco C, et al. Army Eng R&D 2006	Shellfish
Evaluating Ecosystem Effectts of Oyster Restoration in Chesapeake Bay: A Report to the Maryland Dept of Natural Resources	oyster restoration ecosystem	Carl Cerco, Mark Noel	The Chesapeake Bay Environmental Model Package (CBEMP) was used to assess the environmental benefits of oyster restoration in Chesapeake Bay. The CBEMP consists of a coupled system of models including a threedimensional hydrodynamic model, a three-dimensional eutrophication model, and a sediment diagenesis model. Examination of results emphasized dissolved oxygen, chlorophyll concentration, and water clarity.	Yes	PDF	Yes	US Army Engineer Research and Development Center	US Army Engineer Research and Development Center	2005			Cerco C, et al. Army Eng R&D 2005	Shellfish
SHELLFISH AQUACULTURE VULNERABILITY MODEL	Shellfish Aquaculture	VIMS	This study uses GIS to model risks to shellfish aquaculture. The model first considers basics physical and biological conditions necessary for aquaculture success and second, the impacts that current land use and proposed local zoning has on suitable growing areas. Looks at salinity, bathymetry, SAV distribution, water quality, land use, and local zoning.	Yes	PDF + Website	Yes	Center for Coastal Resources Management VIMS	VIMS College of William and Mary	2007	http://ccrm.vims.edu/gis_data_maps/interactive_maps/aquaculture_vulnerability/aquaculture_vulnerability_report_final.pdf Web Maps of Clams: http://ccrm.vims.edu/gis_data_maps/interactive_maps/aquaculture_vulnerability/eshore/es_hard_clam_index.html Oysters: http://ccrm.vims.edu/gis_data_maps/interactive_maps/aquaculture_vulnerability/eshore/es_oyster_index.html	See web page links for clam and oyster maps	VIMS Aquaculture 2007	Shellfish
Ecosystem approaches to aquatic health assessment: linking subtidal habitat quality, shoreline condition and estuarine fish communities	Fish SAV Ecosystem Habitat Quality	Donna Marie Bilkovic, Carl H. Hershner, and Kory Angstadt	Relationships between subtidal habitat and shoreline condition as well as linkages of habitat condition to fish community indices were assessed. Observed relationships and habitat mapping protocols have the potential to be extrapolated to additional watersheds in the coastal plain, and become tools for future development of habitat indices and ecosystem management.	Yes	PDF	Yes	Center for Coastal Resources Management VIMS	VIMS College of William and Mary	2006	http://ccrm.vims.edu/research/coastal_stressors/ecosystem_approaches.html http://ccrm.vims.edu/publications/pubs/Bilkovic_NCBO_Final%20report_May2006.pdf	other areas in coastal area of Virginia. Bilkovic, D.M, C.H. Hershner, and K.Angstadt. 2006. Ecosystem approaches to aquatic health assessment: linking subtidal habitat quality, shoreline condition and estuarine fish communities. Final Report to NOAA/ NOAA Chesapeake Bay Office. Center for Coastal Resources Management, Virginia Institute of Marine	Bilkovic D, Et Al. VIMS 2006	Fish
Virginia's Comprehensive Wildlife Conservation Stragety: Mid-Atlantic Coastal Plain (Chapter 4)	Conservation Endangered Species	Virginia Wildlife Action Plan	Information for the coastal region of Virginia about wildlife species in need of conservation, essential habitats that support them, threats to these resources and priorities for action. Focus on "Top 10" threats faced by terrestrial and aquatic wildlife related to habitat destruction or fragmentation (from development, agricultural and forestry practices)	Yes	PDF	Yes	Virginia Department of Game and Inland Fisheries	Virginia Department of Game and Inland Fisheries	2005	http://www.bewildvirginia.org/wildlife-action-plan/chapter-4.pdf http://www.bewildvirginia.org/wildlifeplan/plan.asp	See main website (http://www.bewildvirginia.org/wildlifeplan/plan.asp) for more data in appendices	Virginia Wildlife Action Plan DGIF 2005	General - Other
Accomack County Shoreline Situation Report	shoreline assessment	Marcia Berman, Carl Hershner	This shoreline inventory is developed as a tool for assessing conditions along the tidal shoreline in Accomack County. Conditions are reported for three zones within the immediate riparian river area: riparian land use, bank and buffers, and the shoreline. Targets bayside and high priority creeks.	yes	PDF + Many Maps on Web	Yes	Comprehensive Coastal Inventory Program	VIMS College of William and Mary	2002 (Data collected in 2000)	MANY Maps: http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/accomack/index.html http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/accomack/index.html http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/accomack/accomack_disclaimer.htm	See online link to view maps: http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/accomack/index.html	Berman M, Et Al. VIMS 2002	General - Other
SHP - AN EVALUATION AND COMPARISON OF DREDGE FISHING ACTIVITY ON THE SEASIDE OF VIRGINIA'S EASTERN SHORE BETWEEN 1994 - 1995 AND 2005 - 2006	dredging shellfish	JAMES A. WESSON	seaside bays, in large part due to efforts though the Seaside Heritage Program. Clam and crab dredging threatens the success of this restoration effort both by physical destruction of the planted beds, and by the increased turbidity blocking light to the plants. The VIMS Eastern Shore Lab and VMRC surveyed the annual dredging activity in the seaside bays and compare these findings with 1994 data.	yes	PDF	Yes	VIMS FISHERIES MANAGEMENT DIVISION	VIMS CONSERVATION AND REPLENISHMENT DEPARTMENT	2007	http://www.deq.virginia.gov/coastal/documents/task9-07-05.pdf http://www.deq.virginia.gov/coastal/description/2005projects/09-07-05.html		Wesson J, VIMS 2007	General - Other
Assessing habitat stability for disturbance-prone species by evaluating landscape dynamics along the Virginia barrier islands	Habitat Stability Landscape	Michael D. Wilson Bryan D. Watts Joshua E. Leclerc	Characterized temporal and spatial patterns of beach habitats within the Virginia barrier island landscape and to quantify the relationship between landscape change and the distribution of avian breeding sites.	yes (tables)	PDF	yes	CCB	College of William and Mary	2007	http://www.deq.virginia.gov/coastal/documents/task11-02-04a.pdf http://www.deq.virginia.gov/coastal/description/2004projects/11-02-04.html	Wilson, M. D., B. D. Watts, and J. E. LecLerc. 2007. Assessing habitat stability for disturbance-prone species by evaluating landscape dynamics along the Virginia barrier islands. Center for Conservation Biology Technical Report	WIlson M, Et Al. CCB 2007	General - Other
CHANGES IN LAGOONAL MARSH MORPHOLOGY AT SELECTED NORTHEASTERN ATLANTIC COAST SITES OF SIGNIFICANCE TO MIGRATORY WATERBIRDS	salt marsh, marsh loss, GIS, Atlantic coast, waterbirds, Spartina, sea-level rise	R. Michael Erwin, Geoffrey M. Sanders, and Diann J. Prosser	Lagoonal salt marsh areas were selected to examine the degree to which Spartina marsh area and microhabitats had changed from the early or mid- 1900s to recent periods. We chose areas based on their importance to migratory bird populations, agency concerns about marsh loss and sea-level rise, and availability of historic imagery	yes	PDF	Yes	Patuxent Wildlife Research Center, Department of Environmental Sciences	USGS, UVA	2004	BioOne (using UVA's VIRGO)	see data on Curlew Bay WETLANDS, Volume 24, No. 4, 2004	Erwin M, Et Al. UVA 2004	Birds
Status Review of Chesapeake Bay Marsh Lands and Breeding Marsh Birds	marsh birds, wetlands, salt marsh, brackish marsh, freshwater marsh, population estimate, habitat requirements, sea-level rise.	Michael D. Wilson Bryan D. Watts DAVID F BRINKER	Review of marshes along the bay's fringe, tributaries, and islands that currently support species at risk of extinction in the Bay are in immediate need of identification and protection. High marshes on the Delmarva peninsula, support greatest concentrations of species at risk and are marshes among the most at risk of loss and degradation.	yes	PDF	Yes	CCB, Natural Heritage Program	College or William and Mary, Maryland Department of Natural Resources	2007	BioOne (using UVA's VIRGO)		Wilson M, Et Al. CCB 2007	Birds
Bay Barometer: A Health and Restoration Assessment of the Chesapeake Bay and Watershed in 2008	bay watershed, water quality, habitat, fish	EPA	Annual review on the health of the Bay - basic information about habitats, water quality, water resources	yes	PDF	Yes	Chesapeake Bay Program	EPA	2008	EPA (Using UVA's Virgo)		EPA Bay Barometer 2008	General - Other

Virginia Eastern Shore: Conservation Lands	Delmarva Peninsula, Virginia Coast Reserve, conservation land map	The Nature Conservancy	This map shows both The Nature Conservancy's conservation projects on the Eastern Shore and the broader context of surrounding conservation lands, including conservation easements, state natural areas and national wildlife refuges.	yes	PDF	Yes	THE NATURE CONSERVANCY	THE NATURE CONSERVANCY	2009	n/a - map was emailed by TNC		The Nature Conservancy Conservation Land 2009	General - Other
Digital Shoreline Situation Report (SSRs) - Description and Disclaimer	Accomack County Shoreline Situation Maps	Center for Coastal Resources Management	This inventory reports condition at the shoreline including land use, stability, and shoreline structures.	yes	website	Yes	Comprehensive Coastal Inventory Program	Center for Coastal Resources Management	2009	http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/accomack/accomack_disclaimer.htm	The website provides links to maps, reports, tables, metadata, and GIS data	N/A - see link	General - Other
Interactive Maps: Aquaculture Vulnerability Model	Aquaculture, water quality, shellfish, SAV	Center for Coastal Resources Management	The Aquaculture Suitability Model releases information on sites at risk to Aquaculture due to development. The eastern shore was the principal target area for the model run.	yes	website	Yes	Comprehensive Coastal Inventory Program	Center for Coastal Resources Management	2009	http://ccrm.vims.edu/gis_data_maps/interactive_maps/aquaculture_vulnerability/aquaculture_vulnerability_model.html	The website provides links to maps, GIS data, fact sheet, and final report.	N/A - see link	General - Other
CHANGES IN LAGOONAL MARSH MORPHOLOGY AT SELECTED NORTHEASTERN ATLANTIC COAST SITES OF SIGNIFICANCE TO MIGRATORY WATERBIRDS	lagoonal marsh morphology waterbirds	R. Michael Erwin, Geoffrey M. Sanders, and Diann J. Prosser	Some lagoonal salt marsh areas were selected from southern DelMarVa peninsula, Virginia to examine the degree to which Spartina marsh area and microhabitats had changed from the early or mid- 1900s to recent periods. At Curlew Bay, Virginia, annual loss was 0.20% (9% from 1949 to 1994) and almost entirely due to perimeter erosion to open water. At Gull Marsh, Virginia, a site chosen because of known erosional losses, we recorded the highest annual loss rate, 0.67% per annum, again almost entirely due to erosional, perimeter loss. In contrast, at the southernmost site, Mockhorn Island Wildlife Management Area, Virginia, there was a net gain of 0.09% per annum (4% from 1949 to 1994), with tidal flats becoming increasingly vegetated. Habitat implications for waterbirds are considerable; salt marsh specialists such as laughing gulls (Larus atricilla), Forster's terns (Sterna forsteri), black rail, (Laterallus jamaicensis), seaside sparrow (Ammodramus maritimus), and saltmarsh sharp-tailed sparrow (Ammodramus caudacutus) are particularly at risk if these trends continue, and all but the laughing gull are species of concern to state and federal managers.	Yes	PDF	Yes	USGS Patuxent Wildlife Research Center	USGS Patuxent Wildlife Research Center	2004			Erwin, M Et Al. Marsh Land USGS 2004	General - Other
SAV													
2007 Distribution of Submerged Aquatic Vegetation in Chesapeake Bay and Coastal Bays	SAV	Robert Orth, David Wilcox, Jennifer Whiting, Leah Nagey, Amy Owens, Anna Kenne	The distribution of submerged aquatic vegetation (SAV) in Chesapeake Bay, its tributaries, and the Maryland and Virginia coastal bays of the Delmarva Peninsula, was mapped from black and white aerial photographs. Notable changes in SAV distribution were measured between 2006 and 2007. SAV increased 10% from 23,941 ha (59,160 ac) in 2006 to 26,271 ha (64,917 acres) in 2007.	yes	Web	yes	VIMS	VIMS College of William and Mary	2008	http://web.vims.edu/bio/sav/sav07/index.html http://web.vims.edu/bio/sav/sav07/quadindex.html	Online only, no PDF	N/A - see link	Plants
Causes of Submerged Aquatic Vegetation Declines in Tangier Sound, Chesapeake Bay	SAV Tangier Sound	Robert Orth, Ken Moore, James Fishman and David Wilcox	• Examination of shoreline loss and effects on SAV • Comparison of current versus historic water quality relative to the loss of SAV • Evaluation of regional water quality in Tangier Sound relative to the loss of SAV	yes	PDF	Yes	VIMS School of Marine Sciences	VIMS College of William and Mary	2002	http://www.vims.edu/bio/sav/tangiersoundreport_final_12_06_02.pdf http://web.vims.edu/bio/sav/Special%20Reports.html		Orth R. Et Al. VIMS SAV 2002	Plants
Status Review of Chesapeake Bay Marsh Lands and Breeding Marsh Birds	Marsh Lands Birds	MICHAEL D. WILSON, BRYAN D. WATTS AND DAVID F. BRINKER	Marshes along the bay's fringe,tributaries, and islands that currently support species at risk of extinction in the Bay are in immediate need of identification and protection. High marshes on the Delmarva peninsula, support greatest concentrations of species at risk and are marshes among the most at risk of loss and degradation. Management to reduce or abate threats to marsh birds is critical to their long term survival.	yes (some)	PDF	Yes	CCB	College of William and Mary	2007			Willson M, Et Al. CCB 2007	General - Other
Wetlands													
Wetland Restoration Catalog	Wetland Restoration Suggestions	J. Christopher Ludwig	DCR-DNH developed a catalog of potential wetland restoration sites, within or adjacent to Natural Heritage Conservation Sites. This catalog is intended to guide localities and regulatory agencies to appropriate sites for various conservation purposes including wetland mitigation.	Yes	PDF	Yes	DCR	Division of Natural Heritage	2008	http://www.dcr.virginia.gov/natural_heritage/wetrestcat.shtml http://www.dcr.virginia.gov/natural_heritage/documents/wetrestcat08.pdf	See pages 39 and 42 for suggested wetland restoration sties in Accomack	Ludwig J C. DCR 2008	General - Other
Forests													
Coastal Maritime Forests in Virginia – Delineation and Distribution	coastal forest	Marcia Berman and Harry Berquist	This project had two major goals. The first goal was to use remote sensing techniques to delineate existing coastal maritime forests. This delineation, unlike earlier efforts would be validated using ancillary datasets and ground validation. The second major goal of this project was to compute, on a county-by-county basis, the amount of maritime forest cover present in each coastal locality, and the extent of maritime forests located within conservation lands. Boundaries for public lands data from VA DCR were used.	yes	PDF	Yes	Center for Coastal Resources Management VIMS	VIMS College of William and Mary	2007	http://ccrm.vims.edu/gis_data_maps/data/maritimeforest/maritime_forest_report.pdf Maps: http://ccrm.vims.edu/gis_data_maps/data/maritimeforest/maritimeforest_maps.html http://ccrm.vims.edu/gis_data_maps/data/maritimeforest/index.html		Berman M, Et Al. VIMS Coastal Forest 2007	General - Other
Data: Maritime Forest Project	Coastal habitats, conservation and recreation	Center for Coastal Resources Management	The Maritime Forest project delineates the few remaining areas within the state that have maritime forest habitat. The eastern shore is one of those areas. Maps and data are available there.	yes	website	Yes	Comprehensive Coastal Inventory Program	Center for Coastal Resources Management	2009	http://ccrm.vims.edu/gis_data_maps/data/maritimeforest/index.html	The website provides links to the final report, maritime forest maps, GIS data, and metadata	N/A - see link	General - Other
Wildlife													
Delmarva Fox Squirrel													
Delmarva Peninsula Fox Squirrel (Sciurus niger cinereus) 5-Year Review: Summary and Evaluation	Delmarva Fox Squirrel, Endangered Species	Chesapeake Bay Field Office (CBFO) staff. Dr. Cherry Keller, Dr. Mary Ratnaswamy. Leslie Gerlich.	This 5-year status review summarizes information obtained since 1993 about the Delmarva Peninsula Fox Squirrel (federally endangered), evaluates the biological status of this subspecies, and conducts an assessment of the five listing factors to determine the appropriate classification of this subspecies under the Endangered Species Act of 1973. Website includes report and distribution map.	Yes	PDF	Yes	Chesapeake Bay Field Office	U.S. Fish and Wildlife Service	2007	http://www.fws.gov/chesapeakebay/EndSppWeb/DFS/StatusReview.html	Website has report + population maps	Keller C, Et Al. Chesapeake Bay Field Office USFWS 2007 - 1,2,3	Fox Squirrel
Evaluating population persistence of Delmarva fox squirrels and potential impacts of climate change	Delmarva Fox Squirrel, Endangered Species, climate change	Robert H. Hilderbranda, Robert H. Gardner, Mary J. Ratnaswamy, Cherry E. Keller	Comparing model results with the size and landscape configuration of currently occupied patches on the Delmarva Peninsula showed that many existing populations are above the size threshold identified by these simulations for long-term persistence under current conditions, but these may become vulnerable should climate variability increase and adverse conditions persist for several years at a time.	Yes	PDF	Yes	University of Maryland Center for Environmental Science, USFWS Chesapeake Bay Field Office,	University of Maryland, USFWS	2007	Using UVA's Virgo		Hilderbranda R, Et AL. UMD USFWS 2007	Fox Squirrel

The Delmarva Fox Squirrel Reintroduction Program on Virginia's Eastern Shore	Delmarva Fox Squirrel	Terwilliger Consulting, Inc.	This project proposes to establish at least two new Delmarva Fox Squirrel populations in Accomack and/or Northampton Counties with subsequent long-term management programs. The desired end result of the Virginia DFS Reintroduction Program is to restore viable squirrel populations on Virginia's Eastern Shore for future generations to enjoy.	Yes	PDF	Yes	Virginia Department of Game and Inland Fisheries	Virginia Department of Game and Inland Fisheries	2008	n/a - document emailed by Ruth Boettcher		Terwilliger Consulting VADGIF 2008	Fox Squirrel
SAFE HARBOR AGREEMENT FOR DELMARVA FOX SQUIRREL IN THE COMMONWEALTH OF VIRGINIA	Delmarva Fox Squirrel		This Safe Harbor Agreement (SHA or Agreement) is entered into between the Virginia Department of Game and Inland Fisheries (VDGIF) and the U.S. Department of the Interior, Fish and Wildlife Service (Service); hereinafter collectively called the "Parties." The purpose of this Agreement is to improve the status and distribution of the Delmarva fox squirrel (DFS or squirrel) in the Commonwealth of Virginia through the release (or translocation) of squirrels obtained from the core of the subspecies range in Maryland on to privately owned lands on Virginia's Eastern Shore. This Agreement will serve as a programmatic safe harbor agreement under which individual private landowners who are willing to have squirrels released on their land and owners of private lands adjacent to the release sites (collectively referred to as Cooperators) will be enrolled through Cooperative Agreements and Certificates of Inclusion. This SHA follows the Service's Safe Harbor Agreement policy (FR 64:32717) and regulations (FR 64;32706), both of which implement section 10(a)(1)(A) of the Endangered Species Act (ESA).	No	Word	Yes	Virginia Department of Game and Inland Fisheries	Virginia Department of Game and Inland Fisheries	2009	n/a - document emailed by Ruth Boettcher		VADGIF Fox Squirrel 2009	Fox Squirrel
Oyster													
ADOPTION STATEMENT 2004 Oyster Management Plan	oyster management	Chesapeake Executive Bay Council	Adoption statement of Oyster Management Plan which provides both a general framework and specific guidance for rebuilding and managing the native oyster, Crassostrea virginica, in the Chesapeake Bay.	No	PDF	Yes	Chesapeake Bay Program	Chesapeake Bay Program	2004			Chesapeake Bay Program Adoption Statement. 2004.	Shellfish
Improving Siting and Construction Criteria for Oyster Reef Restoration	oyster reef restoration	Helen Woods William J. Hargis Jr. Carl H. Hershner Pam Mason	Much of this research has focused upon understanding the natural function of oyster reefs as they historically existed in hope of applying this knowledge to restoration efforts. This paper outlines some of the things which have been learned through these endeavors and ways which these lessons can be applied to continuing restoration efforts to increase restoration success.	Yes	PDF	Yes	VIMS	College of William and Mary	2004			Woods, H. et al. VIMS. 2004.	Shellfish
Virginia Oyster Reef Restoration Map Atlas	oyster reef restoration	Marcia Berman, Sharon Killeen, Roger Mann, Jim Wesson	Atlas of potential oyster reef restoration sites for the Virginia portion of the Chesapeake Bay	Yes	PDF	Yes	VIMS, VMRC	College of William and Mary	2002	http://web.vims.edu/mollusc/oyrestatlas/oraPDF/VIMSOyRestAtlas.pdf	See pages 37-39: Nassawadox and Occohannock Creek, Tangier Island, Pocomoke Sound - See link, could not save document	N/A - see link	Shellfish
Draft Programmatic Environmental Impact Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster	Oyster Beds EIS	Craig Seltzer craig.l.seltzer@usace.army.mil	Proposed action is to introduce a nonnative species, the Suminoe oyster, and continue efforts to restore the native Eastern oyster. The EIS looks in depth at the current oyster population in the Bay, selected other components of the ecosystem of Chesapeake Bay, water quality, threatened and endangered species, essential fish habitat, social factors, economics, aesthetics and recreation, historic and archaeological resources, wetlands, sanctuaries and refuges, environmental justice, air quality, public safety and fouling, commercial navigation, and potentially affected resources outside Chesapeake Bay.	Yes	PDF	Yes	COE, VMRC	U.S. Army Corps of Engineers, Norfolk District	2008	http://www.nao.usace.army.mil/OysterEIS/EIS/homepage.asp	Good information about habitat preferences of a variety of species in the Bay and how they interact with oysters. See "Affected Environment" section of DEIS.	Seltzer C. COE VMRC 2008	Shellfish
Population Assessment of Eastern Oysters (Crassostrea virginica) in the Seaside Coastal Bays	oyster reefs	Paige G. Ross Mark W. Luckenbach	Objective: develop a spatially-explicit oyster stock assessment of this region. VIMS used National Wetlands Inventory habitat together with Virginia Base Mapping Project aerial photography and ground truth sampling to develop detailed oyster habitat maps throughout the ~900	yes	PDF	Yes	Eastern Shore Laboratory VIMS	College of William and Mary	2009	http://www.deq.virginia.gov/coastal/description/2007projects/10-02-07.html http://www.deq.virginia.gov/coastal/documents/task10-02-07.pdf		Ross P, Et Al. VIMS 2009	Shellfish
Songbirds, Shorebirds, Seabirds													
An Investigation of Stopover Ecology of the Red Knot on the Virginia Barrier Islands.	Red Knot Stopover, Migrant Bird	Fletcher M. Smith Adam E. Duerr Barton J. Paxton Bryan D. Watts	Goals: To systematically survey for Red Knots to look at the temporal distribution of the Red Knot in migration and the spatial distribution of the Red Knot on the barrier islands.	yes	PDF	yes	CCB	College of William and Mary	2008	http://www.deq.virginia.gov/coastal/documents/task10-02-06a.pdf http://www.deq.virginia.gov/coastal/description/2006projects/10-02-06.html	Smith, F.M., A. E. Duerr, B.J. Paxton and B.D. Watts. 2008. An Investigation of Stopover Ecology of the Red Knot on the Virginia Barrier Islands. Center for Conservation Biology Technical Report Series, CCBTR-07-14. College of William	Smith F, Et Al. CCB 2008	Birds
SALINITY AND POPULATION PARAMETERS OF BALD EAGLES (HALIAEETUS LEUCOCEPHALUS) IN THE LOWER CHESAPEAKE BAY	bald eagle, salinity	BRYAN D. WATTS,' A. CATHERINE MARKHAM, AND MITCHELL A. BVRD	Evaluated the relationship between salinity and Bald Eagle {Haliaeetus leiicocephalus) population parameters using 26 years of survey data for the lower Chesapeake Bay. Salinity categories included tidal fresh, oligohaline, mesohaline, and polyhaline. The study-wide Bald Eagle population is exhibiting exponential growth, with an average doubling time of 7.9 years. Observed distribution patterns suggest that lands along low-salinity waters are the core of the Bald Eagle nesting population within the lower Chesapeake Bay and should be the focus of long-term programs designed to benefit nesting eagles	yes	PDF	Yes	CCB	College of William and Mary	2006	BioOne (using UVA's VIRGO)	The Auk. The American Ornithologists Union	Watts, B Et Al. Bald Eagle CCB 2006	Birds
Colonial-nesting Seabirds in the Chesapeake Bay Region: Where Have We Been and Where Are We Going?	colonial-nesting seabirds, Brown Pelican, Double-crested Cormorant, gulls, terns, Black Skimmer	BRYAN D. WATTS DAVID F. BRINKER JAMES M. MCCANN BILL WILLIAMS	Since 1993, populations of ten of thirteen seabird species have declined, many significantly. Conservation challenges for seabird species in the region include: 1) habitat change and loss as a result of sea-level rise, 2) increasing mammalian predator populations, 3) competition for colony sites, 4) human infrastructure conflicts, and 5) changing fisheries populations and harvest. Conserving and managing colonial-nesting seabirds in the coming decades as the human population continues to increase in the mid-Atlantic region will present significant challenges to future generations.	yes	PDF	Yes	CCB, Maryland Natural Heritage Program,	College or William and Mary, Maryland Department of Natural Resources	2007	BioOne (using UVA's VIRGO)		Watts B, Et Al. Nesting Birds CCB 2007	Birds
Potential Hazards of Environmental Contaminants to Avifauna Residing in the Chesapeake Bay Estuary	Biomarkers, contaminants, pollution, reproduction, risk assessment, stressors	BARNETT A. RATTNER PETER C. MCGOWAN	Studies conducted on waterbirds in the past 15 years indicate that organochlorine contaminants have declined in eggs and tissues, although p,p' -DDE, total polychlorinated biphenyls (PCBs) and coplanar PCB congeners may still exert sublethal and reproductive effects in some locations. More contemporary contaminants (e.g., alkylphenols, ethoxylates, perfluorinated compounds, polybrominated diphenyl ethers) are detectable in bird eggs in the most industrialized portions of the Bay	yes	PDF	Yes	Patuxent Wildlife Research Center, USFWS	USGS, USFWS	2007	BioOne (using UVA's VIRGO)		Rattner B, Et Al. USFWS 2007	General - Other

The Status of Colonial Nesting Wading Bird Populations Within the Chesapeake Bay and Atlantic Barrier Island-Lagoon System	Colonial nesting wading birds, Chesapeake Bay, herons, egrets, ibises, breeding colonies, population growth	BILL WILLIAMS Bryan D. Watts DAVID F BRINKER	Summarizes changes in species, numbers of breeding pairs, and colony sites for ten species of wading birds surveyed four times over a 26-year period (1977 to 2003) within the Chesapeake Bay and Atlantic coastal barrier island region. Over the period of surveys, wading bird breeding colonies increased 246% (to 537) and numbers of breeding pairs increased 67% (to 26,589). Expansion among Great Blue Herons (Ardea herodias), Great Egrets (Ardea alba), Yellow-Crowned Night-Herons (Nyctanassa violacea) and Glossy Ibis (Plegadis falcinellus), primarily accounted for the dramatic increase, while declines were recorded for Snowy Egrets (Egretta thula), Cattle Egrets (Bubulcus ibis) and Blackcrowned Night-Herons (Nycticorax nycticorax). Rapid loss of breeding wading birds along the Atlantic coastal lagoon system during the last decade is of particular conservation concern	yes	PDF	Yes	CCB	College of William and Mary	2007	BioOne (using UVA's VIRGO)		Williams B, Et Al. CCB 2007	Birds
Annual Plover survey of the Virginia Barrier Islands: A ten year summary	plover, Virginia barrier islands	B.D. Watts, D. S. Bradshaw, and R. R. Cross	Virginia and North Carolina are the only areas of sympatry for Piping and Wilson's Plovers during the breeding season (Bergstrom and Terwilliger 1987). In Virginia, both Piping and Wilson's Plovers nest, almost exclusively, on the Virginia Barrier Islands. In the summer of 1986, in cooperation with the International Piping Plover Census (Haig and Plissner 1993), the Virginia Department of Game and Inland Fisheries coordinated a survey of the Virginia Barrier Islands for Piping Plovers. This survey has been repeated for each of the past 10 years. In 1989, Wilson's Plovers were added to the survey and have been included every year since. This paper presents an overview of survey results.	yes	PDF	Yes	CCB	College of William and Mary	1996	The Raven		Watts B, Et Al. Plovers CCB 1996	Birds
Status and distribution of Cliff Swallows in Coastal Virginia	cliff swallows	Watts, B. D., M. A. Byrd, and M. U. Watts	The purpose of this paper is to report the findings of a broad survey of coastal waterways that resulted in the detection of previously unreported breeding locations for Cliff Swallows, and to present an update on the status of all known, coastal breeding locations.	yes	Puff	Yes	CCB	College of William and Mary	1996	The Raven		Watts B, Et Al. Swallows CCB 1996	Birds
Breeding Season Status of the American Oystercatcher in Virginia, USA	American oystercatcher, bird breeding	ALEXANDRA L. WILKE BRYAN D. WATTS BARRY R. TRUITT RUTH BOETTCHER	Surveys of the American Oystercatcher (Haematopus palliatus) were conducted in all suitable nesting habitat in coastal Virginia during the 2003 breeding season. The total of 588 pairs more than doubles previous estimates for the state, and provides a benchmark for the comparison of future surveys. These results suggest that Virginia supports the largest number of oystercatchers in the breeding season relative to other east coast states.	no	PDF	Yes	CCB, Nature Conservancy, DGIF	William and Mary, Nature Conservancy, DGIF	2005	BioOne (using UVA's VIRGO)		Wilke A, Et Al. 2005	Birds
American Oystercatchers in Maryland and Virginia, USA: Status and Distribution	American oystercatcher, bird	ALEXANDRA L. WILKE BRYAN D. WATTS BARRY R. TRUITT RUTH BOETTCHER DAVID F. BRINKER ASHLEY H. TRAUT JAMES M. MCCANN PAMELA P. DENMON5	The conservation status of the American Oystercatcher (Haematopus palliatus palliatus) along the Chesapeake Bay, coastal bays, and barrier island shorelines of Maryland and Virginia has been investigated in detail in recent years. The region supports approximately 700 breeding pairs with more than 80% occurring on the east coast of the Delmarva Peninsula and less than 20% occurring along the shorelines of the Chesapeake Bay.	no	PDF	Yes	CCB, Nature Conservancy, DGIF, MD Dept of Natural Resources, USFWS	William and Mary, Nature Conservancy, DGIF, MD Dept of Natural Resources, USFWS	2007	BioOne (using UVA's VIRGO)		Wilke A, Et Al. 2007	Birds
Recovery of the Chesapeake Bay Bald Eagle Nesting Population	bald eagle nesting	Brian D Watts, Gleen D Therres, Mitchell A Byrd	We conducted annual aerial surveys throughout the tidal reach of the Chesapeake Bay, USA, between 1977 and 2001 to estimate population size and reproductive performance for bald eagles (Haliaeetus leucocephalus). The population increased exponentially from 73 to 601 pairs with an average doubling time of 8.2 years.	no	PDF	Yes	CCB, Maryland Dept of Natural Resources	William and Mary, Maryland Dept of Natural Resources	2008 (data collected between 1977-2001)	BioOne (using UVA's VIRGO)	JOURNAL OF WILDLIFE MANAGEMENT	Watts B, Et Al. Bald Eagle CCB 2008	Birds
Abundance of Shorebirds Along the Virginia Barrier Islands during Spring Migration	shorebirds, barrier islands, migration	Bryan D. Watts, Barry Truitt	Objective: estimate the number of shorebirds using the barrier islands during spring migration, determine the chronology of migration for the dominant species using the islands, determine the relative use of islands within the chain.	Yes (table)	PDF	Yes	CCB, Virginia Coast Reserve	College of William and Mary, The Nature Conservancy	2000	The Raven		Watts B, Et Al. Shorebirds CCB 2000	Birds
STATUS AND DISTRIBUTION OF COLONIAL WATERBIRDS IN COASTAL VIRGINIA: THE 2003 BREEDING SEASON	colonial waterbirds	Bryan D. Watts Mitchell A. Byrd	Conducted a systematic survey of colonial waterbirds in coastal Virginia during the breeding season of 2003.The colonial waterbird community in coastal Virginia declined by more than 16% during the 10 years between 1993 and 2003. Losses were widespread with 17 of 24 species exhibiting negative trends.	Yes (table)	PDF	Yes	CCB	College of William and Mary	2006 (collected in 2003)	The Raven		Watts B, Et Al. Waterbirds CCB 2006	Birds
2008 Colonial Waterbird Breeding Status on Virginia's Barrier Islands	colonial waterbirds	Ruth Boettcher, Alexandra Wilke	This study represents the first attempt to examine factors affecting the reproductive success of colonial nesting species within the system and how mammalian predator management may be affecting these populations.	Yes	PDF	Yes	DGIF, THE NATURE CONSERVANCY	DGIF, THE NATURE CONSERVANCY	2008			Boettcher R, Et Al. 2008	Birds
2008 Piping Plover, Wilson's Plover and American Oystercatcher Breeding Status in Virginia	Piping Plover, Wilson's Plover, American Oystercatcher	Alexandra Wilke, Ruth Boettcher, Carissa Smith	Three years of the project (2006-2008) of shorebird monitoring efforts focused on continuing existing Piping Plover, Wilson's Plover, and American Oystercatcher productivity studies and population surveys along the barrier islands. Also monitored oystercatcher reproductive success in the seaside marshes located east of Wachapreague and Quinby,Virginia. Coordinated Virginia's second statewide survey of breeding American Oystercatchers which was conducted in conjunction with the state's third coastal plain colonial waterbird survey during the 2008 breeding season.	Yes	PDF	Yes	DGIF, NATURE CONSERVANCY	DGIF, NATURE CONSERVANCY	2009			Wilke, A. Et Al. 2009	Birds
Fishes													
Estimating Relative Juvenile Abundance of Ecologically Important Finfish and Invertebrates in the Virginia Portion of Chesapeake Bay	Finfish Invertebrates	Dr. Mary C. Fabrizio Marcel M. Montane	This survey provides a monthly baseline assessment of the abundance of juvenile marine and estuarine fishes and some invertebrates in the tidal and mainstem Chesapeake Bay. Juvenile indices for most species have declined, most often a result of overfishing, degradation of estuarine nursery habitats, and other natural environmental variation.	Yes	PDF	Yes	Department of Fisheries Science VIMS	VIMS College of William and Mary	2007 (June 2003-May 2007)	http://www.fisheries.vims.edu/trawlseine/Reports/VIMS%20Trawl%20Final%20Report%20For%20NOAA_June2003_May2007.pdf	Fabrizio, M.C. and M.M. Montane. 2007. Estimating relative juvenile abundance of ecologically important finfish and invertebrates in the Virginia portion of Chesapeake Bay, Award # NA03NMF4570378, June 2003-May 2007. Final report to NOAA Chesapeake Bay Office. Virginia Institute of Marine Science, Gloucester Point, VA. 97 pp.	Fabrizio, M, Et Al, VIMS 2007	Fish
Estimating Relative Juvenile Abundance of Recreationally Important Finfish and Crustaceans in the Virginia Portion of Chesapeake Bay	Finfish Crustaceans	Marcel M. Montane Dr. Mary C. Fabrizio	This survey provides a monthly baseline assessment of abundance of juvenile marine and estuarine fishes and crustaceans in the tidal and mainstem Chesapeake Bay. Juvenile indices for most species have declined, most often a result of overfishing, degradation of their estuarine nursery habitats, and year class failure due to natural environmental variation.	Yes	PDF	Yes	Department of Fisheries Science VIMS	VIMS College of William and Mary	2006 (June 2005-May 2006)	http://www.fisheries.vims.edu/trawlseine/Reports%5CMRFABTrawlAnnualReport_RevisedDec2006.pdf	Montane, M.M. and M.C. Fabrizio. 2006. Estimating relative abundance of recreationally important finfish and crustaceans in the Virginia portion of Chesapeake Bay, Project # RF 05-15, June 2005-May 2006. Annual report to the Virginia Marine Resources Commission Marine Recreational Fishing Advisory Board. Virginia Institute of Marine Science, Gloucester Point, VA. 125 pp. (Revised December 7, 2006) Download PDF (8372 KB).	Montane, M, Et Al. VIMS 2006	Fish

The Chesapeake Bay Multispecies Monitoring and Assessment Program - Progress Repprt	Multispecies Fish Monitoring	Christopher F. Bonzek Robert J. Latour James Gartland	Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) is a large-mesh bottom trawl survey designed to sample late juvenile-to-adult fishes in Chesapeake Bay. This field program currently provides data on relative abundance, length, weight, age, and trophic interactions for several important fish species seasonally inhabiting the bay.	Yes	PDF	Yes	School of Marine Science VIMS	VIMS College of William and Mary	2008 (2007 sampling)	http://www.fisheries.vims.edu/Multispecies/survey_reports.htm	Many maps of many fish	Bonzek C, Et Al. ChesMMAP VIMS 2008	Fish
Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP)	Multispecies Fish Monitoring	Christopher F. Bonzek Robert J. Latour James Gartland	Background to ChesMMAP - Powerpoint	Yes - Simple	PPT	Yes	School of Marine Science VIMS	VIMS College of William and Mary	2008	http://www.fisheries.vims.edu/Multispecies/survey_reports.htm	Supplement Powerpoint to ChesMMAP data	Bonzek C, Et Al. ChesMMAP PPT1 VIMS 2008	Fish
Are Piscivores in Chesapeake Bay Forage Limited?	Multispecies Fish Monitoring	Christopher F. Bonzek Robert J. Latour James Gartland	Supplement Powerpoint to ChesMMAP data	Yes - Simple	PPT	Yes	School of Marine Science VIMS	VIMS College of William and Mary	2008	http://www.fisheries.vims.edu/Multispecies/survey_reports.htm	Supplement Powerpoint to ChesMMAP data	Bonzek C, Et Al. ChesMMAP PPT2 VIMS 2008	Fish
Recent Additions of Warmwater Fish Species to Chesapeake Bay	New Species Warmwater Fish Chesapeake Bay	Aimee D. Halvorson	September 2004 and June 2005, VIMS collected specimens of three warmwater fish species uncommon to Chesapeake Bay. Captures of Snakefish, Spotted Whiff, and Red Goatfish are the first substantiated records for these species from Chesapeake Bay. These captures also represent extensions in the documented geographic ranges of Snakefi sh and Spotted Whiff. Occurrences of multiple species heretofore rarely encountered in Chesapeake Bay warrant further attention in view of concerns regarding climate change and its effect on local marine faunas.	Yes	PDF	Yes	VIMS	VIMS	2007			Halvorson, A. VIMS 2007	Fish
Other													
Chapter 6 from the Accomack County Comprehensive Plan			Includes the Future Land Use Plan from the Comprehensive Plan. A section about natural resources is included in this chapter.	no	PDF	Yes	Accomack County	Accomack County	2008			Accomack County 2008	General - Other
Blue Infrastructure Mapping Tool and Final Project Report and Deliverables	web mapping tool blue infrastructure	Marcia Berman, Carl Hershner, and Dan Schatt	Mapping tool with economically and ecologically important aquatic resources in Virginia's Coastal Zone. Data includes anadromous fish streams, aquaculture sites, Baylor Grounds, bottom tye mapping, channel navigation markers, essential fish habitat, fishery management areas, near shore coastal parks and wildlife refuges, oyster reefs, public boat lands, public beaches, SAV, tidal mudflats, endangered species, water trails	yes	PDF + Web Tool	Yes	Center for Coastal Resources Management VIMS	VIMS College of William and Mary	2004	http://ccrmgis.wetlan.vims.edu/blue_infra/viewer.htm	Mapping tool + PDF that describes data included in inventory	Berman M, Et Al. VIMS Blue Infrastructure 2004	General - Other
Data: Blue Infrastructure	Aquatic resources, GIS, SAV, CCI	Center for Coastal Resources Management	This is a collection of aquatic resources	yes	website	Yes	Comprehensive Coastal Inventory Program	Center for Coastal Resources Management	2009	http://ccrm.vims.edu/gis_data_maps/interactive_maps/blueinfrastructure/bi_intro.html	Once the disclaimer is accepted, you are directed to the Blue Infrastructure website with links to the final report, shapefiles, and the Blue Infrastructure mapping website	N/A - see link	General - Other
Quick Fact Sheet about Accomack Threatened Wildlife and Streams/Islands	Accomack Key Facts	Various	Compilation of endangered species, species of concern, areas of focus from compl plan and nature conservancy, streams and island names.	No	DOC	Yes	Various	Various	2009			Accomack Key Features	General - Other
How global warming and climate change may be accelerating losses of Chesapeake Bay seagrasses	seagrass, eelgrass	Ken Moore	Presentation on underwater grass - their importance and vulnerability + locations around the Bay	Yes	PDF Presentation	Yes	School of Marine Science VIMS	VIMS College of William and Mary	2006	http://ccrm.vims.edu/education/seminarpresentations/spring_2007/KMoore%20CCRM%20Sealevel%20Rise%202006.pdf http://ccrm.vims.edu/education/seminarpresentations/spring_2007/spring_2007_presentations.html		Moore K. VIMS 2006	Plants
INFLUENCE OF LAND USE ON THE INTEGRITY OF MARSH BIRD COMMUNITIES OF CHESAPEAKE BAY, USA	index of marsh bird community integrity, estuarine wetlands	William V. DeLuca, Colin E. Studds, Larry L. Rockwood, and Peter P. Marra	We developed an index of marsh bird community integrity (IMBCI) to evaluate marsh bird communities and wetland condition. During the 2002 and 2003 summers, we detected 30 bird species at 219 point count locations distributed among 96 wetlands. IMBCI scores for each wetland were used to determine whether wetland habitat characteristics and urban/suburban development, agriculture, and forest at three different spatial scales (watershed, 1000-m buffer, and 500-m buffer) influenced marsh bird community integrity. The results of our study demonstrate that marsh bird community integrity shows a threshold response to urban/suburban development at local scales. IMBCI scores, combined with the identification of a land-use threshold, can be easy to interpret and may help communicate complex ecological data to natural resource managers and conservation planners.	no	PDF	Yes	Smithsonian Environmental Research Center, Department of Environmental Science and Policy	GMU	2004	BioOne (using UVA's VIRGO)	Data not specifically about Accomack. But may be important to patterns found in the entire Bay.	landusemarshbird2004	Birds
Secondary Resources													
The Effects of Derelict Blue Crab Traps on Marine Organisms in the Lower York River, Virginia	Blue Crab Traps Debris	KIRK J. HAVENS,* DONNA MARIE BILKOVIC, DAVE STANHOPE, KORY ANGSTADT, AND CARL HERSHNER	To address the effect of derelict traps on marine organisms, we investigated the following questions in the lower York River, Virginia: (1) how many derelict traps are present and what is the annual trap loss rate; (2) how long do derelict traps continue to effectively capture organisms; (3) what marine organisms are being trapped; and (4) how does self-baiting of traps affect catch?	Yes	PDF + Website	Maybe	Center for Coastal Resources Management VIMS	VIMS College of William and Mary	2008	Interactive Marine Debris Map** http://ccrmgis.wetlan.vims.edu/marine_debris/viewer.htm York River Report: http://ccrm.vims.edu/marine_debris_removal/protected/Havens%20et%20al%20NAJFM08.pdf http://ccrm.vims.edu/marine_debris_removal/index.html	Report focuses on York River but map (http://ccrmgis.wetlan.vims.edu/marine_debris/viewer.htm) shows locations of debris on the eastern shore	Haven K, Et Al. VIMS 2008	General - Other
Condition of the Mid-Atlantic Estuaries	Estuary Conditions	EPA	The Delmarva coastal bays are the least degraded systems in the Mid-Atlantic Region, but are threatened by encroaching urbanization. The Chesapeake Bay is the estuary most deficient in oxygen in the region. Impacts to the Bay are associated with nutrient over-enrichment and the lack of oxygen.	Yes	PDF	Maybe	EPA	EPA	1998	http://www.epa.gov/emap/html/pubs/docs/groupdocs/estuary/assess/cond_mae.html	Old	EPA Estuary Conditions 1998	General - Other

Evaluating the Indirect Land Use and Environmental Effects of a Toll Discount Proposal	Land use impacts, tourism, Chesapeake Bay	Albert Racciatti, Paul Berge	Physical improvements to a transportation network, or policy actions such as toll decrease, can have an impact on the environment by reducing the time and monetary costs of travel, which can work to enhance the attractiveness of surrounding land to developers, residents and businesses. A proposed toll discount on the Chesapeake Bay Bridge-Tunnel (CBBT) connecting the Hampton Roads metro area with the rural Eastern Shore of Virginia was analyzed for its potential to influence land use and impact the environment. The study illustrates how practitioners can couple well-established technical assessment methods in a variety of disciplines with public involvement and strategic planning to promote a comprehensive vision of the future for a rural area on the fringe of a growing metropolitan region. The study included an assessment of current conditions, assets, needs, goals and potential impacts in several key areas of interest to Eastern Shore residents: transportation, tourism, economic development, agriculture/aquaculture, natural resources, and quality-of-life/livable communities.	yes	PDF	Maybe		ANPDC	2003	http://www.esva.net/~anpdc/tolldiscount.pdf		Racciatti A, Et Al. ANPDC 2003	General - Other
Mid-Atlantic Nearshore Trawl Program Progress Report: Pilot Survey Completion Report	finfish, invertebrates	Christopher F. Bonzek, James Gartland, Robert J. Latour, Ph.D.	This is a pilot study for a new fisheries-independent bottom trawl survey operating in the near coastal ocean waters of the Mid-Atlantic region. The survey is an element of the ASMFC Northeast Area Monitoring and Assessment Program (NEAMAP) and is designed to sample fishes and invertebrates from coastal waters (approximately 20-90 feet) between Montauk, New York and Cape Hatteras, North Carolina using a bottom trawl. The main objective of the survey is the estimation of biomass, length and age structures, and diet compositions of finfishes and select invertebrates inhabiting the area.	yes	PDF	Maybe	Northeast Area Monitoring and Assessment Program (NEAMAP)	VIMS - Multispecies Research	2006	http://www.fisheries.vims.edu/multispecies/whatisneamap.htm	Follow the link to http://www.neamap.net/ after clicking on the Contact Information link	Bonzek C, Et Al. NEAMAP VIMS 2006	Fish
Mid-Atlantic Nearshore Trawl Program Progress Report: Fall 2007 Survey Data Summary	finfish, invertebrates	Christopher F. Bonzek, James Gartland, J. David Lange, Robert J. Latour, Ph.D.	This is a new fisheries-independent bottom trawl survey operating in the near coastal ocean waters of the Mid-Atlantic region. The survey is an element of the ASMFC Northeast Area Monitoring and Assessment Program (NEAMAP) and is designed to sample fishes and invertebrates from coastal waters bounded by the 20ft.and 60ft. depth contours between Montauk, New York and Cape Hatteras, North Carolina and waters between the 60ft.and 120ft. depth contours in Rhode Island Sound and Block Island Sound using a bottom trawl. The main objective of the survey is the estimation of biomass, length and age structures, various other assessment related parameters and diet compositions of select finfishes inhabiting the area.	yes	PDF	Maybe	NEAMAP	VIMS - Multispecies Research	2007	http://www.fisheries.vims.edu/multispecies/whatisneamap.htm	Follow the link to http://www.neamap.net/ after clicking on the Contact Information link	Bonzek C, Et Al. NEAMAP VIMS 2007	Fish
Mid-Atlantic Nearshore Trawl Program Progress Report: Spring 2008 Survey Data Summary	finfish, invertebrates	Christopher F. Bonzek, James Gartland, J. David Lange, Robert J. Latour, Ph.D.	This is a new fisheries-independent bottom trawl survey operating in the near coastal ocean waters of the Southern New England and Mid-Atlantic regions. The survey is an element of the ASMFC Northeast Area Monitoring and Assessment Program (NEAMAP) and is designed to sample fishes and invertebrates from coastal waters bounded by the 20ft.and 60ft. depth contours between Montauk, New York and Cape Hatteras, North Carolina and waters between the 60ft.and 120ft. depth contours in Rhode Island Sound and Block Island Sound using a bottom trawl. The main objective of the survey is the estimation of abundance, biomass, length and age structures, various other assessment related parameters and diet compositions of select finfishes inhabiting the area.	yes	PDF	Maybe	NEAMAP	VIMS - Multispecies Research	2008	http://www.fisheries.vims.edu/multispecies/whatisneamap.htm	Follow the link to http://www.neamap.net/ after clicking on the Contact Information link	Bonzek C, Et Al. Trawl Survey VIMS 2008	Fish
COMMON REED PHRAGMITES AUSTRALIS OCCURRENCE AND ADJACENT LAND USE ALONG ESTUARINE SHORELINE IN CHESAPEAKE BAY	agriculture, development, plant distribution	Randolph M. Chambers, Kirk J. Havens, Sharon Killeen, and Marcia Berman	A shoreline survey of Phragmites occurrence and adjacent land use along more than 8,400 km of shoreline in the Maryland and Virginia portions of the Chesapeake Bay and its tidal tributaries. Phragmites occurrence was highest—up to 30% of all shoreline—in the upper northeastern section of the bay and was over-represented adjacent to cleared but undeveloped land. Although Phragmites was found growing adjacent to all types of land uses including undisturbed forest in the mid-to-upper estuary, its occurrence was positively correlated with the percentage of agricultural shoreline. The extensive Phragmites occurrence throughout the upper estuary suggests that both local and regional environmental factors of management concern may contribute to the suspected spread of Phragmites along both Maryland and Virginia shoreline.	no	PDF	Maybe	Keck Environmental Field Lab, CCB	College of William and Mary	2008	BioOne (using UVA's VIRGO)	WETLANDS, Vol. 28, No. 4, December 2008, pp. 1097–1103 ' 2008, The Society of Wetland Scientists	Chambers R, Et AL. CCB 2008	Plants
Chemistry of surface waters: Distinguishing fine-scale differences in sea grass habitats of Chesapeake Bay	seagrass elements	Emmanis Dorval and Cynthia M. Jones	Tested the hypothesis that the physical and chemical processes acting in sea grass habitats of the lower Chesapeake Bay are spatially structured and that dissolved elemental chemistry of sea grass-habitat surface waters have their own unique identity	no	PDF	Maybe	Center for Quantitative Fisheries Ecology	Old Dominion University	2005	JSTOR (Using UVA's Virgo)		Dorval E, Et Al. ODU 2005	Plants
Empirical relationships between land use/cover and estuarine condition in the Northeastern United States	Landscape analysis, Estuarine condition, Water quality	Wilfrid Rodriguez, Peter V. August, Yeqiao Wang, John F. Paul, Arthur Gold, Norman Rubinstein	Land–water interactions were examined in several northeastern areas. Analyses show a measurable impact of urban land use on coastal ecosystem condition over large areas of the northeastern United States.	no	PDF	Maybe	Department of Natural Resources Science, EPA, Smithsonian Environmental Research Center	Univ of Rhode Island, EPA	2007	Using UVA's Virgo		Rodriguez W, Et Al. U of RI, EPA 2007	General - Other
Long-Term Ecological Research on Disturbance, Succession, and Ecosystem State Change at the Virginia Coast Reserve: LTER IV	grassland, forest, marsh, mudflat, lagoon ecology	Bruce P. Hayden, Karen J. McGlathery, John H. Porter	The Virginia Coast Reserve LTER focuses on understanding the relationships between physical, biological and anthropogenic forces on the dynamic ecology of a coastal barrier island, lagoon and mainland system. Proposal with background research about ecology of area.	Yes	PDF	Maybe	Virginia Coast Reserve LTER	University of Virginia	2000	http://www.vcrlter.virginia.edu/elecvol/VCRLTERIV2000.pdf		Hayden B, Et AL. UVA LTER 2000	General - Other
VIRGINIA BALD EAGLE NEST AND PRODUCTIVITY SURVEY: YEAR 2002 REPORT	Bald Eagle Nests Productivity	Bryan D. Watts, PhD Mitchell A. Byrd, PhD	Study intends to monitor the recovery of the bald eagle and to document the status, distribution, and productivity of breeding bald eagles in Virginia. During the 2002 breeding season, 363 occupied Bald Eagle territories were documented in Virginia.	No	PDF	maybe	CCB	College of William and Mary	2002	http://ccb.wm.edu/publications/publications_technical.cfm	Watts, B. D. and M. A. Byrd 2002. Virginia bald eagle nest and productivity survey: Year 2002 report. Center for Conservation Biology Technical Report Series, CCBTR-02-03. College of William and Mary, Williamsburg, VA.	Watts B, Et Al. Bald Eagle CCB 2002	Birds

Status and Distribution of Colonial Waterbirds in Coastal Virginia	colonial waterbirds	Bryan D. Watts Mitchell A. Byrd	The purpose of this study was to generate population estimates for all colonial waterbird species currently breeding on the Coastal Plain of Virginia. Information presented is intended to: (1) be used in the formulation of management recommendations, (2) allow for the assessment of long-term population trends, and (3) provide a baseline for future comparisons.	No	PDF	maybe	CCB	College of William and Mary	1998			Watts B, Et Al. Waterbirds CCB 1998	Birds
SYNTHESIZING INFORMATION RESOURCES FOR THE VIRGINIA IMPORTANT BIRD AREA PROGRAM: PHASE 1 DELMARVA PENINSULA AND TIDEWATER	important bird areas IBA	Bryan D. Watts	The primary objective of this project is to utilize existing information resources to delineate important bird areas in coastal Virginia. Information resources will be identified, compiled, and synthesized in order to place geographic locations within the appropriate local, regional, and national context in terms of their importance to bird	yes	PDF	Maybe	CCB	College of William and Mary	2006	http://www.deq.state.va.us/coastal/documents/ibaoutercoastalfringereport.pdf http://www.deq.state.va.us/coastal/publicat.html#natives	Watts, B. D. 2006. Synthesizing information resources for the Virginia Important Bird Area Program: Phase I Delmarva Peninsula and tidewater. Center for Conservation Biology Technical Report Series, CCBTR-06-05. College of William and Mary, Williamsburg, VA. 70 pp.	Watts B. Bird Areas CCB 2006	Birds
Waterbirds of the Chesapeake Region: An Introduction	Waterbirds Chesapeake Bay	R. MICHAEL ERWIN, G. MICHAEL HARAMIS, MATTHEW C. PERRY AND BRYAN D. WATTS		No	PDF	Maybe	USGS, CCB	USGS, CCB	2007			Erwin M, Et Al. Waterbird Intro 2007	Birds
Additional Documents													
Accomack County Tidal Marsh Inventory	wetland marsh inventory	GM Silberhorn AF Harris	Inventory of marshland - assess type, dominate plants, etc in each marsh in Accomack	yes	PDF	No	Applied Marin Sciences and Ocean Engineering	VIMS College of William and Mary	1977	http://ccrm.vims.edu/publications/pubs/accomacktmi.pdf http://ccrm.vims.edu/wetlands/tidal_wetlands/tidal_marsh_inventories.html	VERY Old (1977) but does identify wetland names, location and dominate plant types	Silberhorn G M, Et Al. VIMS 1977	General - Other
INVESTIGATION OF GRASSLAND/SHRUBLAND MIGRANTS ON THE LOWER DELMARVA PENINSULA	Grassland Shrubland Bird Migrants	Barton J. Paxton, Bryan D. Watts	The objectives of this study were to investigate the use of grassland/shrubland habitats during the late period of fall migration of birds. Information gathered will be used to determine the abundance and time of movement for open-habitat migrants on the lower Delmarva Peninsula.	No	PDF	No	CCB	College of William and Mary	1999	http://ccb.wm.edu/publications/publications_technical.cfm	Paxton, B. J. and B. D. Watts. 2000. Investigation of grassland/shrubland migrants on the lower Delmarva Peninsula. Center for Conservation Biology Technical Report CCBTR-00-03, College of William and Mary: 23 pp.	Paxton B, Et Al. Grassland CCB 1999	Birds
Chesapeake Bay Trophic Interactions Laboratory Services (CTILS)	Diet of bluefish needlefish	Debra J. Parthree Christopher F. Bonzek Robert J. Latour	Goal: Provide fisheries researchers and managers with the integrated trophic interactions database that can be used to support the development of ecosystem-based fisheries stock assessment models. Working on constructing a thorough fish diet composition database encompassing an array of species, locations/habitats, seasons, and age classes throughout the Chesapeake Bay region.	No	PDF	No	Chesapeake Bay Trophic Interaction Laboratory Services	VIMS	2006 (June 2003 – June 2006)	http://www.fisheries.vims.edu/trawlsiene/Reports/CTILSFINALVMRC06.pdf	Parthree, D.J., C.F. Bonzek and R.J. Latour. 2006. Chesapeake Bay Trophic Interactions Laboratory Services, June 2003-June 2006, Project RF 05-12. Final report to Virginia Marine Resources Commission Marine Recreational Fishing Advisory Board. Virginia Institute of Marine Science, Gloucester Point, VA. 22 pp. Download PDF (563 KB).	Parthree D, Et Al. VIMS 2006	Fish
Red Knot Stopover in Virginia, Delaware, and New Jersey: Numbers, Residence	Red Knot Stopover Migrant Bird	Jonathan B. Cohen jocohen1@vt.edu	Shows that a significant portion of the red knot stopover population uses Virginia as a place to refuel before flying on to the arctic. They use the barrier islands of Virginia. Many other shorebird species use the islands and the marshes between the barrier islands and the mainland. These species include dunlin, black bellied plovers, semi-palmated sandpipers, sanderlings, whimbrel, etc. In addition to the migratory shorebird species a number of shorebirds breed on the barrier islands, including American Oystercatcher, Wilson's plover, and piping plover. The piping plover is on the federal threatened list, the Red Knot is a candidate for listing under the Endangered Species Act.	No	DOC	No	Dept. Fisheries and Wildlife Sciences	Virginia Polytechnic Institute and State University	2009			Cohen J. VT 2009	Birds
CHESAPEAKE BAY LOWLANDS ECOREGIONAL PLAN	Chesapeake Ecoregion Assessment	THE NATURE CONSERVANCY	Portfolio of 5 major types of conservation targets identified in the CBY ecoregion: 1) matrix forest blocks; 2) aquatic ecosystems; 3) "significant conservation areas" in tidal waters (for estuarine, coastal and marine targets); 4) natural communities, and; 5) species. These	No	PDF	No	THE NATURE CONSERVANCY Virginia Natural Heritage	THE NATURE CONSERVANCY	2002	http://conserveonline.org/workspaces/cbdgateway/era/reports/index_html http://conserveonline.org/coldocs/2005/03/CBYplan.pdf	This is a draft publication - it is thorough but could not get a hold of the final report	The Nature Conservancy Eco Plan 2002	General - Other
Report on Ocean Color and Carbon Study for the South Atlantic Bight and Chesapeake Bay Regions	Ocean	Sergio R. Signorini, Charles R. McClain, Antonio Mannino, and Sean Bailey	Summarizes the results of ocean color algorithms applications and analyses of biomass and carbon data sets for the South Atlantic Bight (SAB) and Chesapeake Bay regions. Algorithm testing and intercomparison for chlorophyll-a (Chl-a) and dissolved organic carbon	No	PDF	No	NASA	NASA	2005	http://www.ccpo.odu.edu/Research/US-ECoS/Signorini_TM2005-212787.pdf http://www.ccpo.odu.edu/Research/US-ECoS/publications.html		Signorini S, Et Al. NASA 2005	General - Other
Mid-Atlantic Nearshore Trawl Survey: Data collection and analysis in support of single and multispecies stock assessments and management	Fish Trawl Survey	Christopher F. Bonzek James Gartland J. David Lange Robert J. Latour, Ph.D	The main objective of the survey is the estimation of abundance, biomass, length and age structures, various other assessment related parameters and diet compositions of select finfishes inhabiting the area.	No	PDF	No	Department of Fisheries Science NORTHEAST	VIMS College of William and Mary	2008	http://www.neamap.net/ http://www.neamap.net/publications/VIMS_NEAMAPProjectReportSpring2008Survey.pdf	See data on region 11	Bonzek C, Et Al. Trawl Survey VIMS 2008	fish
IMPACT OF HURRICANE ISABEL ON BALD EAGLE NESTS AND REPRODUCTIVE PERFORMANCE IN THE LOWER CHESAPEAKE BAY	bald eagle nesting hurricane	BRYAN D. WATTS AND MITCHELL A. BYRD	We evaluated the impact of Hurricane Isabel on nest loss and reproductive performance of Bald Eagles (Haliaeetus leucocephalus) in the lower Chesapeake Bay. Approximately 40% of Bald Eagle nest trees were damaged and 127 nests were lost during the storm. Only 46% of pairs that lost nests attempted to breed the following season, compared to 85% of pairs that did not lose nests. Of the pairs that made breeding attempts, only 69% of pairs that lost nests during the hurricane produced young compared to 83% of pairs that did not lose nests. Average brood size was also reduced for pairs that lost nests. The disparity in reproductive performance between the two groups narrowed in the second breeding season after the storm. Hurricane Isabel had a significant but shortlived impact on the Bald Eagle breeding population in the lower Chesapeake Bay.	no	PDF	No	CCB	College of William and Mary	2007	BioOne (using UVA's VIRGO)	The Condor: The Cooper Ornithological Society	Watts B, Et Al. Bald Eagle CCB 2007	Birds
Differential Immersion Survival by Populations of Cicindela hirticollis (Coleoptera: Cicindelidae)	Cicindelidae, tiger beetle, anoxia, soil moisture, ßooding	MATHEW LOUIS BRUST, WILLIAM WYATT HOBACK, KERRI FARNSWORTH SKINNER, AND CHARLES BARRY KNISLEY1	Tested the ability of C. hirticollis (tiger beetle) larvae from two river and one bayshore population to survive immersion in severely hypoxic water. The larvae from the Chesapeake Bay population survived 3 d of immersion, and those from river populations survived about a day longer. Although riverine populations survive longer periods of immersion, dams cause habitats used by riverine populations of this species to be inundated for weeks at a time, far longer than larvae were able to survive under hypoxic or aerated conditions in the laboratory. Thus, alteration of ßooding regimes and subsequent larval habitat immersion is probably a major cause of the observed decline of riverine populations of C. hirticollis.	no	PDF	No	Department of Biology	University of Nebraska at Kearney	2005	BioOne (using UVA's VIRGO)	Data not specifically about Accomack. It studies tiger beetles in the Chesapeake - may be of interest given that this beetle is important for the County.	Brust M, Et Al. U Nebraska 2005	General - Other
Cyanotoxins in Tidal Waters of Chesapeake Bay	cyanobacteria blooms toxin tidal water	Peter J. Tango and Walt Butler	Cyanobacteria blooms have long been described for Chesapeake Bay nontidal and tidal waters, but measurable toxin has only been recently recorded. During September 2000, the earliest tidal-water records of cyanotoxins in the Bay identified microcystin from a Microcystis-dominated bloom on the Sassafras River. Between 2000 and 2006, opportunistic samples collected from cyanobacteria blooms were analyzed for toxin concentration to better inform natural resource, agriculture, and human-health management agencies on potential bloom-related health risks.	no	PDF	No	Maryland Department of Natural Resources	Maryland Department of Natural Resources	2008	BioOne (using UVA's VIRGO)	Data not specifically about Accomack. But may be related to the entire Bay? Journal: NORTHEASTERN NATURALIST	Tango P Et Al. MD DNR 2008	General - Other

Grasshopper (Orthoptera: Acrididae)—Plant-Environmental Interactions in Relation to Zonation on an Atlantic Coast Barrier Island	grasshoppers, Orthoptera, Acrididae, coastal vegetation, barrier island	JOHN F. BARIMO AND DONALD R. YOUNG	Distribution patterns of Þve grasshopper species (Orthoptera: Acrididae) were related to microtopography, plant zonation, and diet preference on a Virginia barrier island	no	PDF	No	Department of Biological Sciences	VCU	2002	BioOne (using UVA's VIRGO)		Barimo J, Et Al. VCU 2002	General - Other
Nest-site selection and hatching success of waterbirds in coastal Virginia: some results of habitat manipulation	American Oystercatcher, Black Skimmer, Common Tern, Gull-billed Tern, habitat manipulation, Haematopus palliatus, Rynchops niger, sea-level rise, shellpiles, Sterna hirundo, S. nilotica	R. A. Rounds, R. Michael Erwin, and John H. Porter1	Rising sea levels in the mid-Atlantic region pose a long-term threat to marshes and their avian inhabitants. The Gull-billed Tern (Sterna nilotica), Common Tern (S. hirundo), Black Skimmer (Rynchops niger), and American Oystercatcher (Haematopus palliatus), species of concern in Virginia, nest on low shelly perimeters of salt marsh islands on the Eastern Shore of Virginia. Marsh shellpiles are free of mammalian predators, but subject to frequent floods that reduce reproductive success. Examines nest-site selection, enhance habitat, and improve hatching success.	no	PDF	No	Patuxent Wildlife Research Center, Department of Environmental Sciences	USGS, UVA	2004	BioOne (using UVA's VIRGO)	Journal of Field Ornithology	Rounds R, Et Al. UVA 2004	Birds
An Overview of the Status and Distribution of Piping Plovers in Virginia	Piping Plover, Charadrius melodus,breeding population, distribution, conservation, management.	RUTH BOETTCHER TOM PENN ROBERT R. CROSS KAREN T. TERWILLIGER RUTH A. BECK	The 2003 breeding season marked the first time Piping Plover productivity approached two fledged young per pair, which was followed by another increase in 2004 when productivity rose to over two fledged young per pair. The virtual doubling of Virginia's breeding population observed in 2005 along with the recent increase in breeding success represents an important contribution to the overall security of the Atlantic Coast Piping Plover population.	no	PDF	No	DGIF, Long Island National Wildlife Refuge Complex, Terwilliger Consulting, Inc, Dept of Biology	DGIF, Long Island National Wildlife Refuge Complex, Terwilliger Consulting, Inc, College of William and Mary	2007	BioOne (using UVA's VIRGO)		pipingplover2007	Birds
Tidal influences on carbon assimilation by a salt marsh	coastal salt marshes, carbon budget, atmospheric carbon fluxes, tidal flooding, sea-level rise	James C Kathilankal, Thomas J Mozdzer, Jose D Fuentes, Paolo D'Odorico, Karen J McGlathery and Jay C Zieman	Study is the first to quantify the effects of tidal inundation on marsh plants, which caused anywhere from 3% to 91% reductions in atmospheric carbon fluxes, with a mean reduction of 46 ± 26%, when compared to non-flooded conditions.	no	PDF	No	Department of Environmental Sciences	UVA	2008	Using UVA's Virgo	Environ. Res. Lett. 3 (2008) 044010 (6pp)	Kathilankal J, Et Al. UVA 2008	General - Other
An Introduction to Mid-Atlantic Seasonal Pools	seasonal pools	Lesley J. Brown, Robin E. Jung	This publication serves as an introduction to seasonal pool ecology and management in the mid-Atlantic; it also provides tools for exploring seasonal pools, including a full-color field guide to wildlife. Information about species that use seasonal pools.	no	PDF	No	USGS Patuxent Wildlife Research Center	USGS	2005	EPA (Using UVA's Virgo)		Brown L, Et Al. USGS 2005	General - Other
Diet of autumn migration Northern Saw-whet Owls on the Eastern Shore of Virginia	Northern Saw-whet Owl, Aegolius acadicus, diet, migration, pellet analysis, stomach-content analysis	D.M. Whalen, B. D. Watts, and D. W. Johnston	The objectives of our study were to determine the diet of autumn migrating saw-whet owls, compare these results with data available from previous diet studies, and compare results obtained from pellet versus stomach-content analyses.	no	PDF	No	CCB	College of William and Mary	2000	Using UVA's Virgo		Whalen D, Et Al. Owls CCB 2000	Birds
Ghost crab preys on Piping Plover eggs	ghost crab, piping plover	B. D. Watts and D. S. Bradshaw	Piping Plover populations have been declining due to modification of nesting habitat, human disturbance on the few remaining nesting grounds, and an apparent rise in nest predation (Haig 1992, Haig and Plissner 1993). Currently, Piping Plover populations in Canada and in the U.S. Great Lakes region are considered endangered (Haig 1985) and populations on the Atlantic Coast and Great Plains are considered threatened (U.S. Fish and Wildlife Service 1985, Haig 1985). For this reason, identification of factors causing nest failure are of interest.	no	PDF	No	CCB	College of William and Mary	1995	Using UVA's Virgo		Watts B, Et Al. Crab Plover CCB 1995	Shellfish
Magnitude and timing of the fall migration of Northern Saw-whet Owls through the Eastern Shore of Virginia	migration, northern saw-whet owls	D.M. Whalen, B. D. Watts, M. D. Wilson, and D. S. Bradshaw	Each autumn, migrating passerines, shorebirds, and diurnal raptors are concentrated on the lower Delmarva Peninsula. It seems likely that the peninsula should also function as a migration bottleneck for Saw-whet Owls reluctant to cross the Chesapeake Bay. The objectives of this study are to determine the magnitude and seasonal timing of the autumn migration of the species on the peninsula and to identify differences in the timing of migration between age classes.	no	PDF	No	CCB	College of William and Mary	1997	The Raven		Whalen D, Et Al. Owls CCB 1997	Birds
Annual Migration Density and Stopover Patterns of Northern Saw-whet Owls	migration, northern saw-whet owls	D.M. Whalen, B. D. Watts	in annual number of individuals migrating in eastern United States. Underlying large differences in the magnitude of the migration may be important density dependent effects on body condition and stopover patterns.	no	PDF	No	CCB	College of William and Mary	2002	The Raven		Whalen D, Et Al. Owls CCB 2002	Birds
Baywide and Coordinated Chesapeake Fish Stock Monitoring	fish stock monitoring	Bonzek, C., E. Houde, S. Giordano, R. Latour, T. Miller, and K.G. Sellner	In March 2006, the Chesapeake Research Consortium (CRC) and the NOAA Chesapeake Bay Office (NCBO) convened a workshop to review the existing fishery-independent surveys in Chesapeake Bay and to recommend how best to ensure that Fishery-Independent surveys in Chesapeake Bay support management requirements. Specifically, the workshop identified needs for additional surveys, modifications of ongoing surveys, and the institutions or infrastructure required to support and coordinate such surveys. The workshop brought together approximately 50 fishery managers and scientists from the Chesapeake Bay region along with five invited external experts. The participants developed four broad consensus recommendations as a foundation for a baywide, integrated fish stock monitoring program.	yes	PDF	No	NOAA Chesapeake Bay Office	NOAA	2007	http://noaa.chesapeakebay.net/docs/FishStockMonitoringReport06.pdf		Bonzek C, Et AL. NOAA 2007	fish
U. S. House of Representatives Committee on Resources Subcommittee on Fisheries Conservation, Wildlife and Oceans Oversight Hearings on the Efforts to Introduce Non-Native Oyster Species to the Chesapeake Bay	non-native oyster species, Chesapeake Bay	James A. Wesson	A testimony by Dr. Jim Wesson from VMRC's Conservation and Replenishment Department to Congress regarding ariakensis	yes	PDF	No	Virginia Seafood	The Virginia Marine Resources Commission	2003	http://www.mrc.state.va.us/ariakensis/ariakensis_testimony_10-14-03.pdf		Wesson J. VMRC 2003	Shellfish
NEAMAP Near Shore Trawl Survey	peer review of NEAMAP trawl surveys	Christopher F. Bonzek, James Gartland, RaeMarie A. Johnson, J. David Lange, Jr.	Provides further information about the trawl surveys discussed in the Mid-Atlantic Nearshore Trawl Program		PDF	No	NEAMAP	VIMS - Multispecies Research	2008	http://www.fisheries.vims.edu/multispecies/whatisneamap.htm	Follow the link to http://www.neamap.net/ after clicking on the Contact Information link	Bonzek C, Et Al. NEAMAP VIMS 2008	Fish

Terms of Reference & Advisory Report of the NEAMAP Nearshore Trawl Survey Peer Review	Review panel suggestions for NEAMAP trawl surveys	Ghislain Chouinard, David Beutel, Mark Wilkins	On December 10-11, 2008, a peer review of the NEAMAP Nearshore Trawl Survey was conducted in Virginia Beach, Virginia. The main objective of this survey was established in a Memorandum of Understanding (MOU) between the various states, fisheries management councils, and relevant federal organizations in the area.		PDF	No	NEAMAP	VIMS - Multispecies Research	2009	http://www.fisheries.vims.edu/multispecies/whatisneamap.htm	Follow the link to http://www.neamap.net/ after clicking on the Contact Information link	Chouinard G, Et Al. NEAMAP VIMS 2009	Fish
MYCOBACTERIOSIS-ASSOCIATED MORTALITY IN WILD STRIPED BASS (MORONE SAXATILIS) FROM CHESAPEAKE BAY, USA	disease-associated mortality, force-of-infection, Morone saxatilis;, mycobacteriosis, striped bass	D. T. Gauthier, R. J. Latour, D. M. Heisey, C. F. Bonzek, J. Gartland, E. J. Burge, and W. K. Vogelbein	The striped bass (*Morone saxatilis*) is an economically and ecologically important finfish species along the Atlantic seaboard of the United States. Recent stock assessments in Chesapeake Bay (USA) indicate that non-fishing mortality in striped bass has increased since 1999, concomitant with very high (>50%) prevalence of visceral and dermal disease caused by *Mycobacterium* spp. Current fishery assessment models do not differentiate between disease and other components of non-fishing mortality (e.g., senescence, predation); therefore, disease impact on the striped bass population has not been established. Specific measurement of mortality associated with mycobacteriosis in wild striped bass is complicated because the disease is chronic and mortality is cryptic. Epidemiological models have been developed to estimate disease-associated mortality from cross-sectional prevalence data and have recently been generalized to represent disease processes more realistically. Here, we used this generalized approach to demonstrate disease-associated mortality in striped bass from Chesapeake Bay. To our knowledge this is the first demonstration of cryptic mortality associated with a chronic infectious disease in a wild	no	PDF	No	Ecological Applications	Ecological Society of America	2008	ESA Online Journals (Using UVA's Virgo)		Gauthier D, Et Al. ESA 2008	Fish
The trophic dynamics of summer flounder (Paralichthys dentatus) in Chesapeake Bay.	Chesapeake Bay, Summer flounder, diet	Latour, R.J., J. Gartland, C.F. Bonzek, and R.A. Johnson	Data on the trophic dynamics of fishes are needed for management of ecosystems such as Chesapeake Bay. Summer flounder (*Paralichthys dentatus*) are an abundant seasonal resident of the bay and have the potential to impact foodweb dynamics. Analyses of diet data for late juvenile and adult summer flounder collected from 2002–2006 in Chesapeake Bay were conducted to characterize the role of this flatfish in this estuary and to contribute to our understanding of summer flounder trophic dynamics throughout its range. Despite the diversity of prey, nearly half of the diet comprised mysid shrimp (*Neomysis* spp.) and bay anchovy (*Anchoa mitchilli*). Ontogenetic differences in diet and an increase in diet diversity with increasing fish size were documented. Temporal (inter- and intra-annual) changes were also detected, as well as trends in diet reflecting peaks in abundance and diversity of prey. The preponderance of fishes in the diet of summer flounder indicates that this species is an important piscivorous predator in Chesapeake Bay.		PDF	No	VIMS	VIMS College of William and Mary	2008	http://www.vims.edu/people/latour_rj/pubs/rjl_Latour_et_al_2008.pdf		Latour R, Et Al. VIMS 2008	Fish
Temporal Changes of Populations and Trophic Relationships of Wintering Diving Ducks in Chesapeake Bay	Diving ducks, seaducks, bay ducks, SAV, food habits, trophic relationships	MATTHEW C. PERRY ALICIA M. WELLS BERLIN DAVID M. KIDWELL PETER C. O SENTON	Population and trophic relationships among diving ducks in Chesapeake Bay are diverse and complex as they include five species of bay ducks (Aythya spp.), nine species of seaducks (Tribe Mergini), and the Ruddy Duck (Oxyura jamaicensis). Here we considered the relationships between population changes and diet over the past half century to assess the importance of prey changes to wintering waterfowl in the Bay	no	PDF	No	Patuxent Wildlife Research Center	USGS	2007	BioOne (using UVA's VIRGO)	Data not specifically about Accomack. But may be important to the entire Bay.	Perry M, Et Al. Patuxent WRC 2007	Birds
Finfish-Waterbird Trophic Interactions in Tidal Freshwater Tributaries of the Chesapeake Bay	fresh tidal river, Bald Eagle, Osprey, fish-bird interactions, American Shad, Atlantic Menhaden, catfishes	CATHERINE B. VIVERETTE G REG C. GARMAN STEPHEN P. MCININCH A. CATHERINE MARKHAM BRYAN D. WATTS STEPHEN A. MACKO	Avian population growth is not uniform throughout the Chesapeake Bay watershed; several species including Bald Eagles (Haliaeetus leucocephalus) and Ospreys (Pandion haliaetus) experienced significantly greater population growth rates in riverine tidal freshwater and oligohaline regions than in higher salinity portions of the bay.	no	PDF	No	Center for Environmental Studies, CCB, Department of Environmental Sciences	VCU, W&M, UVA	2007	BioOne (using UVA's VIRGO)		Viverette C, Et Al. 2007	Fish
Comparison of Gaps and Intact Shrub Thickets on an Atlantic Coast Barrier Island	intact shrubs barrier islands	EDWARD R. CRAWFORD AND DONALD R. YOUNG1	Shrub thicket (Myrica cerifera) gaps were sampled on a Virginia barrier island to elucidate successional mechanisms in the development of maritime forests. Microclimate, edaphic characteristics and spatial heterogeneity within gaps, as well as within intact thicket understories, were compared for young and aging thickets. Species richness was 2.5 to 3.7 times greater within gaps than in intact thicket understories, with highest richness within aging thicket gaps. Relative to intact shrub thickets, gaps enhance environmental variability through greater structural diversity. Gaps may facilitate the establishment of later seral species.	no	PDF	No	Department of Biological Sciences	VCU	1998	BioOne (using UVA's VIRGO)	old	Crawford E, Et Al. VCU 1998	General - Other
Gull predation limits nesting success of terns and skimmers on the Virginia barrier islands	gulls, nest success, predation, skimmers, terns, Virginia barrier islands	Timothy J. O'Connell1 and Ruth A. Beck	We studied seven mixed-species colonies of terns and skimmers on the Virginia barrier islands in 1990 and 1991 to determine the effect of gull predation on nesting success. Overall levels of gull predation were similar between gull-present and gull-absent colonies, likely due to the added impact of aerially foraging Laughing Gulls. Anecdotal evidence suggests that nest site competition with Herring and Great Black-backed gulls may have led to many terns and skimmers nesting in areas that were prone to frequent tidal flooding. In addition, floods may have indirectly prevented terns and skimmers from adequately protecting their surviving eggs and young, thus rendering flooded colonies more susceptible to gull predation.	no	PDF	No	Department of Biology	College of William and Mary	2003	BioOne (using UVA's VIRGO)	old, but conclusion may be of interest	OConnell T, Et Al. CWM 2003	Birds
Ospreys of the Chesapeake Bay: Population Recovery, Ecological Requirements, and Current Threats	Osprey, Chesapeake Bay, breeding population, reproductive rates, recovery, threats, nesting substrates.	BRYAN D. WATTS BARTON J. PAXTON	The Chesapeake Bay supports the largest Osprey (Pandion haliaetus) breeding population in the world. Since WW2 osprey recovery has been exponential but spatially variable with average doubling times for defined geographic areas varying by more than an order of magnitude. Rates of population growth have been negatively related to salinity with the highest rates occurring within tidal fresh reaches suggesting that recovery has progressed from the main stem of the Bay toward the fall line.	no	PDF	No	CCB	College of William and Mary	2007	BioOne (using UVA's VIRGO)		Watts B, Et Al. Osprey CCB 2007	Birds

Chesapeake Bay Breeding Waterfowl Populations	waterfowl, breeding populations, ducks, geese, swans	GARY R. COSTANZO LARRY J. HINDMAN	This paper presents information on the most common species of waterfowl that breed in the Chesapeake Bay including Mallard (Anas platyrhynchos), Wood Duck (Aix sponsa), American Black Duck (Anas rubripes), Canada Goose (Branta canadensis), and Mute Swan (Cygnus olor). Long-term (40 years) and short-term (13 years) trends in breeding populations were evaluated using the North American Breeding Bird Survey and the Atlantic Flyway Breeding Waterfowl Survey. Species that have adapted to landscape-level and local habitat changes in the past 40 years have expanded, especially Mute Swans, Canada Geese, and Mallards, while species that are less tolerant of these changes such as American Black Ducks have declined. Wood Ducks may be showing some recent declines in the Bay region, even though the Atlantic Flyway population is increasing. Losses of forested wetland habitats around the Bay may account for some of this decline.	no	PDF	No	DGIF, Maryland Dept of Natural Resources	DGIF, Maryland Dept of Natural Resources	2007	BioOne (using UVA's VIRGO)		Costanzo G, Et Al. DGIF 2007	Birds
Habitat Preference and the Effects of Beach Nourishment on the Federally Threatened Northeastern Beach Tiger Beetle, Cicindela dorsalis dorsalis: Western Shore, Chesapeake Bay, Virginia	Beach habitat, tiger beetle, beach nourishment, compaction, grain size distribution.	Michael S. Fenster, C. Barry Knisley, and Christopher T. Reed	This study examines the habitat preference of the US federally threatened northeastern beach tiger beetle, Cicindela dorsalis dorsalis, and the effect of beach nourishment on existing habitats along two western Chesapeake Bay beaches.	no	PDF	No	Environmental Studies Program	Randolph-Macon College	2006	BioOne (using UVA's VIRGO)	Data not specifically about Accomack. It studies tiger beetles in the Chesapeake - may be of interest given that this beetle is important for the County.	Fenster M, Et AL. RMC 2006	General - Other
Effect of Temperature and Salinity on Growth Performance in Anadromous (Chesapeake Bay) and Nonanadromous (Santee-Cooper) Strains of Striped Bass Morone saxatilis	Striped Bass Morone saxatilis salinity temperature habitat	DAVID H. SECOR, TROY E. GUNDERSON, AND K. KARLSSON	During the first year of life of Striped Bass Morone saxatilis, the effect of estuarine habitat use on growth rate is poorly understood. In a split-plot experiment, growth and feeding rates were compared between anadromous (Chesapeake Bay) and nonanadromous (Santee-Cooper) broods of juvenile striped bass (45–90 days posthatch) exposed to a range of salinity levels (0.5, 7, and 15 ppt) and temperatures (20, 24, and 28 C). At 28 C, which best simulated the summertime conditions of young juveniles, Chesapeake Bay fish showed highest growth performance. For this temperature and strain, growth was approximately 40% higher at 7 ppt than at 0.5 or 15 ppt. Santee-Cooper juveniles showed no response to salinity. Over combined temperature and salinity levels, Chesapeake Bay juveniles experienced 22% higher growth rates than did Santee-Cooper juveniles, supporting a proposal that early growth rates are inversely related to latitude. Because salinity had a strong effect on Chesapeake Bay striped bass growth rate, we also conclude that variation in distribution patterns within and among estuaries can substantially modify the expected latitudinal gradient in growth rate.	no	PDF	No	n/a	n/a	2000	BioOne (using UVA's VIRGO)	COPEIA, 2000, NO. 1	Secor D, Et Al. 2000	Fish
Long-Term Effects of Nitrogen Fertilization on Plant Community Structure on a Coastal Barrier Island Dune Chronosequence	Ammophila breviligulata, free surfaces, Spartina patens.	Frank P. Day, Christine Conn, Edward Crawford, and Mark Stevenson	Nitrogen limitation typically has considerable influence on plant community composition and structure on coastal barrier island dune ecosystems. The purpose of this study was to quantify plant community responses of different age dunes on a coastal barrier island in Virginia, USA to nitrogen addition. We hypothesized that nitrogen addition would increase density and cover, but with differential effects among species as a result of increased interspecific competition, and decrease species diversity. The increase in total density with fertilization as diversity decreased, coupled with the shifting composition of Ammophila and other dominants, appears to support the interspecific competitive exclusion hypothesis. Changes in the positions of free surfaces (groundwater level in particular) appear to influence plant community composition. The decline in Spartina density may be at least partially attributed to development of drier conditions on the older dunes.	no	PDF	No	Department of Biological Sciences	Old Dominion University	2004	BioOne (using UVA's VIRGO)	Data not specifically about Accomack - it is focused on Hog Island. But may be important to the entire Bay. DAY, F.P.; CONN, C.; CRAWFORD, E., and STEVENSON, M., 2004. Long-term effects of nitrogen fertilization on plant community structure on a coastal barrier island dune chronosequence. Journal of Coastal Research, 20(3), 722–730. West Palm Beach (Florida), ISSN 0749-0208.	Day F, Et Al. ODU 2004	Plants
The 30th Annual Beach Nesting and Colonial Waterbirds Survey of the Virginia Barrier Islands 2004	Beach Nesting Colonial Waterbirds	BILL WILLIAMS Bill Akers, Michael Beck, Ruth Beck, Jerry Via	Survey of Beach Nesting and Colonial Waterbirds on the Virginia Barrier Islands	No	PDF	No	CCB	College of William and Mary, Virginia Tech	2004			Williams B, Et Al. CCB 2004	Birds

Attachment D – Stakeholder Interviews Summary

Accomack County Interviews (August 18-22, 2009)

Overall Summary

Staff interviewed all members of the board of supervisors, the VA Dept. of Fish and Game, the DCR Natural Heritage staff, VA Dept, of Forestry, the Nature Conservancy and Citizens for a Better Eastern Shore. The contents of these interviews are confidential; however this summary provides an overview of key points raised by respondents.

The Board of Supervisors is interested in the project and appreciates that staff have no preconceived agenda for the project's outcome other than to determine the county's most important land and water assets. There are some concerns that our recommendations need to be realistic in line with Accomack's low budget. According to the USDA Accomack County is the second poorest county in the state of Virginia with their 2007 per capita income at $21,084. Taxes are low and as a result, infrastructure and services such as fire, trash, sewage, school system and health services may not always keep up with community demands. The community is losing young people and becoming more saturated with retirees and second home vacationers.

Many interviewees noted that the county is suffering from a lack of major employers except for those at Wallops Island including NASA. The northeastern area of the county will grow the most as the government facilities and resultant consulting firms expand. The county faces a challenge as to whether those who work in the county will choose to live there or commute in from Maryland. The schools appear to be the limiting factor in attracting more residents to choose to reside in northern Accomack.

Most of the supervisors are interested in encouraging development and economic growth as long as it does not destroy the rural character of the county. Many are against coastal development and prefer infill or development near existing towns. Some supervisors felt that land use taxation is being misused because land platted with subdivisions is still getting low tax rates.

Most of the board members are concerned about water quality and protecting the environment. Several mentioned they were interested in low impact development. Several also specifically mentioned the importance of Holden, Pitts, and Bullbeggar Creeks. There is a disagreement in the board about the validity of climate change. The board is also divided about whether the county should have a Public Service Authority to manage their wastewater.

Asset Mapping Implications

Sea level rise should be acknowledged as a future concern but should not be highlighted as the central or first concern (because of the potential to cause unnecessary conflict within the county).

Infill development and growth adjacent to towns are supported by most supervisors, so showing farmland and coastal areas as conservation priorities would likely be supported.

Development in the northeast seems extremely probable, so those cores are not likely to remain (especially the general core within Captain's Cove).

While coastal areas may seem attractive to development, some areas such as Saxis are very unlikely to have development threats as they are experiencing sea level rise.

Regarding risk assessment for threats: Closed shellfish beds may not necessarily be polluted since some are closed due to proximity of a permitted sewage discharge pipe (and there exists the potential for closure). Therefore, these beds are still at risk but we should be careful in not characterizing them as polluted beds per se just because they are closed.

There is concern that some tomato fields (industrial scale agriculture using plastic field covers) are polluting the water and land. We need to ask the extension agent if this is indeed a major problem.

Accomack's comprehensive plan analysis was based on soil suitability for development; however, mounded septic systems have been used to build in areas where the soil does not support them. We were told by Don Hart (current state chair of VACo) that these mounded systems are beginning to fail and are not viable. Staff review of studies conducted in the midwest show these systems to perform well when properly installed and maintained. However, staff need to follow up with Don Hart to learn where and why they are failing in Virginia. This is relevant to our analysis of where growth could occur.

Land on the bayside is generally lower than on the seaside. Bayside land is more poorly drained, marshy and forested due to wet soils. Most development pressure is on the seaside. Large intact forests on the bayside may be easier to conserve because it is difficult to drain and farm them. It may be more controversial to recommend saving well-drained land on the seaside with good forested cores since that land is generally better suited for development.

Recreation was primarily related to water sports. Some supervisors felt there was plenty of access while others wanted better upkeep of existing access and possibly additional sites. None of the interviewees mentioned the importance of trails.