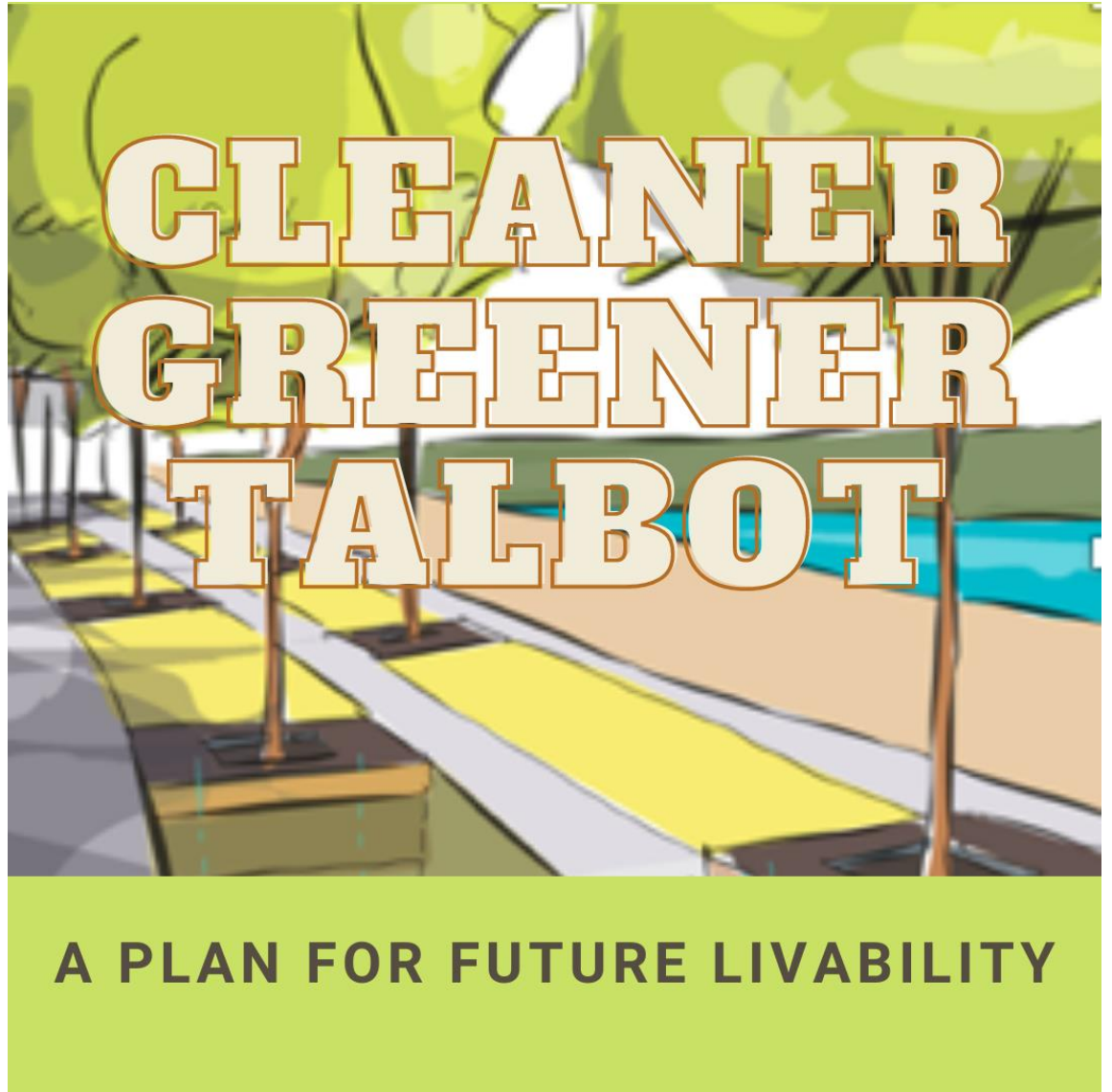


MAY 2021



DEPARTMENT OF PLANNING AND ZONING
TALBOT COUNTY, MD

Cleaner, Greener Talbot: A Plan for Future Livability

Acknowledgement

This *Cleaner, Greener Talbot: A Plan for Future Livability* was prepared by Talbot County Department of Planning and Zoning using Federal funds under award number NA 19NOS4190163 from NOAA, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.

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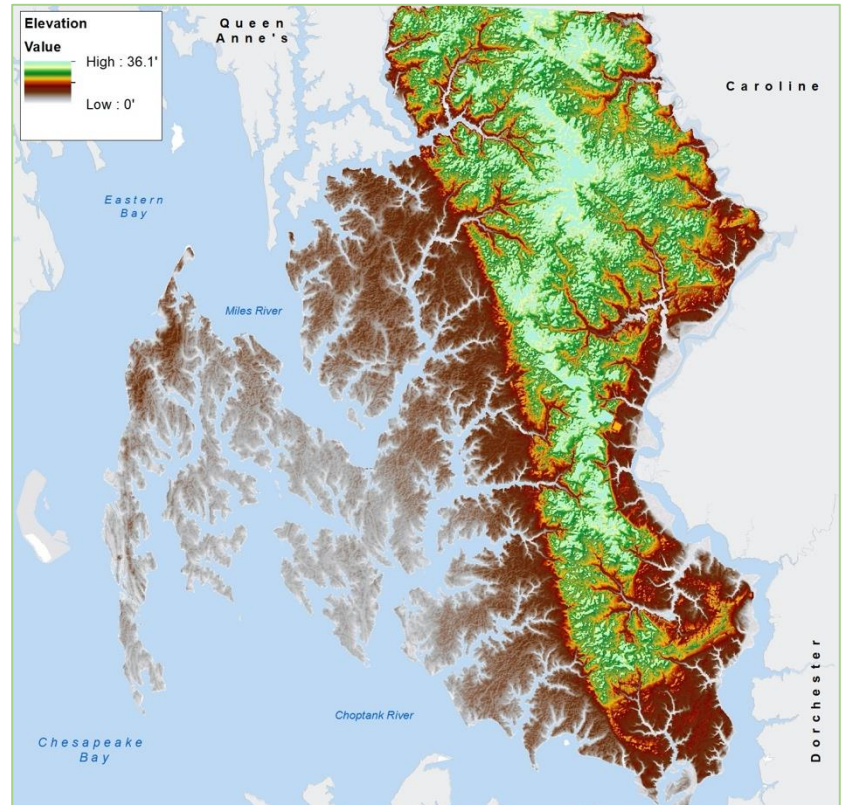
PLANNING AREA

Talbot County lies to the east of Chesapeake Bay and forms a part of what is known as the "Eastern Shore" of Maryland. Talbot County lies entirely within the Atlantic Coastal Plain and its physical features are characteristic of that physiographic province. It is almost entirely surrounded by tidewater estuaries and bays, many of which extend into the county for many miles. The greatest elevations in the county are little more than 70 feet above sea level while almost one-half the county is less than 25 feet above sea level. Talbot County has drawn many people to its borders during the summer season and many summer homes and lodging establishments accommodate those who delight in boating, sunbathing, and fishing. Oxford, St. Michaels, Trappe, and Tilghman are important towns, and small villages are plentifully distributed throughout the county.

Topography

The most prominent features of the topography of Talbot County are the numerous tidewater bays, creeks, and rivers that indent its shores and extend in some cases many miles inland. If all the inlets were to be measured it would be found that the county has close to 600 miles of tidal shoreline. Land bordering bodies of tidewater is low and flat for many miles as most of the county lies only a few feet above the Bay. Hills are practically absent except along the head waters of Talbot's estuaries. In the lower-lying portions of the county one can scarcely observe any irregularities and even in the higher portions of the county the land is level and featureless over large areas.

Talbot County exhibits three distinct topographic features. These vary greatly in the amount of the surface which they occupy and in their physical characteristics, but the principal distinction is that they are found at different elevations.



1. Tidal marshes are commonly at the heads of the estuaries or at the mouths of tributary streams. Tidal marshes are especially prominent along the Choptank River and present along the Bay shore. Such examples may be seen on Tilghman Island and near the Village of Sherwood. Tidal marshes contain an abundant growth of sedges and other marsh plants which aid in serving as obstructions to retain sediment transported by streams.
2. The Talbot plain borders the tidal marshes and extends from sea level to an altitude of about 45 feet. It is found throughout the county along the larger streams and also along the Bay shore. It is most extensively developed in the western part of the county and extends in the form of a continuous plain as far east as Easton. It also is present as a narrow band along both the Choptank River and Tuckahoe Creek as far north as Queen Anne although it is interrupted at several points where the river has cut back to the higher lying plain. Originally the Talbot plain sloped down gently to the water but wave action and increases in sea levels have worn away and exposed most of the lowest-lying portions of the plain. This wearing action generated by waves is almost continuous even with only a moderate breeze. The water near the shore is murky due to the many fine particulates washed from the land and held in

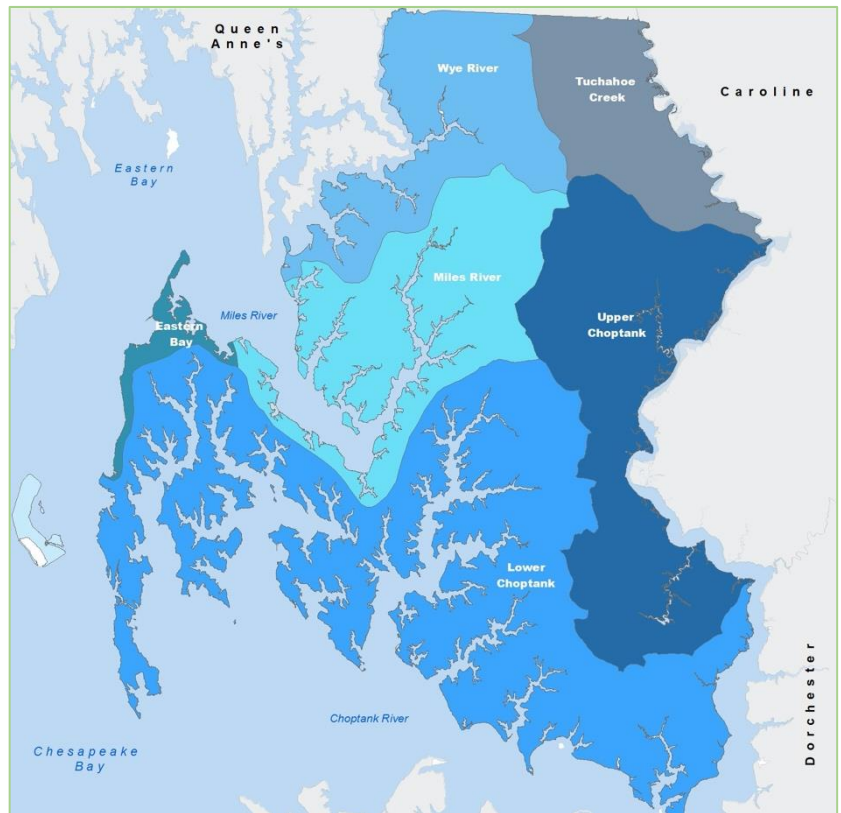
suspension in the water. As a result, the shores are being continuously eroded and the transported materials are dropped in the wide estuaries.

3. The Wicomico plain lies at a higher level than the Talbot plain, from which it is in many places separated by an escarpment that gradually transitions to the Talbot plain. In Talbot County the escarpment has a due north and south course extending from near Wye Mills to a short distance south of Trappe. The escarpment is most pronounced a short distance southwest of Longwoods, between Longwoods and Easton, and near Hambleton. The escarpment rises gently from south to north and is widest in the northern part of the county where it covers almost the entire area between Wye River and Tuckahoe Creek.

Drainage

Land areas, with the exception of developed parcels, are naturally drained. In some places the land has no visible drainage, as in the low-lying areas adjacent to bays and estuaries. Rainwater in these areas escapes by underground drainage. The large proportion of sand in the geological formations of the county especially favor such drainage.

The lower courses of almost all the larger streams emptying into Chesapeake Bay have been converted into estuaries through a submergence; permitting tidewater to pass up the former valleys of the streams. In the early development of the county these estuaries were of great value since they were navigable several miles from their mouths and thus afforded means of rapid and cheap transportation of the products of the region to market. Because of these estuaries the Chesapeake Bay region was settled long before the other portions of the state. The water in the main channel of Chesapeake Bay along Talbot County varies in depth from 6 to 50 feet. In the Choptank River, as far up as Kingston Landing, the water is 1 to 25 feet in depth. The water in the estuaries is brackish in the lower portions but almost fresh near the head of tidewater in all cases where there are incoming fresh-water streams. There is seldom any distinct current in the estuaries except for that due to the incoming and outgoing tides, and this appears to be nearly as strong when moving upstream as when moving in the opposite direction.



Soils

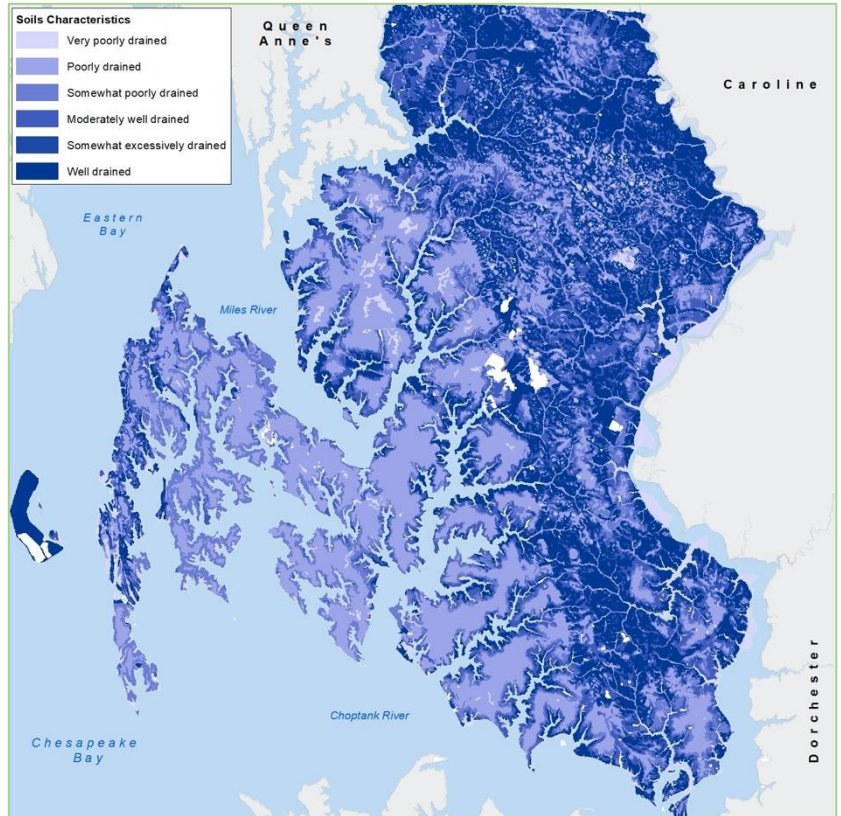
The chief soil-forming materials of both the Wicomico and Talbot formations are sand and silt, the latter being made up of soil grains ranging in sizes between very fine sand and clay. The former is the dominant constituent of all the soils of the northeastern part of Talbot County. Silt is the most prominent constituent in the soils of many areas, especially the flat stretches, in the uplands west of the Choptank River. The underlying or substratum materials usually consist of sand or sand and gravel that is coarser than the constituents of the overlying mass. Below a depth of about 3 or 4 feet, such beds of coarse material frequently alternate or are interstratified with beds of silty clay, sand, and coarse gravel. In some sectional exposures there are exhibited

alternating strata of various thicknesses that range from thin seams to 2 or more feet, presenting great variety in texture and color.

There is very little silt in the deep sand deposits that occur along the east banks of the rivers and larger creeks, but as the distance from the streams increase, the silt content of the soils increases. Erosion, weathering, and drainage have been the dominant factors in the modification of the original material.

Forests

Talbot County lies midway between the typical hardwood forests of the northern Eastern Shore of Maryland and the prevailing pine of the southern Eastern Shore section. In consequence there is a predominance of hardwoods in the northern part of the county, and a predominance of pine in the southern part, with all gradations of mixture of the two. Considered as a whole 19 percent of Talbot County is in pure hardwoods, 26 percent in pine, and 55 percent in mixed hardwood and pine.



On the higher, better drained soils, pure stands of pine occur. There are two species of pine: spruce pine (*Pinus virginiana*), which occurs sparingly in the eastern and southeastern sections of the county, and the loblolly pine (*Pinus taeda*), which is the predominant tree throughout the county. The spruce pine occupies the higher, dryer, and poorer type soils, while the loblolly pine is found in the moister but better types of the lighter soils.



Conservation area in Oxford.

Forested areas and natural stream corridors provide critical water quality and habitat functions, which are important elements of green infrastructure planning.

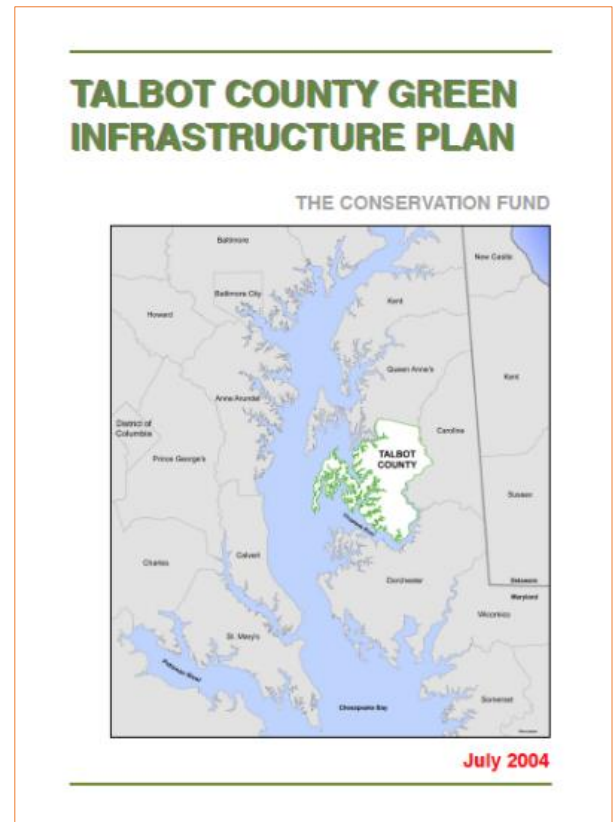
Source: American Planning Association, PAS Quick Notes No.27

PURPOSE & BACKGROUND

Cleaner, Greener Talbot: A Plan for Future Livability is an update of the County's 2004 Green Infrastructure Plan. The new plan provides the County with a modern methodology for prioritizing its land according to resource value and a tool that will enable County leaders to make informed conservation and land-use decisions.

Talbot County has long been a proponent of green infrastructure planning for many years. Green infrastructure (GI) planning began as far back as 2002. The initial GI plan was prepared by The Conservation Fund - Center for Conservation and Development starting in 2002 and completed in July of 2004. The 2004 Green Infrastructure Plan focused on the protection of the County's valuable ecological, agricultural, and aquatic resources. The Plan consisted of two basic parts: Resource Evaluation and Implementation Strategies.

As part of the 2020-2021 plan development process, a modern resource evaluation was undertaken using the ESRI Green Infrastructure Center Model. Utilizing this computer modeling coupled with local data provided area specific results. The model maps and assesses patches of habitats in terms of their viability and quality. This updated modeling of green infrastructure is a tool for stakeholders and decision-makers alike to identify opportunities, potential conflicts, and impacts of those land-use policies and decisions on the community and the environment.



What is Green Infrastructure?

The science of green infrastructure provides a model for sustainable growth and conservation, such as:

- **Protection of the Environment:** Green infrastructure protects the health and diversity of wildlife and maintains natural systems that deliver critical, life-sustaining services.
- **Contributing to a thriving economy:** Green infrastructure benefits property values, lowers health care costs, boosts tourism, and helps communities make smarter investments in grey infrastructure.
- **An enhanced quality of life:** Green infrastructure ensures people can connect with nature; have access to clean air and water; and live healthier, happier lives.

Source: Green Infrastructure: Map and Plan the Natural World with GIS, 2019

PLAN UPDATE PROCESS

Green infrastructure encompasses natural assets that form a system of interconnected ecological activities that protect native species and habitats while providing the community with clean air and water along with significant economic benefits. Therefore, green infrastructure planning assists decision makers and the public to collaborate on preserving and linking natural assets, such as open spaces, wildlife habitats, and other natural areas that improve and support the community’s quality of life and economy.

Green infrastructure (GI) planning is a six-step process for developing GI maps and strategies. These steps assist with identifying, assessing, evaluating, and prioritizing GI assets. The steps include:

1. Setting goals
2. Reviewing data
3. Making asset maps
4. Assessing risks
5. Determining opportunities
6. Implementing a plan

Talbot County began the six-step process by first forming a stakeholder group, including a Core Planning Team. The GI Stakeholders included representatives from various County and municipal government sectors as well as other stakeholders identified by the County. The primary expectation for the group was to provide different perspectives for creating effective solutions. Additional stakeholder expectations included:

- participation in stakeholder meetings;
- review of data and plan material; and,
- represent agency and/or organization and share results of the plan.



The first meeting of the **Stakeholder Group** was held in-person on March 10, 2020 with participants from various departments, agencies, and organizations. A guest speaker was invited to the meeting to provide a local perspective on GI planning. Bryan Lighthner, Cecil County, Maryland, Zoning Administrator, shared insights from Cecil County’s experience. Two breakout sessions were conducted during the meeting at which time **Goals, Opportunities, and Challenges** were identified and discussed. The plan development schedule was reviewed and adjusted based on stakeholder feedback.

Additional information and materials pertaining to the planning process was shared with meeting participants:

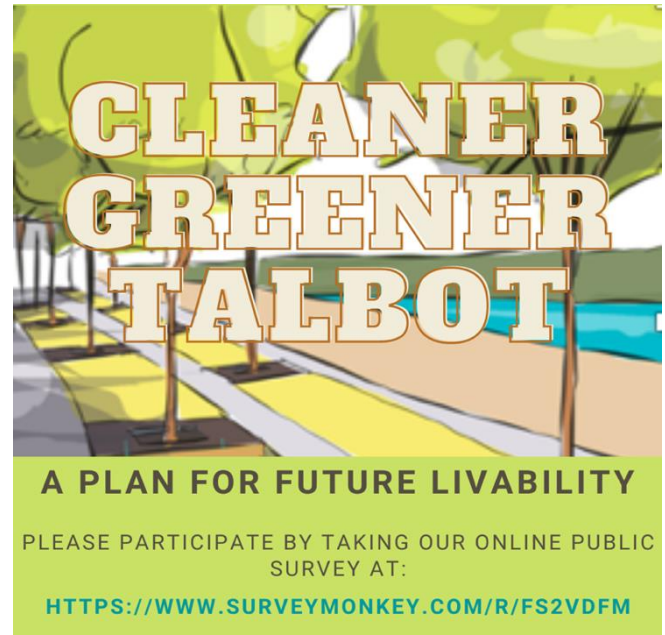
- Review of plans, programs, & policies for application & integration
- Compilation of resources and recommendations for green infrastructure site analysis
 - Assessment and Solution Based GI Strategy
- Promotional outreach package
 - Survey and Educational Handout
 - Community GI Program Implementation Guide
- Development of green infrastructure atlas
 - Additional Climate Resilience Layer
 - GI project locator
- Preliminary design of green infrastructure facilities
 - Location Parameters
 - Capture Rates
 - Code Compliance

● Deliverables – website / final draft green infrastructure plan

Further input was sought following the initial stakeholder group meeting. Both a stakeholder online survey targeted at members of the stakeholder group and a public online survey were developed to safely obtain input during the COVID-19 pandemic. Both online surveys were posted on the county website and on social media. Press releases pertaining to the plan and online public survey were issued and published in the Star Democrat Newspaper. The online surveys were live for six months during the plan development process.

Public & Stakeholder Survey

- Icon Branding for Cleaner, Greener Talbot was used for all outreach efforts.
- Two separate surveys were issued to Stakeholders and General Public:
 - **Stakeholder-** targeted distribution to identified stakeholder group members.
<https://www.surveymonkey.com/r/LH9D8PZ>
 - **General Public-** circulated public survey on social media and web links.
<https://www.surveymonkey.com/r/FS2VDFM>



What is Green Infrastructure

Green infrastructure is an approach to managing stormwater through a variety of landscaping practices that can be applied to neighborhoods and buildings to reduce stormwater flowing into sewer systems, streams, rivers, and the Bay. Green infrastructure provides a cost-effective approach to managing stormwater that simultaneously improves quality of life and provides many community benefits. While traditional gray stormwater infrastructure – conventional piped drainage and water treatment systems – are designed to transport stormwater to be treated and stored at another location, green infrastructure is designed to retain and treat stormwater where it falls.

At the watershed scale, green infrastructure is a network of natural areas and techniques that enhances flood protection and provides habitat, and cleaner air and water. At the neighborhood scale, stormwater management systems that mimic nature soak up and store water within a small-scale environment, filtering out contaminants as the water is absorbed by the ground.

Examples of green infrastructure that could be installed at the neighborhood level or on a homeowner's property are detailed in this document followed with an incentive program survey.



Cleaner, Greener Talbot: 
A Plan for Future Livability

Benefits of Green Infrastructure

Environmental Benefits

- Recharges and improves quality of ground and surface waters
- Provides natural stormwater management
- Improves energy efficiency
- Reduces urban heat island effect
- Improves aquatic and wildlife habitat

Social Benefits

- Improves aesthetics and livability of urban communities
- Increases recreational opportunities
- Improves water and air quality
- Fosters environmental education opportunities

Economic Benefits

- Reduces existing and potential future costs of gray infrastructure
- Increases property values
- Reduces energy consumption costs

Example of **Public Outreach** materials developed for this planning project- Green Infrastructure Fact Sheet. Refer to Appendix C for full version of the Green Infrastructure Fact Sheet.

Additional Stakeholder and Core Planning Team meetings were held virtually:

- **March 3, 2020 - Planning for Stakeholder Engagement** with Core Planning Team
 - Purpose: To plan for the March 10 Stakeholder Kickoff Meeting, presented a draft agenda for that meeting, revised project schedule.

 - Items that were discussed during the call:
 - Project Timeframe
 - Document Formatting
 - Website / Storybook Options
 - GIS Data Request
 - Additional data or studies needed

- **June 24, 2020 - Status Update** with Core Planning Team
 - Topics Discussed:
 - Results of the kickoff meeting and State/County plan integration analysis
 - User-defined GIS green infrastructure layer application to existing county layers
 - Document format options and style guide requirements
 - Draft public survey, fact sheet and GI maintenance/monitoring application

- **August 6, 2020 - Draft Plan and Outreach Materials Review** with Core Planning Team
 - A draft version of the plan and outreach material, including survey and fact sheet were presented and reviewed for design, format, and content during this status call. The name of the plan, Cleaner, Greener Talbot: A plan for Future Livability, was agreed on and a motion was put forward to develop a branding image that would be displayed on all plan outreach material. The draft plan and public survey were circulated to the stakeholder committee members for review and comment after this meeting. At the end of the meeting a date to regroup with the stakeholders was decided and the next steps for plan production/review were established.

- **August 28, 2020 - Identification of Additional Hubs & Scheduling** with Core Planning Team
 - After county review of the material that was presented during the August 6 Status Call a follow-up call was scheduled to decide on a method and schedule for posting plan material on the county web site and social media for review using the Cleaner, Greener branding image. Other items that were discussed during this meeting that were rolled into the plan included:
 - Additional hubs and corridors that were not identified in plan. These included potential rails-to-trails green corridors and integration of other historic/cultural and community assets. This analysis was part of the initial ask from the local communities made prior to the 2nd stakeholder meeting.
 - Site-specific opportunities.

- **September 17, 2020 - Mapping Analysis Meeting** with the Stakeholder Group
 - During the second stakeholders meeting the results of the kickoff meeting and progress on the plan between March and September was presented to the stakeholders. Each element of the plan was discussed and opportunity for comment was given.
 - A presentation and overview of the 6-Step Planning Process was given:
 - Set Goals
 - Review Data
 - Asset Maps
 - Assess Risks
 - Determine Opportunities

- Plan Implementation
 - The green infrastructure fact sheet and survey material were also introduced during this meeting and the stakeholders were asked to participate in a green infrastructure survey and assist with the circulation of the public survey on social media and web links. As a take home assignment, stakeholders were asked to identify opportunities or specific locations where they would like to see the implementation of green infrastructure facilities. One area that brought significant attention during the meeting was a shoreline restoration project targeting Knapp Narrows.
- **October 6, 2020 – Cleaner, Greener Talbot- Nature Based Solution Discussion** with the Stakeholder Group
 - The results from the public and stakeholder surveys were compiled and presented to the stakeholders during this meeting. After each question stakeholders were given an opportunity to comment on the responses and provide additional information. Green infrastructure projects that were generated by stakeholders from the September 17 meeting were presented as site-specific locations to be considered for detailed analysis. The locations that were identified for site evaluation and pilot project consideration included:
 - Knapp Narrows Break Wall Improvements / Living Shoreline Enhancements
 - Southern Talbot County Park Site
 - Benoni Point
 - Southwest end of Town of Oxford
 - Black Walnut Point
 - Claiborne Jetty & beach
 - Sharps Island
 - Nelson Island
 - Barber Road Sand Mine
 - Town of Easton
- **October 15, 2020- Pilot Project Site Review** with Core Planning Team
 - Pilot project sites identified during the plan development process were reviewed and discussed by team members. Following this review and discussion, four (4) pilot project sites were selected for further evaluation.
- **December 3, 2020- Plan Update Meeting** with Core Planning Team
 - Evaluation results of selected pilot project sites were presented to team members. Additional details were added and integrated into the plan document. Additional recommendations and projects were added during this meeting.
- **January 28, 2021- Plan Integration and Project Discussion** with Core Planning Team
 - Working draft plan components were reviewed and modified. Completed components were compiled into a cohesive draft plan. The updated schedule for review and stakeholder engagement was discussed and distributed to team members.
- **March 15, 2021- Draft Final Plan Review** with the Stakeholder Group
 - Draft plan was reviewed with particular emphasis on projects and implementation. An implementation exercise was conducted during the meeting. Responsible entity, tasks and timeframe for each project was reviewed with meeting participants.

STEP 1: SET GOALS

Set Goals

Goals and objectives developed for the 2004 Talbot County Green Infrastructure (GI) Plan were reviewed and discussed by project stakeholders. Four goals from the previous plan were modified and integrated into the new plan, while three new goals were added.

Green Infrastructure (GI) Six Step Planning Process

1. **Set goals**
2. Review data
3. Make asset maps
4. Assess risks
5. Determine opportunities
6. Implement a plan

New 2020-2021 Goals

- Reassess and revise the goals and priorities presented in the previous plan with additional consideration of hazards from the effects of flooding, storm surges, shore erosion, and changes in climate. Identify green infrastructure strategies and projects that will be integrated into the County's regulatory context.
- Develop a public outreach method and educational program to communicate the importance of preserving Talbot County's rural character, integrating nature-based solutions, and preparing for changes in future environmental conditions.
- Coordinate green infrastructure projects to address stormwater management, flood resiliency, recreation plans, tourism, and economic development.

2004 Goals Modified and Integrated

- Identify areas of high conservation value for the protection of important ecological resources, aquatic systems and working landscapes to allow for prioritization of land preservation efforts.
- Recommend implementation strategies and funding sources that leverage existing state and federal programs and introduce innovative local conservation mechanisms.
- Provide a dynamic plan that evaluates opportunities, measures benefits, allows for the incorporation of new data, and is integrated with other County plans, design guidelines, and policies.
- Recommend project development that leverage funding strategies from state and federal programs and introduce innovative local conservation mechanisms that consider private sector stakeholders.

In additions to setting goals for the Cleaner, Greener Talbot, stakeholders also identified gaps in the 2004 Plan. These gaps were addressed during this plan update process.

Key elements that the 2004 plan did not address:

- Climate adaptation and resiliency components, including:
 - Sea level rise;
 - Water quality / quantity,
 - Drought; and,
 - Renewable resources.
- Feasibility of green infrastructure in site specific locations.

STEP 2: REVIEW DATA

Review Data

The initial step in developing the Green Infrastructure network was to obtain all data needed for incorporation into the Green Infrastructure Center (GIC) Model Toolbox. Local GIS data was requested from Talbot County's GIS Manager, Mark Cohoon, and additional national and state datasets were gathered for the analysis. All datasets used for the GIC Model Toolbox included:

- **Land Use/Land Cover**

- Multi-Resolution Land Characteristics Consortium, 2020: National Land Cover Dataset 2016, <https://www.mrlc.gov/data?f%5B0%5D=category%3Aland%20cover&f%5B1%5D=region%3Aconus&f%5B2%5D=year%3A2016>.

The National Land Cover Database (NLCD) provides nationwide data on land cover and land cover change at a 30m resolution with a 16-class legend based on a modified Anderson Level II classification system. NLCD 2016 represents the latest evolution of NLCD land cover products focused on providing innovative land cover and land cover change data for the Nation.

Source: <https://www.mrlc.gov/data?f%5B0%5D=category%3Aland%20cover&f%5B1%5D=region%3Aconus&f%5B2%5D=year%3A2016>

- **Coastal Data - NOAA C-CAP Land Cover**

- Office for Coastal Management, 2020: NOAA's Coastal Change Analysis Program (C-CAP) 2016 Regional Land Cover Data - Coastal United States, <https://inport.nmfs.noaa.gov/inport/item/48336>.

- **Soils**

- Natural Resources Conservation Service, United States Department of Agriculture, 2016: Gridded Soil Survey Geographic Database for the Conterminous United States, <http://gdg.sc.egov.usda.gov/>.

- **National Wetland Inventory**

- US Fish & Wildlife Service (USFWS) National Wetland Inventory, 2020: Maryland Dataset 2019, <https://www.fws.gov/wetlands/Data/State-Downloads.html>.

- **NHD Flowlines**

- USGS National Hydrography, 2020: National Hydrography Dataset 2016, <http://nhd.usgs.gov/data.html>;
- <https://viewer.nationalmap.gov/basic/>

- **NHD Waterbodies**

- USGS National Hydrography, 2020: National Hydrography Dataset 2016, <http://nhd.usgs.gov/data.html>;
- <https://viewer.nationalmap.gov/basic/>

- **NHD Areas**

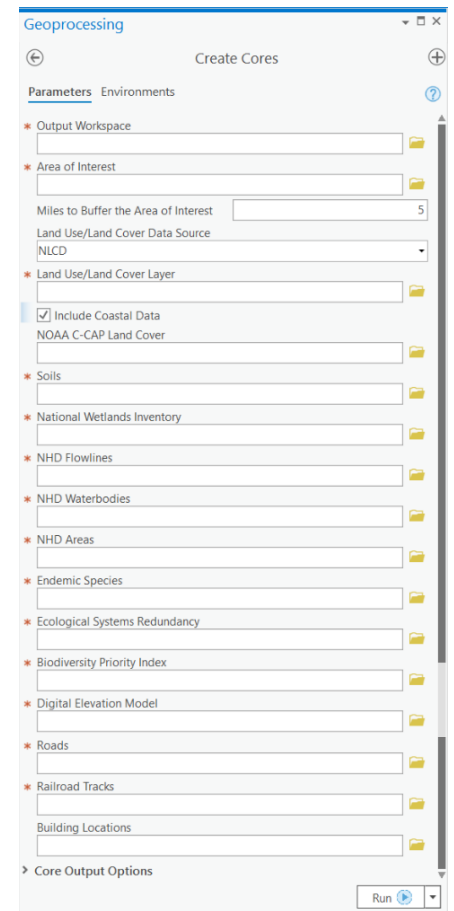
- USGS National Hydrography, 2020: National Hydrography Dataset 2016, <http://nhd.usgs.gov/data.html>;
- <https://viewer.nationalmap.gov/basic/>

- **Ecological System Redundancy**

- ESRI, 2020: Maryland Green Infrastructure Data 2017,

Green Infrastructure (GI) Six Step Planning Process

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- <https://nation.maps.arcgis.com/apps/MapAndAppGallery/index.html?appid=79f24082c91f4314b16bf8373c946ee5>

● Endemic Species

- Number of Endemic Species (Mammals, Fish, Reptiles, Amphibians, Trees) (Jenkins, Clinton N., et. al, (April 21, 2015) US protected lands mismatch biodiversity priorities, PNAS vol.112, no. 16, www.pnas.org/cgi/doi/10.1073/pnas.1418034112).

● Biodiversity Priority Index

Biodiversity Priority Index Areas: Endemic species, small home range size and low protection status. (Jenkins, Clinton N., et. al, (April 21, 2015) US protected lands mismatch biodiversity priorities, PNAS vol.112, no. 16, www.pnas.org/cgi/doi/10.1073/pnas.1418034112).

Note: As surrogates for the variables "Rare/Threatened/Endangered Species Abundance" and "Rare/Threatened/Endangered Species Diversity" in the Green Infrastructure Center's methodology, data from the BiodiversityMapping.org site. Specifically, their Priority Areas for USA Biodiversity Conservation data layer and a composite file summarizing the number and distribution of their endemic mammal, reptile, amphibian, freshwater fish, and trees files in the US. The research that produced these data is described in detail in the scientific paper, "U.S. protected lands mismatch biodiversity priorities," by Clinton N. Jenkins, Kyle S. Van Houtan, Stuart L. Pimm, and Joseph O. Sexton. Published April 6, 2015, in Proceedings of the National Academy of Sciences. www.pnas.org/cgi/doi/10.1073/pnas.1418034112.

● Digital Elevation Model

- Maryland iMaps, 2020: Talbot County Elevation Dataset, USGS, 1 m resolution, <https://data.imap.maryland.gov/datasets/maryland-lidar-talbot-county-dem-meters>.

● Roads

- Talbot County GIS, 2020: TalbotGreenInfGIS Database: Centerlines, <http://www.talbotcountymd.gov/index.php?page=gis-maps>.

● Railroad Tracks

- United States Census Bureau, 2016: TIGER/Lines Shapefile - Rails, <https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html>

● Building Locations

- Talbot County GIS, 2020: TalbotGreenInfGIS Database: BuildingFootprints, <http://www.talbotcountymd.gov/index.php?page=gis-maps>.

Beyond the Plan Document- Data Rich Analysis and New GIS Layers

Esri's Green Infrastructure Center Model (GIC Model) Toolbox was used to create Geographic Information Systems (GIS) data layers and mapping products. Michele King, GIS analyst for this planning project, downloaded the model, added data layers, including local data, and ran the model at the county level. Challenges were identified during this process, as this model had not yet been tested on a smaller scale i.e., county level. Issues were reported to Esri and modifications to the coding within the model were made as a result. Esri staff worked closely with Ms. King to ensure that Talbot County was able to use and benefit from this GI model tool.

While some mapping products are presented herein, parcel level GI network mapping, created during this planning process, will be made available. The Talbot County Department of Planning and Zoning will include GI network data layers into their existing Land Use Interactive Mapping Application.

STEP 3: MAKE ASSET MAPS

Make Asset Maps

For the third step, the Esri's Green Infrastructure Center Model (GIC Model) Toolbox was utilized. The central purpose of a Green Infrastructure map is to illustrate the location and extent of the County's natural assets with the highest values that are also the most likely areas for the County to achieve its GI goals.

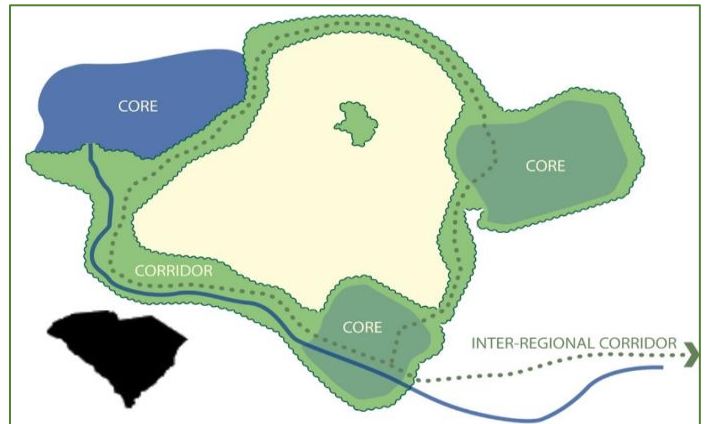
Green Infrastructure (GI) Six Step Planning Process

1. Set goals
2. Review data
3. **Make asset maps**
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The GIC Model assisted in automating the process for identifying and prioritizing natural assets, including habitat cores, corridors, and fragmentation. Both a national and a state Green Infrastructure model have been developed. However, by utilizing the GIC Model Toolbox, Talbot County was able to update, add or change priorities and reveal new relationships to inform county-specific conservation planning. The State's model covers the entire state using a statewide dataset, which is useful for creating a natural asset map. However, for this specific project, creating a local base map of natural assets required the addition of new data from state, federal, and locally sourced data, which provided county-specific results.

Asset mapping involves the identification of high-quality habitat cores and corridors. This map is referred to as the **green infrastructure basemap**. This basemap identifies intact habitat, major landscape elements such as topography and water features and connections across the landscape. The basemap provides context for other GI assets that are mapped and overlaid.

Source: Green Infrastructure: Map and Plan the Natural World with GIS, 2019



The ecosystem-based approach was used to develop the habitat cores for the project. This approach mapped natural lands in combination with human modifications to estimate *ecological integrity*. Using this approach, **habitat cores** are defined as lands with minimal human impact. These cores are intact landscapes (no development) that are large enough to support a multitude of native species. Habitat cores are connected by **corridors**, which provide pathways for movement across landscapes. Corridors are at least 1,000 feet wide to provide enough space to allow 330 feet of edge habitat on each side while still maintaining 330 feet or more of interior habitat.

Ecological Integrity

The ability of an ecosystem to maintain those natural processes that sustain the species it supports. It is quantified by the size of the habitat, extent of fragmentation, depth to its interior, area-to-perimeter ratio, soil diversity, elevation changes, water availability, and whether the area supports rare or endangered species.

Source: Green Infrastructure: Map and Plan the Natural World with GIS, 2019

The output from the model is a raster dataset that was converted into unique polygons that form the Green Infrastructure (GI) Overlay. Parcel-based results were then achieved by setting the following criteria: 50% or more of the parcel within the overlay would be assigned with the GI Overlay's attributes. Utilizing this model assisted with assessing risks to critical natural assets to determine where to expand, conserve, or restore Green Infrastructure networks.

The Green Infrastructure Network consists of “cores”, “corridors” and “fragments”.

Habitat Cores (Hubs): An intact landscape that is large enough to support a multitude of native species. Cores are connected by corridors, which provide pathways for movement across landscapes. Cores are measured by subtracting the edge area (average tree height times 3), then determining if enough interior habitat remains to support a multitude of species.

Habitat Corridors: Vegetated linear areas of similar habitat types that differ from adjacent areas and allow sheltered passage, habitat, and foraging from one core to another. Corridors should be a minimum of 1,000 feet wide to provide enough space to allow 330 feet of edge habitat on each side while still maintaining 330 feet or more of interior habitat.

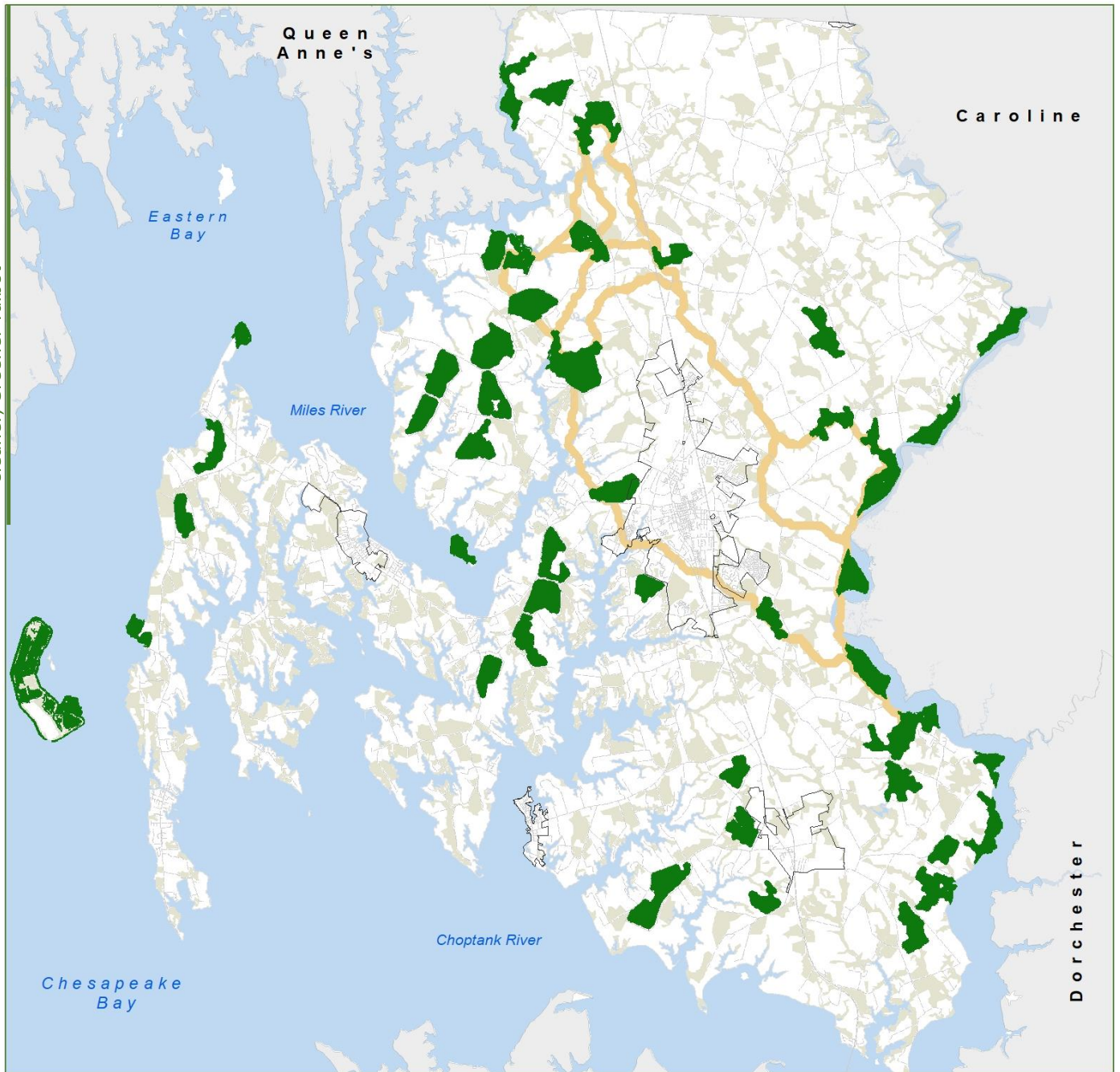
Habitat Fragmentation: The breaking up of natural landscape into smaller, disconnected pieces. Human activities are the main cause of habitat fragmentation by development of roads, urbanization, mining and other land disturbance activities.

As a result, **44 Habitat Cores** were identified in Talbot County. Acreage for the cores range from 119 acres to over 1,000 acres. Habitat fragments and corridors were developed through the use of the GIC Model Toolbox. As depicted on the maps below, habitat fragments are located throughout the county, but within proximity to the habitat cores. These fragments act as steppingstones for wildlife to access habitat cores. The corridors developed by the GIC Model Toolbox provide the least-cost paths between the habitat cores. The least-cost paths provide the least resistance for plants and animals to move across the landscape to habitat cores. Lands containing corridors should be preserved or restored to ensure the GI Network can function properly.

The intact habitat cores depicted in dark green on Map 1 are a minimum of 100 acres in size. This is the minimum size for protecting many interior dwelling birds in the eastern United States.

GI Network is an interconnected landscape of prioritized cores and connecting corridors.

Source: Green Infrastructure: Map and Plan the Natural World with GIS, 2019



Habitat Cores, Fragments & Corridors

Legend

-  Habitat Cores
-  Habitat Fragments
-  Corridors
-  Centerlines
-  Municipalities
-  Talbot County
-  Surrounding Counties

Habitat Cores: Intact landscapes that are large enough to support a multitude of native species. Cores are connected by corridors.

Habitat Fragmentation: Disconnect of natural landscapes into smaller, more disconnected pieces caused by human activities.

Corridors: Linear vegetated areas that allow sheltered passage, habitat and foraging from one core to another



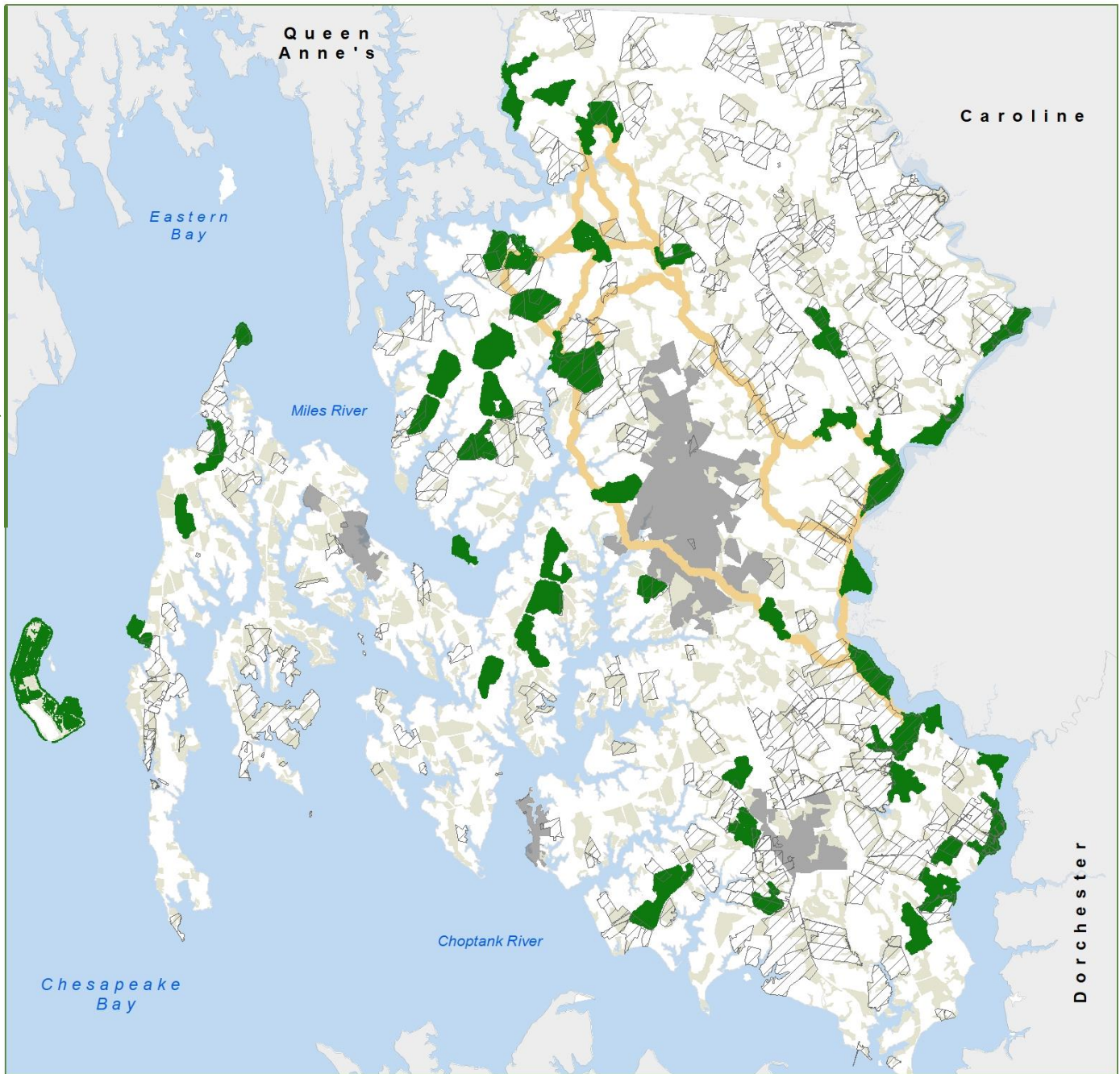
Prepared for:
Talbot County Planning & Zoning



Prepared by:
Smith Planning & Design



SP&D
Smith Planning and Design



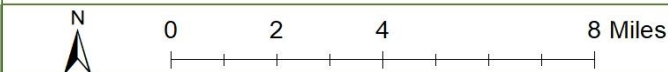
Habitat Cores, Fragments, Corridors & Protected Lands

Legend

-  Protected Lands
-  Habitat Cores
-  Corridors
-  Habitat Fragments
-  Municipalities
-  Talbot County
-  Surrounding Counties

Protected lands include: Agriculture Districts, Agriculture Easements, County Parks, and properties owned by Maryland Environmental Trust (MET), Eastern Shore Land Conservancy (ESLC) properties, Department of Natural Resources, Maryland Agricultural Land Preservation Foundation Easements (MALPF), and Rural Legacy Program (RLP).

A total of 5,008 acres of protected lands intersect with the habitat cores, while 10,022 acres are within habitat fragments.



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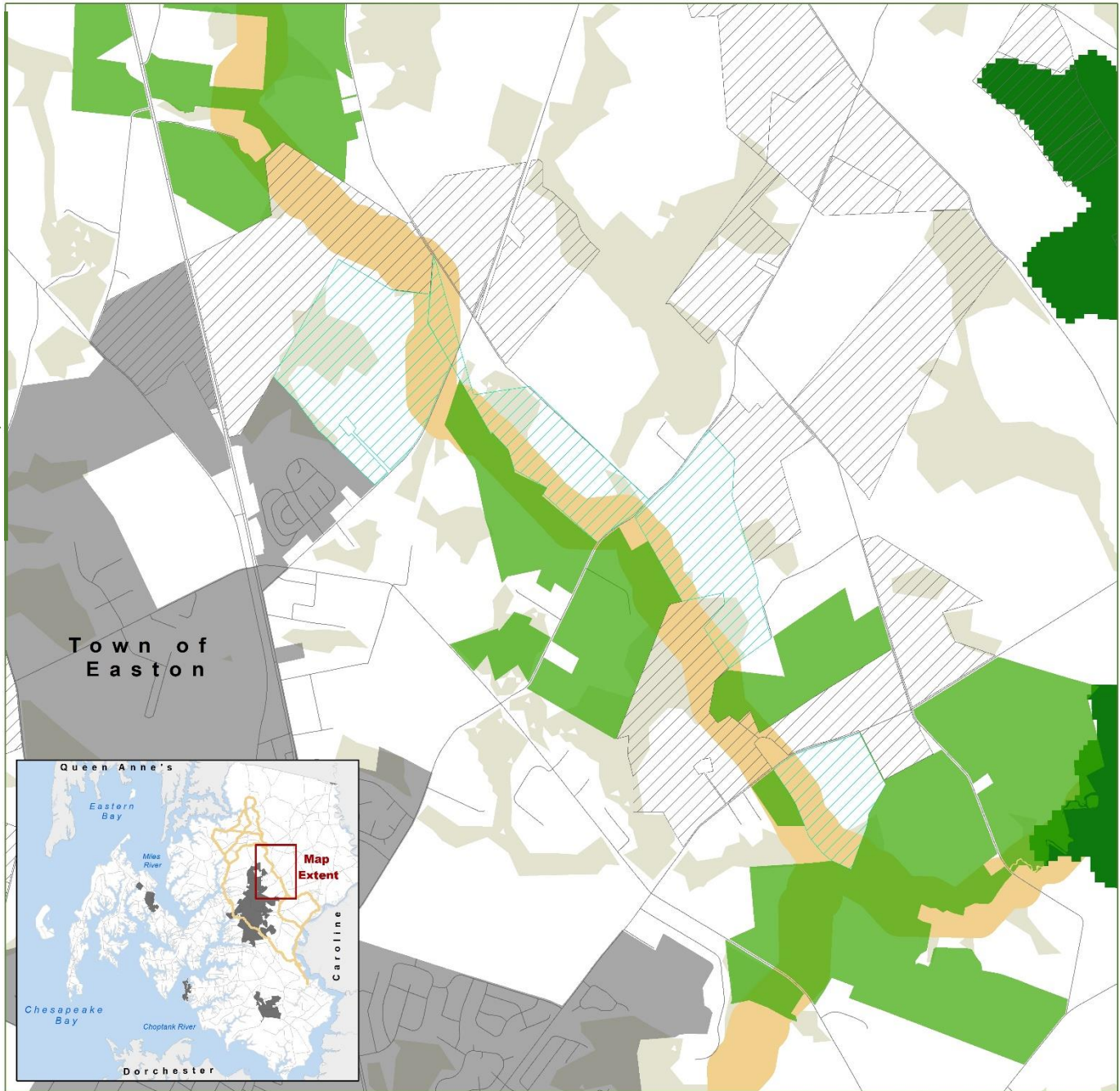
SP&D
Smart Planning and Design

Protected lands, which include agriculture districts, agriculture easements, county parks, properties owned by Maryland Environmental Trust (MET), Eastern Shore Land Conservancy (ESLC) properties, Department of Natural Resources, and Rural Legacy Program (RLP) were reviewed in conjunction with habitat cores, habitat fragments and corridors.

A total of 5,008 acres of protected lands intersect with the habitat cores, while 10,022 acres are within habitat fragments. Small sections of the corridors are located within the protected lands. These are located northeast and southeast of Easton. These protected lands surrounding the corridors should be reviewed for preservation or restoration.



Conservation Area- Oxford



Corridors & Protected Lands: Preserve

Legend

- Agriculture Parcels
- Protected Lands to Preserve
- Protected Lands
- Municipalities
- Centerlines
- Habitat Cores
- Corridors
- Habitat Fragments
- Talbot County
- Surrounding Counties

Protected lands to preserve along this corridor are Agriculture Districts. Four parcels totaling of 575.7 acres of protected lands intersect with the habitat corridors located northeast of Easton. The four Agriculture District parcels currently have a temporary status.

In addition, 13 parcels totaling 1,511 acres are located along this corridor and are classified as Agricultural Land Use. These parcels should be reviewed for Agricultural Easements.



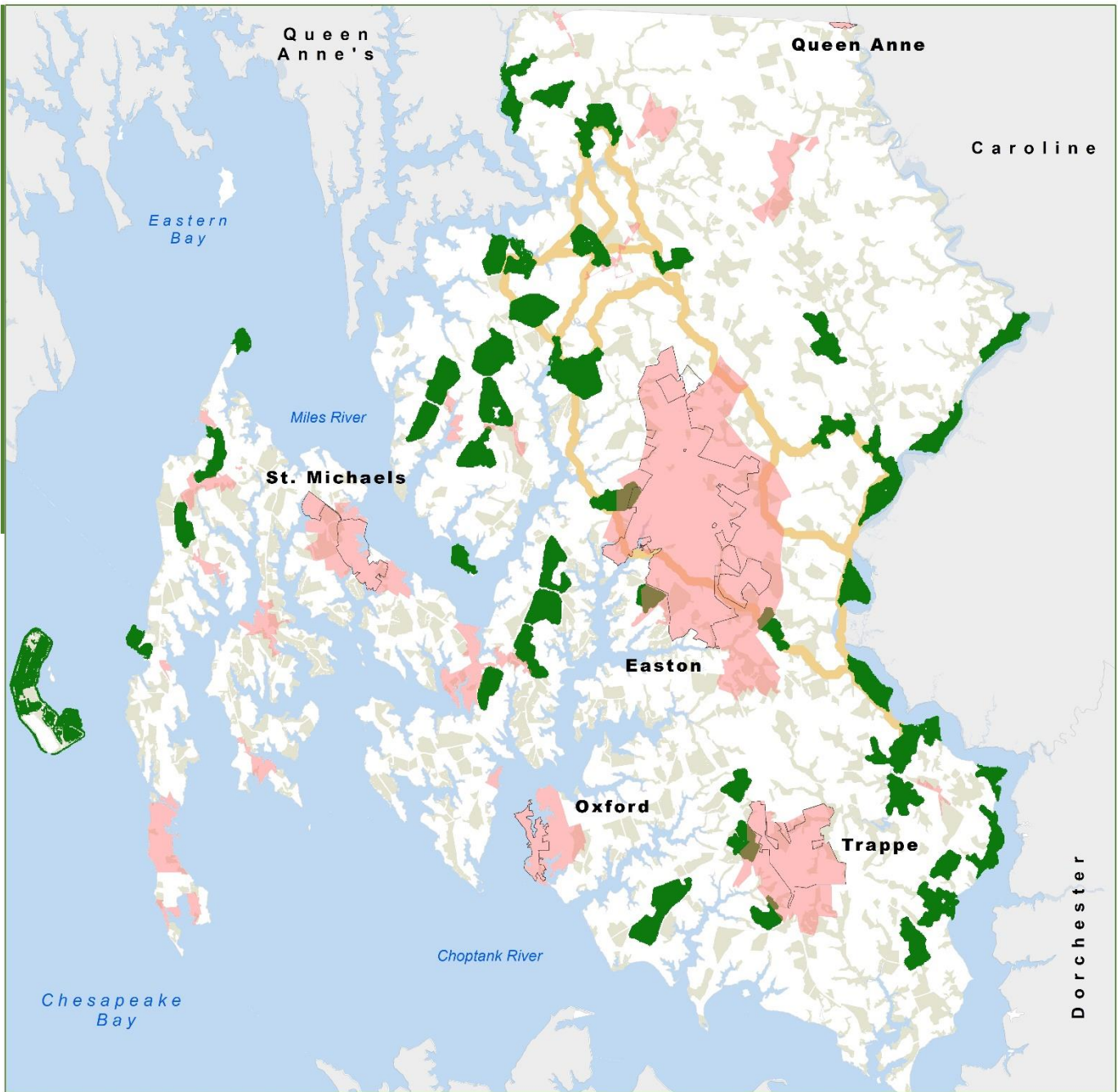
0 0.375 0.75 1.5 Miles

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Habitat Cores, Corridors, Fragments & Priority Funding Areas

Legend

- Priority Funding Areas
- Habitat Cores
- Corridors
- Habitat Fragments
- Municipalities
- Talbot County
- Surrounding Counties

Priority Funding Areas are existing communities and places where local governments want State investment to support future growth. The 1997 Priority Funding Areas Act capitalizes on the influence of State expenditures on economic growth and development. Funding for projects in municipalities, other existing communities, industrial areas, and planned growth areas designated by counties receive priority State funding over other projects. (Source: Maryland iMaps)



0 2 4 8 Miles

Prepared for:
Talbot County Planning & Zoning



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STEP 4: ASSESS RISKS

Assess Risks

The fourth step includes assessing *natural risks*, such as sea level rise or floods; or risks caused by *human factors*, such as new roads, or development.

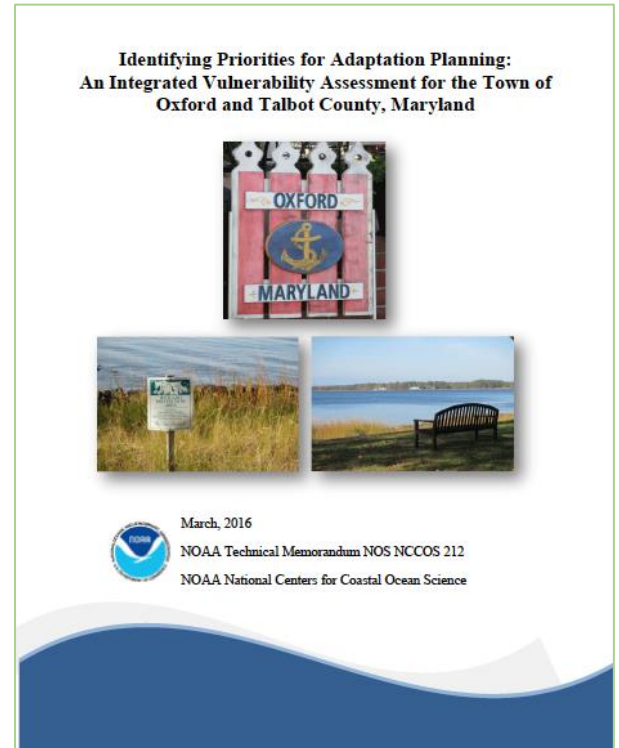
In terms of a climate profile for Talbot County, *Identifying Priorities for Adaptation Planning: An Integrated Vulnerability Assessment for the Town of Oxford and Talbot County, Maryland*, pictured right, provides the following information:

Talbot County is located within the Eastern Shore of Maryland and its climate is significantly influenced by both the Chesapeake Bay and the Atlantic Ocean. The average temperature is 51 degrees Fahrenheit, with temperatures below 32 degrees Fahrenheit for 80 days of the average year and temperatures 90 degrees Fahrenheit or higher for 15-20 days of the average year. Precipitation in Talbot County averages 43.2 inches annually, with daily rainfall events that could cause flooding (≥ 1 inch) occurring most commonly in October (17 events from 2005-2014). Winds in this area are typically from the south in summer and from the west and northwest in winter, with an average velocity of 8-10 mph.

Natural resource vulnerability to climate and coastal hazards were assessed. The natural resources assessed were wetland, submerged aquatic vegetation, oyster sanctuaries, green infrastructure, forested areas, sensitive species location, beaches, and marsh buffer. For natural resources, the intersection of flood hazard risks was limited to sea level rise (1 ft) and storm surge (category 1 hurricane). These flood hazard scenarios were selected because they are more likely to have a negative impact on natural resources than stormwater flooding. Natural resources vulnerable to the impacts of sea level rise and storm surge were determined by intersecting the natural resource richness layer with each flood hazard layer (See Figures E-27 and E-28).

Green Infrastructure (GI) Six Step Planning Process

1. Set goals
2. Review data
3. Make asset maps
4. **Assess risks**
5. Determine opportunities
6. Implement a plan



Source: Messick, E. and M. Dillard. 2016. *Identifying Priorities for Adaptation Planning: An Integrated Vulnerability Assessment for the Town of Oxford and Talbot County, Maryland*. NOAA Technical Memorandum NOS NCCOS 212. 149 pp.

doi:10.7289/V5/TM-NOS-NCCOS-212

Projected Sea Level Rise

The percentage of the total land area covered by natural resources at risk to a projected 1-foot sea level rise ranges from 1% to 99% among Talbot County census blocks. The average percentage of total land area for all census blocks having any amount of natural resources which are at risk to sea level rise is 5%. The median value is 2.6%. The majority of blocks with a medium to high rating are concentrated along the Choptank River. Only nine census blocks, 1.5% of the total, are classified as high, the largest of which is Poplar Island. The analysis determined that roughly 68% of the island's area contains natural resources which are at risk to this sea level rise scenario. This is explained by the fact that the entire island is classified as a wetland which means it would likely disappear under this scenario, assuming no mitigation measures were put into place.

Encroaching seas will transform habitat, perhaps turning shallow march into deep-water habitat and a dry area into a march. Rising sea could drown a coastal forest or change species composition from those that inhabit hummocks (raised areas of land) to those that inhabit swamplands.

Source: Karen E. Firehock and Andrew Walker; ESRI Press 2019, Green Infrastructure: Map and Plan the Natural World with GIS

Storm Surge

The percentage of the total land area covered by natural resources at risk to a present category 1 storm surge scenario ranges from 1% to 100% among Talbot County census blocks. The average percentage of total land area for all blocks having any amount of natural resources which are at risk to category 1 storm surge is nearly 11%. The median value is 5.7%. The majority of blocks with a medium to high rating are concentrated along the Choptank River and Tuckahoe Creek. Only 26 census blocks, 4% of the total, are classified as high. Poplar Island is the largest census block to be classified as high, and nearly 67% of its land area is covered by natural resources at risk to storm surge. This is explained by the fact that the entire island is classified as a wetland and that the island exists at a low elevation.

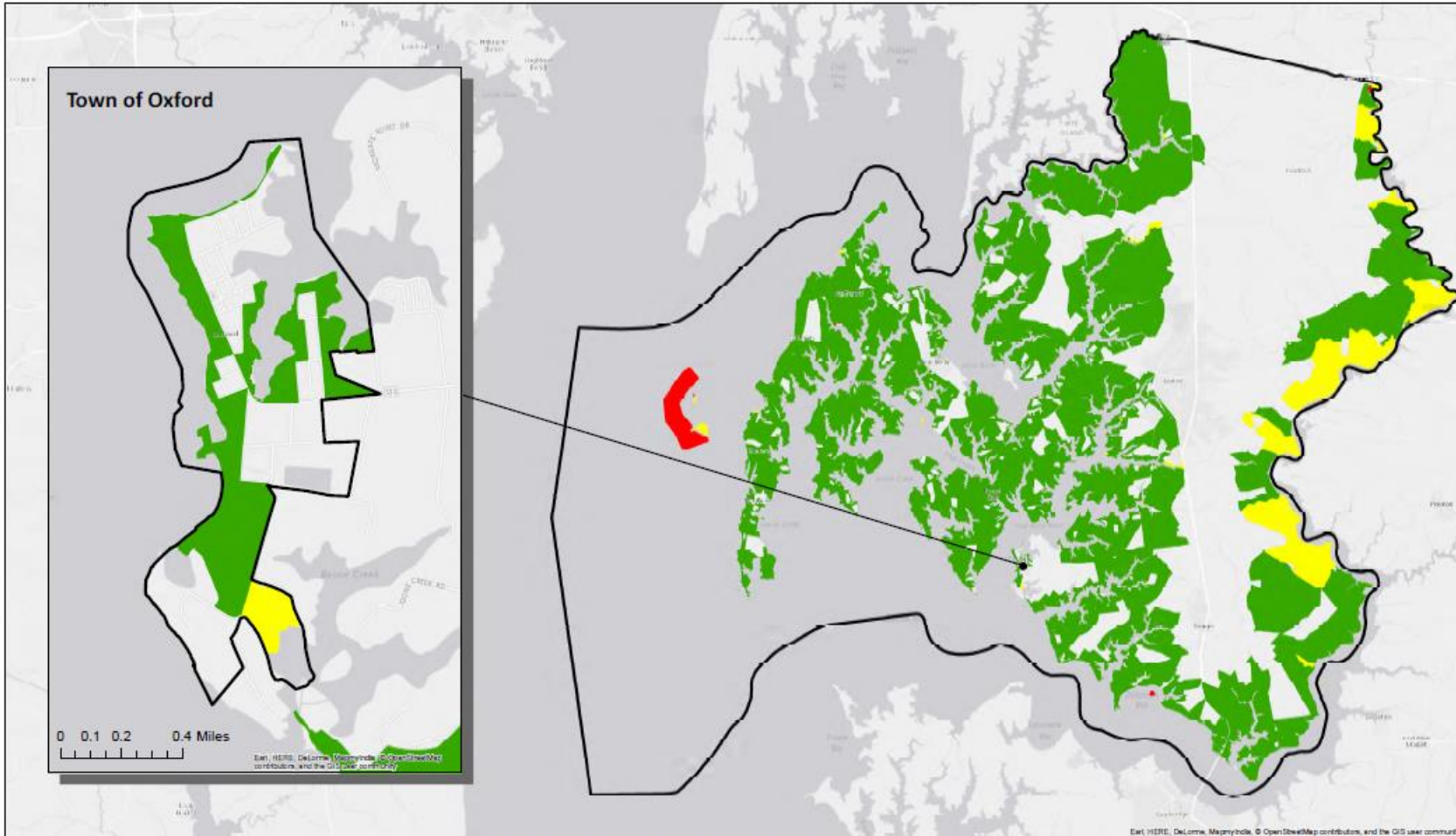
Storm surge is defined as the abnormal rise of water generated by a storm, over and above the predicted astronomical tides. A category 1 hurricane produces storm surge 4 to 5 feet above normal. The category 1 storm surge inundation zone was selected as one of three flood hazard layers. This level of inundation most accurately reflects the type of storm that can be expected within the study area.

Stormwater Flood Prone Areas

The percentage of the total land area covered by natural resources within stormwater flood prone areas ranges from 1% to 100% among Talbot County blocks. The average percentage of total land area for all blocks having any amount of natural resources which are within stormwater flood prone areas is 13%. The median value is 6.0%. The majority of census blocks with a medium to high rating are concentrated along the Choptank River, Tuckahoe Creek, and Tilghman Island. Only 65 census blocks, 6.9% of the total, are classified as high. The largest census block to be classified as high has an area of 79 acres and just over 50% of its land area is covered by natural resources within stormwater flood prone areas. This area is adjacent to the Choptank River where many different natural resources intersect. Another area ranked as medium with pockets of high is a census block in Easton which contains the Walmart and Giant shopping centers. This area is considered by the State of Maryland to contain sensitive species, and 70% of this block is comprised of stormwater flood prone areas. The most obvious reason for this is the large amount of impervious surface contained within the developed census block.

Sensitive species locations consist of buffered areas that primarily contain habitat for rare, threatened, and endangered species and rare natural community types. It generally includes, but does not specifically delineate, such regulated areas as Natural Heritage Areas, Wetlands of Special State Concern, Colonial Waterbird Colonies, and Habitat Protection Areas.

Projected Sea Level Rise (1 ft) Impacts to Natural Resources by Block - Talbot County, Maryland



Block Score

- Low
- Medium
- High

Description:

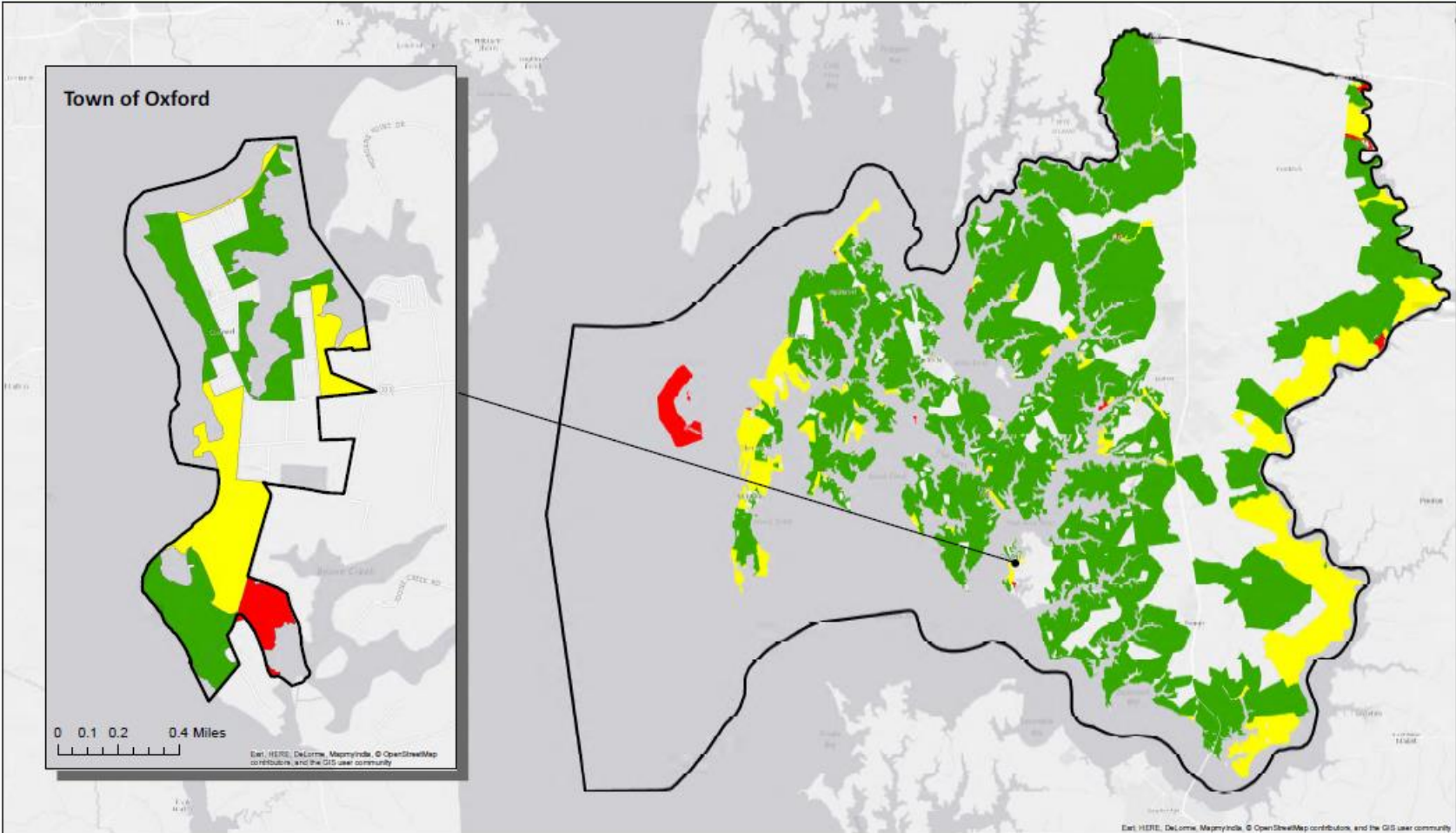
Vulnerability of natural resources to projected sea level rise is expressed as a percentage of the total land area (in acres) of the block covered by sensitive natural resources that would be exposed to inundation. Blocks are scored as low, medium, or high based upon this percentage. Scores ranging from 0-13% fall into the low category, 14-44% medium, and 45-100% are high.



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Figure E-27

Storm Surge (Cat 1) Impacts to Natural Resources by Block - Talbot County, Maryland



Block Score

- Low
- Medium
- High

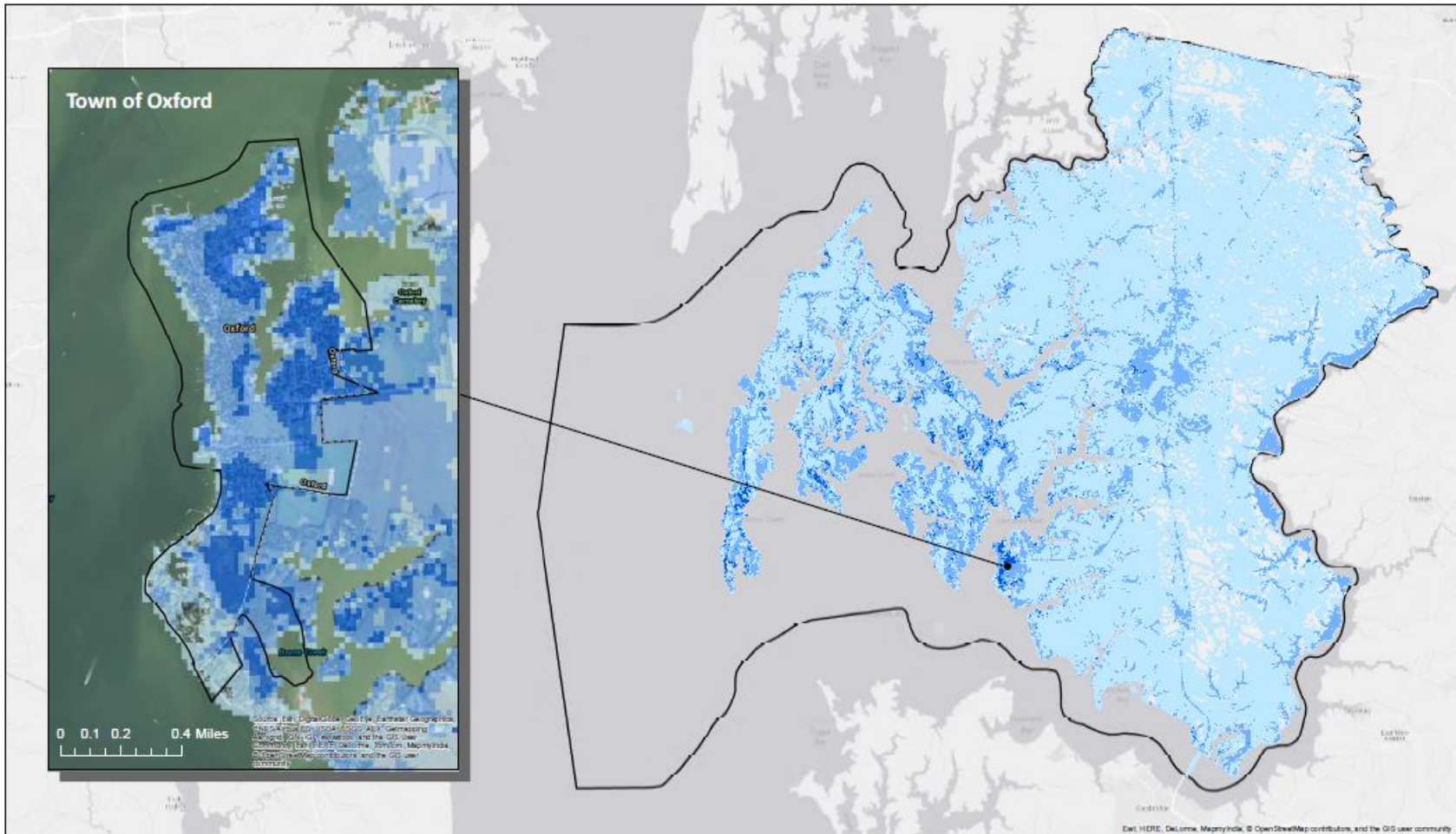
Description:
 Vulnerability of natural resources to storm surge is expressed as a percentage of the total land area (in acres) of the block covered by sensitive natural resources that would be exposed to storm surge. Blocks are scored as low, medium, or high based upon this percentage. Scores ranging from 0-13% fall into the low category, 14-44% medium, and 45-100% are high.



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Figure E-28

Stormwater Flood Prone Areas - Talbot County, Maryland



Hazard Score	Description:
1 2 3	Scores are the summation of the presence of three conditions: elevation (0-2 feet), developed land cover, and poorly drained soil. Areas are ranked as slightly prone when only one condition is present, moderately prone when two conditions are present, and highly prone if all three conditions are present.



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Figure E-13

STEP 5: DETERMINE OPPORTUNITIES

Determine Opportunities

Identifying opportunities to achieve the goal of protecting areas of significant economic and ecological value and restoring other identified areas to provide richness, diversity, and connectedness involves a high degree of stakeholder engagement. Results of the stakeholder survey, online public survey, and stakeholder group meetings informed the opportunities presented herein. The following types of opportunities that included co-benefits were identified during this step of the planning process.

- Pilot projects were identified, and preliminary assessments and engineering analyses were conducted.
- Green infrastructure network gaps and natural resources mitigation & restoration were determined and mapped.
- Preservation/Open Space opportunities around Frederick Douglass Park on the Tuckahoe were identified along with Rails to Trails green corridor opportunities.
- Community greening opportunities were discussed in relation to online survey results

Green Infrastructure (GI) Six Step Planning Process

1. Set goals
2. Review data
3. Make asset maps
4. Assess risks
5. **Determine opportunities**
6. Implement a plan

Green infrastructure projects lend themselves to innovative funding strategies that take advantage of their various desirable **co-benefits** for the environment, economy, and community.

Source: Rouse, David and Ignacio Bunster-Ossa. 2013. Green Infrastructure: A Landscape Approach. PAS Report no. 571. Chicago: American Planning Association.



Shoreline along Island Creek- Oxford

PILOT PROJECTS

Pilot Projects

As part of the 2020-2021 plan development and implementation process, an evaluation of specific nature-based infrastructure projects sited throughout the County was completed. Members of the stakeholder committee group were given sample project types and asked to provide details of any known projects in the County. For example, the Tilghman on Chesapeake Plan for a Resilient and Adaptive Coastline study was presented as a model pilot project for the plan. The Tilghman on the Chesapeake Plan will utilize nature-based infrastructure to reduce loss of shoreline, increase protection of the community, and improve water quality in Harris Creek which is vital to the survival of an oyster sanctuary that has regional economic importance. The project will also build resilience to increases in sea level rise. The project involved restoring the existing marsh with a living shoreline, upland meadow creations and stormwater improvements.

Site selection and project specifics were discussed during the September 17 and October 6 stakeholder committee meetings. During both meetings the group decided to develop preliminary engineering analyses of five general areas of interest for further investigations:

- Location 1 - Knapp Narrows Break Wall Improvements / Living Shoreline
 - Develop a long-range plan with multiple phases that include a combination of land management policy, living shoreline applications and structural improvements. This effort will involve creation and cooperation of a Narrows Project Committee that will implement the results of this plan.
- Location 2 –Waterfront Park
 - Identify and develop a County or state park in the southern half of Talbot County to provide opportunities for water access, passive recreation, habitat protection and land preservation.
- Location 3 - Barrier Island Restoration – Multiple Locations
 - Construct build-out points and new islands using sand and dredged material to provide a natural defense for areas now experiencing erosion and scour. Areas of concentration include:
 - Benoni Point
 - Black Walnut Point
 - Claiborne Jetty & Beach
 - Nelson Island
 - Sharps Island
- Location 4 - Town of Oxford Green Infrastructure / Living Shoreline
 - The town of Oxford has four locations that would be suitable for living shoreline applications. These areas are adjacent to private properties and will require cooperation with the property owners.
- Location 5 - Tilghman on the Chesapeake Resilient Green Infrastructure Design
 - Construct living shoreline with marsh migration corridor, meadow habitat, and stormwater outflow components along Harris Creek.

The initial engineering analysis that is presented for each site will be an important tool for future planning and consideration of nature-based projects across the County. A brief summary of each project is outlined below. Design data sources and guidelines is provided in Appendix A.

Location 1: Knapps Narrows Break Wall Improvements / Living Shoreline

- Current conditions include deteriorating bulkheads, shore erosion from storm surges and the effects of rising sea levels and increased erosion of the placed dredge material on Tar Island.
- This site is of regional economic importance as it's the last remaining large-scale working waterfront in the Country and the Knapps Narrows is a critical maritime interstate highway in the Chesapeake Bay region for maritime and maritime-related business as well as for recreation.
- The formation of a Narrows Project Committee can study existing conditions and develop detailed strategies for future improvements.
- Potential partners: former Phillips Wharf Environmental Center site, Severn Marine. Knapps Narrows Marina, Tilghman Island Marina, MES and others.



Action: Develop a long-range plan with multiple phases that include a combination of land management policy, living shoreline applications and structural improvements. The effort will involve creation and cooperation of a Narrows Project Committee.

Preliminary Assessment and Engineering Analysis

1. Data Review
 - National Wetlands Inventory
 - Historical Aerial map analysis – determine historical habitat, calculate rate of erosion
 - Floodplain map/FIRM map
 - Water quality data
 - Li-Dar/contour data
 - USFWS IPac Report – protected species and critical habitat
 - NOAA Data – Flow

2. Preliminary Land Management Policy Goals

- No new seawalls
- Seawall replacement with living shoreline component or riprap in front of seawall
- No fertilizer use
- No wake zones – minimize wave action
- Non combustion engine zones – Blue way (kayaks and canoes only)

3. Living Shoreline Applications

- Wave Attenuation Devices
- Oyster Bags under docks, oyster balls, vertical oyster gardens

4. Structural Improvements

- Wave Attenuation Devices
- Breakwater
- Coastal modeling
- Shoreline protection/stabilization - open cell articulated concrete block, riprap, etc.
- Need to identify/estimate environmental impact of construction including route, staging and storage

Location 2: Waterpark Park

- A county or state park can solve a regional problem of limited public access to water, provide an opportunity for low-impact passive recreation and offer significant conservation opportunities such as habitat protection areas and wetland mitigation.
- The area, or portions of the area, can be identified as a future consideration to add as part of the green infrastructure network.
- Maritime protection areas can be determined where properties are flood-prone and susceptible to erosion.

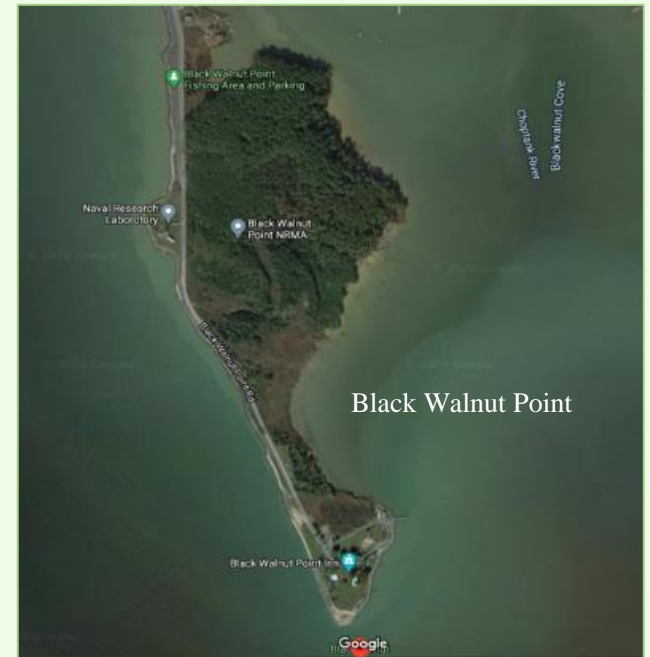
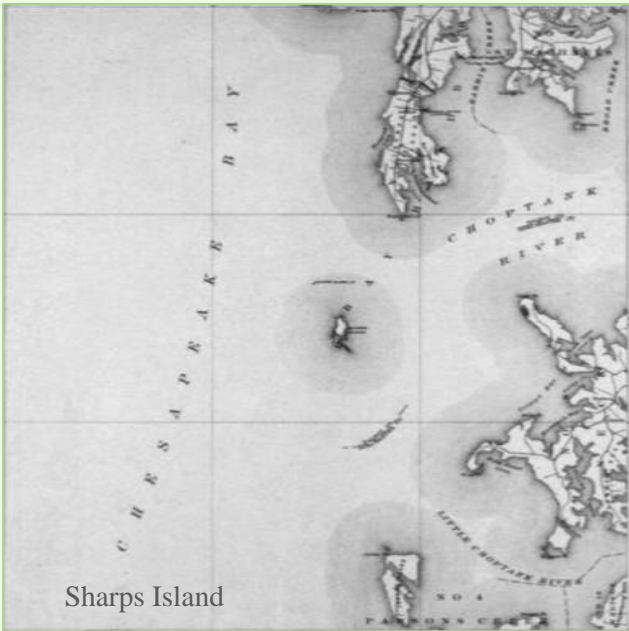
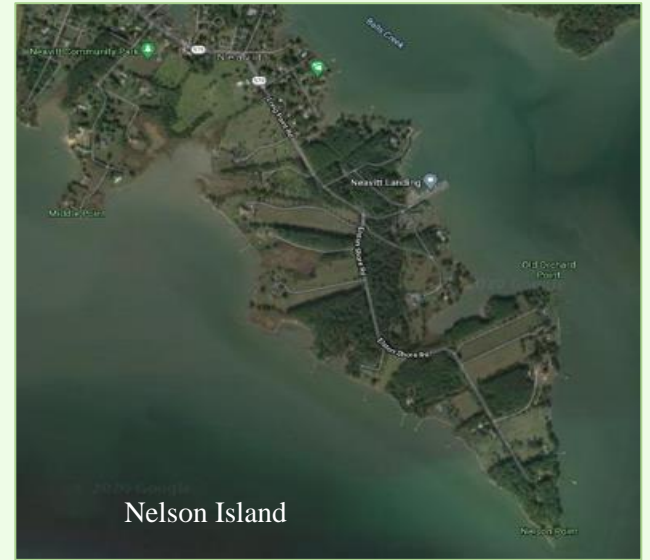
Action: Identify properties adjacent to MD State Highway 50. Finding large tracts of land owned by few property owners is rare. For this reason, the potential development of a waterfront park can be a high priority project. Such a project would require voluntary cooperation from the property owners. A land trust or state mechanisms can be a means of land preservation.

Preliminary Assessment and Engineering Analysis

1. Data Review
 - National Wetlands Inventory
 - Historical Aerial map analysis – determine historical habitat, calculate rate of erosion
 - Floodplain map/FIRM map
 - Water quality data
 - Li-Dar/contour data
 - USFWS IPac Report – protected species and critical habitat
 - NOAA Data – Flow
 - NRCS Soils
2. Preliminary Approach
 - Identify flood prone areas and use the area to create a channel for marsh mitigation and compensate for wetland impacts for the waterfront development that provides increased water access and enhances wildlife habitat value.
 - There could be potential to widen and extend existing channels to provide more water access but should be combined with wetland creation; one side should be kept natural and one side with limited development. The channel should be meandering to mimic natural creeks and dissipate energy.
 - Identify areas for future purchase to expand the preservation area.
3. Preliminary Design
 - Estimate project area – total area, dredging and filling in cubic yards/acres
 - Dredging will require sediment grain analysis, priority pollutants and metals analysis
 - Need dredge disposal plan and site
 - Corps of Engineers Dredge and Fill Permit
 - Water Quality permit
 - SWPPP
 - Turbidity Monitoring plan

Location 3: Barrier Island Restoration – Multiple Locations

Sharps Island has completely eroded away. It once functioned as a barrier island at the mouth of the Choptank River limiting fetch and wave action and protecting landforms east of the island. Nelson Island is also completely gone, as is the protection it provided Talbot County peninsulas from erosion and waves. With the disappearance of these two islands, other areas have experienced extensive erosion on the west side of each peninsula due to the southwest and western prevailing winds.





Barrier Island Restoration - Multiple Locations

Legend

- Restoration Locations
- Centerlines
- Villages
- Municipalities

With the disappearance of Sharps Island and Nelson Island, other areas have experienced extensive erosion on the west side of each peninsula due to the southwest and western prevailing winds.

A long-term solution is to protect the shorelines from the wave action caused by the prevailing wind with a rock barrier/breakwater or other wave attenuation structure.



0 1.25 2.5 5 Miles

Prepared for:
Talbot County Planning & Zoning



Prepared by:
Smith Planning & Design



SP&D
Smith Planning and Design

Action: Build out points and new islands using sand and dredged material to provide a natural defense for areas now experiencing erosion and scour. Highlight USACE projects in the Chesapeake Bay to provide examples of opportunities for interagency coordination.

The Poplar Island sand stockpile facility provides a unique opportunity for Talbot County to use dried dredged material to build or rebuild the natural defenses of the impacted shorelines. There are an additional two Beneficial Use Dredge Material Containment Facilities planned for construction in Dorchester County: one on Barren Island and one on James Island.

Preliminary Assessment and Engineering Analysis

1. Data Review

- National Wetlands Inventory
- Historical Aerial map analysis – determine historical habitat, calculate rate of erosion
- Floodplain map/FIRM map
- Water quality data
- Li-Dar/contour data
- USFWS IPac Report – protected species and critical habitat
- NOAA Data – Flow

2. Funding

- Maryland Department of Natural Resources - Chesapeake & Coastal Grants Gateway
- Natural Resources Conservation Service - Watershed and Flood Prevention Operations Program
- U.S. Fish and Wildlife Service - North American Wetlands Conservation Act Grants Program; Chesapeake Bay Stewardship Fund Grants Program
- FEMA Building Resilient Infrastructure and Communities (BRIC)/Flood Mitigation Assistance (FMA) Grant Program

General Comment – Renourishing eroded areas is a temporary fix as they will erode again. A longer-term solution is to protect the shoreline from the wave action caused by the prevailing wind with a rock barrier/breakwater or other wave attenuation structures. The shoreline of these structures should be planted with native salt tolerant wetland vegetation to enhance shoreline stability. The stockpile dredged material needs to be tested for metals and priority pollutants before it can be used to renourish shorelines unless the material has already been approved by the USACE for use.

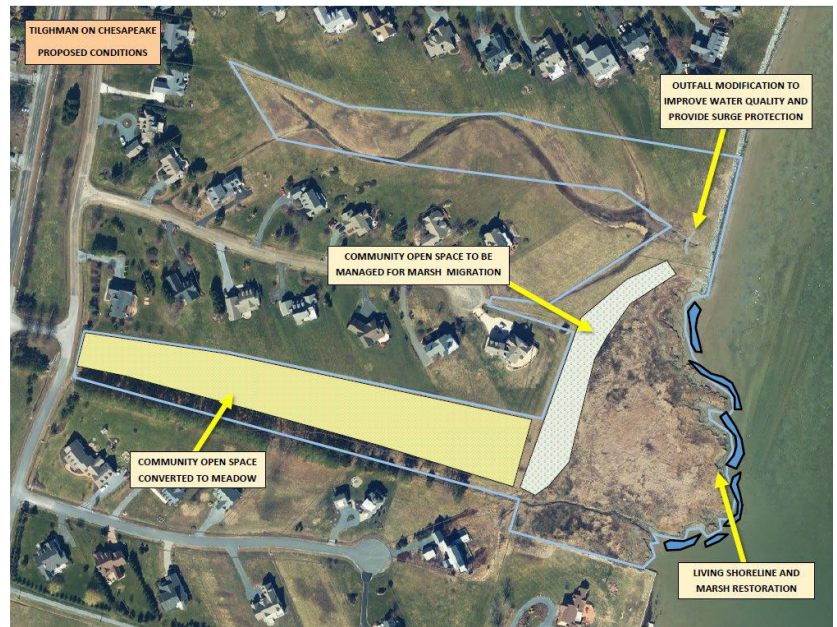
Location 5: Tilghman on the Chesapeake Resilient Green Infrastructure Design

Talbot County has worked with the Tilghman on the Chesapeake Community Association (TOCCA) and University of Maryland Sea Grant Extension to design a living shoreline with marsh migration corridor, meadow habitat, and stormwater improvements. Practices will be designed to adapt to sea level rise and coastal storm impacts, and address erosion and stormwater runoff. The project will serve as a demonstration site for Cleaner, Greener Talbot.

TOCCA represents a community of 95 homes on 186 acres. The community is in the Lower Choptank watershed that sits along Harris Creek within the Choptank River. In response to shoreline and tidal marsh loss, TOCCA established a Wetland Committee in 2015 and developed a Wetland Management Recommendations Plan to begin exploring solutions to shoreline and habitat loss. Analysis indicated loss of approximately 0.25 acres between 2013 and 2017, with greater erosion rates adjacent to gray infrastructure. The Committee explored alternative management approaches for open space in light of sea level rise and other climate change threats.

The objectives of this project include:

1. Design a living shoreline with marsh migration corridor, meadow habitat, and stormwater outflow components to address current and future erosion, sea level rise, and storm impacts on the Tilghman on the Chesapeake community on Tilghman Island. This project will serve as a local demonstration project.
2. Engage and educate local stakeholders about climate resiliency, nature-based solutions, and the Talbot County Green Infrastructure Plan.



This project supports Phase I of the Tilghman on the Chesapeake Resilient Green Infrastructure Project, as outlined below. Funding is provided by the Maryland Department of Natural Resources (DNR) Chesapeake and Coastal Service. DNR will work with project partners towards Phases II and III once Phase I deliverables are complete, but future phases are contingent on available funding and approvals.

- Phase I: Design, Permit Acquisition, and Baseline Monitoring (FY21-22)
- Phase II: Construction (FY23-24)
- Phase III: Monitoring and Maintenance for Adaptive Management (FY24-26)

TOCCA received 2021 hazard mitigation funding to complete Phase I of the Tilghman on the Chesapeake Resilient Green Infrastructure Design project that is expected to extend through spring 2022.

GI NETWORK FRAGMENTS, NATURAL RESOURCES MITIGATION & RESTORATION

Habitat fragmentations, habitat cores and hydric soils were analyzed for potential mitigation and restoration opportunities. Hydric soils within Talbot County total 283,003 acres. These soils were mapped along with habitat cores and fragments identified during this planning process. Three large areas or sites were selected due to potential opportunities for restoration and enhanced connectivity within the GI network. Further analysis of the three selected sites was conducted and presented on mapping products shown on the following pages.

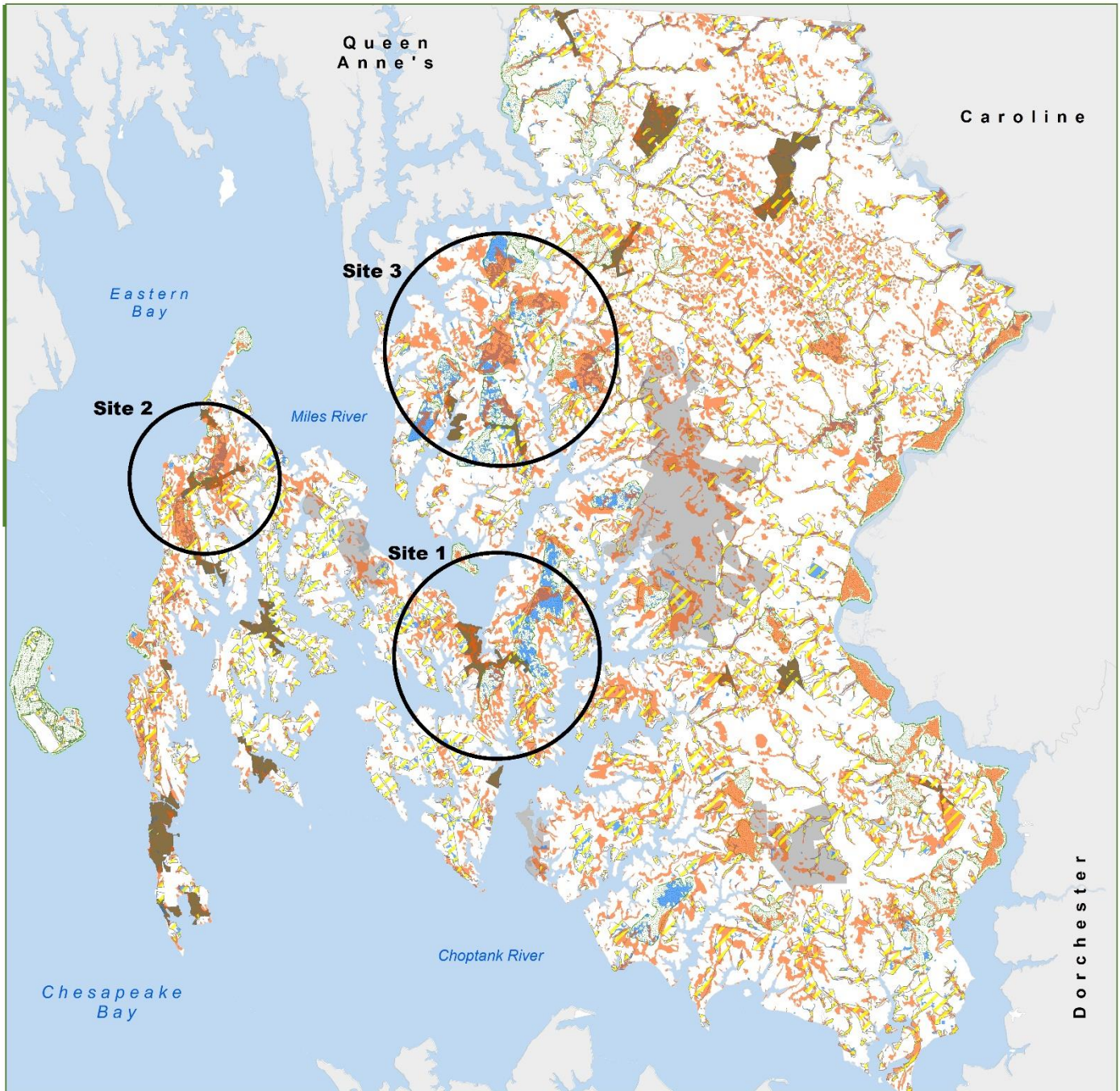
Hydric soils were probably once wetlands and could be restored as such. Other opportunities include reforestation along streams. Reforestation and/or riparian planting along stream banks would not only benefit wildlife but would also improve water quality and stream stability. Stream blockages can be examined for fish ladders, bypasses, or other structures that allow fish passage.

A habitat fragmentation is the breaking up of natural landscape into smaller, more disconnected pieces. Human activities are the main cause of habitat fragmentation by such ways as development of roads, urbanizing, mining and so on.

There are numerous programs for environmental restoration, whether the focus is improving water quality, mitigating construction impacts, or offsetting CO2 emissions. By focusing restoration in suitable habitat fragment areas and areas providing GI network connectivity to habitat cores, multiple ecological benefits can be realized.



Marsh, type of wetland ecosystem characterized by poorly drained mineral **soils** and by plant life dominated by grasses. The latter characteristic distinguishes a **marsh** from a **swamp**, whose plant life is dominated by trees.



Habitat Cores & Fragments: Hydric Soils

Legend

-  Habitat Fragments
-  Hydric Soils
-  Non-Tidal Wetlands
-  Habitat Cores
-  Villages
-  Municipalities
-  Talbot County
-  Surrounding Counties

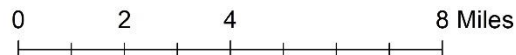
Talbot County contains a total of 283,003 acres of hydric soils.

The three areas designated by the black circles exhibit areas of hydric soils within habitat cores and fragments.

Site 1: Area around Newcomb & Royal Oak Villages

Site 2: Area around Claiborne & McDaniel Villages

Site 3: Area around Unionville, Copperville & Tunis Mills Villages



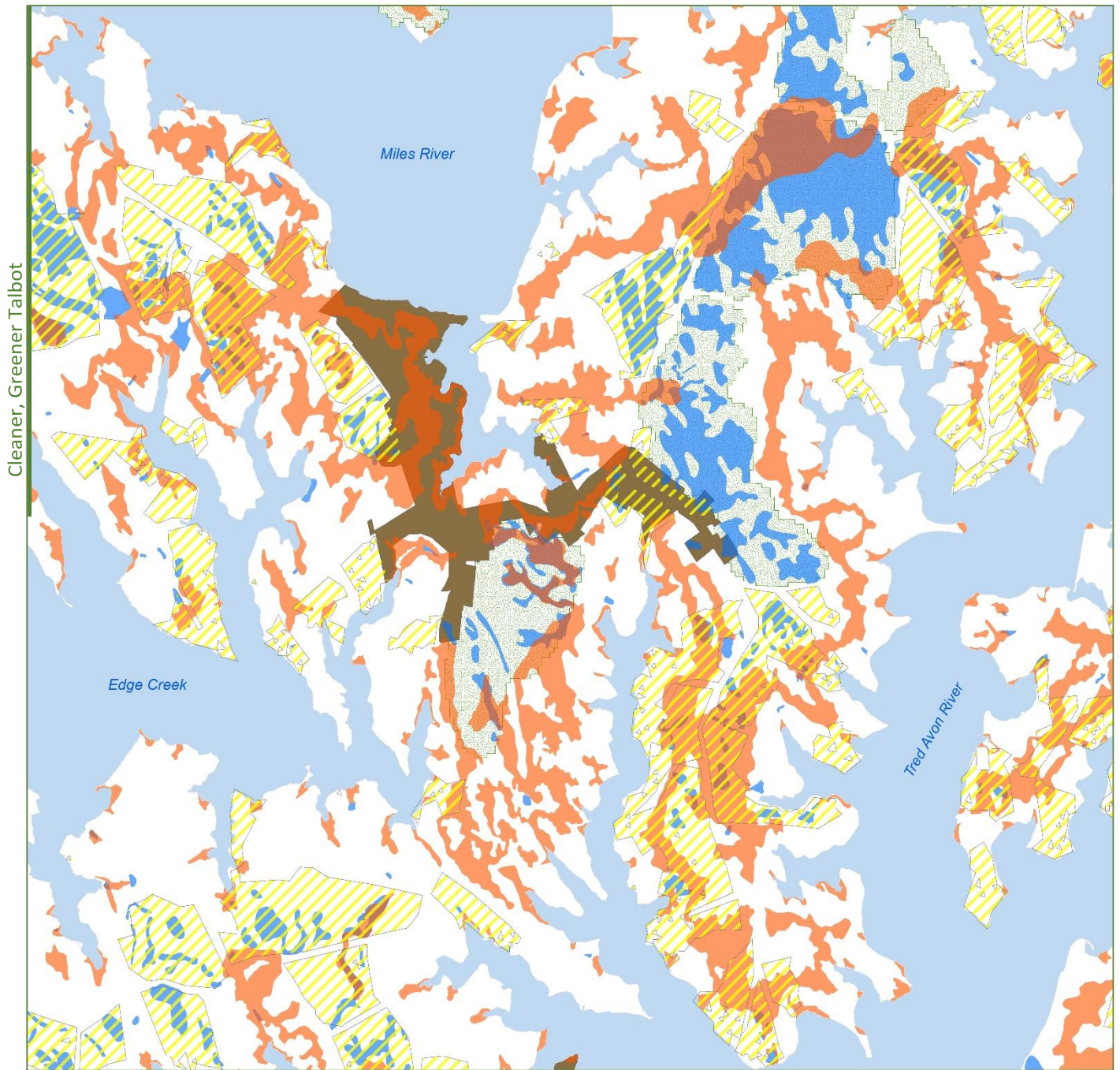
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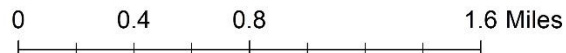
Habitat Cores, Fragments & Hydric Soils: Site 1

Legend

-  Hydric Soils
-  Non-Tidal Wetlands
-  Habitat Fragments
-  Corridors
-  Habitat Cores
-  Villages

Focus in and around the Newcomb and Royal Oak villages for preservation/open space opportunities. Several habitat cores are located within this area as well as habitat fragments. This area has a high concentration of hydric soils.

Hydric soils are permanently or seasonally saturated by water, resulting in anaerobic conditions, as found in wetlands.



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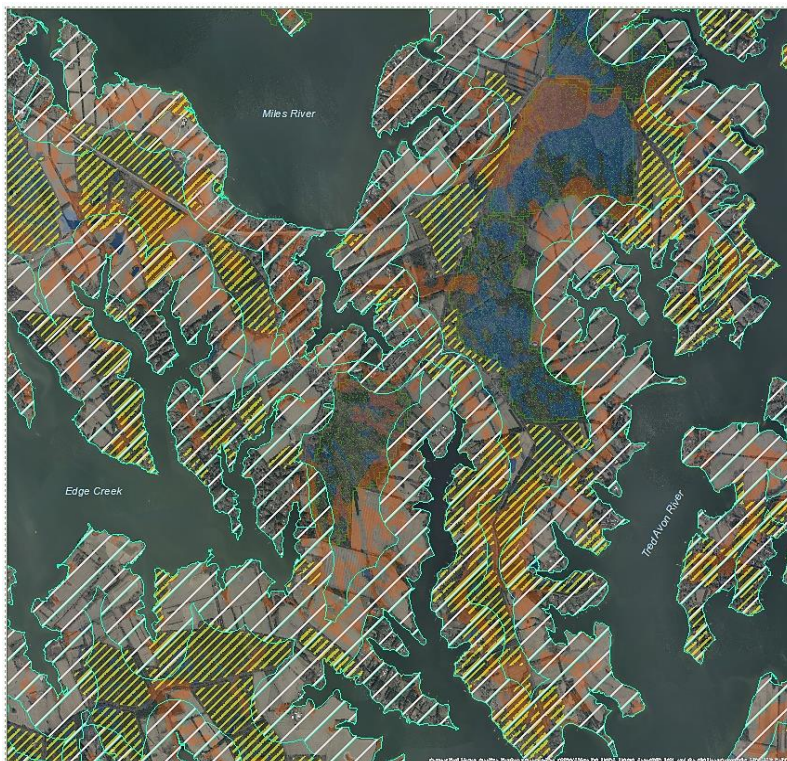
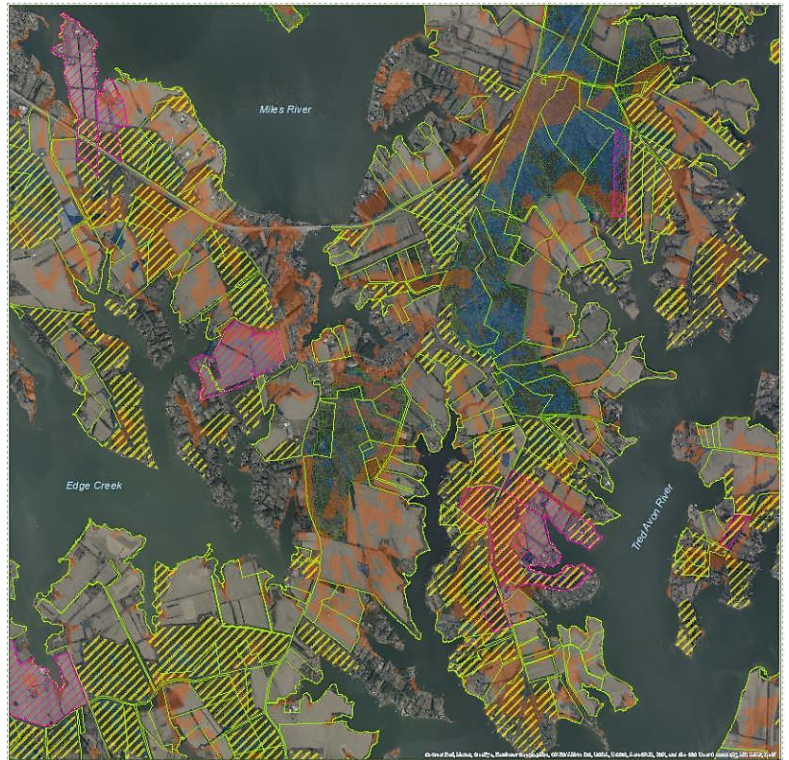


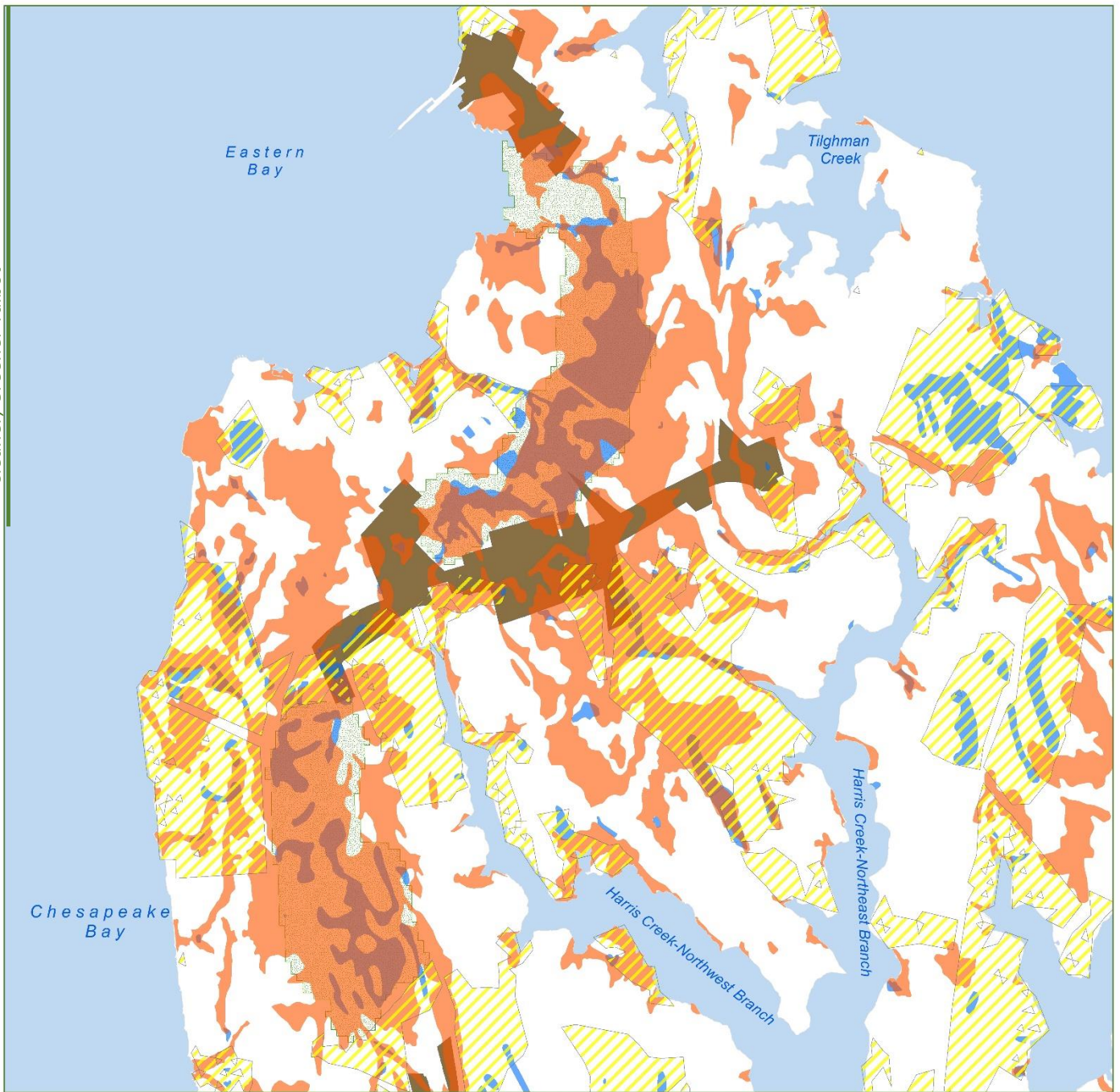
SP&D
Smith Planning and Design

Perservation and/or open space opportunities should be focused in and around the Newcomb and Royal Oak villages. Several habitat cores are located within this area as well as habitat fragments. This area has a high concentration of hydric soils and non-tidal wetlands. Hydric soils are permanently or seasonally saturated by water, resulting in anaerobic conditions, as found in wetlands. These areas may be suitable for forested wetland creation, which are highly valuable. Therefore, further consideration for restoring the wetlands in Site 1 should be considered.

In 2008, legislation passed that required the Department of Natural Resources to develop a Statewide Base Map that includes a State-determined shoreline and landward boundary of tidal wetlands and a digitally generated, geo-referenced 1,000-foot Critical Area boundary.

Site 1 contains a high concentration of unprotected agricultural lands that are within the Chesapeake Bay Critical Area, which is also zoned Resource Conservation Area (RCA) in Talbot County (below). Preserving agricultural lands and restoring wetlands within the Critical Bay Area would allow habitat fragments and cores to connect, creating larger habitat cores. In addition, Site 1 contains Oak Creek surrounded by hydric soils and habitat fragments.





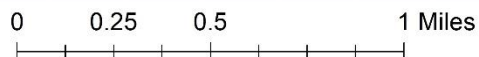
Habitat Cores, Fragments & Hydric Soils: Site 2

Legend

-  Hydric Soils
-  Non-Tidal Wetlands
-  Habitat Fragments
-  Corridors
-  Habitat Cores
-  Villages

Focus in and around the Claiborne and McDaniel villages for preservation/open space opportunities. Several habitat cores are located within this area as well as habitat fragments. This area has a high concentration of hydric soils.

Hydric soils are permanently or seasonally saturated by water, resulting in anaerobic conditions, as found in wetlands.



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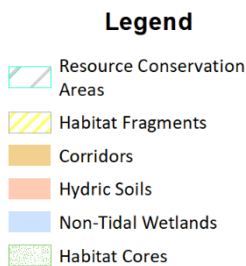
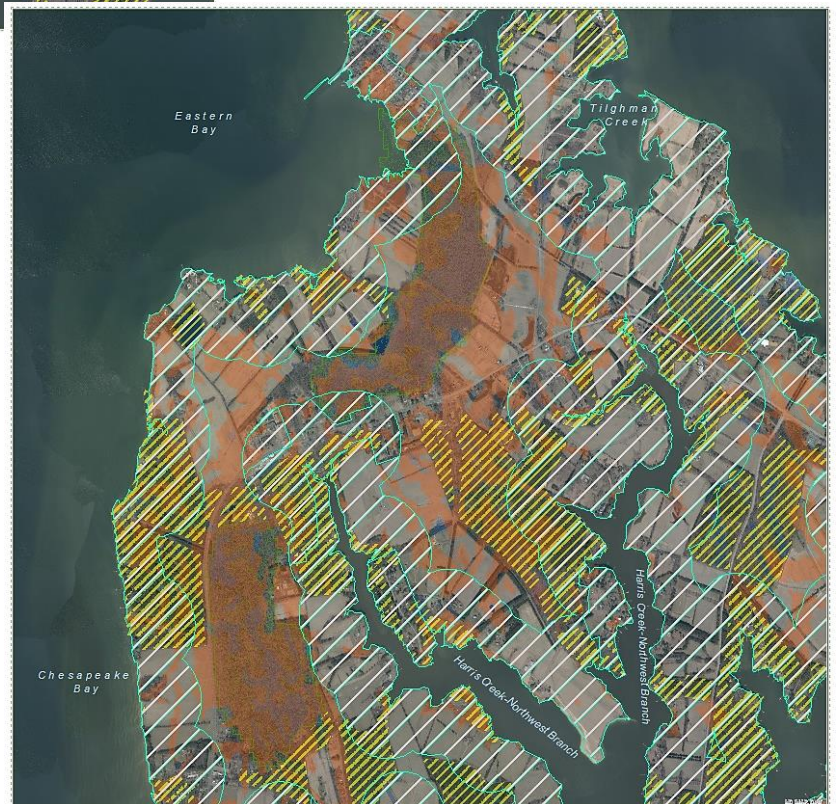
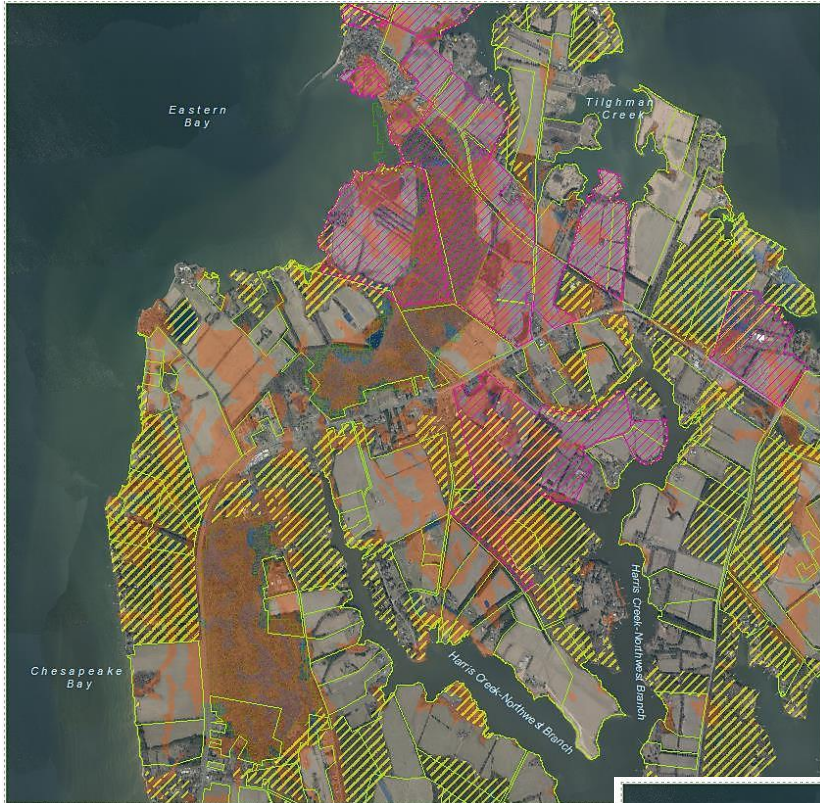


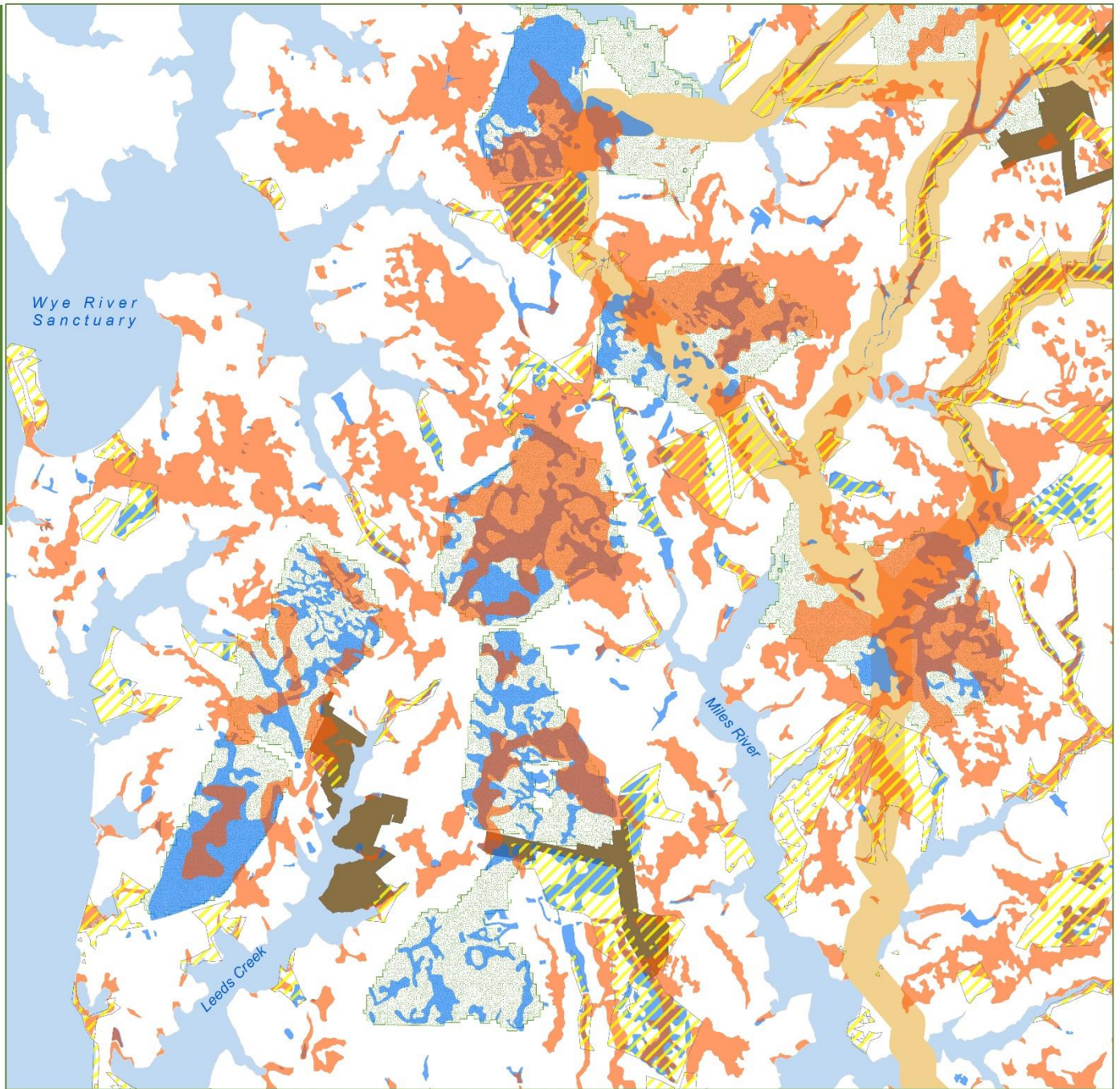
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Smith Planning & Design



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A high concentration of hydric soils are located in and around the Claiborne and McDaniel villages. Several habitat cores are located within this area as well as habitat fragments. Site 2 also is predominately within the Chesapeake Bay Critical Area. Evaluation should be conducted of this area for wetland restoration on agricultural lands that are protected, denoted in pink hashing. Also, agricultural lands connecting habitat fragments to cores should be conserved to ensure the GI network becomes interconnected. Finally, the area around Northwest Harris Creek contains both hydric soils and habitat fragments ideal for restoration.





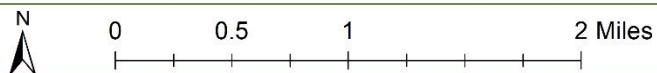
Habitat Cores, Fragments & Hydric Soils: Site 3

Legend

- Habitat Fragments
- Hydric Soils
- Non-Tidal Wetlands
- Corridors
- Villages
- Habitat Cores

Focus in and around the Unionville, Copperville and Tunis Mills villages for preservation/open space opportunities. Several habitat cores are located within this area as well as habitat fragments. This area has a high concentration of hydric soils.

Hydric soils are permanently or seasonally saturated by water, resulting in anaerobic conditions, as found in wetlands.



Prepared for:
Talbot County Planning & Zoning




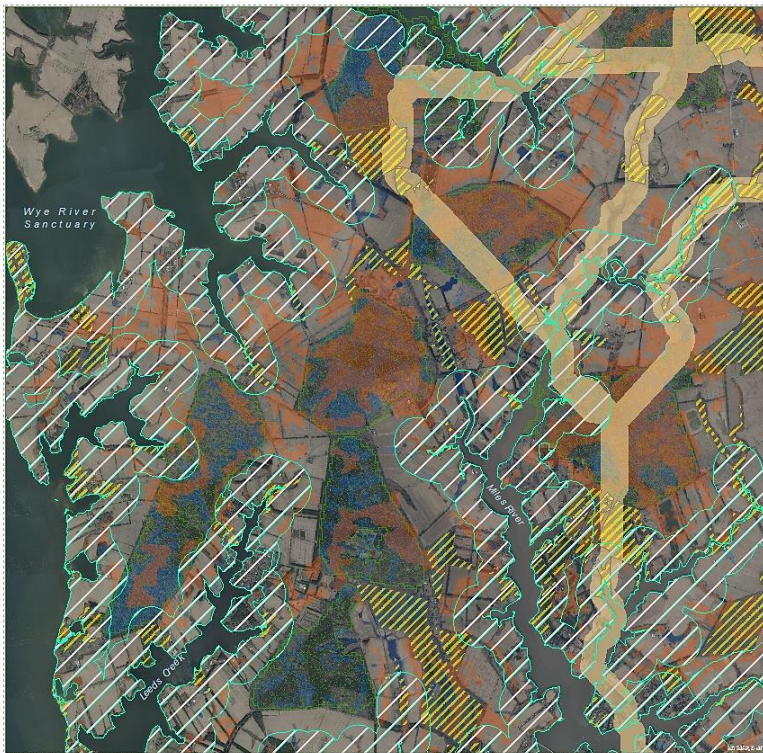
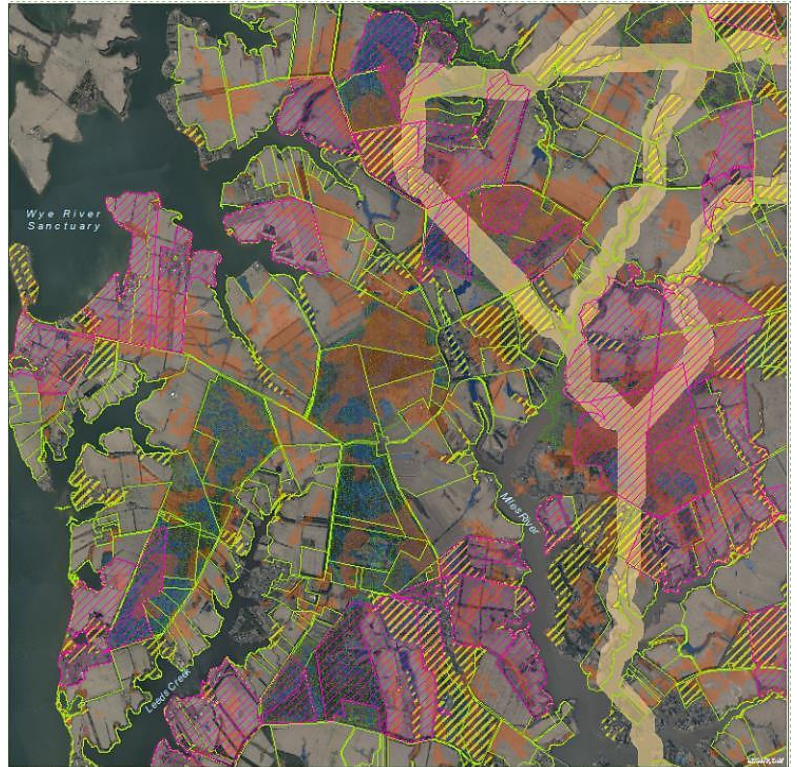
Prepared by:
Smith Planning & Design








SP&D
Smith Planning and Design

Opportunities for preservation and/or open space are in and around the Unionville, Copperville and Tunis Mills villages. Site 3 contains several habitat cores as well as habitat fragments and the habitat corridor. Large areas of hydric soils are scattered throughout Site 3. All areas of hydric soils connect or border the Critical Area. A majority of the protected agricultural lands contain areas of hydric soils, however lands containing hydric soils and habitat cores are not protected. These areas should be evaluated for preservation and/or conservation along with restoration opportunities along the upper reach of Potts Mill Creek.

- Legend**
-  Protected Lands
 -  Agriculture
 -  Habitat Fragments
 -  Corridors
 -  Hydric Soils
 -  Non-Tidal Wetlands
 -  Habitat Cores



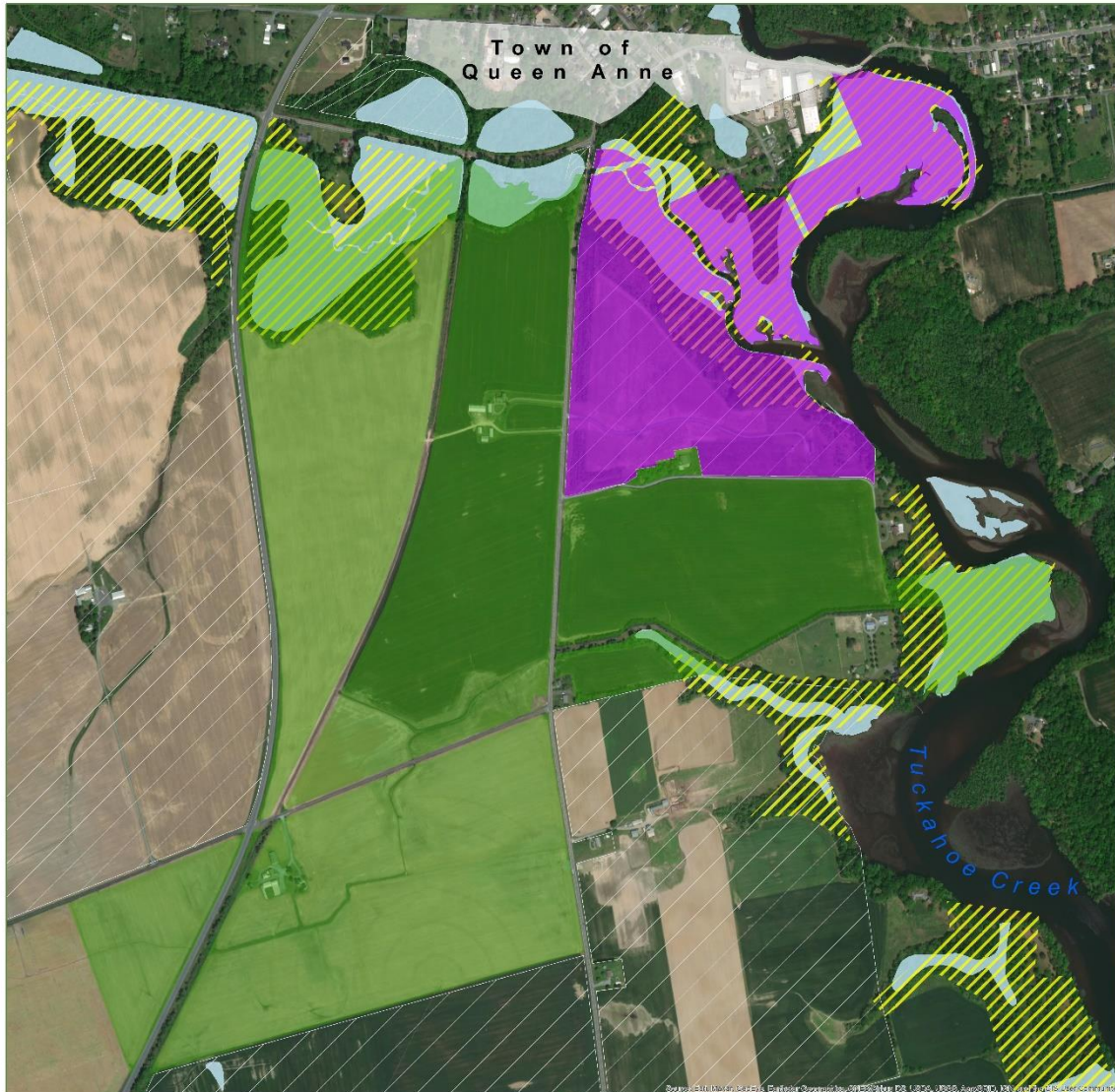
- Legend**
-  Resource Conservation Areas
 -  Habitat Fragments
 -  Corridors
 -  Hydric Soils
 -  Non-Tidal Wetlands
 -  Habitat Cores

PRESERVATION/OPEN SPACE AROUND FREDERICK DOUGLASS PARK ON THE TUCKAHOE

The Frederick Douglass Park on the Tuckahoe is located at 13211 Lewistown Road. The park is located within the Priority Preservation Area, Resource Conservation Area, and State Targeted Ecological Area.

The northern boundary of the park is surrounded by habitat fragments. These fragments are similar to habitat cores, however, they do not qualify as a core due to their small sizes. Three agriculture parcels surrounding the park do not have any type of protection easement and should be considered for conservation and/or open space.

Cleaner, Greener Talbot

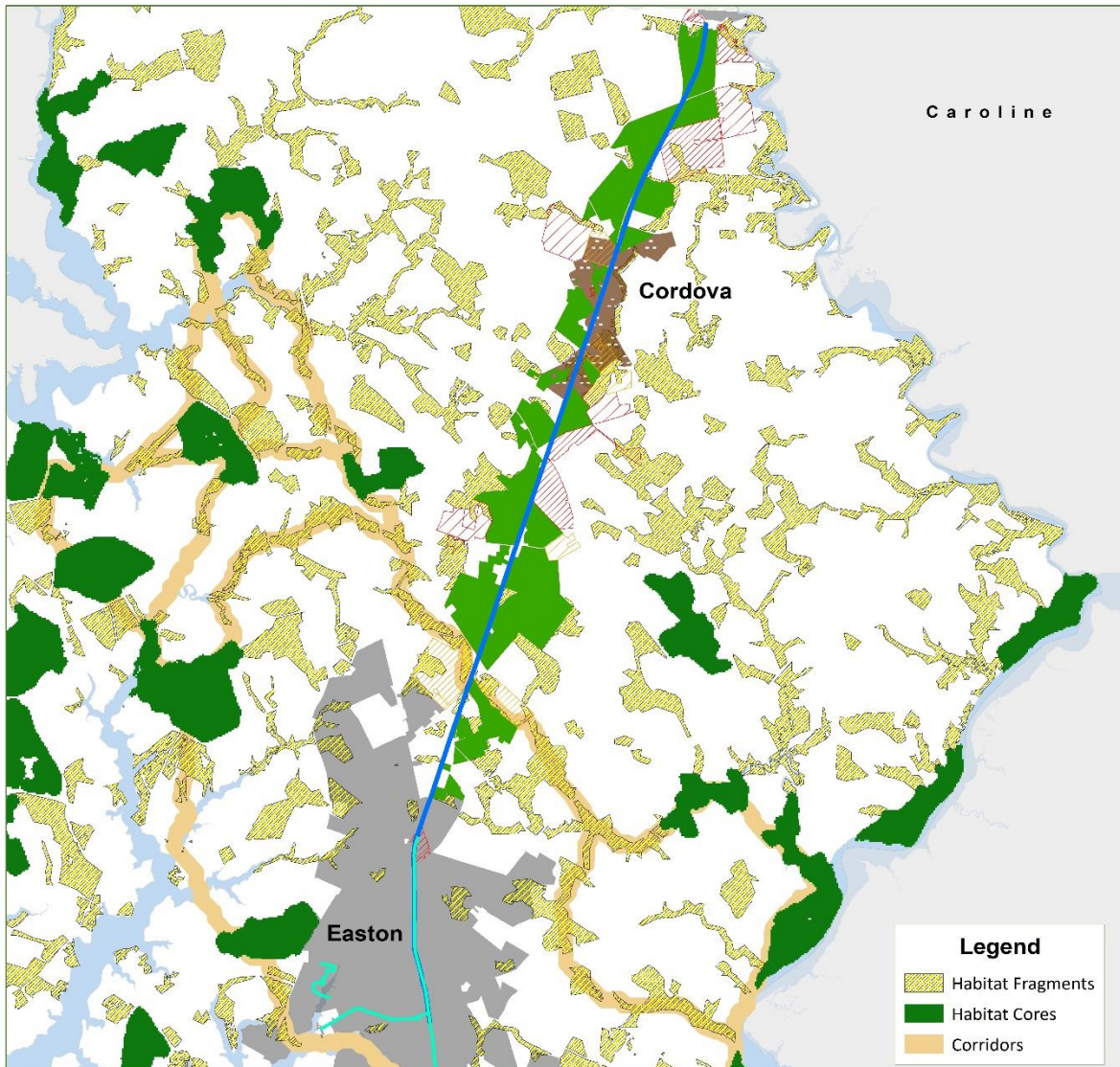


Preservation/Open Space Around Frederick Douglass Park	
<p>Legend</p> <ul style="list-style-type: none"> Frederick Douglass Park on the Tuckahoe Agriculture Parcel-No Easement Protected Lands Habitat Fragments DNR Non-Tidal Wetlands Town of Queen Anne 	<p>The Frederick Douglas Park is located at 13211 Lewistown Road. The park is located within the Priority Preservation Area, Resource Conservation Area and State Targeted Ecological Area.</p> <p>The northern boundary of the park is surrounded by habitat fragments. These fragments are similar to habitat cores, however do not qualify as a core due to size. Three agriculture parcels surrounding the park do not have any type of protection easement. Consider these parcels for permanent preservation/open space.</p> <div style="text-align: center;"> </div>
<div style="display: flex; justify-content: space-between;"> <div style="font-size: small;"> <p>Prepared for: Talbot County Planning & Zoning</p> <p>Prepared by: Smith Planning & Design</p> <p style="font-size: x-small;">SP&D Spatial Planning and Design</p> </div> </div>	



RAILS-TO-TRAILS

The Town of Easton has established a highly successful “Rails to Trails” system that bisects the town. A potential Rails to Trails from Easton through the Village of Cordova is possible using the abandoned rail system, Vanderbilt, that travels from Easton through the Tuckahoe State Park and Cordova. This project could become a green corridor that is connected to the larger green corridor system in Talbot, leading to connectivity with Easton’s Rails to Trails, Frederick Douglass Park on the Tuckahoe, the trail system in Queen Anne County, and ultimately with the Rails to trails through Caroline County.

Cleaner, Greener Talbot



Potential RAILS-TO-TRAILS (RTT) Project

<p>Legend</p> <ul style="list-style-type: none"> — Potential RAILS-to-Trail — Eastons Existing & Proposed RTT <p>Protection Status</p> <ul style="list-style-type: none"> Permanent Protection Temporary Agriculture Parcels-No Easements Cordova 	<p>The Town of Easton has established a very successful “Rails to Trails” system that bisects the town. However a potential Rail to Trails from Easton through Cordova is possible using the abandoned rail system, Vanderbilt, that travels from Easton through the Tuckahoe State Park and Cordova. This could possibly connect to a trail system in Queen Anne County; and ultimately find a suitable connection to Caroline County.</p> <p>A total of 26 agricultural parcels are located along the old Vanderbilt railroad that could possibly be preserved.</p> <div style="text-align: center;"> </div>	<p>Prepared for: Talbot County Planning & Zoning</p>  <p>Prepared by: Smith Planning & Design</p>  <p>SP&D <i>Small. Clever. Not Simple.</i></p>
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A total of 26 agricultural parcels (light green parcels) are located along the old Vanderbilt railroad that could possibly be preserved.



COMMUNITY “GREENING”

Community “greening” is the strategic use of vegetation for urban stormwater runoff management and other functions. Greening practices range from planting street trees and vegetated road medians to rain gardens, to installation of vegetated green roofs and planters on balconies. Greening practices are typically completed at the neighborhood level. While these actions are important and provide several types of benefits, true green infrastructure is a broader ecosystems concept.

Survey participants indicated that community “greening” activities were particularly interesting and applicable to community members. Included below is an excerpt of survey questions and results.

Participants of the online public survey were asked if they were aware of the Talbot County Green Infrastructure Plan. More than a third, 36%, answered “yes”. When asked what type or green infrastructure would they themselves or their community install, answers included (in order of priority- highest to lowest):

- Rain Barrels;
- Planter Boxes (urban setting);
- Rain Garden;
- Permeable Pavement;
- Bioswale; and,
- Green Roof.

Participants of the online public survey answered that the primary motivation for installing green infrastructure include:

- Improve the Environment & Natural Settings;
- Reduce Stormwater;
- Reduce Flooding;
- Reduce Non-Point Source Pollution; and,
- Climate Adaptation.

The following green infrastructure practices that survey participants would like installed in their community in the future include:

- Rain Garden;
- Living Shoreline;
- Bioswale;
- Permeable Pavement;
- Rain Barrel;
- Green Roof;
- Wetland Restoration;
- Riparian Buffer Installation; and,
- Native Planting and Removal of Invasive Plants.



RAIN GARDENS

A rain garden is a shallow, vegetated basin that collects and absorbs runoff from rooftops, sidewalks, and streets.

Rain gardens can be added around homes and businesses to reduce and treat stormwater runoff.



VEGETATED SWALES

A vegetated swale is a channel holding plants or mulch that treats and absorbs stormwater as it flows down a slope.

Vegetated swales can be placed along streets and in parking lots to soak up and treat their runoff, improving water quality.



GREEN ROOFS

A green roof is fitted with a planting medium and vegetation. A green roof reduces runoff by soaking up rainfall. It can also reduce energy costs for cooling the building.

Extensive green roofs, which have deeper soil, are more common on commercial buildings. Intensive green roofs, which have shallower soil, are more common on residential buildings.



RAINWATER HARVESTING

Rainwater harvesting systems collect and store rainfall for later use. They slow runoff and can reduce the demand for potable water.

Rainwater systems include rain barrels that store tens of gallons and rainwater cisterns that store hundreds or thousands of gallons.



PERMEABLE PAVEMENT

Permeable pavements allow more rainfall to soak into the ground. Common types include pervious concrete, porous asphalt, and interlocking pavers.

Permeable pavements are most commonly used for parking lots and roadway shoulders.



TREE CANOPY

Tree canopy can reduce stormwater runoff by catching rainfall on branches and leaves and increasing evapotranspiration. By keeping neighborhoods cooler in the summer, tree canopy can also reduce the "urban heat island effect."

Because of trees' many benefits, many cities have set urban tree canopy goals.



TREE TRENCHES

A stormwater tree trench is a row of trees planted in an underground infiltration structure made to store and filter stormwater.

Tree trenches can be added to streets and parking lots with limited space to manage stormwater.

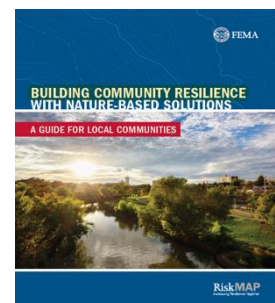


GREEN STREETS

Green streets use a suite of green infrastructure practices to manage stormwater runoff and improve water quality.

Adding green infrastructure features to a street corridor can also contribute to a safer and more attractive environment for walking and biking.

Source: FEMA RiskMAP- Building Community Resilience with Nature-Based Solutions: A Guide for Local Communities



Survey results conducted for this planning project indicated a high degree of community interest in rain gardens. Therefore, a rain garden and bioretention assessment tool developed by *Washington State University in coordination with Stormwater Action Monitoring and Stewardship Partners for the Puget Sound* was reviewed and tailored for Talbot County. This tool is intended for use by a data collection team comprised of residents, community groups and business partners within the County. The tool assesses and catalogs restoration and stewardship projects at the neighborhood level. The toll will complement the University of Maryland Extension's Stormwater Management and Restoration Tracker. The completion of this assessment will lead to an “community greening” inventory for Talbot County, and continued tracking of bioretention areas and rain garden projects.



The Data Collection Input Form (pictured left) would be used to collect data such as:

- Background Information;
- Contributing Area/Hydrology; and,
- Conditions – Soils, Vegetation, Public Amenities.

In addition to the assessment tool itself, instructions for the use of the assessment tool were developed for this planning project. Data obtained from the assessment tool will populate the countywide inventory. Using analysis and visualization the inventory will be capable of producing results that will provide users a mechanism to measure the success of “community greening” initiatives.

Data Collection Input Form and instructions are within Appendix D. An MS Excel version may be obtained through the Department of Planning and Zoning.

Difference Between Rain Gardens & Bioretention

Rain gardens are smaller, depressed areas designed to collect and filtrate residential stormwater. These gardens are planted with grasses and flowers. **Bioretention** areas are more complexed rain gardens with drainage systems and amended soils. These areas are used for commercial and agricultural settings to satisfy permit requirements.

Source: EPA

The goals of the Community Greening Assessment and Inventory:

- To create an easy and inspiring way to track distribution of “community greening” in the County.
- To collect data and compile it in one place to see the collective impact at a Countywide scale.

Photo Source: FEMA Building Community Resilience with Nature-Based Solutions

Bioretention and Rain Garden Assessment Program		
Data Collection Input Form - Talbot County Monitoring		
	Site 1	Site 2
Data Collection Team		
Team Member 1 Name		
Cell # or Email		
Team Member 2 Name		
Cell # or Email		
Team Member 3 Name		
Cell # or Email		
Team Member 4 Name		
Cell # or Email		
I. BACKGROUND INFORMATION		
Site Name		
Survey Date		
Start Time		
Street Address		
City		
County		
Location Lat (such as 47.019716)		
Location Longitude (such as -122.785379)		
Sound Impacts ID:		
Rain Fall		
Today (inches)		
Yesterday (inches)		
2 Days Ago (inches)		

PLAN REVIEW AND INTEGRATION

Plan Review and Integration

The goal of plan integration is to effectively integrate plans and policies across disciplines and agencies by considering potential impacts and implications to the Green Infrastructure (GI) network and related GI initiatives. As part of this planning process a plan review was conducted for the following documents:

- 2004 Maryland's GI Assessment and GreenPrint Program;
- 2008 Maryland Working Waterfront Commission Final Report;
- 2010 A Sustainable Chesapeake: Better Models for Conservation;
- 2011 Talbot County Stormwater Management Process and Implementation Guide;
- 2013 Economic Development Strategic Plan for Talbot County and the Towns – an Opportunity for Alignment;
- 2015 Building a Framework for Sustainable Working Waterfronts – Cambridge (Environmental Finance Center);
- 2016 County Comprehensive Plan Ch 2 Land Use Plan;
- 2016 County Comprehensive Plan Ch 6 Natural Resource Conservation;
- 2017 Hazard Mitigation Plan;
- 2017 Bellevue Village Master Plan;
- 2017 Tilghman Village Master Plan;
- 2017 Talbot County Floodplain Management Plan Progress Report;
- 2018 Land Preservation, Parks and Recreation Plan;
- 2019 Eastern Shore Land Conservancy – Mainstreaming Sea Level Rise Preparedness in Local Planning and Policy on Maryland's Eastern Shore; and,
- 2020 Eastern Shore Land Conservancy-Preparing for Increases in Extreme Precipitation Events in Local Planning and Policy on Maryland's Eastern Shore.

Each of the planning documents listed above was reviewed and the following information was gathered:

- Relevant Values, Goals, Objectives, Priorities;
- Useful Data Sources or Maps;
- Relevant Projects (related to GI and/or in focus areas);
- Discussion of water resources and stormwater; and,
- Relevant Current Policies or Policy Incentives.

Following the plan review, opportunities for GI integration were identified along with other relevant information. The complete plan review and integration tool has been included in Appendix B.

STEP 6: IMPLEMENT A PLAN

Implement a Plan

In review of the previous five steps in the Green Infrastructure (GI) six step process, an implementation table has been developed. This table includes action items, timeframe for implementation, responsible entity and potential funding sources.

It is important to consider a wide range of funding sources for green infrastructure. Local sources of funding may include general funds, bonds, taxes (dedicated/ad valorem, property, real estate transfer, business improvement district, tax increment financing, stormwater), and fees (impact fee in lieu, utility). In addition, there are federal, regional, and state grants and loans. While potential funding sources have been identified within the implementation table, careful exploration and consideration of project phasing and the use of various funding sources should be applied.

Green Infrastructure (GI) Six Step Planning Process

1. Set goals
2. Review data
3. Make asset maps
4. Assess risks
5. Determine opportunities
6. **Implement a plan**

Green infrastructure projects lend themselves to innovative funding strategies that take advantage of their various desirable **co-benefits** for the environment, economy, and community.

Source: Rouse, David and Ignacio Bunster-Ossa. 2013. Green Infrastructure: A Landscape Approach. PAS Report no. 571. Chicago: American Planning Association.

The implementation table was reviewed and discussed during the March 15, 2021 stakeholder group meeting. In addition, the stakeholders discussed potential GI facility locations and implementation considerations.



Pilot Project Location 1- Knapps Narrows Break Wall Improvements / Living Shoreline	Responsible Entity	Task	Timeframe
<p>Action: Develop a long-range plan with multiple phases that include a combination of land management policy, living shoreline applications and structural improvements. This effort will involve creation and cooperation of a Narrows Project Committee that will implement the results of this plan.</p>	<p>Talbot County Planning & Zoning; Narrows Project Committee</p>	<ul style="list-style-type: none"> ▪ Committee Formation ▪ Long Range Plan & Policy Integration into Existing Planning Framework 	<p>6 Months 1-3 years</p>
<p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ FEMA Building Resilient Infrastructure and Communities (BRIC)/Flood Mitigation Assistance (FMA) Grant Program ○ Environmental Protection Agency - Wetland Program Development Grants ○ National Fish & Wildlife Foundation’s Chesapeake Bay Stewardship Fund ○ NOAA Coastal Resilience Grants Program/Restoration Fund 		<ul style="list-style-type: none"> ▪ Grant Application(s) ▪ Project Construction 	<p>1-3 years 2-5 years</p>

Pilot Project Location 2- Waterfront Park	Responsible Entity	Task	Timeframe
<p>Action: Develop a regional park providing public access to the water and opportunities for low-impact passive recreation. In addition, offer significant conservation opportunities such as habitat protection areas and wetland mitigation. Acquisition of parcels and conservation efforts will contribute to the Green Infrastructure (GI) network.</p>	<p>Talbot County Planning & Zoning; Talbot County Department of Public Works; Talbot County Tourism; Talbot County Parks & Recreation</p>	<ul style="list-style-type: none"> ▪ Review and prioritize properties for potential park consideration targeting land trust or state mechanisms 	<p>6 months</p>
<p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ Chesapeake Bay Trust - Non-Tidal Wetlands Grant Program ○ Maryland Department of Natural Resources – Rural Legacy Program ○ Maryland Department of Natural Resources – Community Parks & Playgrounds Program; Project Open Space ○ Maryland Environmental Trust (MHT) – Conservation Easements & Land Trusts ○ Maryland Historical Trust – Certified Heritage Area Programs (**There is also a National Register site with a MHT Easement on one of the parcels – MHT identification number T-146) ○ Environmental Protection Agency - Wetland Program Development Grants ○ U.S. Fish and Wildlife Service - North American Wetlands Conservation Act Grants Program ○ Chesapeake Bay Stewardship Fund Grants Program ○ DNR Chesapeake & Coastal Grants Gateway - Capital Resiliency Program and Waterway Improvement Fund 		<ul style="list-style-type: none"> ▪ Property acquisition ▪ Further explore opportunities for protection, restoration, and low-impact recreation with stakeholders ▪ Develop concept design for potential Park 	<p>1-2 years 1-2 years 2-3 years</p>

Pilot Project Location 3- Barrier Island Restoration – Multiple Locations	Responsible Entity	Task	Timeframe
<p>Action: Build out points and new islands using sand and dredged material to provide a natural defense for areas now experiencing erosion and scour. Areas of concentration include:</p> <ul style="list-style-type: none"> ● Benoni Point ● Black Walnut Point ● Claiborne Jetty & Beach ● Nelson Island ● Sharps Island <p>Note: These are expensive facilities to build and the USACE would likely support a project that would add volume to an existing facility.</p> <hr/> <p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ Maryland Department of Natural Resources - Chesapeake & Coastal Grants Gateway ○ Natural Resources Conservation Service - Watershed and Flood Prevention Operations Program ○ U.S. Fish and Wildlife Service - North American Wetlands Conservation Act Grants Program ○ Chesapeake Bay Stewardship Fund Grants Program ○ FEMA Building Resilient Infrastructure and Communities (BRIC)/Flood Mitigation Assistance (FMA) Grant Program 	<p>Talbot County Planning & Zoning; Talbot County Department of Public Works; USACE</p>	<ul style="list-style-type: none"> ▪ Review locations and prioritize sites ▪ Discuss options with USACE and determine federal interest, if any ▪ Discuss options with Maryland Environmental Services ▪ Site(s) Design 	<p>6 Months</p> <p>1 year</p> <p>1 year</p> <p>2-3 years</p>

Pilot Project Location 4- Town of Oxford Projects	Responsible Entity	Task	Timeframe
<p>Action: The Town of Oxford has four locations that would be suitable for living shoreline applications. These areas are adjacent to private properties and will require cooperation and coordination with the property owner.</p> <hr/> <p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ Maryland Department of Natural Resources - Rural Legacy Program ○ Maryland Department of Natural Resources - Community Parks & Playgrounds Program; Project Open Space ○ North American Wetlands Conservation Act Grants Program; Chesapeake Bay Stewardship Fund Grants Program ○ Department of Housing & Community Development – Strategic Demolition/Community Legacy Grant Programs ○ Maryland Historic Trust- CLG/Non-Cap Grants Program 	<p>Town of Oxford</p>	<ul style="list-style-type: none"> ▪ Explore each of the four identified potential project locations in cooperation with property owners ▪ Develop and submit grant applications- living shorelines ▪ Design and Construction 	<p>6 months</p> <p>1-2 years</p> <p>2-3 years-site specific</p>

Pilot Project Location 5- Tilghman on the Chesapeake Resilient Green Infrastructure Design	Responsible Entity	Task	Timeframe
<p>Action: Talbot County has worked with the Tilghman on the Chesapeake Community Association (TOCCA) and University of Maryland Sea Grant Extension to design a living shoreline with marsh migration corridor, meadow habitat, and stormwater improvements. Practices will be designed to adapt to sea level rise and coastal storm impacts, and address erosion and stormwater runoff. The project will serve as a demonstration site for Cleaner, Greener Talbot.</p>	<p>Talbot County; Tilghman on the Chesapeake Community Association</p>	<ul style="list-style-type: none"> ▪ Design a living shoreline with marsh migration corridor, meadow habitat, and stormwater outflow components 	<p>1-2 years</p>
<p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ Maryland Department of Natural Resources (DNR) Chesapeake and Coastal Service 		<ul style="list-style-type: none"> ▪ Engage and educate local stakeholders 	<p>1-2 years</p>

GI Network Fragments, Natural Resources Mitigation & Restoration	Responsible Entity	Task	Timeframe
<p>Action: Examine the three sites analyzed for restoration and GI connectivity. Each site provides unique opportunities for restoration, with an emphasis on wetland restoration based on the presence of hydric soils, soil indicative of previous wetlands.</p> <p>Site 1- Area around Newcomb & Royal Oak Villages Site 2- Area around Claiborne & McDaniel Villages Site 3- Area around Unionville, Copperville & Tunis Mills Villages</p> <p>In addition, opportunities for stream buffer restorations are present within each of the three site areas identified.</p>	<p>Talbot County Planning & Zoning; Talbot County Department of Public Works; Eastern Shore Land Conservancy; Shore Rivers</p>	<ul style="list-style-type: none"> ▪ Review and inventory assessment of each identified site area ▪ Restoration project listing. ▪ Project scoring criteria and prioritization ▪ Restoration activities 	<p>6 months</p>
<p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ North American Wetlands Conservation Act Grants Program; Chesapeake Bay Stewardship Fund Grants Program ○ Clean Water State Revolving Funds 			<p>1 year</p> <p>1 year</p> <p>2-5 years</p>

Rails-To-Trails	Responsible Entity	Task	Timeframe
<p>Action: A potential Rails to Trails from Easton through Cordova is possible using the abandoned rail system, Vanderbilt, that travels from Easton through the Village of Cordova. This project could become a green corridor that is connected to the larger green corridor system in Talbot, leading to connectivity with Easton’s Rails to Trails, Frederick Douglass Park on the Tuckahoe, the trail system in Queen Anne County, and ultimately connection with Rails to Trails through Caroline County.</p>	<p>Talbot County Planning & Zoning; Town of Easton; Talbot County Tourism; National Park Service; Maryland Department of Transportation</p>	<ul style="list-style-type: none"> ▪ Conduct corridor research to determine who owns the right-of-way, undertaking environmental assessments, negotiating with the railroad, figuring the cost, or value, of the corridor 	<p>1-2 years</p>
<p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ Recreational Trails Program (RTP) ○ National Recreation Trails (NRT) ○ Rivers, Trails, and Conservation Assistance Program (RTCA) ○ Land and Water Conservation Fund (LWCF) Stateside Program ○ Community Development Block Grant Program (CDBG) 			

Plan Review & Integration	Responsible Entity	Task	Timeframe
<p>Action: Review and implement recommendations for Green Infrastructure (GI) integration into other relevant county plans and policies detailed in Appendix B of this document. For instance, the 2022 Talbot County Hazard Mitigation Plan. In addition, integrate GI map layers developed during this planning process into the county land use mapping application.</p>	<p>Talbot County Planning & Zoning; Talbot County Department of Emergency Services; Talbot County Municipalities and Villages</p>	<ul style="list-style-type: none"> ▪ Review Appendix B: Plan Review & Integration 	<p>6 months</p>
<p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ County Staff Time ○ Municipal Staff Time ○ Planning Committee Members Contribution 		<ul style="list-style-type: none"> ▪ Determine schedule for relevant plan updates and prioritize. 	<p>6-8 months</p>
		<ul style="list-style-type: none"> ▪ Integrate GI as applicable across relevant plans and policies 	<p>1-5 years</p>
		<ul style="list-style-type: none"> ▪ Integrate GI mapping layers into county land use mapping application 	<p>6 months</p>

Community Greening Assessment & Inventory	Responsible Entity	Task	Timeframe
<p>Action: Collect data on community greening activities such as rain gardens and bioretention areas using assessment tool developed for Talbot County during this plan development project. Populate countywide community greening inventory using the data gathered following assessment.</p> <hr/> <p>Potential Funding Sources:</p> <ul style="list-style-type: none"> ○ Local Resources – Data Collectors ○ Staff Time ○ Sponsors for Outreach Campaign 	<p>Talbot County Planning & Zoning; Talbot County Municipalities and Villages; Community Groups; Businesses Partners</p>	<ul style="list-style-type: none"> ▪ Form data collection teams. ▪ Deploy teams across the county to complete community greening assessment(s). ▪ Populate inventory using collected assessment data. ▪ Share results of the assessment and determine next steps. 	<p>6 months</p> <p>1 year</p> <p>6 months</p> <p>2-3 years</p>

TERMS

Ecological Integrity: The ability of an ecosystem to maintain those natural processes that sustain the species it supports. It is quantified by the size of the habitat, extent of fragmentation, depth to its interior, area-to-perimeter ratio, soil diversity, elevation changes, water availability, and whether the area supports rare or endangered species.

Edge: The transitional boundary of a core, where the vegetation assemblage and structure differ markedly from the interior. Human alterations to the landscape create the edge environment, such as roads, housing developments, etc.

Green Infrastructure Gaps: Disturbed lands within the green infrastructure network that produce corridor breaks or reduce interior habitat.

Green Roof: A layer of vegetation planted over a waterproofing system that is installed on top of a flat or slightly-sloped roof. ... Intensive green roofs have more soil and a deeper growing medium—sometimes several feet—that can support a more diverse plant selection, including small trees.

Habitat Cores (Hubs): An intact landscape that is large enough to support a multitude of native species. Cores are connected by corridors, which provide pathways for movement across landscapes. Cores are measured by subtracting the edge area (average tree height times 3) and then determining if enough interior habitat remains to support a multitude of species.



Habitat Fragmentation: Breaking up of natural landscape into smaller, more disconnected pieces. Human activities are the main cause of habitat fragmentation by such ways as development of roads, urbanizing, mining and so on.

Habitat Corridors: Vegetated linear areas of similar habitat types that differ from adjacent areas and allow sheltered passage, habitat and foraging from one patch to another. Corridors should be a minimum of 1,000 feet wide to provide enough space to allow 330 feet of edge habitat on each side while still maintaining 330 feet or more of interior habitat.

Bioswales: Storm water runoff conveyance systems that provide an alternative to storm sewers. They can absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters. Bioswales improve water quality by infiltrating the first flush of storm water runoff and filtering the large storm flows they convey.

Living Shoreline: The result of applying erosion control measures that include a suite of techniques which can be used to minimize coastal erosion and maintain coastal process. Techniques may include the use of fiber coir logs, sills, groins, breakwaters or other natural components used in combination with sand, other natural materials and/or marsh plantings. These techniques are used to protect, restore, enhance or create natural shoreline habitat.

Riparian Buffer: A riparian buffer or stream buffer is a vegetated area near a stream, usually forested, which helps shade and partially protect the stream from the impact of adjacent land uses. It plays a key role in increasing water quality in associated streams, rivers, and lakes, thus providing environmental benefits.



Appendix A: Pilot Projects Concept Design

Chesapeake Bay Existing Barrier Island Characteristics

The long, southernmost chains of islands on both the eastern and western shores of Chesapeake Bay contain a discontinuous, irregular mix of classic and marsh fringe type islands. The chains are regularly broken by wide inlets corresponding with the outlet points of rivers, both large and small. The islands on the western shore are typically longer (1 km) and wider (75m) than those on the eastern shore (0.5km and 20m, respectively). There is also considerable difference in the width of the back barrier lagoon between the southern islands of the western and eastern shorelines. Barrier islands on the western shore are backed by a lagoon just half the width on average of that on the eastern shore. This difference is likely attributable to the asymmetric distribution of large storms. Nor'easters, the storms that generate the greatest sediment supply originate from the east and tend to push sediment westward.

Islands in the Tangier Sound and near the mouth of the Nanticoke River on the eastern shore are almost exclusively marsh fringe barrier islands and are associated with marsh wetlands as much as 5km wide. The northernmost islands (Hoopers Islands) are short marsh fringing barriers associated with the drowned mainland topographic fragments extending from the mainland. The barrier islands within the Potomac River sub estuary (to the north) and the James River sub-estuary (to the south) are a mix of classic and marsh fringe barrier islands. The three islands of Currioman Bay, within the Potomac River, are densely vegetated and protect a 300m-wide open water back barrier lagoon. Excepting their short length, they are indistinguishable from open ocean barrier islands. Two sets of two-sided islands with their long axes oriented north and south divide the Tangier Sound from the main channel of the Chesapeake Bay. Although they appear to be situated in the geographic center of the bay, they sit on a narrow, submerged shallow topographic high that extends south from the mainland 'neck' between Nanticoke and Choptank Rivers.

The average shore normal fetch varies considerably among the barrier islands in the Chesapeake. Barriers south of the Potomac River mouth are subject to fetches ranging from 20 to 30 km, while islands in the Tangier Sound, Potomac River, and James River are subject to shore perpendicular fetch distances of less than 15 km. The two-sided islands are subject to 20 km fetch both due east and due west. Neither island length, nor width, nor type appear to be closely correlated to shore normal fetch, although all of the longest islands are along the main channel of the lower bay where the maximum fetch along the north-south axis of the bay exceeds 50 km. Classic, marsh fringe, and two-sided barrier islands are representative of the barrier islands in the Chesapeake Bay where (1) the land surface slope is low enough (2) the sediment supply great enough and (3) a topographic or vegetative nucleus exists to provide the impetus for island growth and development. Barrier islands in the Bay are very numerous in the extremely low-gradient southern reaches of the bay, but do not exist along the central-western shore in the vicinity of the 10m high Calvert Cliffs. In areas where barrier islands are abundant, tidal and mud flats are universally present, extending a kilometer or more offshore to the 3m contour depth. In the region of the Calvert Cliffs, the 3m contour is just 200m from shore. Likewise, much of the marsh shoreline of Tangier Sound lacks barrier islands because the sediment supply is too low or there is not adequate wave energy to push the sand onshore.

A wave-energy gradient is also responsible for the division between classic and marsh fringe islands. Greater wave energy, in part related to greater fetch, is responsible for creating longer, wider islands, and for smoothing islands into elongated sand bodies. Higher wave energy prevents vegetation from growing on the shoreface and in the inter-tidal zone. The growth of vegetation on and behind marsh fringe barrier beaches, a direct result of lower wave energy, exerts strong controls on the plan form of those islands. Classic islands develop nearest the bay openings; marsh fringe islands develop in the lower wave energy, northern estuarine waters. Both the marine contribution to the sediment supply and wave energy are major reasons for such a division. Sediment in the intertidal zone, nearshore system and bay bottom is rarely impacted during fair weather conditions. However, heavy seas and high winds will mobilize the sediment. As waves shoal on shore, the existing marsh

grass stabilized in a peat or mud substrate reduces wave energy and induces sediment settling. Storm deposits of sediment on the salt marsh fringes of the bays and the consequential over wash and future storm breaching are the primary mechanisms for island development. These barrier islands are thus subjected to breaching and over wash with each passing storm event

Wave Climate:

Wave climate refers to averaged wave conditions as they change throughout the year. As waves are generated by winds, wave climate reflects both seasonal winds as well as those caused by extreme storms. Wave climate is a good measure of potential shoreline change because on a daily basis shorelines erode minimally. Pronounced erosion often occurs during high-energy storms, such as northeasters and hurricanes, when high winds blow across the bay and greatly increase wave conditions.

Seasonal wind patterns vary in the Chesapeake Bay region. From late fall to spring, the dominant wind directions are north and northwest. During the late spring, the dominant wind shifts to the southwest and continues so until the following fall. Northeast storms, which occur from late fall to early spring, are associated with eastward moving, low pressure areas. Often, there is a period of intense north to northwest wind after a storm front passes. Hurricanes, with sustained winds of at least 74 mph, occur from mid-summer to mid-fall. Although hurricanes generate higher winds and storm surge than northeast storms, their duration generally is shorter. During storms, the rate of erosion at any location depends upon the following conditions:

- Storm frequency
- Storm type and direction
- Storm intensity and duration
- Storm surge, currents, and waves.

The wave climate of a particular shoreline along the Chesapeake Bay system depends upon several factors other than wind, including fetch, shore orientation, shore type, and nearshore bathymetry. Fetch is the distance of open water over which wind can blow and generate waves in an area. The greater the fetch, the greater the potential wave energy. Wave energy is measured by wave height and wave period. Wave period is the time it takes successive waves to pass a fixed point. Fetch can be used as a simple measure of relative wave energy.

- Low-energy shorelines have average fetch exposures of less than 1 nautical mile and often are found along tidal creeks and small tributary rivers.

In low wave-energy environments (small tidal creeks), shore types are usually slowly eroding, upland sediment banks or marshes. Shorelines with a sufficiently wide marsh fringe generally have little or no problem with upland bank erosion because established marsh fringes will absorb most of the wave energy before it can impact the upland banks.

Shorelines that have exposed and eroding upland banks most likely had a marsh fringe in the past. However, the marsh slowly eroded away leaving the base of the upland vulnerable to wave attack. Oftentimes, on low energy shorelines, the base of the bank is eroding, and the upper bank face is relatively stable as evidenced by abundant, woody vegetation. In these cases, the bank does not require grading, and only the base needs to be protected. In many instances, overhanging tree limbs shade out the marsh fringe leaving the base of the upland banks vulnerable to even the slightest wave action. In the low-energy regimens, boat wakes may even increase shoreline erosion.

Recommended erosion control measures in the low energy wave regimen include marsh planting and bank grading, marsh toe revetments, small stone breakwaters or sills (to maintain beach fill), and small, stone revetments or bulkheads.

- Medium-energy shorelines typically occur along the main tributary estuaries; average fetch exposures of 1 to 5 nautical miles.

Medium wave-energy environments generally are located along main tributaries of the Chesapeake Bay. Shoreline types include moderately to highly eroding upland banks and marsh shorelines. Shore zone features need to be wider in this regimen than in low energy environments to compensate for higher wave energy.

Recommended abatement measures in the medium wave energy regimen include bank grading combined with bulkheads and stone revetments, and headland breakwaters with beach fill and marsh plantings. Along eroding marsh shorelines, marsh toe revetments and sills are recommended.

- High-energy shorelines occur along the main stem of the bay and at the mouths of tributary estuaries; average fetch exposures of over 5 nautical miles.

High wave-energy environments are generally located on the Chesapeake Bay proper. Shoreline types include highly eroding upland banks, sand beaches, and marsh shorelines. The increased fetch in these areas results in larger waves hitting the shoreline in storm conditions. Increased wave size also translates to high costs for a properly designed structure. Protective measures such as bank grading, marsh plantings, and beach fill may be used in these areas, but are best applied in combination with headland breakwaters, sills, and groins.

In high-energy environments, more than in medium-energy regimens, stone revetments, seawalls, and bulkheads must be designed to withstand powerful waves that may run up, or even break over the top of the structure.

Marsh toe revetments can be used, but the high wave-energy environment will require increased rock size; a sill might be a better option—both should be considered. Armor rock should be 600 to 1,600 pounds each for sills along high-energy shorelines. Large armor rock will create a thick structure; plan on using two layers of armor stone.

Dredge Material Regulations - USACE and EPA Roles

USACE and EPA have long had general policies offering broad support for the use of dredged material for beneficial purposes. Throughout the years, these policies allowed USACE to incorporate to some extent beneficial use projects into its Civil Works dredging programs. In the past 20 years, Congress has provided new legislative authorities and funding that enable and encourage USACE to pursue beneficial use opportunities, particularly habitat restoration projects, on a much wider scale

In 2004, EPA and USACE published a guidance document titled *Evaluating Environmental Effects of Dredged Material Management Alternatives—A Technical*. This document provides EPA and USACE a consistent technical framework for evaluating potential environmental impacts of dredged material management alternatives, including beneficial use options, and for meeting the substantive and procedural requirements of the governing regulations.

USACE is the nation's largest dredger through its Civil Works dredging projects. USACE is also responsible for issuing permits for dredged material disposal, after review or concurrence by the EPA. Other federal, state, and local agency reviews are required depending on the jurisdictions in which the dredging occurs and the

location of dredged material disposal or placement sites. The central role of USACE and EPA in dredging provides them the opportunity to broadly and strongly support beneficial use projects.

USACE Permitting

Port authorities, state or local governments, and private entities engaging in dredging activities are subject to permitting requirements under a number of federal statutes. Although USACE does not issue permits to itself for Civil Works projects, it applies the same regulatory criteria and guidelines, as appropriate, to its own Civil Works projects. Under Section 10 of the Rivers and Harbors Act of 1899, USACE issues permits for, among other things, dredging operations and/or disposal of dredged material, in “navigable waters of the United States.” The “navigable waters of the United States” subject to Section 10 are all waters historically used, currently used, or susceptible to use to transport interstate or foreign commerce, including the three-mile territorial sea as well as all waters subject to the ebb and flow of the tide (33 C.F.R. 329.4). Compliance with other laws, including NEPA, CZMA, the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), and Section 401 of the CWA, are considered as part of USACE’s processing of permit applications.

A permit application filed with USACE where the dredging is proposed, describes the proposed activity’s location, purpose, need, and schedule, as well as the proposed means of disposing of the dredged material. Standard permits are issued following an evaluation process including NEPA analysis, compliance with the CWA Section 404(b)(1) Guidelines and ESA, and several other analyses. If USACE deems the application complete, it publishes a Public Notice to inform other agencies and the public of the proposed activity, and to solicit comments and information necessary to evaluate its probable impact.

Timing and Project Planning

One of the most important considerations for dredged material managers is knowing sufficiently far in advance when suitable material will be available. It normally takes project proponents 2 or 3 years to plan and design a beneficial use project, arrange project financing, and meet all applicable regulatory requirements. Much of USACE’s dredging conducted under its waterway maintenance program means that much of USACE dredging is done as part of a routine, predictable process on an annual basis. USACE staff can provide information on characteristics, volumes, and availability of material from these programs. Local permittees also may dredge on schedules consistent with federal projects to be able to contract with area USACE dredgers, thereby reducing project costs. USACE District staff handling these permits should be able to help characterize this non-USACE dredged material and help coordinate with the permittees.

Beneficial use project sponsors can take advantage of this predictability by working with the local USACE District early in project planning. It is particularly important that interested parties expecting to use USACE dredged material be ready to take and use this material at a time consistent with the USACE dredging schedule. Because of the complexity of setting up beneficial use projects and USACE’s need to spend funds allocated for particular dredging projects in the particular year for which they were allocated, project sponsors should start planning and regulatory compliance activities as early as possible to be ready for the material when dredging begins.

Dredging in the Chesapeake Bay

Most dredged material from Chesapeake Bay, including Baltimore Harbor's navigation channels, is comprised of clean sediments that can be used on the land as soil amendments or engineered fill or in the water to create aquatic habitat and help improve water quality. In 2001, the Maryland general Assembly enacted the Dredged Material Management Act (DMMA) that established a [Dredged Material Management Program](#) (DMMP) and the DMMP Executive Committee to provide oversight and guidance over the Port's dredging needs through a rolling 20-year capacity/ placement plan. The DMMA prioritizes beneficial use and innovative reuse as the preferred placement options in Maryland.

In 2017 Maryland Department of the Environment published the Innovative Reuse and Beneficial Use of Dredged Material Guidance Document. This Document describes the policies and procedures for reviewing proposed beneficial use and innovative reuse projects utilizing dredged material as authorized by The Dredged Material Management Act of 2001, Maryland Code Annotated, Environment Article §§ 5-1101 through 5-1108 and other laws and regulations applicable to specific uses.

As referred to in the guidance document, dredged material is considered a resource with a variety of potential applications, including fill, that can be used safely and in a manner protective of human health and the environment. The purpose of the Document is to guide scientists, engineers, and other technical professionals in how the Department makes approvals and related determinations to beneficially use or innovatively reuse dredged material. In so doing, those seeking Departmental approvals will better understand what information is required, leading to increased transparency and efficiency in the approval process.

The USACE Baltimore District is responsible for maintaining over 290 miles of navigation channels within the Chesapeake and Coastal Bays, including nearly all tidal waters within the State of Maryland. To maintain safe and efficient navigation for the purposes of international and interstate commerce the USACE manages projects involving the dredging and maintenance of marked, federal navigation channels associated with deep-water ports, major waterways and similar navigational projects. These projects, as well as the funds to construct and maintain them, are subject to prior authorization by the U.S. Congress.

When performing dredging activities in this capacity the USACE is generally not subject to typical state or local permitting requirements. However, such federal projects are still required to obtain a Maryland State Water Quality Certification (WQC) in accordance with Section 401 of the Clean Water Act if any discharge associated with the dredging activity will occur into waters of the United States, as well as a Coastal Zone Consistency Concurrence (CZCC) in accordance with the Coastal Zone Management Act (CZMA). These federal projects may not proceed without the state's WQC and CZCC, or the state's waiver thereof.¹⁰ For many dredging projects, USACE partners with a state, local or municipal entity as the "local sponsor" who assumes responsibility for the management and disposal of dredged materials generated by the federal navigational dredging project. Local sponsors are generally subject to all applicable federal, state and local permitting requirements, as discussed under the "Dredged Material Management" section (Section III.D).

MDE has the authority to regulate proposed dredging activities and the management of dredged material under the following (See also Appendix A1):

- Environment Article Title 5, Subtitle 5-901 through 5-911; Annotated Code of Maryland; COMAR 26.23; (Nontidal Wetlands).
- Environment Article Title 5, Subtitle 5-501 through 5-514; COMAR 26.17.04; (Waterway Construction).
- Environment Article Title 16; COMAR 26.24; (Tidal Wetlands)
- Clean Water Act, Section 401 (Water Quality Certification).
- Coastal Zone Management Act, Section 307 Federal Consistency Requirements

For Beach Nourishment and Marsh Creation Projects – Current regulations (COMAR 26.24.03.05 and 26.24.03.06D) require grain size analyses for both the dredged material and placement site. The dredged material must be equal to or larger in grain size and character than the existing beach material, or determined otherwise to be compatible with existing site conditions acceptable to MDE. The dredged material may not contain more than 10 percent silts and clays, or control measures such as breakwaters, groins or similar structures should be used to control movement. These regulations also require that the dredged material must be relatively free of organic material, floating debris, or other objects and not cause adverse impacts to existing navigation channels, longshore currents, adjacent properties, and fish spawning, nursery or migration patterns. Any adverse impacts to commercial and sport fishing shall also be minimized.

For Island Habitat Restoration Projects – Restoration of island habitats in the Chesapeake Bay and outside of Baltimore Harbor are regulated through the State’s Tidal Wetlands License and WQC. Island restoration projects are designed to keep dredged material in place using containment dikes or similar controls to prevent movement of placed dredged materials. Accordingly, MDE focuses on regulating discharges from the island habitat restoration sites through special conditions in the Tidal Wetlands License or WQC to minimize turbidity, pH, and associated metals excursions. Additionally, exterior community monitoring may be required to ensure that there are no adverse impacts to the exterior aquatic environment from these regulated discharges.

Poplar Island, Talbot Co.

By 1994, Poplar Island had eroded to just four acres from an estimated 1,140 acres in 1846. Rather than let the island continue to disappear, the Corps, Maryland Port Administration, and many other federal and state agencies decided to restore the island.



Poplar Island’s 1996 feasibility report first suggested the idea of rebuilding Poplar Island using clean dredged material from the Port of Baltimore approach channels. The environmental study included in the report used input from conservation groups, local governments and other stakeholders to conclude that the rebuilding of Poplar Island was both environmentally and economically beneficial.

The approach channels to the Port of Baltimore need to be routinely dredged to keep the waterways safe for navigation and to keep the Port of Baltimore economically viable for large cargo ships. Finding suitable placement sites for this dredged material had always been difficult, but with the addition of Poplar Island, millions of cubic yards of material has had a place to go since 2002.

Construction first began on Poplar Island in January 1998 with the building of containment dikes in, at that time, the northern part of the island. Then in 2000, a second construction contract began to build the southern part of the island. More than 35,000 feet of containment dikes were built using sand and rock around the last remnants of Poplar Island. Once the containment dikes were complete, clean dredged material was pumped into the cells. Through much experiment in crust management, the project team developed innovative ways to dry the dredged material and from it, create upland and wetland habitat.

Beginning in 2001, the island already began to attract various bird species and reptiles including osprey, eagles, terns and terrapins. Significant, innovative engineering work went into the development of wetlands and dikes at Poplar Island that have significantly contributed to the restoration goals for the Chesapeake Bay. These efforts have become a model for ecosystem restoration throughout the world.

With optimum funding, the project at Poplar Island will be completed in 2044 and will contain 68 million cubic yards of dredge material, creating 776 acres of tidal wetlands, 829 acres of upland habitat and a 110-acre open water embayment area in the Chesapeake Bay.

James Island and Barren Island, Dorchester Co

Army Corps of Engineers and Maryland Port Administration plan to transform the swiftly eroding James Island into a formidable storm barrier and wildlife sanctuary using the same methods as nearby Poplar Island. Poplar Island is growing by 2 million cubic yards a year in the Army Corps’ largest beneficial use of dredged material undertaken on the East Coast. State and Federal managers of the island estimate that the island will reach its

1,715-acre capacity by 2030 or 2031. In need of somewhere else to deposit the sediment, the agencies are turning to other locations

After 20 years of planning, the next phase is set to make history again. The rebirth of James Island off Dorchester County. Once complete, James Island will encompass nearly 2,100 acres of new ground. The \$1.9 billion undertaking, known as the Mid-Chesapeake Bay Island Ecosystem Restoration, also includes using local dredge sites to add 72 acres to Barren Island, another Dorchester land mass in danger of disappearing.

The primary objective of the Barren Island restoration project was abatement of barrier island erosion through breakwater construction and restoration of marsh habitat through beneficial use of dredged material. The benefits of the project included abatement of eroding shoreline, creation and restoration of coastal marsh habitat, and providing additional erosion protection to the adjacent Hooper Island and associated built infrastructure from storm events in Chesapeake Bay. Segmented breakwaters along the west side of Barren Island were designed and built to permit full tidal flows and to minimize the influence of overtopping and tidal flushing associated with continuous breakwaters. Operational efficiencies of material dredged from the adjacent Honga River and Tar Bay federal channels minimized operational costs as compared to the traditional upland placement alternative. Essential to the success of the project was the collaboration with USFWS and Dorchester County for selection of wetland plant species and post restoration monitoring.

These projects will enhance the bays ecosystem by reducing the amount of sediment that washes into nearby waters and enlarging nesting areas for rare and threatened bird species. Plans for James Island call for a ring of boulders and other armoring. In many locations, such “hardened” shorelines have been shown to reduce important habitat for waterbirds, crabs and fish. However, federal biologists tracking the presence of wildlife on Poplar, which also sports a stone perimeter, have documented up to 15,000 birds a day touching down on the island, representing more than 200 species. Before the work got under way, only 10 bird species frequented it.

The Corps selected James Island after analyzing 100 potential island restoration sites. James Island was chosen because it offered a large viable area that would maximize the material placement capacity while allowing infrastructure costs to be kept to a minimum. Initial engineering designs for the islands have been completed and construction of the Barren Island dike is set to begin in 2022 with dredge placement expected to take place two years later and extend through 2029. James Island is expected to begin after Poplar Island is scaled back and will begin dike construction in 2024, with dredge material beginning in 2028.

Isle of Wight Bay, Worchester Co

The Isle of Wight Federal channel is a three-mile navigation channel that is six feet (ft) deep and 75 ft wide that extends into the Isle of Wight Bay. The shoreline had eroded at this location, exposing built infrastructure and loss of marsh habitat. The Isle of Wight Bay restoration project involved dredging the Isle of Wight Federal channel and strategic placing channel sediments in constructed rubble mound breakwaters to restore salt marsh habitat.



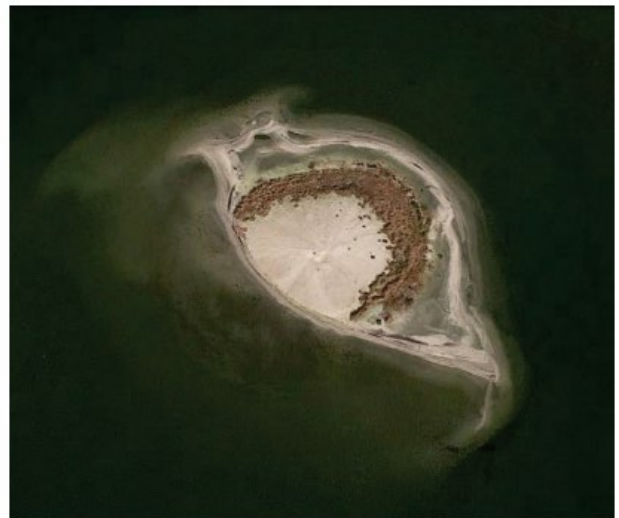
Dredged material was hydraulically pumped with a diffuser behind breakwaters to create a bayside and upland marsh. On the western side of the restored marsh, an opening in the breakwater was created to allow for tidal flows into and out of the marsh. The opening allows for natural water flows that sculpt the marsh. Additionally, a handicap accessible pier was constructed, providing the public with recreational fishing and crabbing opportunities. The benefits of the project include abatement of eroding shoreline, creation and restoration of coastal marsh habitat, and creation of recreational opportunities via the construction of the pier. This project allowed for the restoration of the Isle of Wight to its historical 1850 footprint, and included the creation of a salt marsh that provides critical habitat for fish, crabs, and waterfowl. In total, the project restored 4.6 acres of low marsh and 1.9 acres of high marsh (6.5 acres total) that extends approximately 325 ft from the existing shoreline.



Collaborations essential to the success of the project included coordination with the Maryland Department of Natural Resources (MDNR), Worcester County, MD, and the U.S. Fish and Wildlife Service (USFWS).

Mark-12 Island Restoration, Worcester Co

The primary objective of the Mark-12 Island restoration project was to restore a back bay island of Sinepuxent Bay, which had been completely eroded since the 1930s, through the use of strategically placed dredged material. Sandy dredged material, sourced from the Sinepuxent Bay navigation channel located near Assateague Island and Ocean City, MD, was used to restore the eroded island habitat. The dredged material was placed in an unconfined manner, allowing wind and waves to self-form the island and for the colonization of native vegetative propagules, to serve as valuable wildlife habitat



In addition to the Mark-12 Island, three other islands (Mark-14, Tern Island, and Robins Marsh) were created in Sinepuxent and Isle of Wight Bays in a similar manner, beneficially using dredged material from the adjacent federal channels to restore coastal island migratory bird habitat. Collaboration with the Assateague Island National Park Service, MDNR, the Town of Ocean City, and USFWS were critical to the success of the project for identification of critical habitat(s) in Sinepuxent Bay and post-restoration monitoring

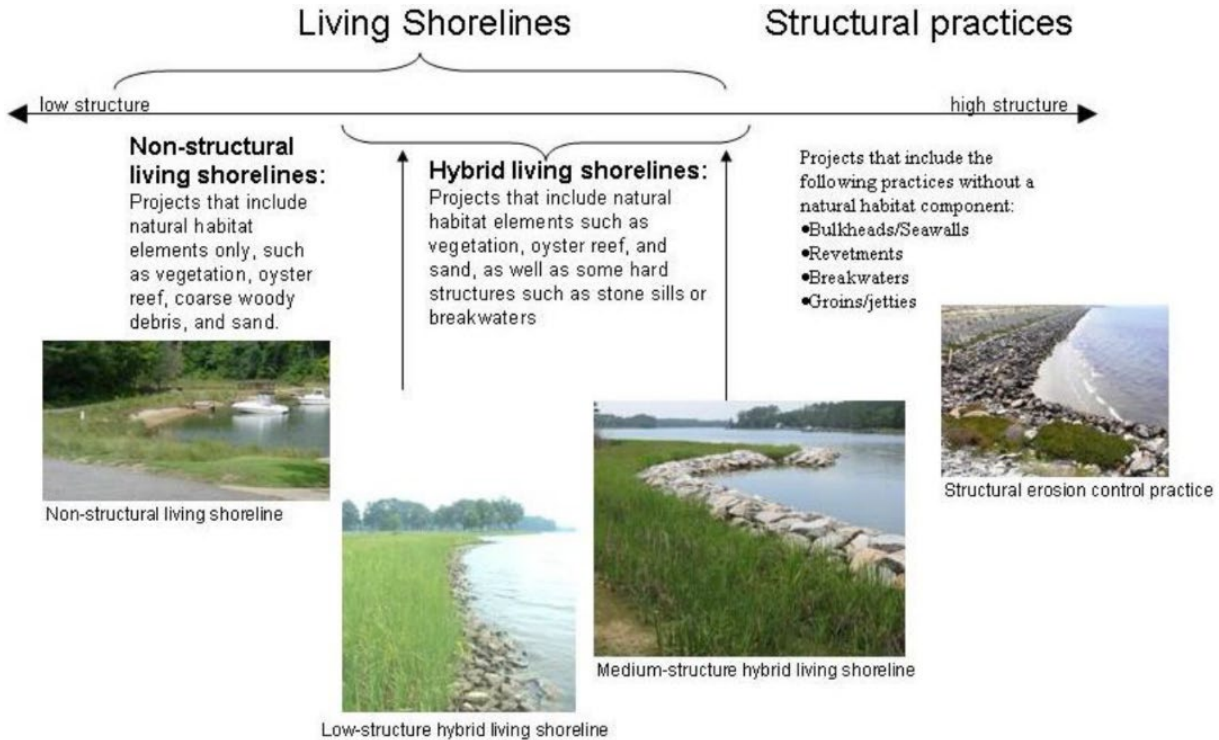
Talbot County Pilot Projects

The remain portion of this analysis will presents feasible living shoreline design alternatives at the following locations and recommended approach to design these structures:

- Knapps Narrows
- Howell Point and Roberts
- Benoni Point
- Blackwalnut Point
- 5) Claiborne Jetty and Beach
- 6) Nelson Island
- 7) Sharps Island
- 8) Town of Oxford

Living shorelines can be designed to provide multiple benefits including erosion control and water quality improvements; protection, restoration or growth of natural shoreline habitat; and maintenance of coastal processes through placement of plants, stone, sand fill, and other structural and organic materials.

The figure below shows various living shoreline management practices based upon the amount of shoreline structure used in implementation.



(Source: Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects, 2015)

Recommended Design Approach

Erosion and recession of shorelines are likely due to various combinations of:

- 1) Increasing sea levels leading to establishment of new equilibrium shorelines and beach profiles.
- 2) Fetch limited waves leading to cross-shore and longshore sediment transport, and boat wakes.
- 3) Storm water levels and wave action.

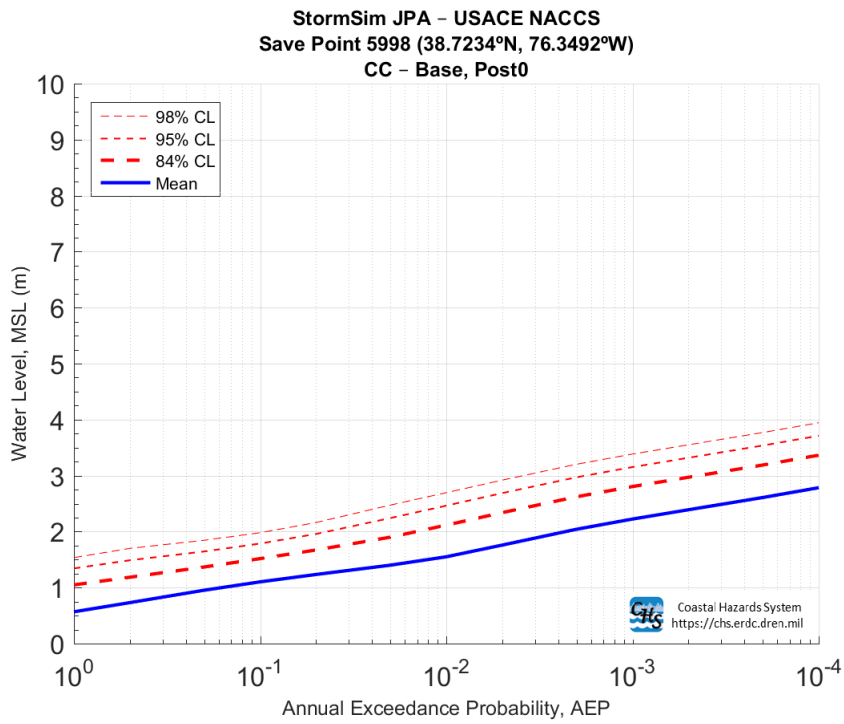
The following approach is suggested to develop detailed design solutions:

- 1) Obtain latest topo bathymetric data and augment with detailed field surveys for all 8 locations.
- 2) Obtain Annual Exceedance Probability (AEP) curves for water levels and waves from the USACE North Atlantic Comprehensive Coastal Study (NACCS) at points near the 8 project sites.
- 3) Obtain AEP curves for water levels and waves from the latest FEMA Flood Insurance Studies.
- 4) It is recommended that the NACCS and FEMA studies should be used for preliminary guidance and design. For detailed design, a local wave modeling effort, incorporating detailed local bathymetry, and using the NACCS and FEMA data as boundary conditions is recommended. This model can be used to evaluate best alternatives as well.
- 5) Using the AEP curves, risk exposure, and asset criticality, and other factors important to the community, determine desired level of protection for each location. It may generally not be economically feasible to design for extreme storms like a 50 or a 100-year event.



6)

USACE NACCS Save Points in Orange in the project area



AEP curve for water levels at the entrance to Knapps Narrows from USACE NACCS (2015)

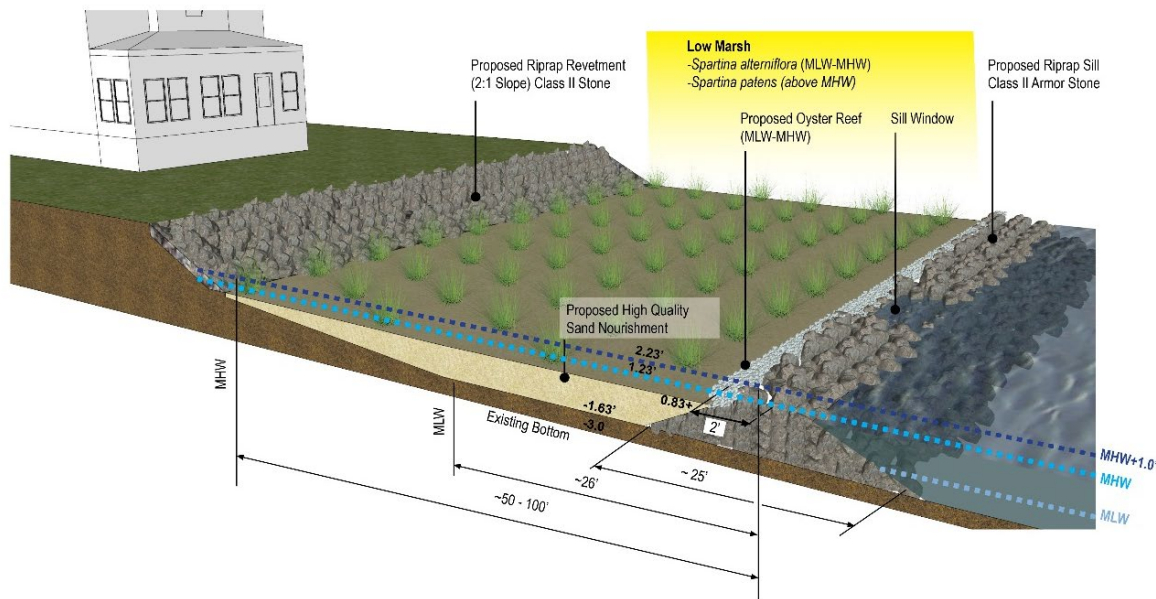
Design Components

The purpose of providing multiple designs is to consider multiple options at various costs. Each component can be combined with other components to achieve desired objectives.

Some suggested components are given below.

- Riprap sill: A nearshore structural component design to absorb or reflect a majority of the wave energy causing shoreline erosion. As an example, for the design, this can be expected to be designed predominantly with Class II armor stone, filter cloth, and a Class A-1 stone core with following components determined for each location:
 - Cross-Section: Trapezoidal
 - Top Width:
 - Bottom Width:
 - Height:
 - Side Slopes: 3:1 (H:V) is common.
- Riprap revetment: a sloping structure placed on the bank of shorelines to absorb or reflect wave energy to preserve shoreline use and reduce erosion.
- Oyster reef: Oysters are beneficial to filtering local waterways and by potentially incorporating them into the design, as the oysters reef matures, it can strengthen the sill while providing natural habitat.
- Sand Nourishment and Marsh Planting: High quality sand nourishment and associated marsh planting will be required for each of the design options. Designed slope of this area could be approximately 10:1.
- Upper Limit of Wetland (ULW) Planting: This area is elevation of approximately 1.5 times the mean tide range at the site. This area is generally a transition area from marsh plants to more herbaceous and woody upland species.
- Earthen Berm: An earthen berm is proposed for areas of the project area which does not protect assets or buildings directly behind the living shoreline. This creates a more natural landscape while also reducing costs where more structural solutions may not be required.
- Upland Riparian Planting: Beyond the areas impacted by tidal fluctuations and the ULW, more traditional upland riparian planting practices can be utilized to reduce pollutant loads. Current use at the site is a mixture of open grassy areas intermixed with some upland woody vegetation.

A schematic of an example using a riprap revetment, a riprap sill, and a regraded low marsh wetland area is given below. This was developed for a site on the Elizabeth River in the Chesapeake Bay.



Schematic of a living shoreline solution on Elizabeth River in the Chesapeake Bay.

The following three design guidelines are excellent resources and will be invaluable for site-specific living shoreline design guidance. The first reference is in the Chesapeake with case studies that will be invaluable.

- 1) **Hardaway Jr, C. Scott, et al. 2017.** *Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments*. s.l. : College of William and Mary: W&M ScholarWorks, 2017.
- 2) *Engineering with Nature, An Atlas, Volume 2*, USACE, April 2021.
- 3) **U.S. Army Corps of Engineers. 2008.** *Coastal Engineering Manual*. s.l. : Department of the Army, 2008. EM 1110-2-1100.

Soils

For marsh creation, clean, high quality, beach sand will be required for backfill behind the riprap sill. Also, topsoil will need to be imported to provide an organic component. These sites will benefit from exploring beneficial use of dredge material solutions in coordination with USACE NAB.

Project site adjacent sediment samples (i.e. flood shoal at the southern tip of the headland) are recommended to confirm the appropriate grain size and organic composition to best match the native material.

Based on the USDA Web Soil Survey, the in-situ soil within the riparian buffer is to be determined. Amendments may need to be made to facilitate riparian plant establishment.

Vegetation

There are two primary species used in marsh creation in the Chesapeake; *Spartina alterniflora* and *Spartina patens*. *Spartina alterniflora* flourishes between the mean low water (MLW) and mean high water (MHW) where it is regularly inundated. Both species can thrive in an intermixing zone between the MHW and mean high high-water line (MHHW). *Spartina patens* flourishes above the MHHW line and becomes the predominant plant until an elevation is reached where other high marsh species, like *Juncus effusus* can compete. It is recommended in the transitional areas where low marsh and high marsh meet to plant both species to allow for a natural propagation of plants within this zone.

For the marsh planting strategy, it is critical to know the tidal range and fluctuations associated with the project site to know where respective species should be planted. For the presented designs, the predominant marsh vegetation will be comprised of *Spartina alterniflora*. A planting density of 1 plant per square foot is recommended for both the low marsh area and upper limit of wetland area. The best planting period is spring, providing an entire growing season for plants to become established.

New plants should take into account the existing, adjacent vegetated area. Plants selected should also be based on the results of soil testing. Soil pH, organic content, and moisture can all be important factors when selecting species for a forest buffer, as well as the ability of the species to grow and thrive without the addition of nutrient fertilizer.

The desired result is that of a natural forest, with a variety of tree and understory plants. Some of the fast-growing native trees and shrubs that may be suitable for this moderate to dry site include Red Mulberry, Loblolly pine, Red Maple, Buttonbush, Arrowwood and Ninebark. Further information on species can be found in the Virginia Cooperative Extension publication entitled “*Understanding the Science Behind Riparian Forest Buffers: Planning, Establishment, and Maintenance*” (VCE Pub. 420-155).

Maintenance Considerations

Each component of living shorelines need periodic maintenance to ensure proper performance and the life cycle costs including maintenance should be considered. Some examples are given below.

Structural Sill & Revetment:

Annual inspections are recommended to monitor slope stability of the sill and revetment. Additional inspections after extreme surge events are recommended as well to monitor slope stability and damage due to extreme surge and wave action.

Oyster Reef:

For the oyster reef design, clean, sundried shells from the local area should be utilized and placed into some type of containment bag. Research has shown, oyster spat (after the larval stage) are significantly more likely to

settle on another oyster shell. The oyster reef is on the landward side of the sill, protected from the predominant wave energy. However over the course of a season, or multiple seasons where storms, boat wakes, etc. may impact the sill, it is best to implement a regular monitoring strategy, replacing existing oyster marl which has been lost. Additionally, a more active role in oyster settlement could be recommended by introducing oyster spat directly to the area.

Marsh Restoration:

Currently there are no existing guidelines for marsh restoration maintenance, however the effort is fairly straightforward. A proper maintenance plan should be developed during the next design phase. In the newly planted marsh area, tidal debris should be removed on a regular basis, any tilting plants or those damaged by wave energies should be replaced, and foot traffic or recreational use should be kept to an absolute minimum.

Riparian Buffer:

Since the performance of the riparian buffer is highly dependent upon proper establishment and maintenance of plants, care for native grasses and seedlings must be adequately performed. Specific maintenance requirements and schedule can be determined during the detailed design, once the buffer plan is finalized and species are selected.

The goal of maintenance operations within the first year of land use conversion are to ensure that the desired vegetative cover is properly established. Once vegetation is established, maintenance is minimal. Typical first year maintenance is provided below.

Typical First Year Maintenance

Activity	Description
Spot Reseeding/ Replanting	<ul style="list-style-type: none"> ● Re-seed areas where initial seeding did not take. ● Replace seedlings if density falls to less than 400 per acre
Fertilization	<ul style="list-style-type: none"> ● One-time, spot start-up fertilization may be needed for initial seed and/or plantings.
Watering	<ul style="list-style-type: none"> ● Water planted area once a week during the first two months, then as needed during the growing season (April-October).

Initial and annual inspections are suggested to identify any changes to the site or deficiencies to the vegetation. See table below for typical elements of annual inspections and ongoing maintenance.

Typical Annual Inspections & Ongoing Maintenance

Activity	Description
Vegetation	<ul style="list-style-type: none"> ● Ensure 95% vegetative cover has been established. ● Check for winter or salt-killed vegetation and replace as necessary; and ● Stabilize bare soil or sediment.
Clean Up	<ul style="list-style-type: none"> ● Remove trash and debris.

A more thorough documentation of inspections and maintenance subject matter is provided in the Chesapeake Bay guidance published by the Chesapeake Stormwater Network at the website: <http://chesapeakestormwater.net/training-library/stormwater-bmp-maintenance/>. This website also contains other design and construction information for a variety of other structural, non-structural, and shoreline management BMPs.

Preliminary Design Data and Mitigation Options

At locations close to the project sites, flood elevations at different recurrence intervals were estimated from the FEMA Flood Insurance Report and presented in the table below. This data is based on detailed coastal hydrodynamic and wave modeling, using coupled ADCIRC+SWAN, conducted between 2008-2012 as part of the FEMA Region III Risk Map coastal studies. It should be noted that these flood elevations are determined based on topobathymetric and climatological conditions that are more than 10 years old and are not reflective of current conditions. These studies did not incorporate impacts of Sea Level Rise. However these values are helpful in gaining an understanding of relative flood elevations and for preliminary design efforts. The table below provides flood water surface elevation estimates for 10, 50, 100, and 500, year events. Intermediate periods can be obtained by linear interpolation.

Flood elevations at various recurrence intervals from FEMA Flood Insurance Studies (2016)

Flooding Source and Location	Elevation (feet NAVD88)			
	10-percent	2-percent	1-percent	0.2-percent
CHESAPEAKE BAY				
At Tilghman Island	3.4	4.0	4.1	4.8
At Clairborne	3.5	4.1	4.2	5.1
At Eastern Bay	3.6	4.1	4.2	5.3
CHOPTANK RIVER				
At Bow Knee Point	3.9	4.8	5.0	5.9
At Cambridge	3.5	4.1	4.3	5.0
TRED AVON RIVER				
At Oxford	3.5	4.1	4.3	5.1
At Southern End of Baileys Neck	3.6	4.2	4.4	5.5
WYE EAST RIVER				
At Bruffs Island	3.7	4.2	4.4	5.5
MILES RIVER				
At St. Michaels	3.5	4.1	4.3	5.2
HARRIS CREEK				
At Indian Point	3.6	4.2	4.9	5.8
BROAD CREEK				
At Mulberry Point	3.6	4.1	4.5	5.7

In addition to the water surface elevations at various recurrence intervals, the FEMA FIS studies provide estimates of 100-year wave statistics that are used for overland wave modeling using WHAFIS. These data are provided at the offshore end of the FEMA Transects and the values at transects of relevance to the project locations are provided below.

FEMA Transect	Water Level (ft NAVD 88)	Hm0 (ft)	Tp (s)	Suggested Solution	Flooding Source
35	4.2	2.5	2.7	Barrier Island Restoration	Eastern Bay
29	4.3	5.1	4.8	Barrier Island Restoration	Choptank River – Black walnut Cove
29	4.3	5.1	4.8	Barrier Island Restoration	Choptank River – Black walnut Cove
29	4.3	5.1	4.8	Barrier Island Restoration	Choptank River – Black walnut Cove
23	4.3	5.4	4.9	Barrier Island Restoration	Choptank River
18	4.2	4.3	4.1	Barrier Island Restoration	Choptank River
13	4.3	2.4	3.9	Private Property - Green Infra/Living Shoreline	Tred Avon River
13	4.3	2.4	3.9	Private Property -Green Infra/Living Shoreline	Tred Avon River
13	4.3	2.4	3.9	Private Property - Green Infra/Living Shoreline	Tred Avon River
12	4.2	3.8	4.0	Yacht Club - Green Infra/Living Shoreline	Choptank River
31	4.1	4.2	4.7	Wall Improvements/ Living Shoreline	Chesapeake Bay

A detailed hydrodynamic and wave modeling effort using ADCIRC and STWAVE, called the North Atlantic Coast Comprehensive Study (NACCS 2015), was carried out by the USACE Engineering Research and Development Center (USACE_ERDC). This effort was to quantify coastal surge, associated waves, and impacts of sea level rise on surge due to tropical and extra tropical storms from Virginia to Maine.

The NACCS 2015 study data at locations closest to the sites is presented in the tables below. The Nelson Island location is sheltered and consequently, an appropriate NACCS 2015 save point could not be identified. The tables contain information on 10, 20, 50, 100-year water levels at the identified save points close to each site. Additionally, wave statistics associated with an event producing 10, 20, 50, and 100-year water levels are also presented. It should be noted that these are not the 10, 20, 50, and 100-year wave statistics. These are the waves calculated for an event that produces 10, 20, 50, 100-year water levels.


Project Location	Nearest NACCS Save Point	
	Latitude	Longitude
Claiborne	38.836833°	-76.293282°
Knapps Narrows	38.723371°	-76.349226°
Black Walnut Point	38.66055°	-76.33704°
Nelson Island	38.71278°	-76.25967°
Benoni Point	38.672911°	-76.187667°
Oxford	38.68227°	-76.18293°

Project Location	10-year Water Level (ft MSL)	Associated H_{mo} (ft)	Associated Tp (s)	20-year Water Level (ft MSL)	Associated H_{mo} (ft)	Associated Tp (s)
Claiborne	3.7	2.9	3.2	4.2	3.3	5.2
Knapps Narrows	3.6	1.8	2.9	4	3.2	5.2
Black Walnut Point	3.6	3.3	3.9	4	3.9	4.7
Nelson Island	3.6	3.9	4.3	4.1	2.3	2.9
Sharps Island						
Benoni Point	3.7	3.1	3.2	4.1	2.8	3.6
Oxford	3.7	1.6	2.7	4.1	3.2	4.3

Project Location	50-year Water Level (ft MSL)	Associate d H_{mo} (ft)	Associate d Tp (s)	100-year Water Level (ft MSL)	Associate d H_{mo} (ft)	Associate d Tp (s)
Claiborne	4.8	3.6	5.2	5.3	3.6	5.7
Knapps Narrows	4.6	2.9	4.7	5.1	5.1	5.2
Black Walnut Point	4.5	3.9	4.3	4.9	4.3	4.7
Nelson Island	4.7	2.2	2.9	5.2	2.6	3.6
Sharps Island						
Benoni Point	4.6	4.5	4.3	5.1	4.3	4.3
Oxford	4.7	3.4	3.9	5.2	3.9	3.9

Both the NACCS 2015 and FEMA FIS data are in reasonable agreement with each other for the return periods of interest. The NACCS 2015 data has information at various recurrence intervals that is readily available for preliminary design. The NACCS 2015 data presented above do not include sea level rise estimates.

A variety of living shoreline solutions as described above can work for the project sites. The choice on a specific solution should be a combination of a detailed assessment of local hydrodynamics, waves, sediment transport, engineering, BCA, feasibility, construction costs, desired level of protection, and constructability. The shoreline on either side of Knapps Narrows is filled with sea walls and docks. Consequently, for this area a submerged or emergent oyster reefs and riprap sills would likely not be beneficial. These solutions can work well Oxford, Claiborne Jetty and Beach, and Sharps Island. The other project sites including Benoni Point, Black Walnut Point, and Nelson Island are candidates for restoration using beneficial reuse of dredge material.



Appendix B: Plan Review & Integration

Land Preservation, Parks and Rec Plan	
Plan Date	10/9/2018
Relevant Values, Goals, Objectives, Priorities	Goal: Provide an improved system of parks and recreation facilities based on residents needs
Useful Data Sources or Maps	HUC watersheds (p. 18) FEMA floodplain (p.19) Zoning (p.22), Updated GI hubs/corridor map (p. 161)
Relevant Projects (related to GI and/or in focus areas)	As of the publishing of this plan, Talbot County did not have any land acquisition projects underway.
Discussion of water resources and stormwater	Detailed discussion of water resources (pp. 137-151), including activities to address point source, NPS, agricultural, septic, and other water quality concerns. Some water quality goals and activities may overlap with green infrastructure.
Relevant Current Policies or Policy Incentives	Zoning (as of this plan) reflects land use goals in GI plan. Coastal areas designated "resource conservation"; agricultural areas (per GI plan) designated "priority preservation"
Ways GI can be Integrated into this Plan	Add new GI data layers detailing Habitat Cores, Fragments, and Corridors

Bellevue Village Master Plan	
Plan Date	9/2017
Relevant Values, Goals, Objectives, Priorities	Values: the community values their shoreline and access to the water. They also value outdoor meeting space. Goal 2: Preserve and improve the existing working waterfront assets for complementary and appropriately scaled water-dependent businesses and commercial access while being sensitive to the concerns of adjoining neighbors.
Useful Data Sources or Maps	2011 Chesapeake & Coastal Program Coastal Communities Initiative (CCI) funded shoreline assessment report created maps of stable/unstable shoreline
Relevant Projects (related to GI and/or in focus areas)	Bellevue Park--no green infrastructure mentioned, but there may be an opportunity there
Discussion of water resources and stormwater	Coastal resources
Relevant Current Policies or Policy Incentives	N/A
Ways GI can be Integrated into this Plan	Any GI project in the community could be incorporated.
Other relevant information or notes	The Chesapeake Bay Green Streets-Green Jobs-Green Towns (G3) Grant Program funded by the United States Environmental Protection Agency, Region III (EPA), Chesapeake Bay Trust (Trust), and the City of Baltimore Office of Sustainability with support from the Maryland Department of Natural Resources, was created to support design projects, financing strategies, and/or implementation of green street projects.

Tilghman Village Master Plan	
Plan Date	9/2017
Relevant Values, Goals, Objectives, Priorities	Values: the island community values their shoreline and access to the water. The community also values their spirit of volunteerism. Economic development goal also references the working waterfront
Useful Data Sources or Maps	Map 13 Community Map of Proposed Maritime Commercial and Maritime Support Commercial Land Use (p.34)
Relevant Projects (related to GI and/or in focus areas)	
Discussion of water resources and stormwater	Coastal resources
Relevant Current Policies or Policy Incentives	Creating a Working Waterfront Overlay District (WWOD)
Ways GI can be Integrated into this Plan	Any GI project in the community could be incorporated
Other relevant information or notes	The Chesapeake Bay Green Streets-Green Jobs-Green Towns (G3) Grant Program funded by the United States Environmental Protection Agency, Region III (EPA), Chesapeake Bay Trust (Trust), and the City of Baltimore Office of Sustainability with support from the Maryland Department of Natural Resources, was created to support design projects, financing strategies, and/or implementation of green street projects.

County Comprehensive Plan: Chapter 2 Land Use Plan	
Plan Date	8/6/2016
Relevant Values, Goals, Objectives, Priorities	The County's vision for land use begins: "Land use decisions preserve and enhance the rural character and natural resources of Talbot County."
Useful Data Sources or Maps	Zoning maps, pp. 6-9
Relevant Projects (related to GI and/or in focus areas)	The Comprehensive Plan supports the implementation for the Green Infrastructure Plan.
Discussion of water resources and stormwater	N/A
Relevant Current Policies or Policy Incentives	Land Use Policy 2.1: The County should preserve its unique rural landscape through conservation of farmland, forestlands, and environmentally sensitive lands by application of land use regulations and easement programs that conserve open space in rural areas. Land Use Policy 2.7: Sensitive environmental areas shall be protected or mitigated onsite to the greatest extent possible.
Ways GI can be Integrated into this Plan	Elements of the 2004 Green Infrastructure Plan have been incorporated into this plan (pp. 17-19).
Other relevant information or notes	The GI Plan Update may contain suggestions for the next comp plan update. To be Addresses in GI Plan.

County Comprehensive Plan: Chapter 6 Natural Resource Conservation	
Plan Date	8/6/2016
Relevant Values, Goals, Objectives, Priorities	The County's vision for land use begins: "Land use decisions preserve and enhance the rural character and natural resources of Talbot County."
Useful Data Sources or Maps	"Countywide, no more than 3% of all land is impervious. Even in Talbot County's most developed watersheds—the Miles River and Lower Choptank River—impervious surface coverage is under 5%." (p. 17)
Relevant Projects (related to GI and/or in focus areas)	The Chesapeake Bay has a Total Maximum Daily Load (TMDL) requirement from the EPA, so there are specific requirements about runoff, etc.
Discussion of water resources and stormwater	Integrated throughout the chapter.
Relevant Current Policies or Policy Incentives	Natural Resource Policy 6.28: The County will recognize the interdependence of floodplains and preservation of sensitive areas, wetlands, wildlife habitat and stream corridors.
Ways GI can be Integrated into this Plan	Elements of the 2004 Green Infrastructure Plan have been incorporated into this plan (p. 27).
Other relevant information or notes	The GI Plan Update may contain suggestions for the next comp plan update. To be Addresses in GI Plan.

Talbot County Floodplain Management Plan Progress Report 2017	
Plan Date	2018
Relevant Values, Goals, Objectives, Priorities	N/A
Useful Data Sources or Maps	Locally published flood information, as well as the required FEMA documents, are available for public review at County libraries. Hazard Mitigation Plan original data sources
Relevant Projects (related to GI and/or in focus areas)	Historic Preservation Commission is developing a work plan for hazard mitigation best practices for historic structures. There might be an opportunity for integration there. Program for public information about flood risk (PPI for CRS credit).
Discussion of water resources and stormwater	N/A
Relevant Current Policies or Policy Incentives	CRS: As of 2019, Talbot County has achieved a Class 8 rating in CRS.
Ways GI can be Integrated into this Plan	As GI becomes a portion of Talbot County's floodplain management strategy, it may be integrated into this report.
Other relevant information or notes	Communities can receive CRS points for Green Infrastructure

Hazard Mitigation Plan	
Plan Date	2017
Relevant Values, Goals, Objectives, Priorities	Goal 1: Minimize damage caused by flooding Objective 1.7: Restore barrier islands Goal 14: Integrate plan and policies across disciplines and agencies within the County through the consideration of potential hazards and future development. Objective 14.1: Integrate hazard mitigation and resilience into areas such as land use, transportation, climate change, natural and cultural resource protection, water resources, and economic development.
Useful Data Sources or Maps	Using FEMA Flood Zones, high-risk areas include: Oxford, St. Michaels, Tilghman Island, and the areas of Royal Oak, Sherwood, Bozman, and Whitman. In particular, Tilghman Island area is rated as a high hazard area and is in Evacuation Zone 1. (p. 80) Repetitive flood issues are listed in Ch. 11-12. These could be mapped and used as criteria for GI project prioritization.
Relevant Projects (related to GI and/or in focus areas)	Action Item #6: Flood Prevention & Stormwater Management Best Practices includes "Incentivize incorporation of green infrastructure on private property." It does not include info on how or which incentives to use. Action Item #7: Open Space Preservation includes "Identify priority shoreline parcels for acquisition or easement to improve flood storage and wave buffering" Action Item #22: Restore barrier islands to provide protection for Talbot County's shorelines from wave action. Action Item #24: Mitigate Flood Prone Properties includes a suggestion for property acquisition and the idea that "green infrastructure could be incorporated onto the acquired property"
Discussion of water resources and stormwater	Discussion of flood hazards
Relevant Current Policies or Policy Incentives	Membership in NFIP Action Item #6: Flood Prevention & Stormwater Management Best Practices includes "Incentivize incorporation of green infrastructure on private property." It does not include info on how or which incentives to use.
Ways GI can be Integrated into this Plan	GI projects will reduce vulnerability to flood and coastal hazards. Specific projects could be incorporated as hazard mitigation actions.
Other relevant information or notes	Note: MD Green Infrastructure Resiliency Grant Program, if still active, may be a potential funding source

Eastern Shore Land Conservancy – Mainstreaming Sea Level Rise Preparedness in Local Planning and Policy on Maryland's Eastern Shore	
Plan Date	1/2019
Relevant Values, Goals, Objectives, Priorities	Protect the Eastern Shore against Sea Level Rise
Useful Data Sources or Maps	Detailed GIS modeling of Sea Level Rise
Relevant Projects (related to GI and/or in focus areas)	N/A
Discussion of water resources and stormwater	Extensive discussion of SLR. Talbot County has most buildings/potential damage in the projected 2100 1% floodplain (pp. 10-11)
Relevant Current Policies or Policy Incentives	Policy recommendation: Integrate resilience into capital improvement planning. Note: green infrastructure is one way to do that.
Ways GI can be Integrated into this Plan	N/A
Other relevant information or notes	Current modeling by the U.S. Geologic Survey (USGS) indicates that sea level is rising in the Chesapeake Bay nearly twice as fast as the global rate

Eastern Shore Land Conservancy-Preparing for Increases in Extreme Precipitation Events in Local Planning and Policy on Maryland's Eastern Shore	
Plan Date	1/2020
Relevant Values, Goals, Objectives, Priorities	Bulk of the report is in 7 policy options, including: Policy Option 1: Upgrade Infrastructure to Reflect Future Precipitation Estimates; Policy Option 2: Utilize Hybrid Green-Gray Infrastructure; and Policy Option 6: Restore Unutilized Agricultural Lands to Natural Ecosystem
Useful Data Sources or Maps	Green vs. Gray Analysis (GGA) tool from U.S. Center for Sustainable Economy; example of City of Hampton, Virginia
Relevant Projects (related to GI and/or in focus areas)	N/A
Discussion of water resources and stormwater	Extensive discussion of ways to respond to extreme precipitation, in a general sense across the region.
Relevant Current Policies or Policy Incentives	Policy Option 1: Upgrade Infrastructure to Reflect Future Precipitation Estimates; Policy Option 2: Utilize Hybrid Green-Gray Infrastructure; and Policy Option 6: Restore Unutilized Agricultural Lands to Natural Ecosystem
Ways GI can be Integrated into this Plan	N/A--already part of this report

Talbot County Stormwater Management Process and Implementation Guide	
Plan Date	10/31/2011
Relevant Values, Goals, Objectives, Priorities	Per the State Stormwater Management Act of 2007, this Guide provides guidance about how to achieve "environmental site design to the maximum extent practicable"
Useful Data Sources or Maps	N/A
Relevant Projects (related to GI and/or in focus areas)	N/A
Discussion of water resources and stormwater	This guide describes how the county will manage stormwater using environmental site design to the maximal extent possible.
Relevant Current Policies or Policy Incentives	The Guide includes a list of stormwater management/environmental site design/GI measures and when they are or are not recommended (pp. 9-13).
Ways GI can be Integrated into this Plan	N/A--already part of this guide
Other relevant information or notes	This plan is to create implementation guidelines to be consistent with the State and County stormwater management ordinance.

Building a Framework for Sustainable Working Waterfronts – Cambridge 2015 (Environmental Finance Center)	
Plan Date	6/2015
Relevant Values, Goals, Objectives, Priorities	This report follows up on the Working Waterfronts Report and broadens the priority area to everyone who uses the waterfront (not just the fishing industry).
Useful Data Sources or Maps	N/A
Relevant Projects (related to GI and/or in focus areas)	City of Cambridge, MD started a Sustainable Working Waterfront Program in 2014. They may have best practices or other suggestions.
Discussion of water resources and stormwater	Discussion of working waterfronts, from a holistic perspective.
Relevant Current Policies or Policy Incentives	State Program: Working Waterfronts Program within the Department of Natural Resources Chesapeake and Coastal Service
Ways GI can be Integrated into this Plan	Green infrastructure of waterfronts and coastal systems can be incorporated into waterfront planning. The report mentions using GI funding sources.

Economic Development Strategic Plan for Talbot County and the Towns – an Opportunity for Alignment	
Plan Date	5/2013
Relevant Values, Goals, Objectives, Priorities	This plan focuses on the economic growth of the County.
Useful Data Sources or Maps	N/A
Relevant Projects (related to GI and/or in focus areas)	N/A
Discussion of water resources and stormwater	Some mention of the importance of the waterfront, otherwise not mentioned.
Relevant Current Policies or Policy Incentives	Recommendation 16: Ongoing land/ natural resource preservation - Many of Talbot County's largest industries – or potential growth industries – (i.e., tourism/recreation, environmental technology/renewable energy, environmental research) are directly related to the quality of the natural environment. The importance of protecting natural resources was emphasized during each community SWOT analysis meeting, with all groups agreeing that environmental deterioration represents a significant threat to their communities.
Ways GI can be Integrated into this Plan	GI and economic development are not an obvious pair. However, the report emphasizes the importance of natural resource protection to the economic success of the county, and GI is a part of those efforts.

Maryland Working Waterfront Commission Final Report 2008	
Plan Date	12/1/2008
Relevant Values, Goals, Objectives, Priorities	This report is mostly about the economic factors related to working waterfronts. It highly values the fishing industry and the land uses, environmental protection, and other community choices that support them.
Useful Data Sources or Maps	N/A
Relevant Projects (related to GI and/or in focus areas)	The relevant programs sections contain many case studies.
Discussion of water resources and stormwater	Discussion of working waterfronts, mostly from an economic perspective.
Relevant Current Policies or Policy Incentives	State Programs: Program Open Space: purchases fee simple or conservation easements on waterfront properties using a real estate transfer fee Article 66B – Reasonable Access to the Waterways: certain counties are required to support fish loading and processing Coastal Communities Initiative: provides financial and technical assistance to local governments to promote the incorporation of natural resource and/or coastal management
Ways GI can be Integrated into this Plan	This report is focused on economics, but there can be some connections to GI.
Other relevant information or notes	Special Area Management Plans: SAMPs are resource management plans and implementation programs developed to improve the management of a discrete geographic area.

Maryland's GI Assessment and GreenPrint Program	
Plan Date	2004
Relevant Values, Goals, Objectives, Priorities	Sensitive land protection
Useful Data Sources or Maps	Maryland's Green Infrastructure Assessment identified 33% of Maryland's total area as providing important green infrastructure benefits.
Relevant Projects (related to GI and/or in focus areas)	N/A
Discussion of water resources and stormwater	N/A
Relevant Current Policies or Policy Incentives	The Statewide Green Infrastructure Assessment provides a vision for an interconnected network of ecologically valuable hubs and corridors. The GreenPrint Program.
Ways GI can be Integrated into this Plan	N/A--already part of this report
Other relevant information or notes	The 2004 Talbot County GI Plan borrowed heavily from this assessment's methodology.

A Sustainable Chesapeake: Better Models for Conservation	
Plan Date	2010
Relevant Values, Goals, Objectives, Priorities	Environmental stewardship in transportation planning, with the goal of creating a net benefit to the environment.
Useful Data Sources or Maps	This case study shows a process for evaluating which areas are most important for protection. The process overview can be found on page 6.
Relevant Projects (related to GI and/or in focus areas)	This project was not within Talbot County, but could serve as a potential model.
Discussion of water resources and stormwater	Integrated throughout the report.
Relevant Current Policies or Policy Incentives	N/A
Ways GI can be Integrated into this Plan	N/A--already part of this report



Appendix C: Stakeholder & Outreach Materials

Cleaner, Greener Talbot: Stakeholder Group	
Name	Department/Agency
Miguel Salinas	Talbot County Department of Planning & Zoning
Brennan Tarleton	Talbot County Department of Planning & Zoning
Martin Sokolich	Talbot County Department of Planning & Zoning
Mary Kay Verdery	Talbot County Department of Planning & Zoning
Elisa Deflaux	Talbot County Department of Planning & Zoning
Gregory Allis	Talbot County Department of Planning & Zoning
Cassandra Vanhooser	Talbot County Economic Development & Tourism
Geneva Schaffle	Talbot County Department of Emergency Services
Mark Cohoon	Talbot County Department of Public Works
Mike Mertaugh	Talbot County Department of Public Works
Jessica Morris	Talbot County Assistant County Manager
Preston Peper	Talbot County Department of Parks & Recreation
Brett Dobelstein	Eastern Shore Regional GIS Cooperative
Cheryl Lewis	Town of Oxford
Sierra Crist	Town of Easton
Lynn Thomas	Town of Easton
Kymberly Kudla	Town of St. Michaels
Elle Bassett	ShoreRivers
Kelly Leo	The Nature Conservancy (TNC)
Jim Bass	Eastern Shore Land Conservancy (ESLC)
Shannon Dill	University of Maryland
Eric Buehl	University of Maryland
Jen Sparenberg	Maryland Environmental Services (MES)
Mark Wiest	Deadrise Maritime
George Yurek	Phillips Wharf Environmental Center (PWEC)

What is Green Infrastructure

Green infrastructure is an approach to managing stormwater through a variety of landscaping practices that can be applied to neighborhoods and buildings to reduce stormwater flowing into sewer systems, streams, rivers, and the Bay. Green infrastructure provides a cost-effective approach to managing stormwater that simultaneously improves quality of life and provides many community benefits. While traditional gray stormwater infrastructure – conventional piped drainage and water treatment systems – are designed to transport stormwater to be treated and stored at another location, green infrastructure is designed to retain and treat stormwater where it falls.

At the watershed scale, green infrastructure is a network of natural areas and techniques that enhances flood protection and provides habitat, and cleaner air and water. At the neighborhood scale, stormwater management systems that mimic nature soak up and store water within a small-scale environment, filtering out contaminants as the water is absorbed by the ground.

Examples of green infrastructure that could be installed at the neighborhood level or on a homeowner's property are detailed in this document followed with an incentive program survey.



Cleaner, Greener Talbot: A Plan for Future Livability



Benefits of Green Infrastructure

Environmental Benefits

- Recharges and improves quality of ground and surface waters
- Provides natural stormwater management
- Improves energy efficiency
- Reduces urban heat island effect
- Improves aquatic and wildlife habitat

Social Benefits

- Improves aesthetics and livability of urban communities
- Increases recreational opportunities
- Improves water and air quality
- Fosters environmental education opportunities

Economic Benefits

- Reduces existing and potential future costs of gray infrastructure
- Increases property values
- Reduces energy consumption costs

Rain Gardens (Bioretention)

Rain gardens (also known as bioretention) are vegetated basins that collect and absorb stormwater runoff from rooftops, sidewalks, and other paved surfaces. They are designed to be shallow basins - as opposed to typical mounded landscapes – to allow for infiltration to occur.



Opportunities and Challenges

- Fits into most open spaces and right of ways
- Provides stormwater quantity and quality control (reduces stormwater that goes in sewer system and filters the water that infiltrates the ground)
- Are aesthetically pleasing and beautify neighborhoods
- Requires little regular maintenance to retain their appearance and remove trash and sediments that can reduce the infiltration capacity
- Underdrains may be needed in urban areas, which can make rain gardens infeasible if the storm sewer for the underdrain pipe is too shallow

Typical Maintenance

- Periodic removal of sediment build-up
- Replenishing mulch as needed
- Weeding and replacement of dead vegetation
- Trash removal
- Flushing and monitoring of underdrain (if underdrain is needed)

Bioswales

Bioswales are vegetated channels that serve as retention areas and move stormwater from one place to another. They are well suited for linear spaces such as the space between the sidewalk and the curb to allow stormwater to slow and infiltrate into the soil.



Opportunities and Challenges

- Can replace curb and gutter while providing site drainage
- Provides stormwater quality and quantity control (reduces stormwater that goes in sewer system and filters the water that infiltrates the ground)
- Are aesthetically pleasing and beautify neighborhoods
- Limited application in areas where space is a concern

Typical Maintenance

- Similar to what is needed to maintain rain gardens
- Periodic removal of sediment build-up
- Replenishing mulch as needed
- Weeding and replacement of dead vegetation
- Trash removal
- Flushing and monitoring of underdrain (if underdrain is needed)

Rain Barrels

This practice reroutes rooftop downspouts from draining directly into the storm sewer system. Rain barrels collect and store rainwater to be used later for lawn irrigation and to water planters and gardens. The barrels are typically connected to downspouts to capture and store water runoff from roofs.



Opportunities and Challenges

- Rain barrels can fit into many areas including above ground, below ground, inside buildings, on roofs, and beside buildings
- Reduce the need for water to be used for irrigation of plants and landscaping
- Water within an above ground system can freeze in colder seasons
- Water reuse may not remove enough water from the rain barrel, leaving inadequate storage capacity to capture runoff from the next precipitation event
- Provides reserve water supply when used in conjunction with capture system (e.g. rain barrel)
- Reduces stormwater runoff quantity

Typical Maintenance

- Periodic inspection and replacement of worn parts
- Periodic removal of sediment build-up
- Regular use of harvested water is required to create enough volume in the barrel to capture additional water

Planter Boxes

Planter boxes collect stormwater runoff from sidewalks and parking lots and serve as rain gardens in areas where space may be limited. They are an attractive tool that can be used simultaneously as a streetscaping element.



Opportunities and Challenges

- Enhances site aesthetics
- Provides habitat
- Wide applicability, particularly in urban areas
- Provides limited stormwater runoff reduction
- Can be costly due to structural components

Typical Maintenance

- Bypass valve may be required during winter to prevent damage to box when temperatures drop below freezing.
- Similar to what is needed to maintain rain gardens
- Periodic removal of sediment build-up
- Replenishing mulch as needed
- Weeding and replacement of dead vegetation
- Trash removal
- Flushing and monitoring of underdrain (if underdrain is needed)

Tree Planting

Trees act as a sponge for rainwater, soaking up precipitation on their leaves and branches and absorbing water through their roots. Planting additional trees reduces the amount of water draining into a sewer system during a storm event. By providing shade, the presence of trees cools the air temperature. Through the absorption of carbon, trees can reduce the effect of greenhouse gases and improve air quality. Trees are an aesthetically pleasing element to streetscaping projects.



Opportunities and Challenges

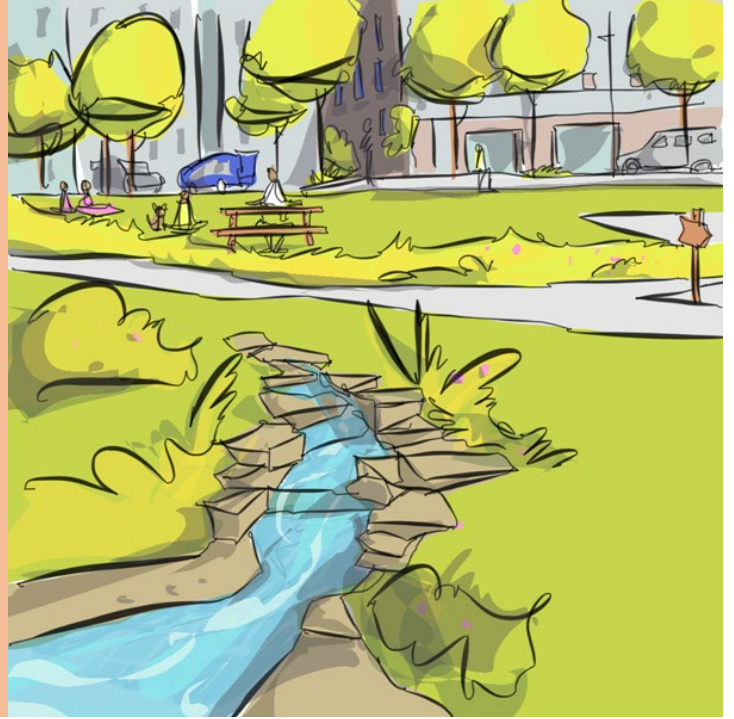
- Provides first interception of precipitation to help reduce stormwater quantity
- Provides additional shade canopy in urban areas, reducing heat island effect and reducing the amount of energy needed for cooling buildings
- Improves air quality by removing air pollution
- Generally low maintenance

Typical Maintenance

- May require fertilizing and pruning
- May require watering during drought conditions until well established

Native Landscaping

Plants that are native to an area typically have deeper and more extensive root systems which prevent erosion and absorb more water. Utilizing native plants also minimizes maintenance by reducing costs related to mowing, fertilizing, and watering.



Opportunities and Challenges

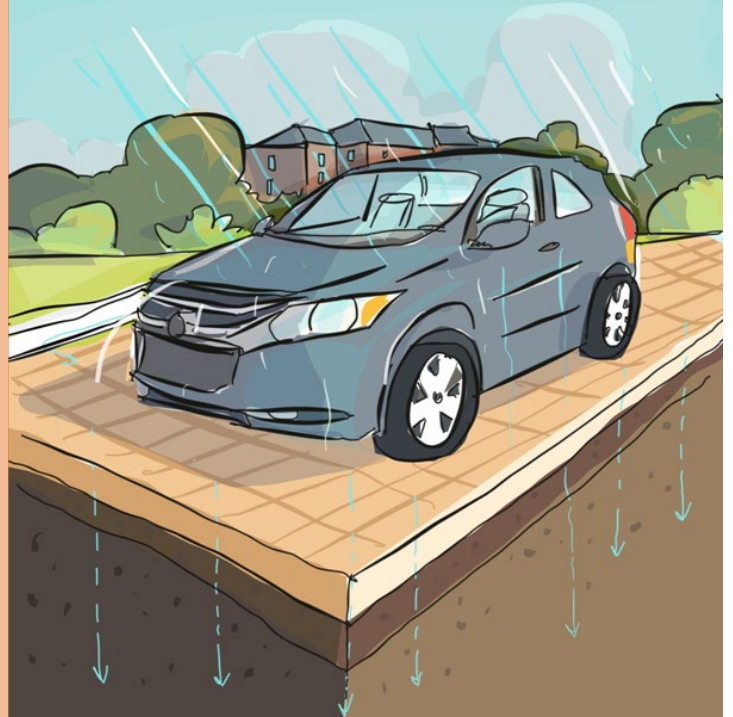
- Deeper and more extensive root systems increase stormwater quantity and quality by absorbing and filtering rainwater
- Prevents erosion by retaining soil with its deep and extensive root system
- Once established, native plants are generally low-maintenance because they are adapted to the environment
- Improves wildlife ecosystem
- Requires less watering than exotic plants

Typical Maintenance

- Periodic watering during drought conditions
- Trash removal
- Weeding

Pervious Pavement

Removing pavement and other impervious surfaces and replacing them with permeable pavements or landscaping allows more water to be absorbed and infiltrated. Permeable pavement is porous and captures rainwater where it falls. It can be particularly useful in places where land values are high, and flooding is a common issue.



Opportunities and Challenges

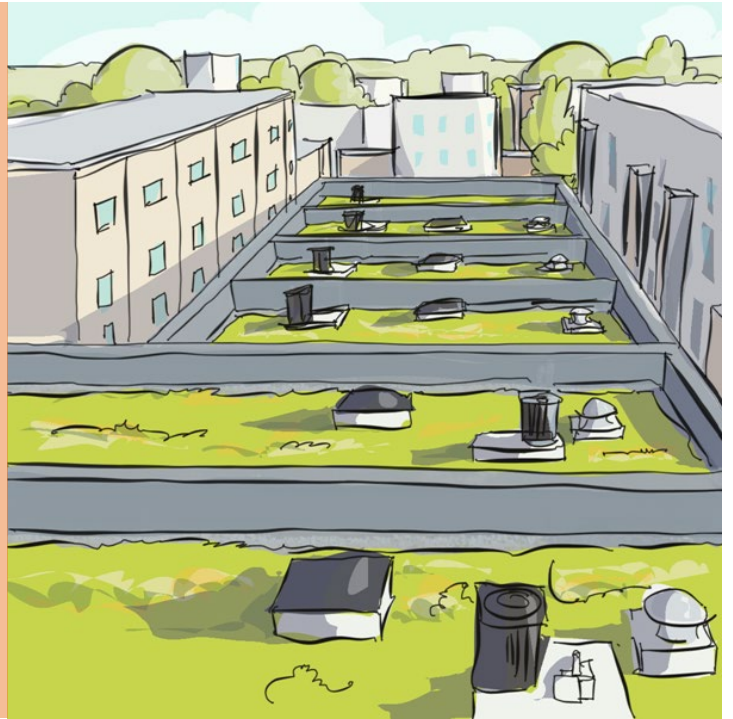
- Can be used on roads, parking lots, sidewalks and provides infiltration while maintaining a flat surface
- Works best in low or slow traffic areas where vehicles will not make sharp turns or sudden stops
- Dual use for pavement structure and stormwater management
- Higher maintenance needs than standard pavement

Typical Maintenance

- Clean inlets
- Vacuum annually to remove accumulated dirt and grit
- Maintain adjacent landscaping
- Periodic replacement

Green Roofs

Green roofs are vegetated roofs that enable rainfall to infiltrate into planted vegetation. Green roofs also provide insulation and can reduce costs for heating and cooling the building beneath them. These roofs also provide some carbon sequestration as the plants absorb carbon dioxide, thereby improving air quality. Replacing a black or dark roof with a green roof can also reduce the heat island effect, by cooling the ambient air temperature.




Opportunities and Challenges

- Reduces stormwater quantity
- High aesthetic value
- Energy benefits for heating and cooling the building beneath
- Urban heat island reduction
- Improvement in air quality through carbon sequestration
- Higher maintenance needs until vegetation is established
- Need adequate roof structure to support weight of green roof

Typical Maintenance

- Once vegetation is established, little maintenance is needed
- Periodic watering
- Weeding and replacement of dead vegetation



Appendix D: Community Greening Assessment Tool

Bioretention and Rain Garden
Functional Assessment Form Instructions

A. OVERVIEW

1. **Assessment GOALS:** This assessment protocol has been designed to assess the following aspects of bioretention and rain garden facilities:

- Does the rain garden infiltrate stormwater during storm events?
- Is the facility supporting plant growth?
- How well do soils reflect infiltration conditions?
- Do site design, construction and maintenance activities correlate with other signs of rain garden success?
- Does the rain garden offer community value to neighbors and passersby?
- Does the rain garden age correlate with other signs of functional success and community acceptance?

(Note that some of these aspects can only be determined during the proper field conditions.)

2. GEAR:

Team Equipment:

Safety vests

Clipboard(s)

Functional assessment **data form**

Either a hand bucket auger or soil-core probe

Narrow spade or trowel

Instructions and color guides (Plant/weed guides, simplified soil texture flowchart, etc.)

Pencils and pencil sharpeners

Screwdriver

Flashlight

Small tarp or plastic sheet

12" Ruler

100 ft. tape measure

Permanent markers

Site and /or planting plans (if available)

Spray bottle of water (for soil texturing)

Site location flags

Personal Gear: Recommended

Weather-appropriate clothing/supplies (hats, raingear, sunscreen/sunglasses)

Water & refreshments for 3 hours

3. RAIN GARDEN TERMINOLOGY:

Zones: There are three zones in a rain garden:

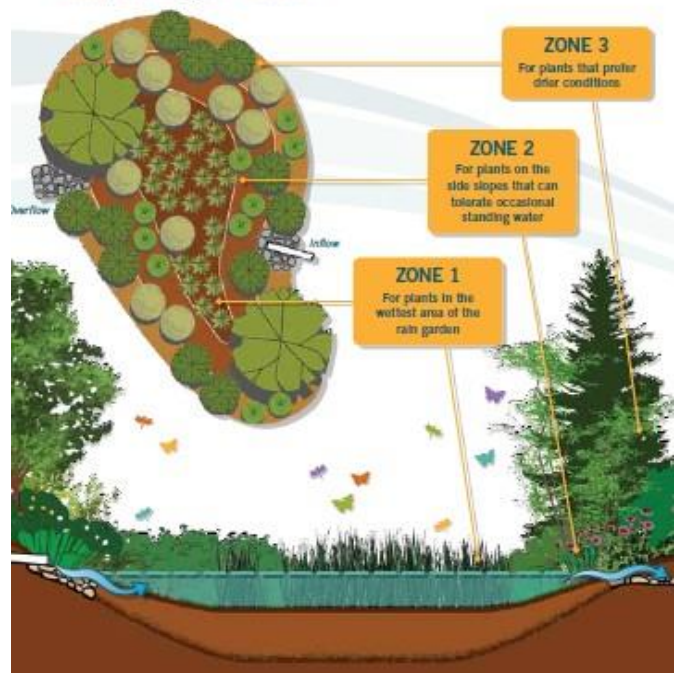
- Zone 1: The flat bottom part of the rain garden.
- Zone 2: The area from the bottom of the overflow extending down to Zone 1. This is the area where water will infiltrate.
- Zone 3: The area from the bottom of the overflow extending up to the defined edge of the rain garden. If there is no defined edge, then the rain garden will end one meter beyond the highest points.

Terms: There are six important terms used when discussing rain gardens or bioretention:

- **Inflow(s):** Intended source of stormwater into the rain garden, which could be a pipe, rain chain, open-channel swale, curb-cuts in paved area, or overland flow from landscaped areas.
- **Overflow(s):** A defined exit area for stormwater used in cases of heavy storm events to ensure water flows to an appropriate discharge location.
- **Contributing Area:** Sometimes referred to as “drainage area,” this is the area that will drain into the rain garden. It can include sections of roof, roads, parking lots, driveways, landscape areas and other surfaces.
- **Sheet Flow:** This will be evident when no clear inflow is visible and generally refers to an overland flow or downslope movement of stormwater as a continuous film over relatively smooth sidewalk, street, driveway, lawn/landscaped area, bare soil or rock surfaces and not concentrated into channels larger than rills. The rain garden or bioretention facility will be graded to permit the sheet flow to enter, and it may be armored along the edge with drain rock to prevent erosion.
- **Bioretention:** Bioretention facilities are defined in regulation and refer to swales, planting cells, or planters that are engineered to treat and infiltrate a specific amount of stormwater. They have exact design criteria to ensure they function according to their permitted design intent. They require a soil mix specified by the regulators. They may contain control structures such as under-drains, elevated overflow structures in Zone 1, catch basins to filter sediment, or check dams or weirs to slow the flow of water moving through the facility. Bioretention facilities are commonly found on commercial properties, in public rights-of-way, and recent construction.
- **Rain Gardens:** Rain gardens do not fall under regulations and are not usually built in response to mandatory stormwater permits. They include compost-amended native soils or non-engineered designed soil mixes. Typically, they have simple inflow(s) and an overflow near their surface rather than in Zone 1 (but not always). Rain gardens do not require complex modeling.

Planting Zones

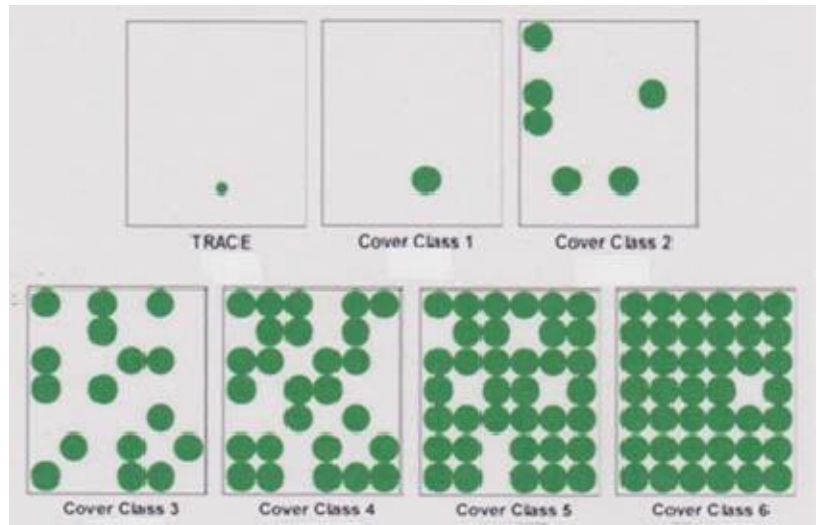
Rain gardens have three planting zones. Zone 1 is the bottom of the rain garden—the wettest area. Zone 2 covers the side slopes, which occasionally may become wet. This zone requires plants to help stabilize the slopes. Zone 3 covers the area around the perimeter of the rain garden and/or on the berm, where plants will grow in drier soil.



Source: *Rain Garden Handbook for Western Washington*, Hinman, et al., 2013.

4. Understanding “Cover-class”

method: Review the online training slides for more details on understanding the cover-class method for designating land-use cover. Throughout the assessment, you will be defining coverage areas for several rain garden features based on evaluating a range of percentages.



Modified from: Daubenmire, R. 1959. A canopy-cover method of vegetation analysis. *Northwest Sci.* 33:43-65.

USING THE ASSESSMENT FORM

NOTE: View the self-paced online training slides to assist you in preparing for monitoring and provide background information. The sections outlined below are explained in more detail in this helpful resource

Functional Assessment – The Functional Assessment allows the group to survey as-built conditions, maintenance practices and concerns, vegetation coverage, hydrology and community values.

Team Names: Please record all team names and contact information here.

Page Recorder Name: Please note the recorder on each page, as it is encouraged to share the data recording responsibility.

Section I: BACKGROUND INFORMATION

- Provide a site name, which will be the agreed-upon name by which your coordinator has referred to the site.
- Note the date and starting time of the survey.
- Provide the closest street address.
- Using the map application on Google maps, provide the latitude and longitude of your site.
 - Open the map application on your phone or computer and enter site address or intersection location.
 - Satellite view allows you to identify *actual site* of rain garden or bioretention facility.
 - Drop a pin on the facility.
 - Pin drop will trigger new box appearing, containing latitude / longitude numbers.
 - The first number shown will be *latitude*, and the second number shown will be *longitude*.
- In advance of your survey, or when you are finished, use the **wunderground.com** web site to note the actual precipitation to this area as noted: today (but not after you were there), yesterday, and two days ago. Log in and enter zip code or nearest town into search bar in top left corner. There are usually multiple sites in each area to look at, select the closest location to the facility you are assessing by scrolling down. Once found, click on the site and

then choose the "history" tab. Enter the date you want and click "View." Then, scroll down to precipitation and record precipitation (in inches) for the day of the survey and the prior two days. If no precipitation, record "0."

Section II: SITE OVERVIEW

- Type of Site: Determine if the facility is a "rain garden," "bioretention," or "unknown." Please explain how you determined the information under "Source of 'Type'." **Note:** Bioretention sites' plans will often have a Professional Engineer's Stamp, and sites are typically located on commercial or public property, in the right-of-way, or in recent construction.
- Record the rain garden age by assessing the site plan or other background information provided, such as from the owner ("Verifiable Source"). If you have no verifiable source but you are confident using factors such as plant vigor, personal knowledge of the area surveyed, or other clues, you may check one of the age boxes, but must provide a description of how you came to your estimate. State "unknown" if not sure of age.

Section III: CONTRIBUTING AREA/HYDROLOGY

Getting Ready: Before doing this survey, the team will need to define the zones and outer limits of the rain garden. See "Terms" on page 2 for guidance.

Section III-1: Land Uses of Water Source: Select the one land use type that represents where the rain garden or bioretention facility water is running off from (contributing area). This may not be the most dominant land use in the area.

Section III-2: Overflow: Find each overflow and determine if it is graded to direct water away from the facility. Circle Yes, No or Unknown.

Section III-3. Blockages: Evaluate the inflow(s), overflow(s), and any sheet flow area to determine if flow of water is obstructed by sediment buildup, leaves, sticks, trash, weeds, and other possible blocks. To determine how blocked a structure/pipe is, remove any rock that is covering the structure and look (use flashlight if necessary) or poke around inside any existing inflow or overflow pipes with the screwdriver in your kit – not all sites will have pipes or structures. The goal is to discover if the pipe or channel has blocked water flow, not if there is rock covering the structures, as that may be for aesthetic reasons and should still allow for water flow.

Record the percentage of blockage (if any) and type of blockage. Please use the following cover-class codes, *as shown on the form*: **N = None; T = <0.5%; A = 0.5-5%; B = 6-25%; C = 26-50%; D = 51-75%; E = 76-95%; F = >96%.**

Section III-4. Erosion: Assess the severity of erosion in each zone, based on evidence of channelization, scouring or sloughing in the rain garden.

"Minor" erosion would be evident if:

- sloughing of soils within the **total facility** is under 20%;
- erosion is **not** occurring on side slopes (e.g., zone 2);
- site is not in need of prompt repair; and
- an easy remedy option is available to address erosion problem (e.g., replacing mulch, increasing

rock armoring).

“Moderate” erosion would be evident if:

- sloughing of soils within the **total facility** is occurring under 60%;
- **or it may** involve side slopes at **any** level of erosion;
- level of erosion requires remedy soon but not *urgently*; and
- addressing erosion **might** require more complicated repair option than suggested in “minor” (e.g., substantial plants added or replanting, possible change of elevations in order to deepen or enlarge size of rock armoring).

“Extensive” erosion would be evident if:

- sloughing of the soils is *over 90% in **any particular zone*** (note difference from other two categories);
- complications of remedies potentially needed to repair erosion would be **irrelevant**; and
- addressing erosion requires **urgent action**.

Section III-5: Other Hydrology Concerns: Provide any descriptive information that you believe will help data reviewers understand how stormwater is moving in the facility. This is a place to note any information that has not yet been recorded in prior parts of Section III, or to clarify your findings, particularly in non-typical situations.

Section IV: ZONE 1 CONDITIONS

Section IV-1. Zone 1 Length: Determine the extent of Zone 1 (the flat bottom). Use a tape measure to record the length of Zone 1. Divide that length into thirds and record the length of each third. Use pin flags or leave the tape measure stretched out to visually demarcate Zone 1 into Sections 1A, 1B and 1C. When looking at the rain garden, Section 1A will be to the left and Section 1C to the right. The direction a team uses to view a rain garden is up that team, but please be consistent in the use of the Sections throughout your site visit.

Section IV-2. Standing Water, Siltation, and Liners: Record the depth and condition of any standing water in Sections 1A, 1B and 1C on the form. If there is no standing water, record “none” in that row. Note the level of siltation found in each section using the code provided. Silt will be very fine material that has dropped out of the water column.

Record if a liner or filter fabric is present. A liner would be noted on the site plan and **should** be well below the depth you’ll be investigating. Filter fabric may be encountered as you proceed with the next step, IV-3, where you will carefully clear small areas to prepare to investigate the underlying soils. Either way, if you encounter any liners or fabrics, record the depth of placement and do not puncture them

Section IV-3. Soil Texture: Take three soil core samples: one each in Sections 1A, 1B, and 1C. Take the readings at least two feet away from the **origin point** for inflow and the **exit point** for overflows or in-ground overflow structures. Complete each column completely before moving to the next sample. Note in section IV-4 under “other substrate observations” if you cannot take a sample for any reason (such as fabric present throughout).

1. To classify soil texture, first carefully move aside any rocks, mulch or vegetation from the area that you will be sampling, being careful not to mix these materials with each other.
2. Determine if the soil is compacted. If the soil meets both of the following conditions, then

record it as compacted. Signs of compacted soil are:

- a. It is very hard to drive soil-core probe or shovel into the soil;
 - b. There are clods or crusting at surface indicating that there is often standing water, and thus, less porous soils.
3. Use the appropriate tools — either a hand bucket auger or soil-core probe — to determine the depth to native soils first. As you probe the soils, you'll first encounter the special rain garden soil mix. Below that you will find the original, native soils. Since the native soils' composition is generally more mineral and with much less organic matter, you will be able to see the change in color that indicates you've reached native soils (usually lighter in color).
 4. As you probe the soils, you'll take samples until you reach the native soils (or you can go no further, which *could* occur prior to reaching native soils). As you bring up soil from your sample hole, place excavated soil on a plastic tarp to prevent soil from contaminating adjacent armoring, mulched areas, landscaping, etc.
 5. **Method: Hand bucket auger:** You will almost always need to take multiple samples from the same hole to reach the full depth of the bioretention/rain garden soils, which will likely be in the range of 12" -24" deep. When you see the soil surface at the top of the bucket, remove the auger. Turn the auger slightly to keep the soils from falling out and place your sample(s) on the tarp. Stop taking bucket augers/soil cores when you can go no further or have reached the native soils.
 - a. **Important:** Once you see native soils in your bucket sample, carefully remove the soil plug and measure the **exact number of inches of soil plug that is composed of the native soil depth**. If your sample isn't cohesive, don't empty it on your tarp until you've measured inches of native soils contained in the auger bucket.
 - b. Depth to native soils can be measured by placing a tape measure into the auger hole, reading measurement, and **subtracting** the length of native soil plug that was previously measured in the last auger sample. This calculation—depth of hole minus the inches of native soils in your final excavated plug—will equal "depth to native soils" on the form.
 - c. In larger holes, where you can actually see the clear line in the hole showing the two different soils, you can just measure the depth of the hole *just to the line where native soils start*; you many need to use a flashlight to ensure you can accurately place the bottom of your tape measure where the native soils begin.
 6. **Method: Soil-core Probe:** This probe is longer and narrower than the hand bucket auger. Therefore, it may be easier to push into the soils, and it may require fewer samples brought up until you reach the native soils. (Sometimes, you'll reach the native soils on the first probe.) As with the hand bucket auger method, take as many samples as required until you see the native soils appear in your soil plug.
 - a. As before, carefully move aside mulch, rocks etc. to reveal bare ground. With some pressure, push the core into the ground. If you encounter early resistance, it could be a rock below the surface. You may need to move your probe a few times to find a location with less resistance.
 - b. As you bring up each soil core, give a gentle half-twist to ensure soils don't fall out of probe.
 - c. As before, empty the soil core plugs onto the tarp, being careful not to spill into the rocks or mulch. Sometimes the plug is hard to remove. Carefully extricate the plug from the probe onto your tarp using a screwdriver in your equipment kit.
 - d. As with the method above, measure the exact number of inches of the portion of the plug that contains the native soils.

- e. **Always keep the rain garden soils separate from the native soils** on your tarp. (You'll soon be doing an additional analysis of these two types of soil.)
 - f. Once you've reached the native soils and measured the number of inches of native soil plug in your final sample, return your empty probe to the hole and **mark the ground-level location on your soil probe. Measure this length** (i.e., you're measuring how deep the hole is).
 - g. **Subtract** the length of native soils in the final soil plug from this measurement of the length of the soil probe from hole bottom to ground level. This calculation is your "depth to native soils."
7. Continue this process for each column so you record data for each third of Zone 1 as requested on the form.
 8. If you were unable to reach the native soils, record "didn't reach" rather than noting number of inches to native soils. If you were unable to reach native soils, but you were able to take **some** measurements, include that information on the form under section IV-4, "other substrate observations." For instance, if you were able to probe up to 15" but no further due to compacted soils below that point, that information would be useful for the data reviewers.
 9. **Soil texture characterization.** Now turn your attention to the soils on your tarp from your probing activities. First, characterize the texture of the rain garden/bioretenion soils for each of the three sections of Zone 1, then characterize the underlying native soils (if you have been able to obtain a sample) for each section. Even if you were unable to penetrate your tool very deeply, you should be able to gather enough soil to do a texture assessment of the top of the rain garden soils at a minimum. Use the trowel or spade provided to obtain rain garden soil from each section if you were unable to use a probe tool.
 10. Use the *simplified "texture by feel"* method **outlined in the flow-chart in your supplies.**
 - a. Take a heaping tablespoon/peach-pit sized soil sample in your palm. Make sure that the soil is *damp*, but not wet (a light very spray of water might be necessary, but start with un-sprayed soil first).
 - b. Try to make a ball with the soil sample. If the ball falls apart, the soil should be described as sandy. If a ball forms, make a ribbon by slowly rubbing/pushing the soil with your thumb across your fingers, from your pinky to your index finger. Measure the "ribbon" of soil that extends over your index finger. Using the definitions below, select the soil type for each sample.
 - **Sandy:** Mostly gritty; may not form a ball; forms no ribbon or a very short ribbon.
 - **Silty:** Feels mostly smooth (like wet flour) but could have some grit. Forms short ribbons (less than 1").
 - **Clayey:** Feels mostly slippery/smooth (but could have some grit). Forms longer ribbons (1" or more).

Replace materials: When you have finished all soil observations, return as much soil as you can to the holes and replace any moved mulches and/or rock armoring. Remember to be careful not to spill soils in rock armoring or mulched areas.

Section IV-4. Other Substrate Observations:

Provide any descriptive information that you believe will help data reviewers understand substrate characteristics. This is a place to note any information that has not yet been recorded in prior parts of Section IV or to clarify your findings, particularly in non-typical situations. An example might be soils

not compacted above, but compacted below, limiting amount of soil characterization ultimately possible.

Section V: OVERALL SUBSTRATES, VEGETATION, CONDITIONS

Section V-1. Substrate: In each Section of Zone 1, and overall, for Zones 2 and 3, record predominant type of mulch and its depth in the first box, using the codes provided at the end of the section.

In the second box, record the overall percent coverage of the **mulch, bare ground** and types of **rock** armoring or **large stones/logs** using the cover classes provided, for all of Zones 1 (not individual sections), 2 and 3. Please record the cover class abbreviation and not a specific percentage. If none of the items in the first column is found in a zone, then record "N" for None, as noted on the form.

Section V-2. Vegetation: Assess vegetation communities' coverage and vigor in each of the three zones, using the percent cover class abbreviations and vigor definitions provided on the form

Note: Review the online training slides for more information about determining plant "vigor" designation.

The definitions below retain consistency in the monitoring:

All Vegetation: This is an assessment of all vegetative coverage, *without* a vigor assessment.

Target Problem Plants ("TPP"): You will need to refer to your **handout** and note just those specific plants that are called out under this definition. Note that some of these include *whole groups* of plants, such as spreading grasses, all clovers/vetches, etc.

Non-Target Weeds: This includes all weeds **not** on the TPP, noted above. Examples include: lawn dandelions, plantain, shot weed and other weedy mustard-family plants.

Deciduous Shrubs/Trees: All woody plants that lose their leaves in the winter. Typically, these are broad-leaved plants but can include some needle-leaved plants. When in doubt, rub the leaves between your thumb and forefinger: Are they tender? Do they fall apart quickly when pressure is applied? If so, they are most likely deciduous.

Evergreen Shrubs/Trees: All woody plants that have leaf coverage in the winter. These leaves will be leathery or tough and will not wither easily when pressure is applied. This group includes sub-shrubs such as low-growing sunroses (*Helianthemum*), wallflowers (*Erysimum*), Heathers (*Erica* or *Calluna*), candytuft (*Iberis*), kinnikinnik (*Arctostaphylos uva-ursi*), and other shrub-like evergreens that grow over one-foot high.

Herbaceous: This broad category includes all the **intentional** rain garden plants that are either non-woody perennials, self-seeding annuals, bulbs, ferns, desirable grasses (such as various bunching grasses), and the "emergents"—rushes, sedges, and bulrushes. Some of these will be ephemeral and only visible at certain times of the year (though evidence of them may persist, such as a daylily flower stalk or dried grass foliage from the previous growing season). Some of the emergents grow in bunches from a primary base and some spread by rhizomes underground but can be identified by their distinctive leaves and flowers. When in doubt, consult the plant photos/descriptions in your *Rain Garden Handbook for Western Washington*.

Ground Cover: This category includes those plants that spread out quickly, completely cover all the ground as they spread, and provide all-season coverage. Plants may provide coverage through spread by runners or vegetative sprigs, or by fast-growing, prostrate, dense woody growth. Common examples include: coastal strawberry (*Fragaria chiloensis*), creeping raspberry (*Rubus calycinoides*) ground-hugging *Ceanothus* varieties or ground-hugging cotoneasters such as *Cotoneaster dammeri*, some evergreen stonecrops (*Sedum* species), creeping herbs such as the various creeping thymes, carpet-bugles (*Ajuga*), and periwinkles (*Vinca*).

Section V-3. Other Vegetation Observations:

Provide any descriptive information that you believe will help data reviewers understand vegetation characteristics. This is a place to note any information that has not yet been recorded in prior parts of Section V or to clarify your findings, particularly in non-typical situations.

Note: If vegetation from *outside of the rain garden is overhanging the facility*, it should **not be counted** in the coverage described above. However, it may be **noted in this section**, especially if it has implications for maintenance, such as potential to introduce invasive species/weeds, potential to drop branches that need to be attended to after storms, or potential to create heavy leaf/needle drop that will require regular maintenance so as not to smother rain garden plants.

Section V-4. Public Amenities: Within your team, discuss these *qualitative* questions and come to *consensus*. Record the *team answers* to the first three questions in this section. The final question is a simple “yes” or “no” based on presence/absence of educational signage. You may need to look around for a sign if you are monitoring one rain garden in a cluster; to record “yes,” you should be able to see the sign from the rain garden being monitored.

Section V-5: Other Observations

Provide any final descriptive information that will help data reviewers understand how the rain garden is functioning, is being maintained or other needed insights.

B. WRAPPING UP

- Record your End Time on the Functional Assessment Form.
- Note any areas of the form that did not work to represent the rain garden accurately or thoroughly. Please describe how.
- Gather and clean/dry all equipment, tools, and laminated sheets. Stow in kit.
- Review data form for completeness and confirm who is submitting the form.
- Confirm who is returning the kit.
- Let the program contact know if any equipment is missing or needs repair or if the team had any questions or concerns.

C. PHOTO DOCUMENTATION (Optional): Maintaining *regular photo points* adds to the database for any given rain garden. Collaborate with your data collectors/reviewers or program coordinator to determine how to *maintain* and *share* photo records.

If photo documentation is requested by the program coordinator, consider these tips:

- If monitoring multiple sites, make the **first photo** for each site a photo of some form of documentation noting: site name, date, and monitoring team members.

- Take the overview photographs **before starting to make observations.**
- If monitoring is being done in conjunction with regular maintenance visit, take “before” and “after” photos to document maintenance efforts from that visit.
- Photograph problems, innovative solutions employed, or *anything noteworthy.*
- **Identify and record consistent locations to be photographed at each monitoring visit.** Consider these ideas:
 - ✓ Photos from opposite sides of the rain garden, looking inward;
 - ✓ Photos of the inflow and overflow structures/systems;
 - ✓ Photos of the predominant form of organic mulch and rock armor (if any) in the rain garden (use pencil for scale);
 - ✓ Photo from best public viewpoint, if it exists.

D. PROGRAM CONTACTS

If you have any questions on methods or instructions, problems with equipment or challenges with scheduling, please contact the following people / person:

Name: _____ Telephone: _____

Email: _____

**Bioretention and Rain Garden Assessment Program
Data Collection Input Form - Talbot County Monitoring**

Site 1

Site 2

Data Collection Team

Team Member 1 Name

Cell # or Email

Team Member 2 Name

Cell # or Email

Team Member 3 Name

Cell # or Email

Team Member 4 Name

Cell # or Email

I. BACKGROUND INFORMATION

Site Name
Survey Date
Start Time
Street Address
City
County
Location Lat (such as 47.019716)
Location Longitude (such as -122.785379)
Sound Impacts ID:
Rain Fall
 Today (inches)
 Yesterday (inches)
 2 Days Ago (inches)

II. SITE OVERVIEW

Type of Site	Bioretention	Bioretention
Age of Site	<1 year	<1 year
Source of "age"	Verifiable Source	Verifiable Source
Describe		

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III. CONTRIBUTING AREA/HYDROLOGY

III-1. Contributing water source (check all that apply):

Rooftop	Yes	Yes
Lawn	Yes	Yes
Residential Street, low use parking lot	Yes	Yes
High use street, livestock confinement area	Yes	Yes
Driveway	Yes	Yes

Maintained Pasture	Yes	Yes
Moderate use street, high use parking lot	Yes	Yes
Industrial or other high contaminant area	Yes	Yes

III-2. Does overflow direct water away from facility?

Overflow 1	Yes	Yes
Overflow 2	Yes	Yes
Overflow 3	Yes	Yes

III-3. Blockages

Inflow 1 Percent Blockage	N=None	N=None
Inflow 1 Blockage Type	N=None	N=None
Inflow 2 Percent Blockage	N=None	N=None
Inflow 2 Blockage Type	N=None	N=None
Inflow 3 Percent Blockage	N=None	N=None
Inflow 3 Blockage Type	N=None	N=None
Sheetflow Percent Blockage	N=None	N=None
Sheetflow Blockage Type	N=None	N=None
Overflow 1 Percent Blockage	N=None	N=None
Overflow 1 Blockage Type	N=None	N=None
Overflow 2 Percent Blockage	N=None	N=None
Overflow 2 Blockage Type	N=None	N=None
Overflow 3 Percent Blockage	N=None	N=None
Overflow 3 Blockage Type	N=None	N=None

III-4. Erosion

Zone 1 Erosion/Channelization	N – None	N – None
Zone 2 Erosion/Channelization	N – None	N – None
Zone 3 Erosion/Channelization	N – None	N – None

III-5. Other Hydrology Concerns

Describe

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IV. ZONE 1 CONDITIONS

IV-1. Zone 1 Length

Length of Zone 1 in feet
 Length of Sections 1A, 1B and 1C (length/3) in ft

IV-2. Standing Water, Siltation, and Liners

Standing Water Depth

Sect. 1A (Left Third) in inches. Use 0 if none.

Sect. 1B (Midpoint) in inches. Use 0 if none.
 Sect. 1C (Right Third) in inches. Use 0 if none.

Siltation Depth

Sect. 1A (Left Third)	N=None	N=None
Sect. 1B (Midpoint)	N=None	N=None
Sect. 1C (Right Third)	N=None	N=None

Is liner present?

Sect. 1A (Left Third)	Unknown	Unknown
Sect. 1B (Midpoint)	Unknown	Unknown
Sect. 1C (Right Third)	Unknown	Unknown

At what depth?

Sect. 1A (Left Third) in inches or N/A
 Sect. 1B (Midpoint) in inches or N/A
 Sect. 1C (Right Third) in inches or N/A

Is Filter Fabric present?

Sect. 1A (Left Third)	Unknown	Unknown
Sect. 1B (Midpoint)	Unknown	Unknown
Sect. 1C (Right Third)	Unknown	Unknown

At what depth?

Sect. 1A (Left Third) in inches or N/A
 Sect. 1B (Midpoint) in inches or N/A
 Sect. 1C (Right Third) in inches or N/A

IV-3. Soil Texture

Depth to Native Soils

1A in inches or DR for didn't reach
 1B in inches or DR for didn't reach
 1C in inches or DR for didn't reach

Compacted surface soils

1A	Yes	Yes
1B	Yes	Yes
1C	Yes	Yes

Rain Garden Mix Soil Texture

1A	Sandy	Sandy
1B	Sandy	Sandy
1C	Sandy	Sandy

Native Soil Texture

1A	N/A	N/A
1B	N/A	N/A
1C	N/A	N/A

IV-4. Other Substrate Observations

Describe

V. OVERALL SUBSTRATES, VEGETATION, CONDITIONS

Type of Mulch

1A	N – None	N – None
1B	N – None	N – None
1C	N – None	N – None
2	N – None	N – None
3	N – None	N – None

Depth of Mulch

1A	N - None	N - None
1B	N - None	N - None
1C	N - None	N - None
2	N - None	N - None
3	N - None	N - None

Mulch Coverage

Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None

Bare Ground Coverage

Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None

Pea Gravel Coverage

Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None

Drain Rock Coverage

Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None

2 – 12” Rock Coverage

Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None

>12” Rock/Log Coverage

Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None

V-2. Rain Garden Vegetation

All Vegetation coverage

Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None
Target Problem Plants coverage		
Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None
Target Problem Plants vigor		
Zone 1	M – Moderate	M – Moderate
Zone 2	M – Moderate	M – Moderate
Zone 3	M – Moderate	M – Moderate
Non-Target Weeds coverage		
Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None
Non-Target Weeds vigor		
Zone 1	M – Moderate	M – Moderate
Zone 2	M – Moderate	M – Moderate
Zone 3	M – Moderate	M – Moderate
Deciduous Shrubs /Trees coverage		
Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None
Deciduous Shrubs /Trees vigor		
Zone 1	M – Moderate	M – Moderate
Zone 2	M – Moderate	M – Moderate
Zone 3	M – Moderate	M – Moderate
Evergreen Shrubs/Trees coverage		
Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None
Evergreen Shrubs /Trees vigor		
Zone 1	M – Moderate	M – Moderate
Zone 2	M – Moderate	M – Moderate
Zone 3	M – Moderate	M – Moderate
Herbaceous coverage		
Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None
Herbaceous vigor		
Zone 1	M – Moderate	M – Moderate
Zone 2	M – Moderate	M – Moderate
Zone 3	M – Moderate	M – Moderate

Ground Cover coverage

Zone 1	N = None	N = None
Zone 2	N = None	N = None
Zone 3	N = None	N = None

Ground Cover vigor

Zone 1	M – Moderate	M – Moderate
Zone 2	M – Moderate	M – Moderate
Zone 3	M – Moderate	M – Moderate

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V-3. Other Vegetation Observations

Describe

V-4. Public Amenities

How visible is the site to the public?	Moderate	Moderate
How aesthetically pleasing is this site?	Moderate	Moderate
How well maintained is this site?	Moderate	Moderate
Any educational signage affiliated with the rain garden?	Yes	Yes

V-5. Other Observations

Describe

End Survey Time

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