AGRICULTURAL MODELING TEAM BRIEFING NOVEMBER 1, 2022

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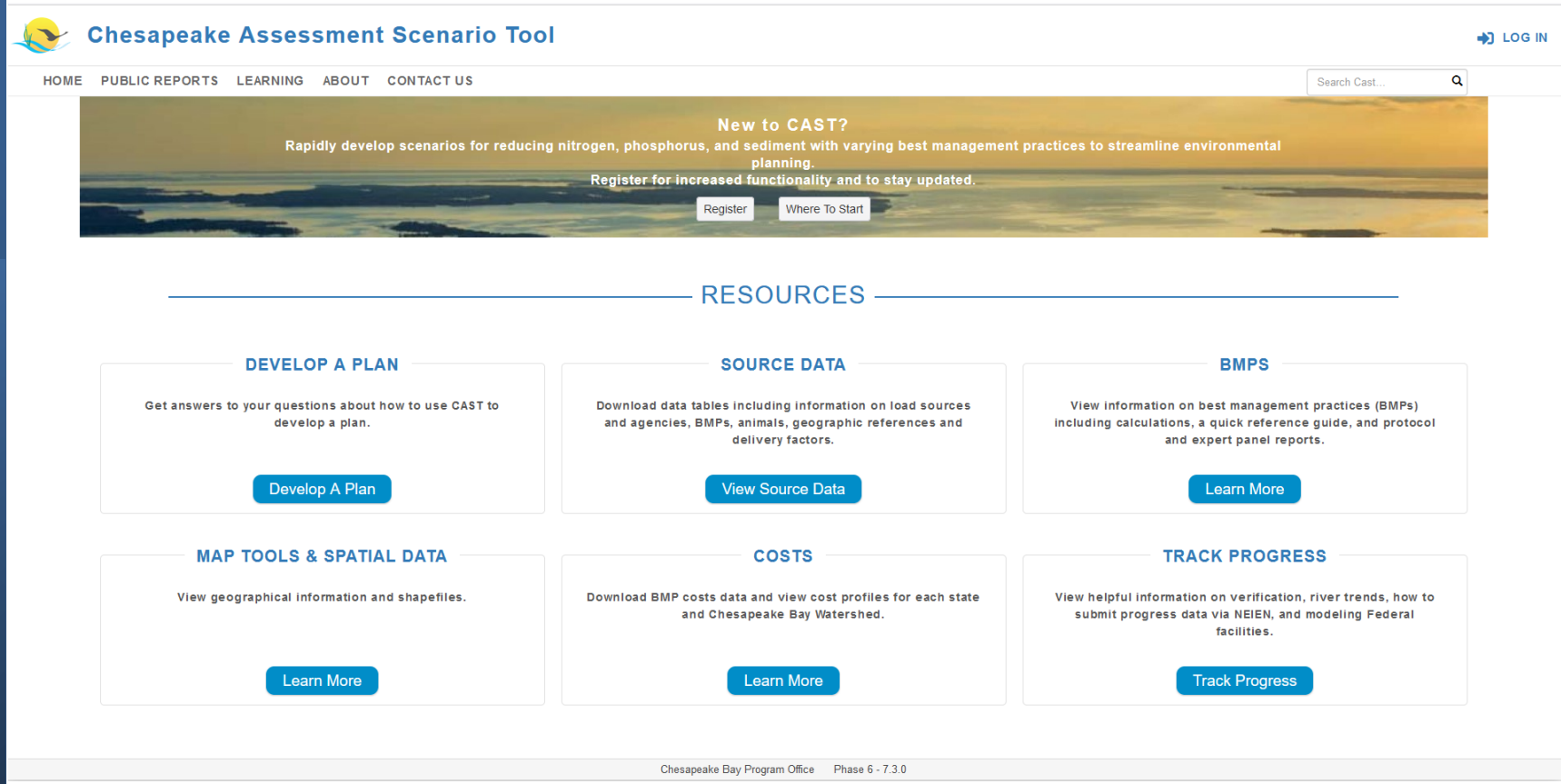


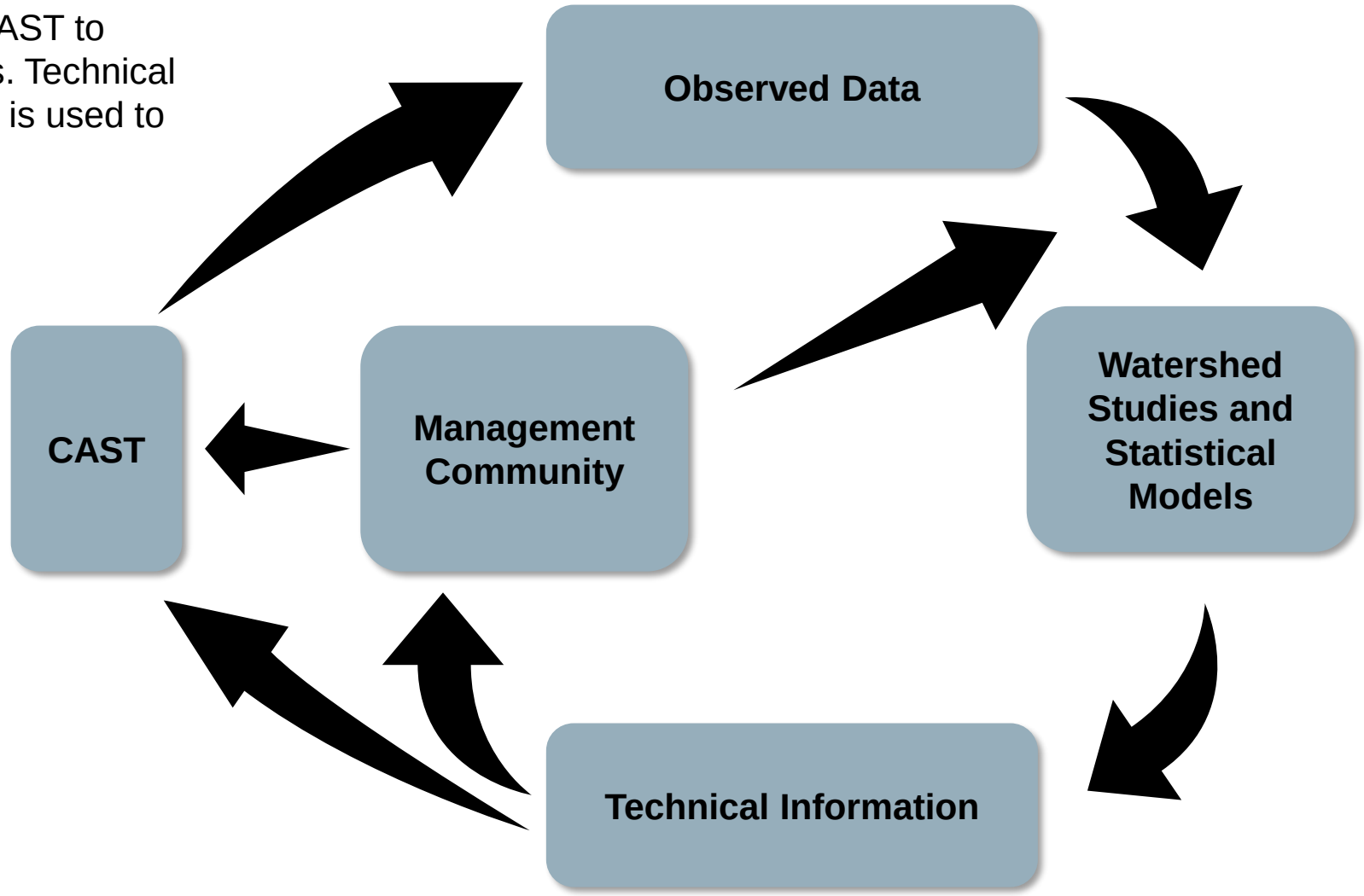
https://cast.chesapeakebay.net/

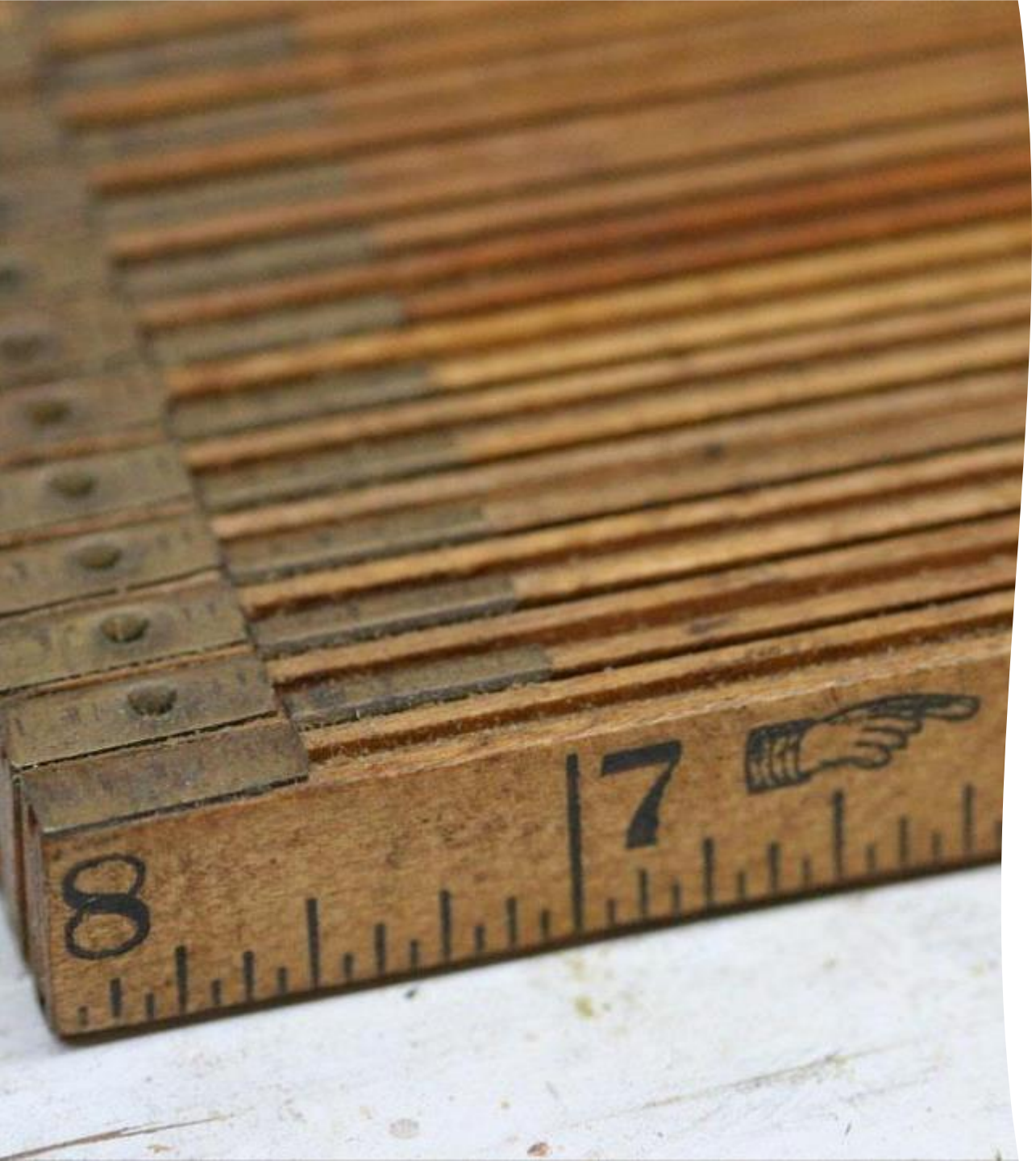
11/1/2022

The Chesapeake Bay watershed model (CAST) is a comprehensive synthesis of knowledge that can help direct management

The management community largely relies on CAST to understand and improve water-quality conditions. Technical information about water-quality loads and trends is used to improve and assess modeled predictions.

- **Observed data** are used to develop **watershed studies and statistical models**, based on priorities identified by the **management community**.
- **Watershed studies and statistical models** provide **technical information** that are communicated to the **management community** and used to improve **CAST**.
- The **management community** uses **CAST** to develop management strategies.
- **CAST** assesses predictions and performance against **observed data**.





Chesapeake Bay TMDL: Planning and Tracking

- Setting goals and tracking progress holds all our partners accountable for their work.
- Phase III Watershed Implementation Plans (WIPs) are the roadmap for how to get from 2017 to 2025
- The new model version, Phase7, will result in new planning targets for each state river basin, with a new implementation plan. This will guide us toward Bay restoration post 2025
- States use CAST to track best management practices (BMP) implementation toward the Bay TMDL, as required in the jurisdictions' grant guidance
- Pollutant load reductions (N, P, S) from BMPs are modeled in CAST, online at CAST.chesapeakebay.net
- CAST is the watershed model used for annual assessments and planning, and the official documentation of the model is on the CAST site
- CAST is named as the tool to develop the Maryland TMDL plans and is referenced in Virginia's TMDL implementation plan guidance

History

- The first version was launched in 2011 at the request of MDE to provide local jurisdictions, such as counties, with a tool to provide input into the Bay TMDL Phase II WIP process.
- The Bay Program decided that the tool was useful and should become a Bay Program tool available to the entire Chesapeake Bay Watershed.
- CAST can be accessed online for free. CAST has 1,500+ users
- CAST is used to develop implementation plans and show the loads reduced for annual progress assessments
- CAST allows local communities to generate results and can help states, local governments and others identify which pollution prevention strategies and conservation practices make the most sense, given their available resources.

➢ **Outcome: The model became more transparent and could be used by anyone**

Uses of CAST

- Planning tool to:
  - Develop a plan with multiple BMPs across a large area, not a single farm, and determine load difference from present condition
  - Understand the data that is used to inform CAST load estimates
  - Prioritize which BMPs have the most effect on loads
  - Evaluate cost effectiveness of BMPs
  - Assess where a BMP would have the most load reduction

Who is CAST for?

Technical managers within jurisdiction agencies who plan and report for the 2010 Bay TMDL
Local watershed organizations
Local government planners
Federal, state, and academic researchers

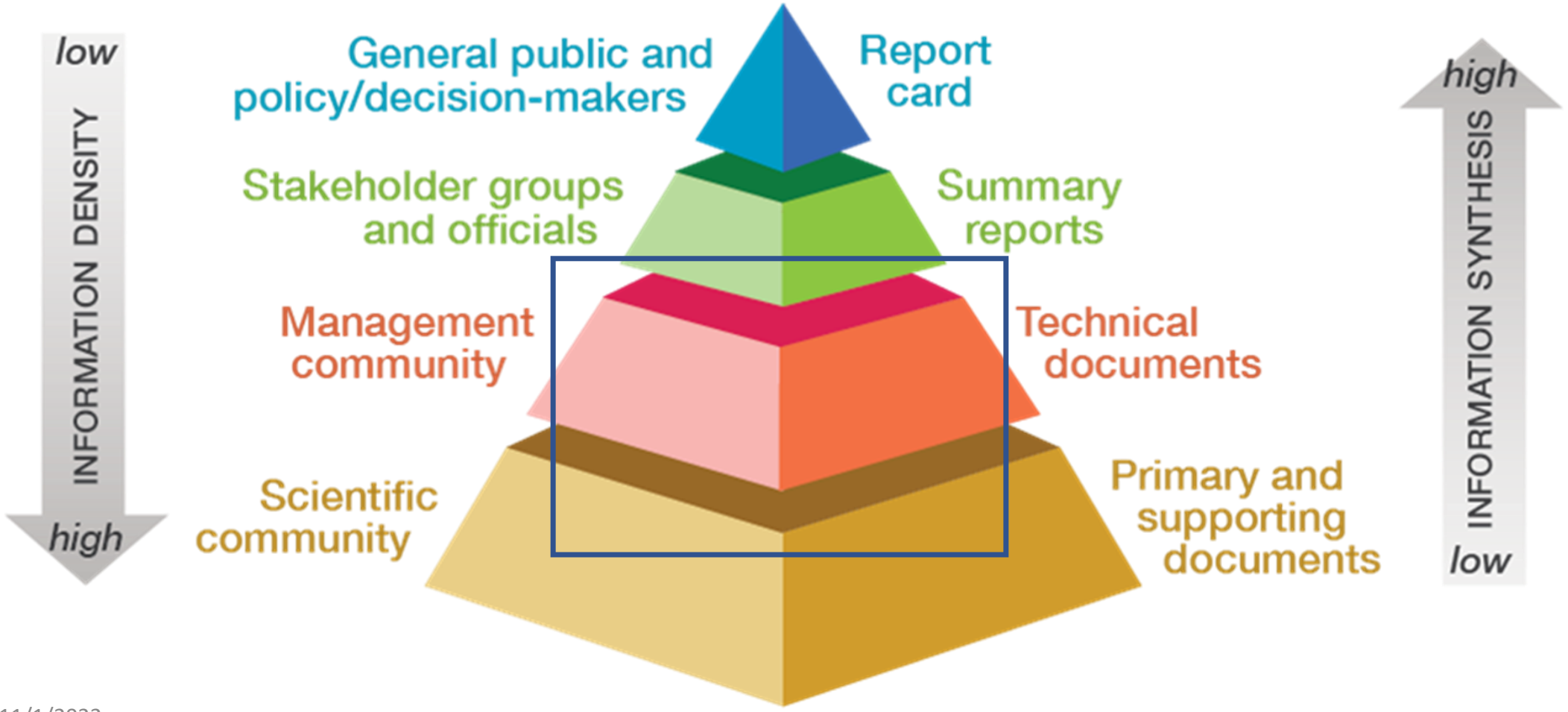
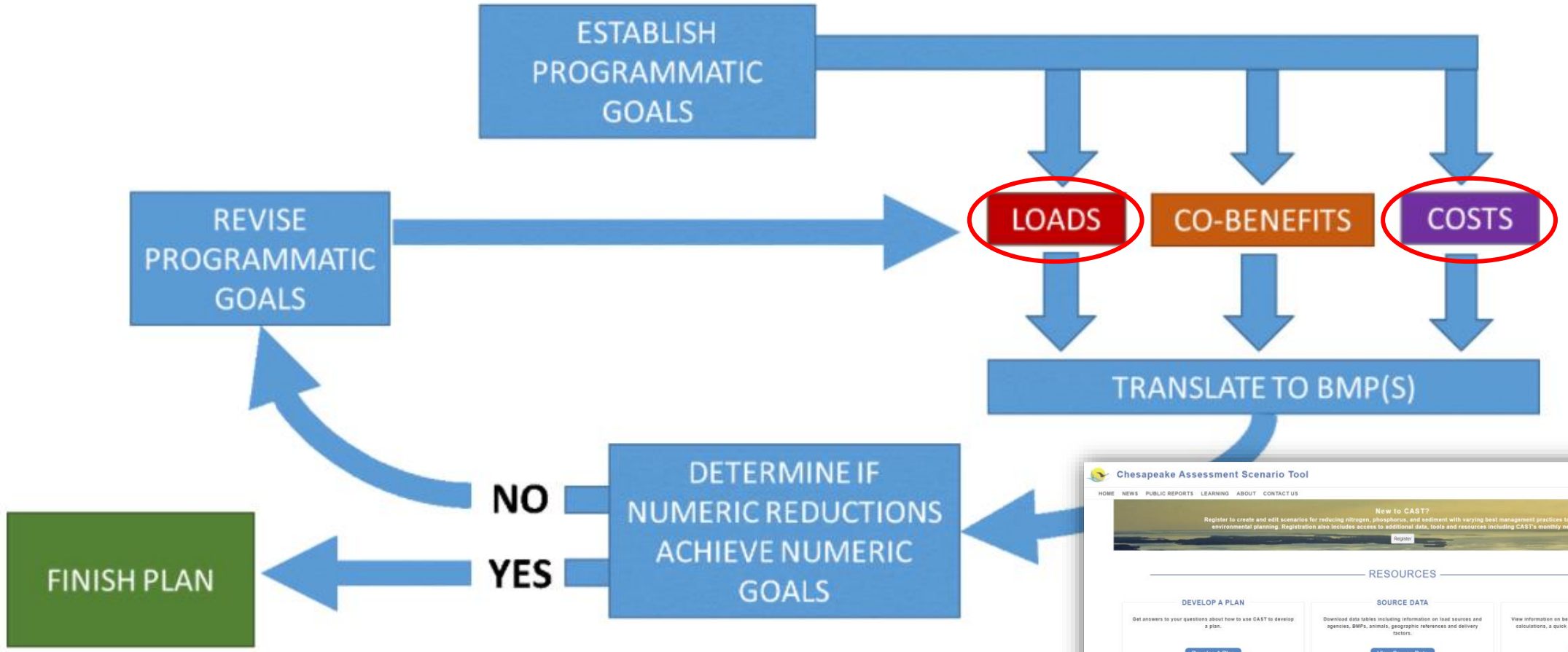
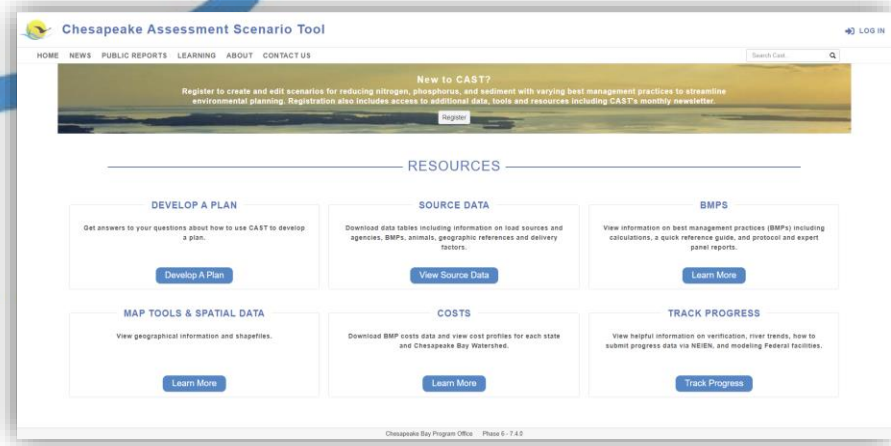


Figure courtesy UMCES Integration and Application Network, ian.umces.edu

Steps to Developing a Plan and Assessing Progress





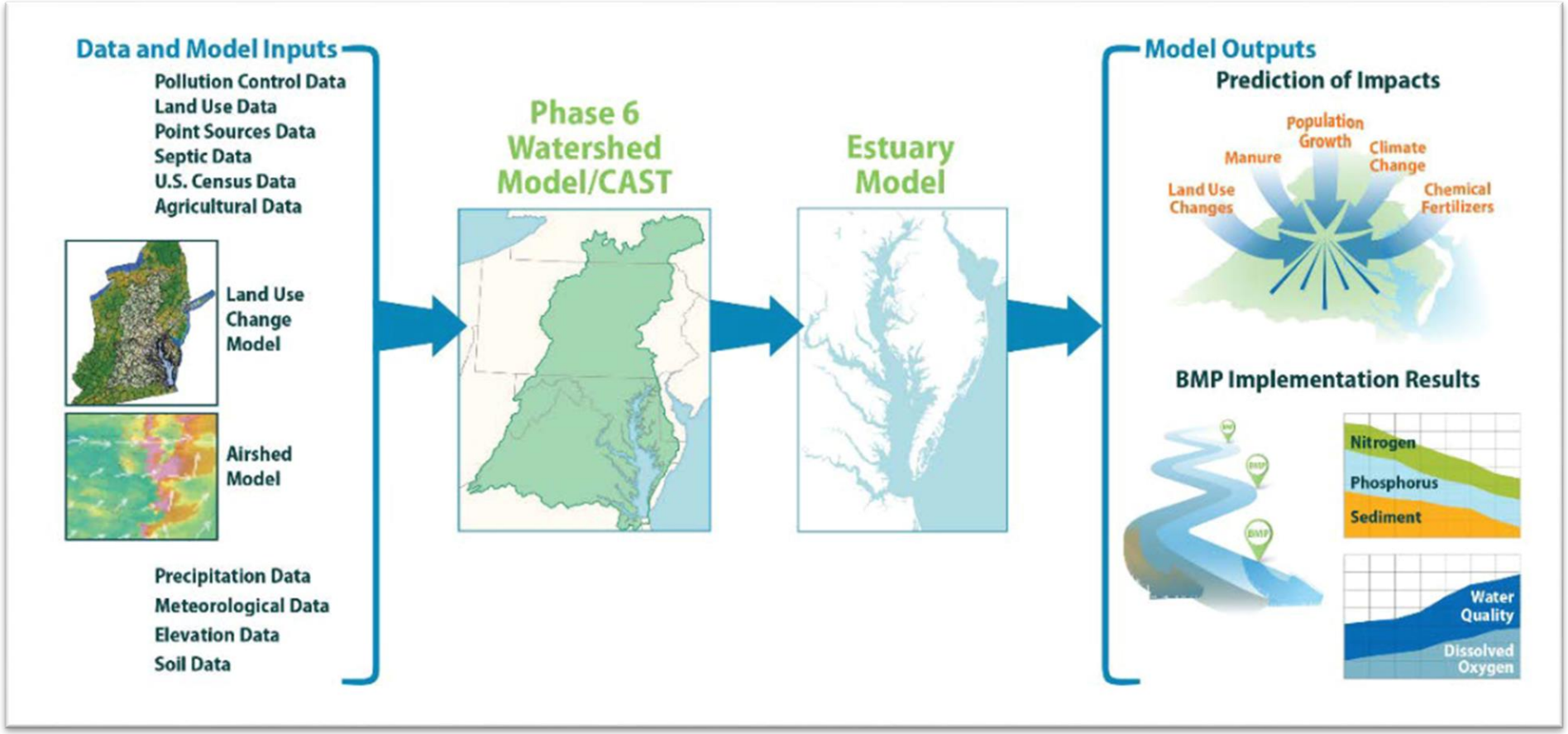
Typical Questions Answered with CAST

1. What is the load reduction from a BMP implemented in my community?
2. What is the current land use and land cover in my community and where can I quickly access these data?
3. How do I find out how my pollutant loads and land uses are projected to change for various 2025 development scenarios for my community?
4. Which BMPs are currently in the Model for my community?
5. How can I estimate which of those BMPs were implemented as part of my MS4 permit?

More Questions CAST Can Answer

6. How do I find out what the load reductions are from BMPs implemented and planned?
7. Which BMPs are most cost-effective?
8. What are the co-benefits associated with each BMP?
9. How can I show the results of my analyses in a way that makes sense to non-technical people?
10. Which BMP will give me the most load reduction?
11. Where should I target BMPs to generate the most load reduction?

Data Sources

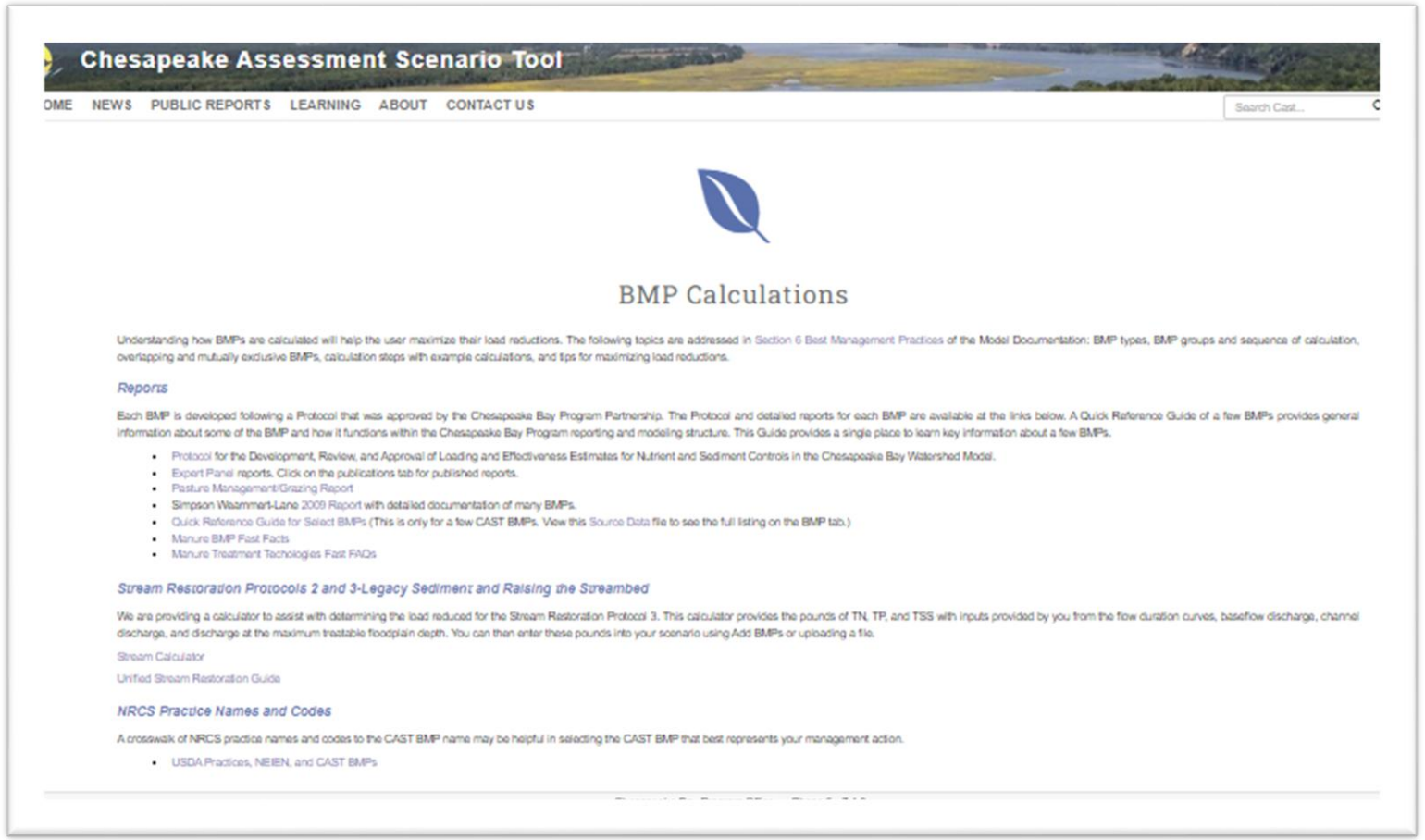


- Agricultural Census
  - Animals and feeding space
  - Crops/land use
  - Crop yield
- Chesapeake Bay Land Use – Land Change Model
- Onsite wastewater disposal systems
- Crop Nutrient Need and Availability

Current Geographic Scales

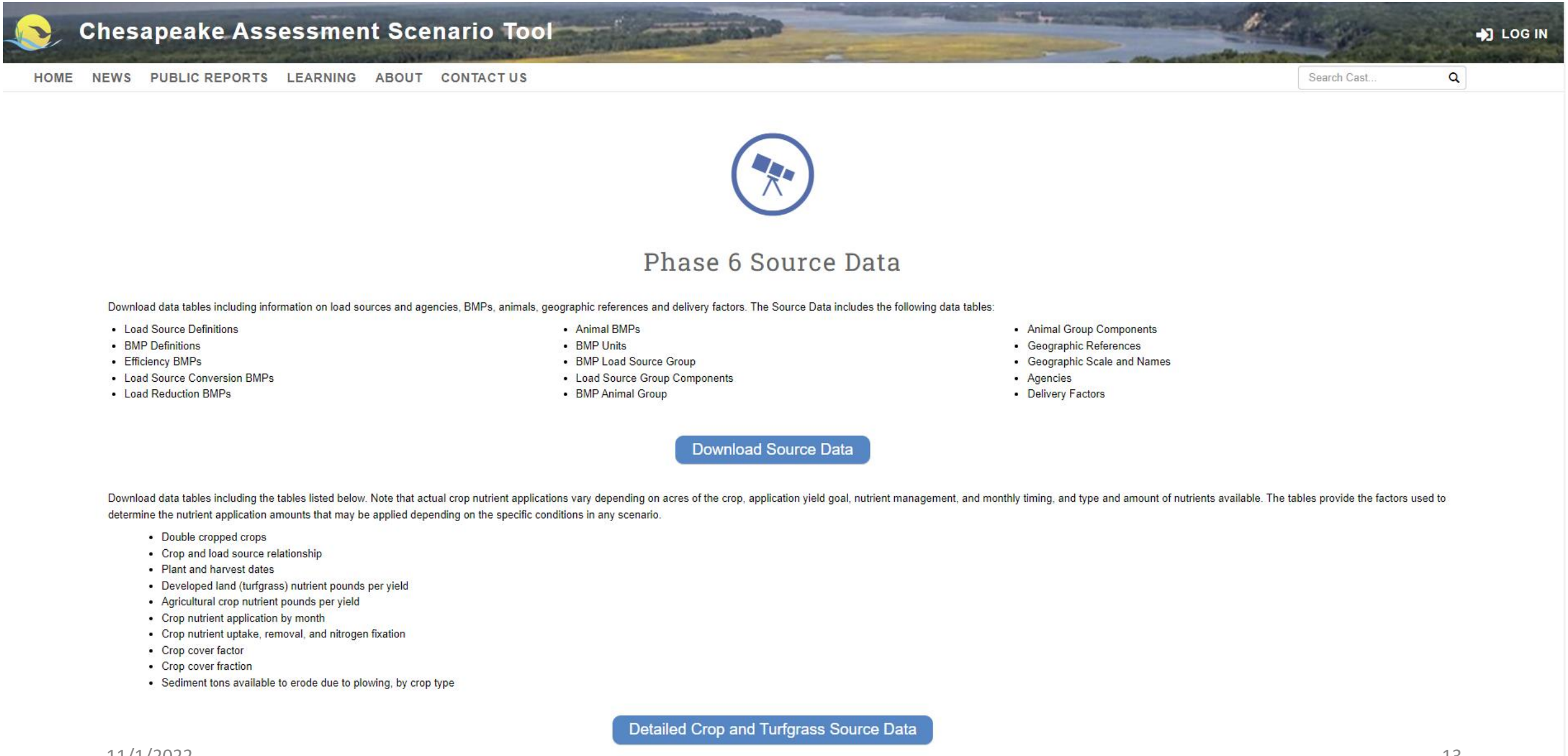
- Chesapeake Bay Watershed
- State
- County
- Major and minor basins
- Watersheds defined in hydrologic unit code scales of 4, 6, 8, 10, and 12 digits
- Land-River Segments
- In Virginia
  - Planning District Commission
  - Conservation Districts
  - Conservation District Areas

BMPs

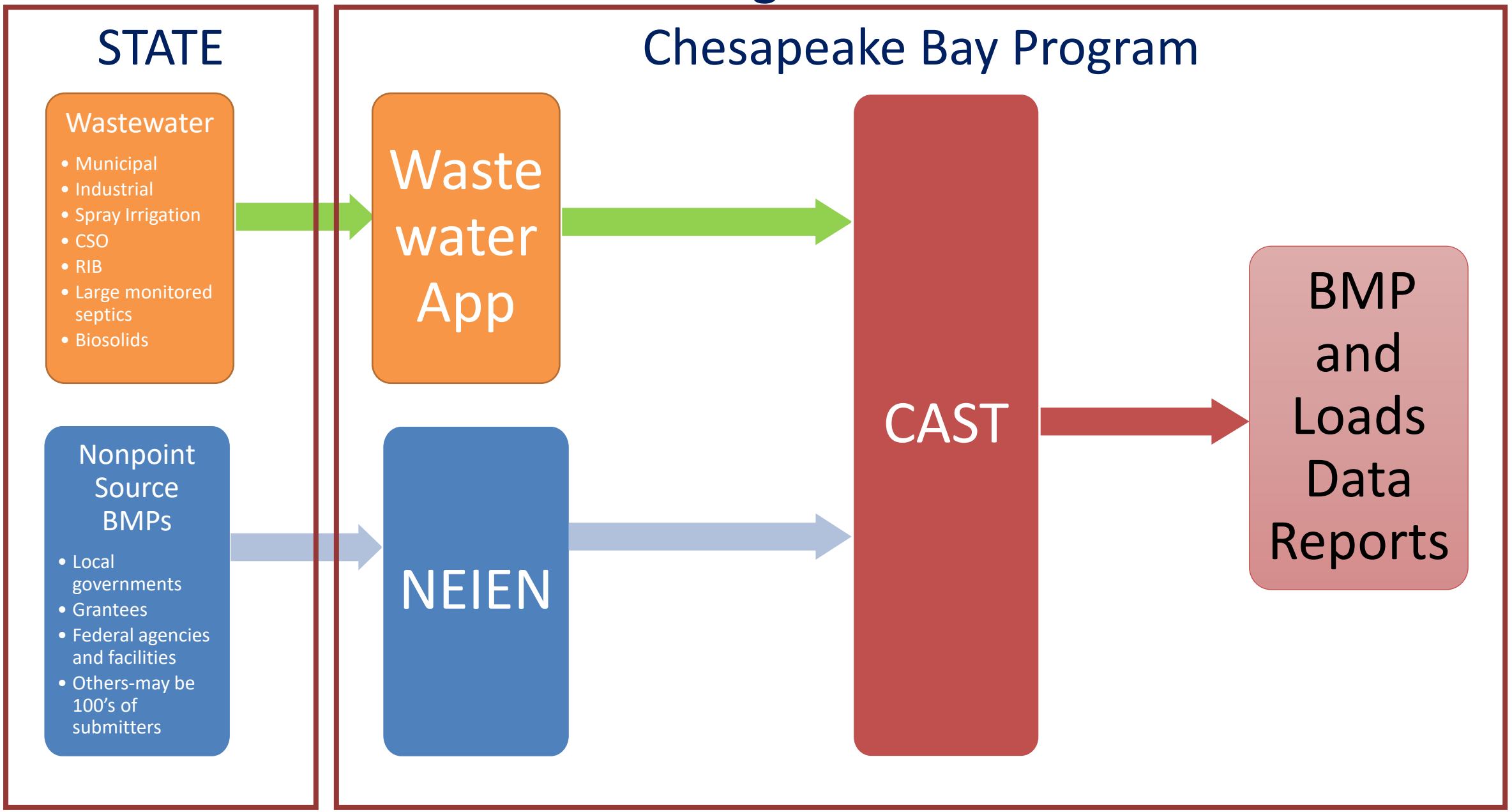


- Information about BMPs
- Sources of BMP data
- Process for introducing new BMPs for use in scenarios
- Crosswalks to NRCS and other practice names

Comprehensive Source Data



TMDL Progress data



COST PROFILES

My Cost Profiles

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Add New Cost Profile | Clear Filters

Cost Profile Name	Edit	Download	Delete
MD			
pa			
Maryland_ExampleMaxCosts			
Lancaster			

Shared Cost Profiles

Clear Filters

Cost Profile Name			Download
West Virginia			
Virginia			
Pennsylvania			
New York			
Watershed	CBP Admin	2016-06-29 01:05:02 PM	
Maryland	CBP Admin	2016-06-29 01:04:45 PM	
Delaware	CBP Admin	2016-06-29 01:04:16 PM	
District of Columbia	CBP Admin	2016-06-29 01:03:58 PM	

Add Cost Profile

* Required field

Name *

Description *

(Max. characters 500)

Copy From Existing *: Select Cost Profile

Cost Formula *: Select Cost Formula

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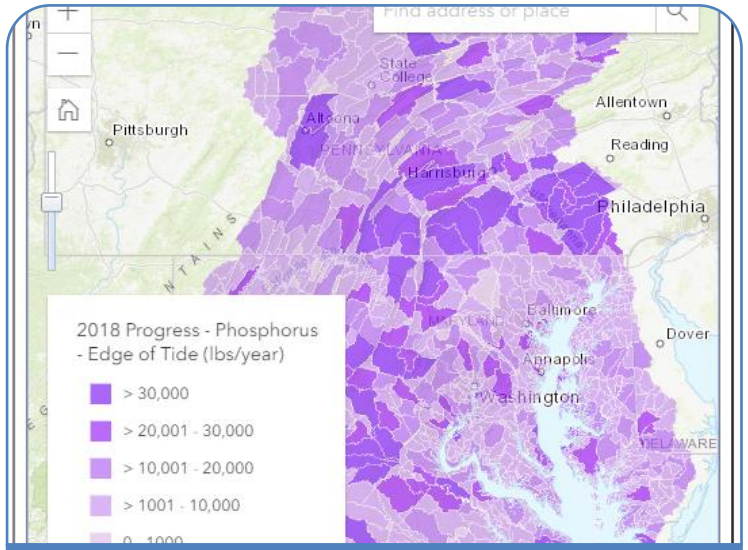
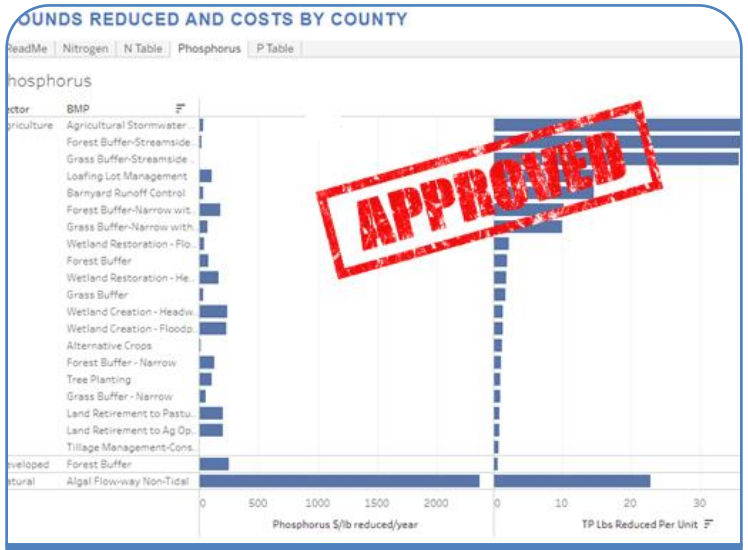
Save | Cancel

Targeting Reductions

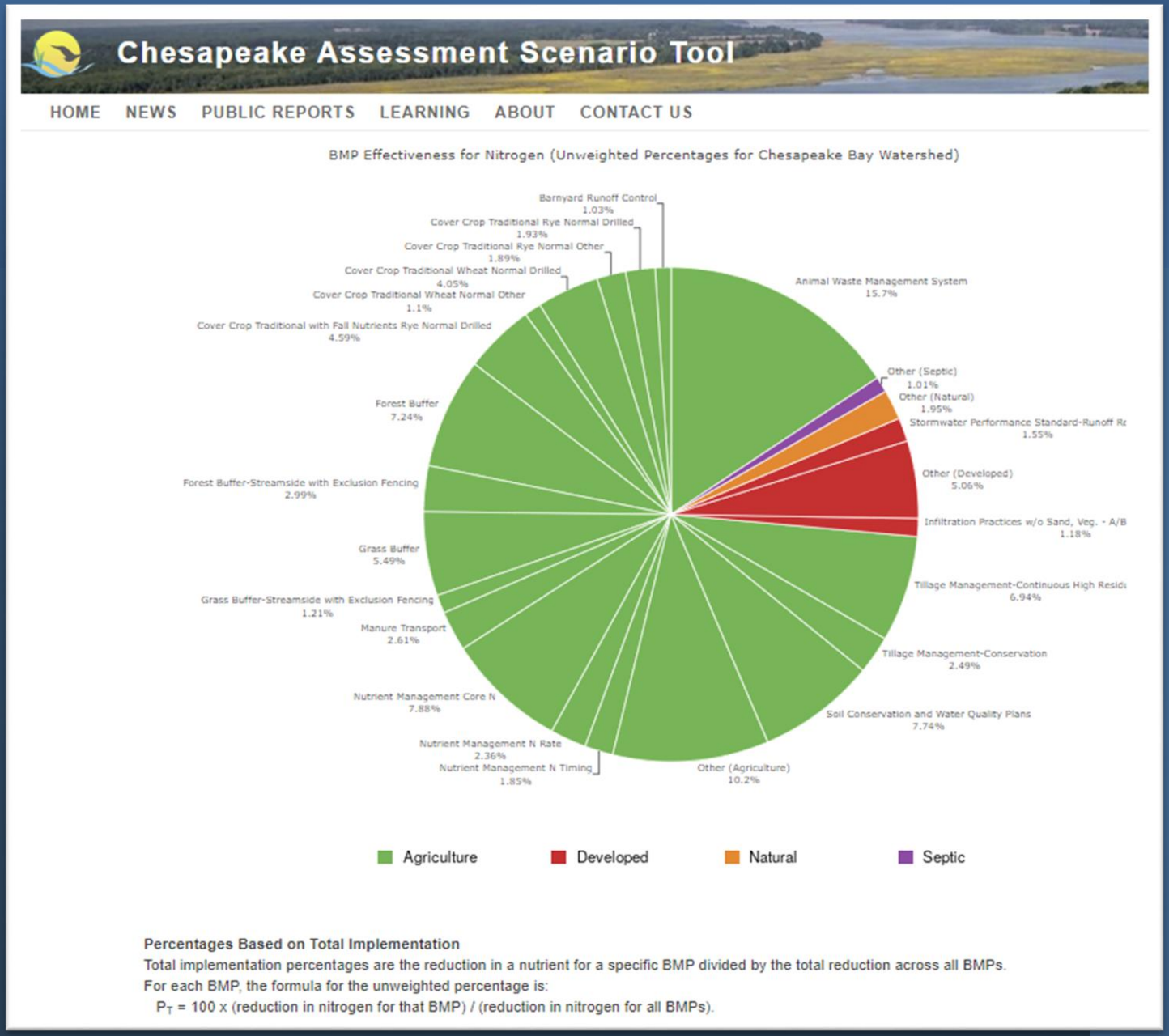


Location

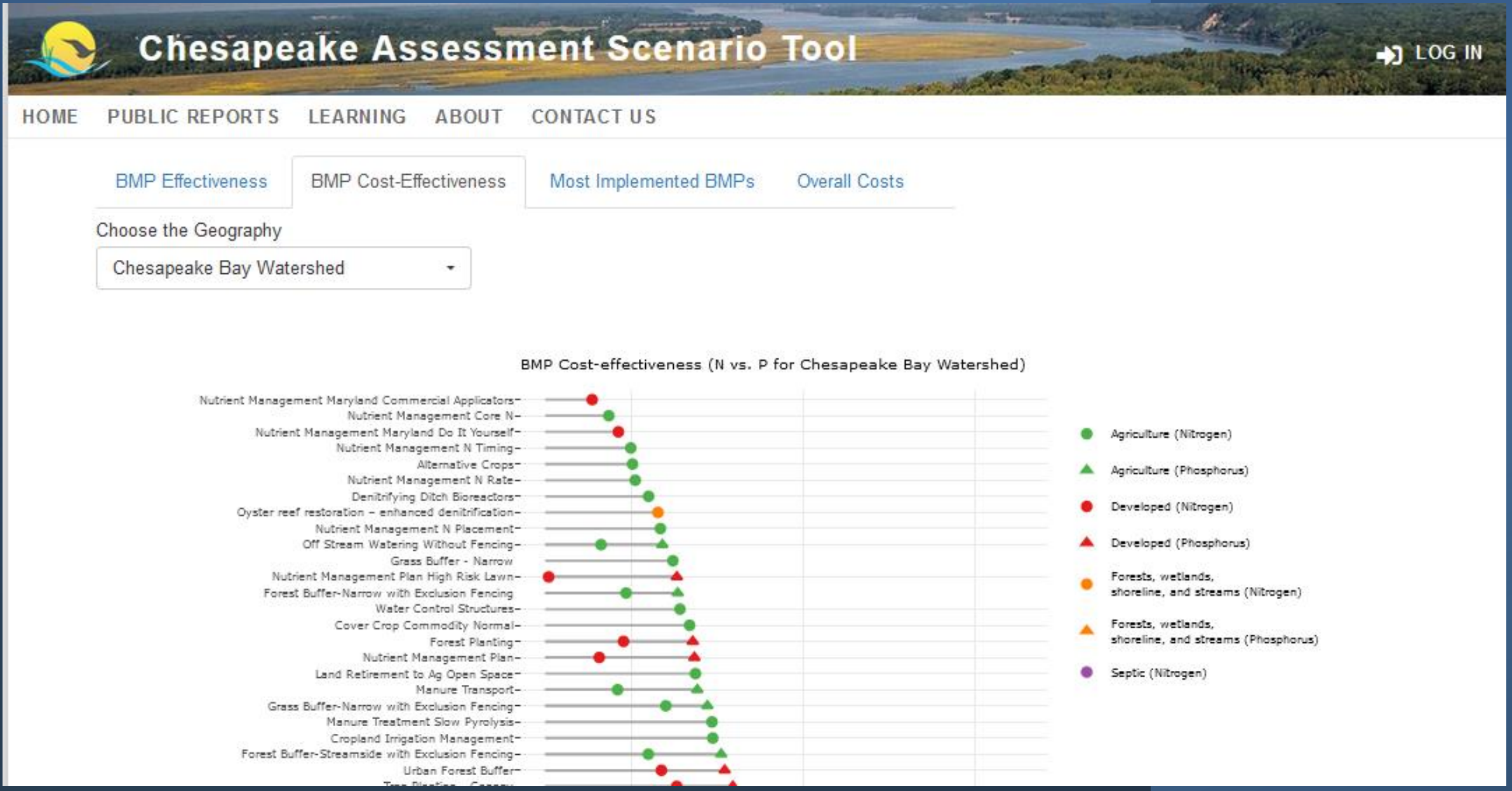


BMP

Land Use



https://cast.chesapeakebay.net/Documentation/wipbmpcharts



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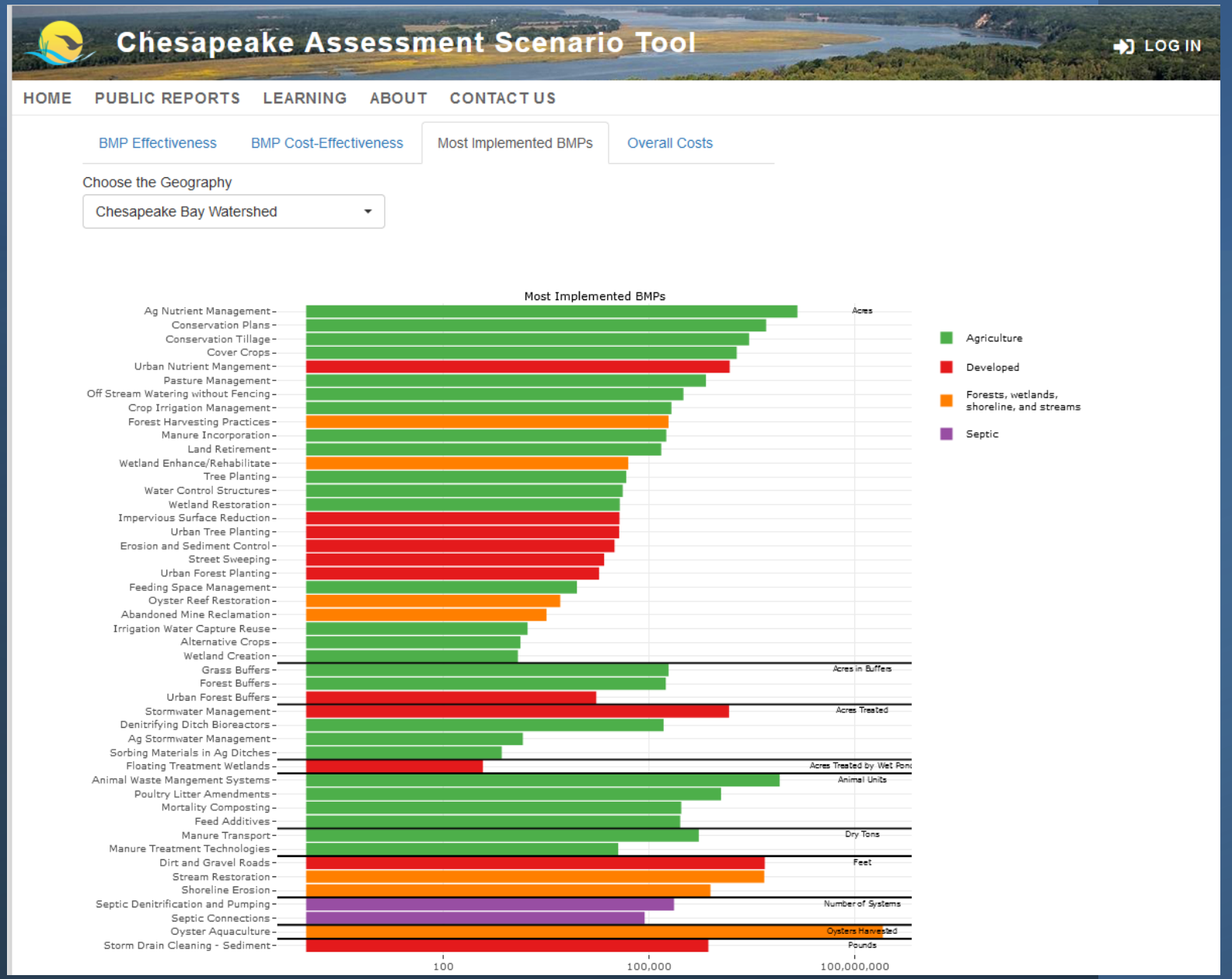
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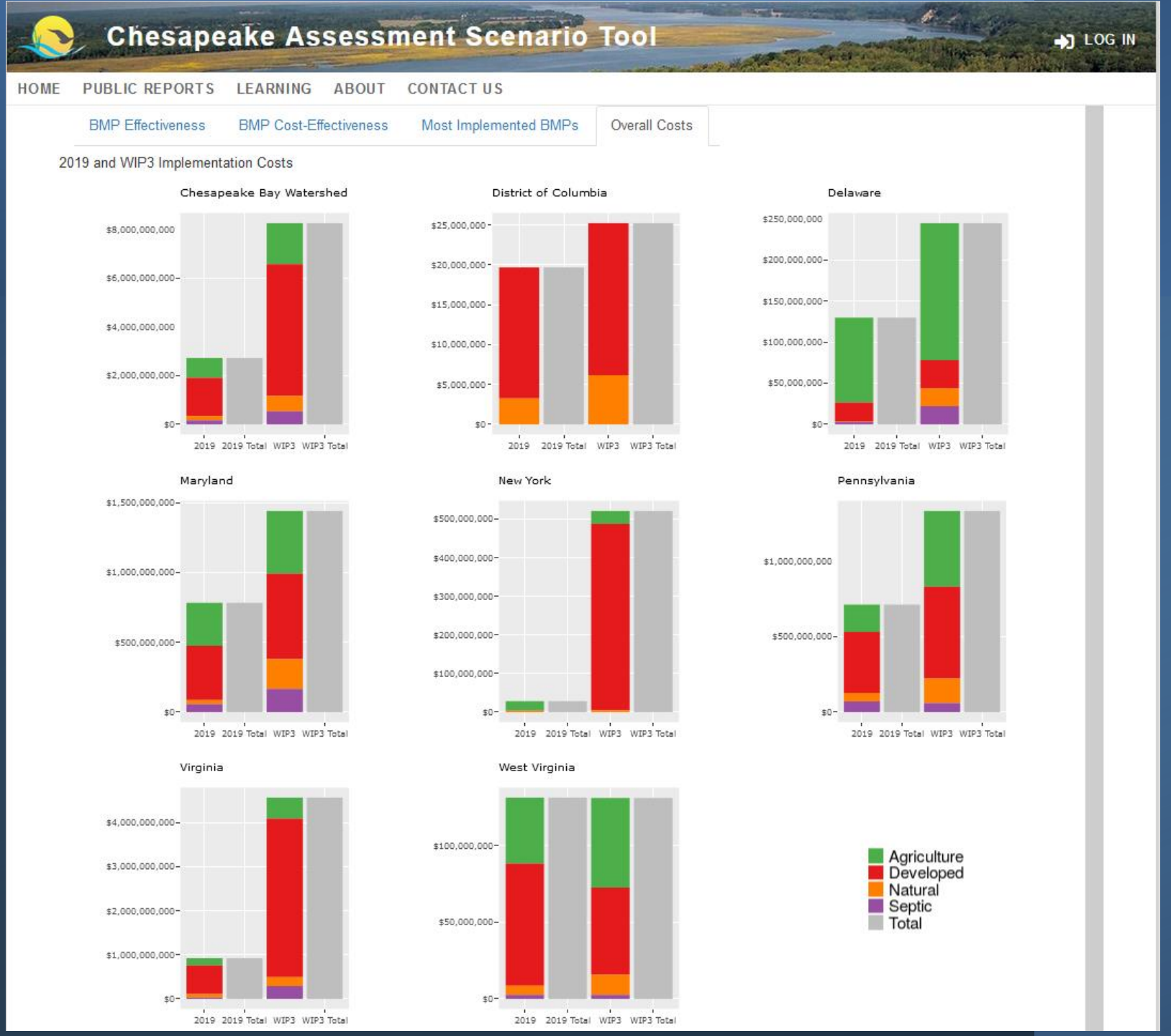
BMP Effectiveness
BMP Cost-Effectiveness
Most Implemented BMPs
Overall Costs
Choose the Geography
Chesapeake Bay Watershed
Most Implemented BMPs
Ag Nutrient Management
Conservation Plans
Conservation Tillage
Cover Crops
Urban Nutrient Mangement
Pasture Management
Off Stream Watering without Fencing
Crop Irrigation Management
Forest Harvesting Practices
Manure Incorporation
Land Retirement
Wetland Enhance/Rehabilitate
Tree Planting
Water Control Structures
Wetland Restoration
Impervious Surface Reduction
Urban Tree Planting
Erosion and Sediment Control
Street Sweeping
Urban Forest Planting
Feeding Space Management
Oyster Reef Restoration
Abandoned Mine Reclamation
Irrigation Water Capture Reuse
Alternative Crops
Wetland Creation
Grass Buffers
Forest Buffers
Urban Forest Buffers
Stormwater Management
Denitrifying Ditch Bioreactors
Ag Stormwater Management
Sorbing Materials in Ag Ditches
Floating Treatment Wetlands
Animal Waste Mangement Systems
Poultry Litter Amendments
Mortality Composting
Feed Additives
Manure Transport
Manure Treatment Technologies
Dirt and Gravel Roads
Stream Restoration
Shoreline Erosion
Septic Denitrification and Pumping
Septic Connections
Oyster Aquaculture
Storm Drain Cleaning - Sediment
Acres
Acres in Buffers
Acres Treated
Acres Treated by Wet Pond
Animal Units
Dry Tons
Feet
Number of Systems
Oysters Harvested
Pounds
100
100,000
100,000,000
Agriculture
Developed
Forests, wetlands, shoreline, and streams
Septic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BMP Cost-Effectiveness
Most Implemented BMPs
Overall Costs
2019 and WIP3 Implementation Costs
Chesapeake Bay Watershed
District of Columbia
Delaware
Maryland
New York
Pennsylvania
Virginia
West Virginia
2019
2019 Total
WIP3
WIP3 Total
Agriculture
Developed
Natural
Septic
Total

Better Targeting CBP Resources to Achieve Multiple Outcomes: Approach and Tools

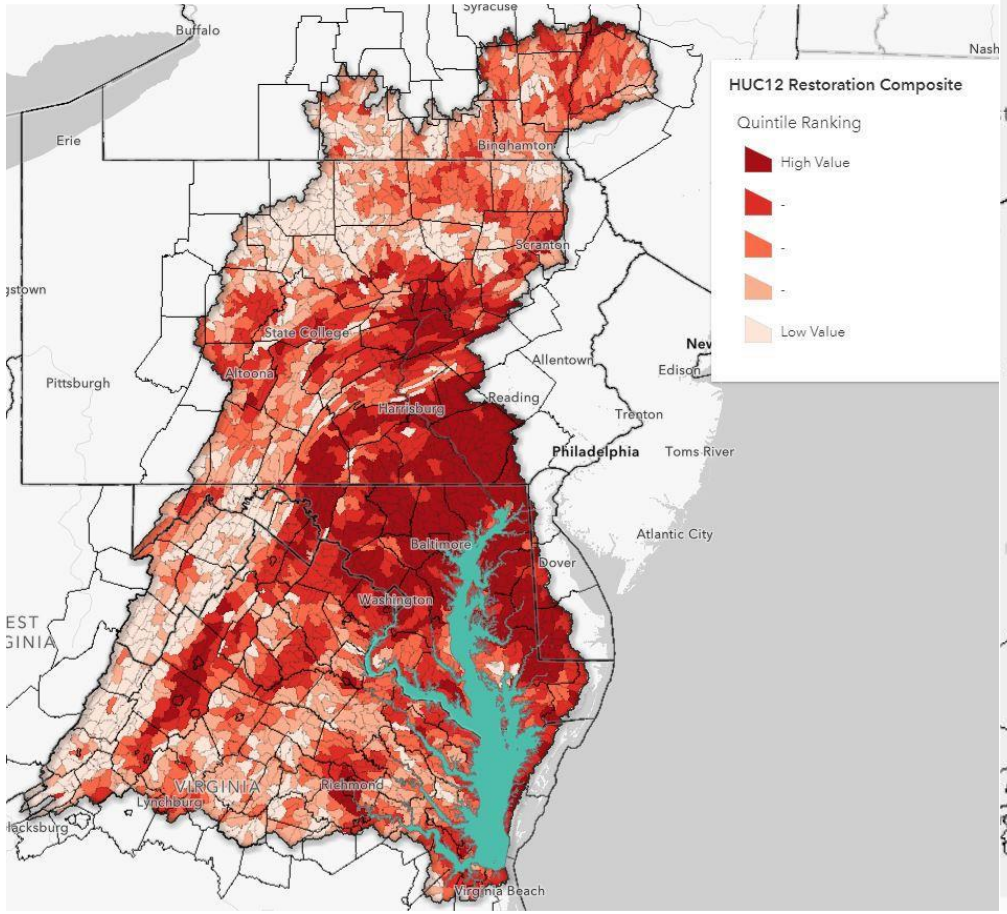


Figure 4 shows the composite restoration map of places where multiple outcomes can be met for water-quality improvements, toxic contaminants, and habitat connectively. These outcomes were selected by the GITs.

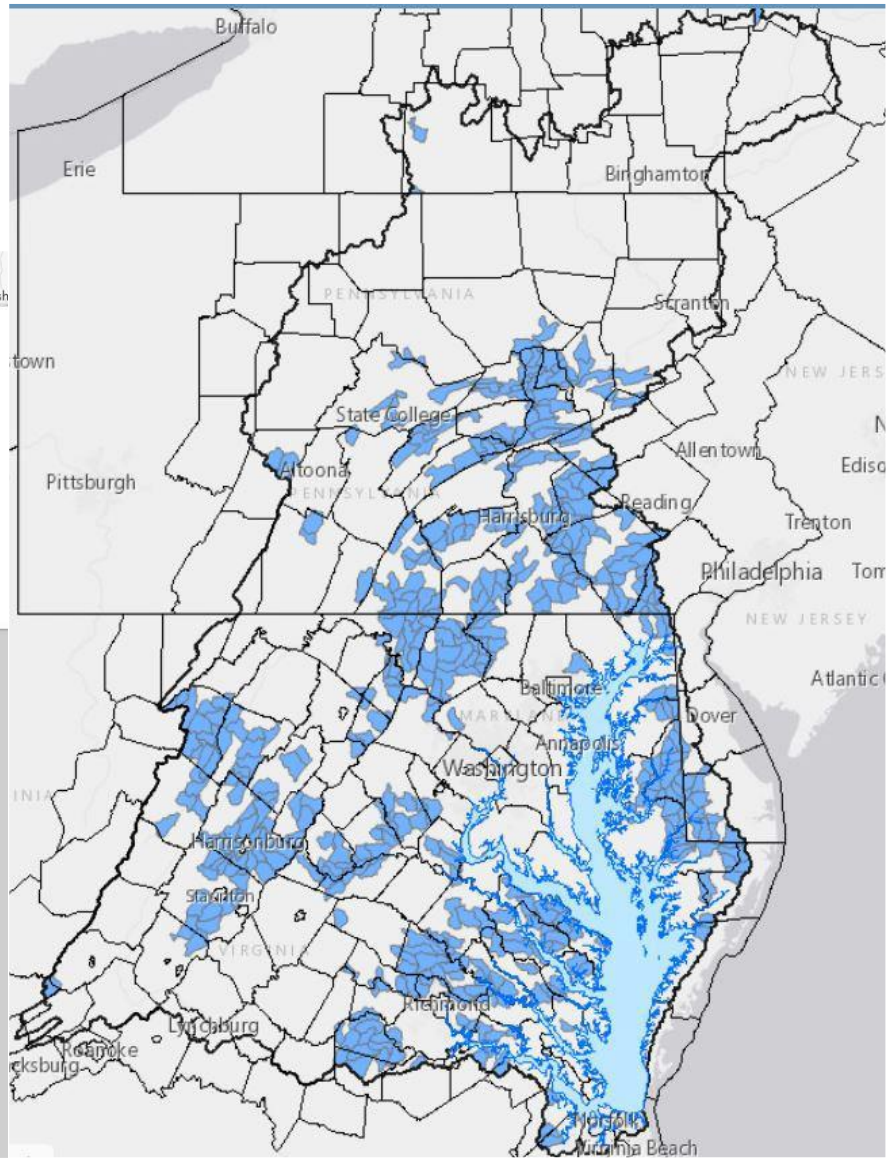
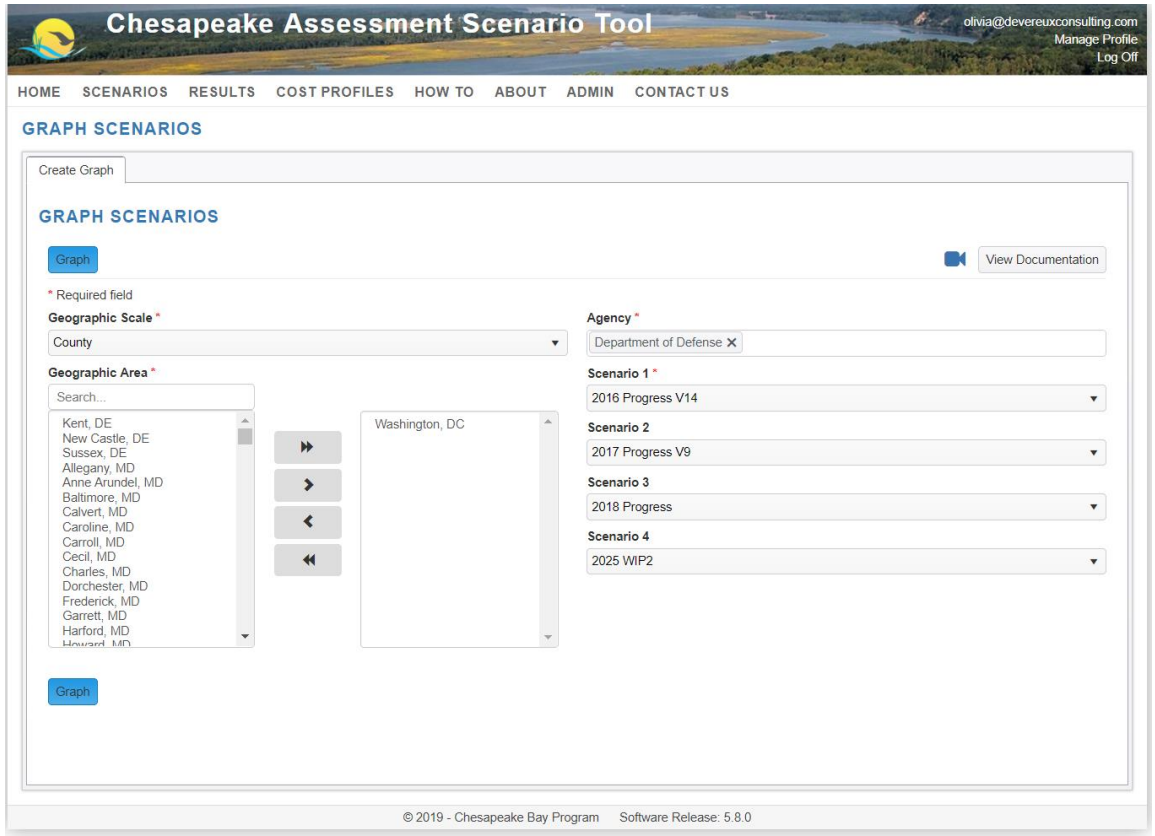
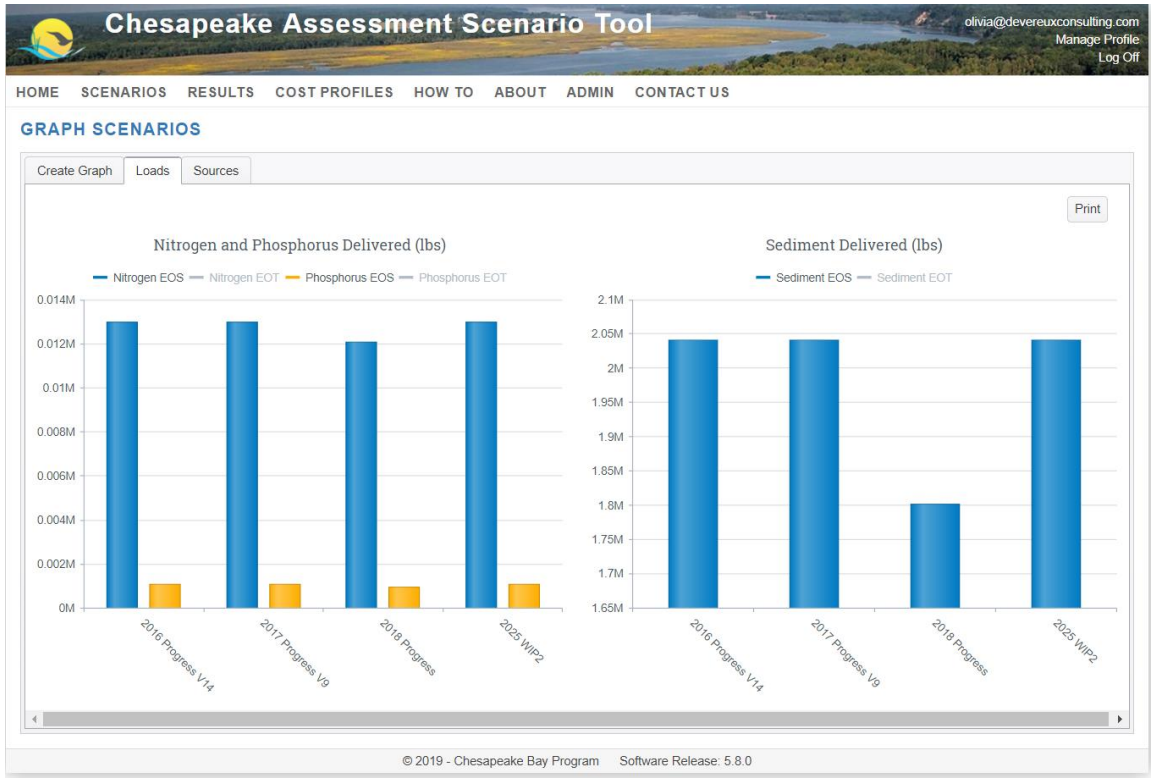


Figure 3. Ranking by states for places to get the highest reduction of nitrogen loading to the Bay and local water-quality improvements (from the Chesapeake Agricultural Priority Watersheds tool).

Use Results → Graphs to Evaluate Load Reductions





https://cast.chesapeakebay.net/PlanningTargets

Chesapeake Assessment Scenario Tool

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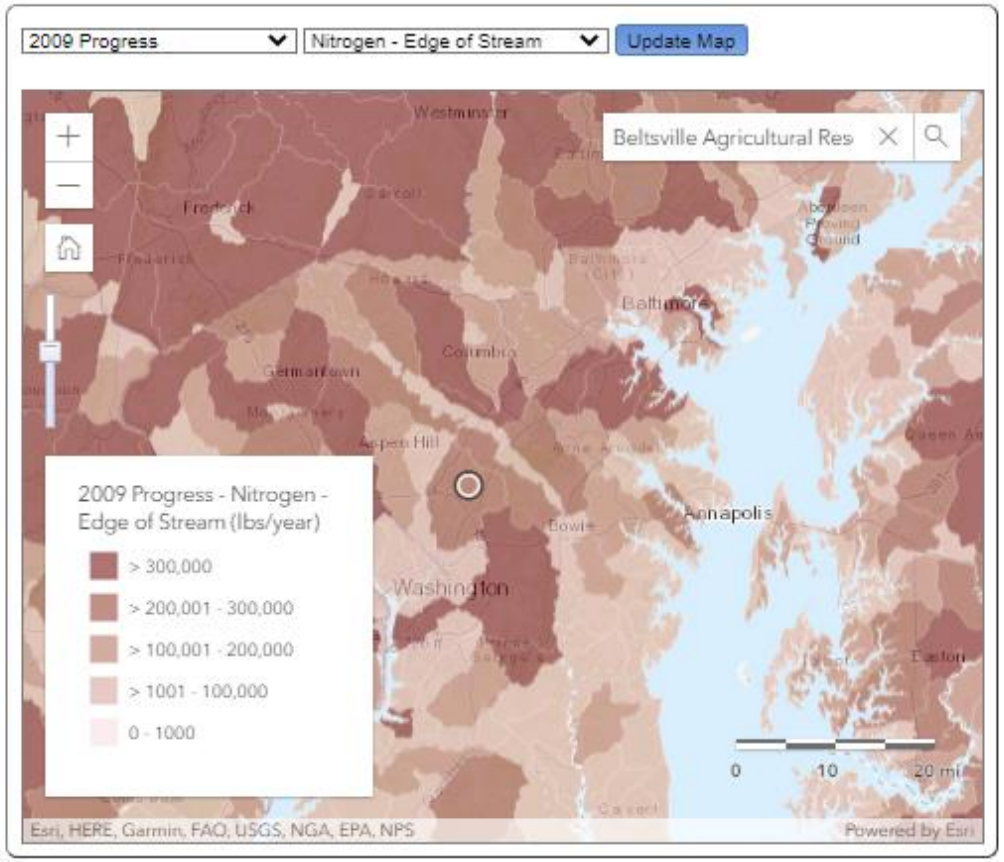
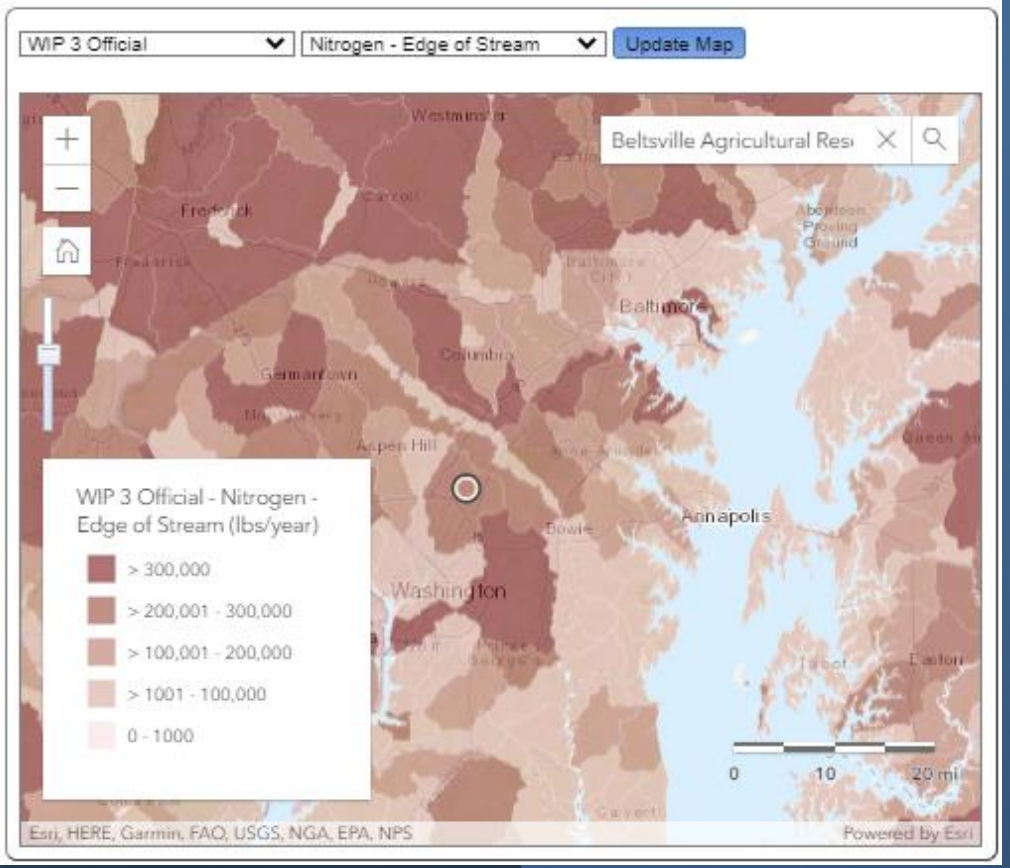
PUBLIC REPORTS - COMPARE MAP

The publicly-shared scenarios include annual progress, no action, Everything by Everyone, Everywhere (E3) and the Phase 2 Watershed Implementation Plans (WIP2). These maps facilitate comparison of nitrogen, phosphorus, and sediment loads at either the edge-of-stream or edge-of-tide scale. Select a scenario and pollutant in each map to compare scenarios, then click a land-river segment for more details. View a full sized version of the map here.

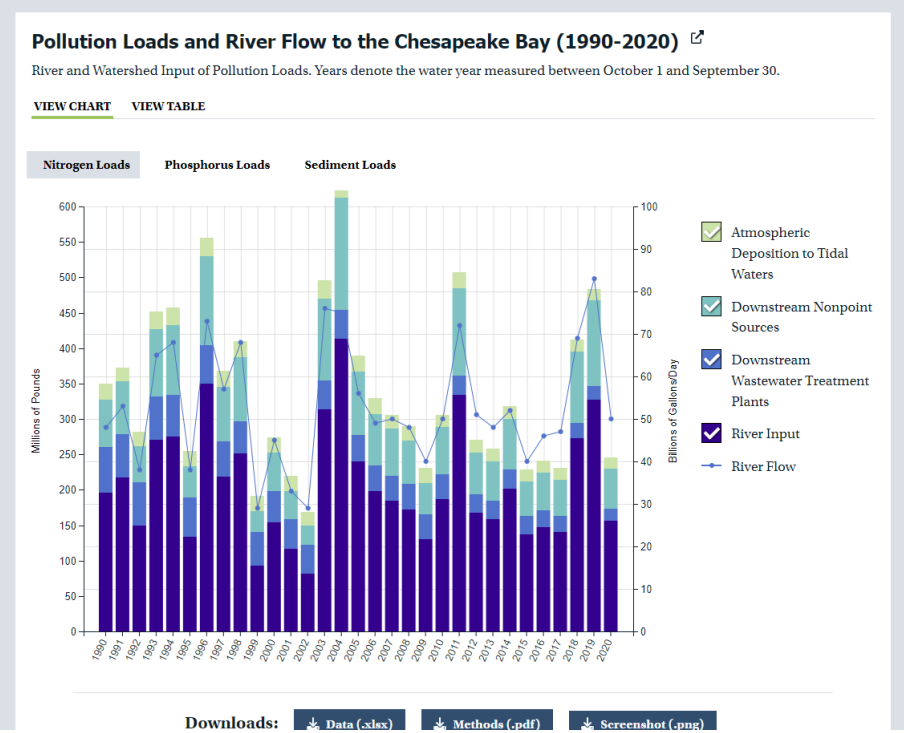


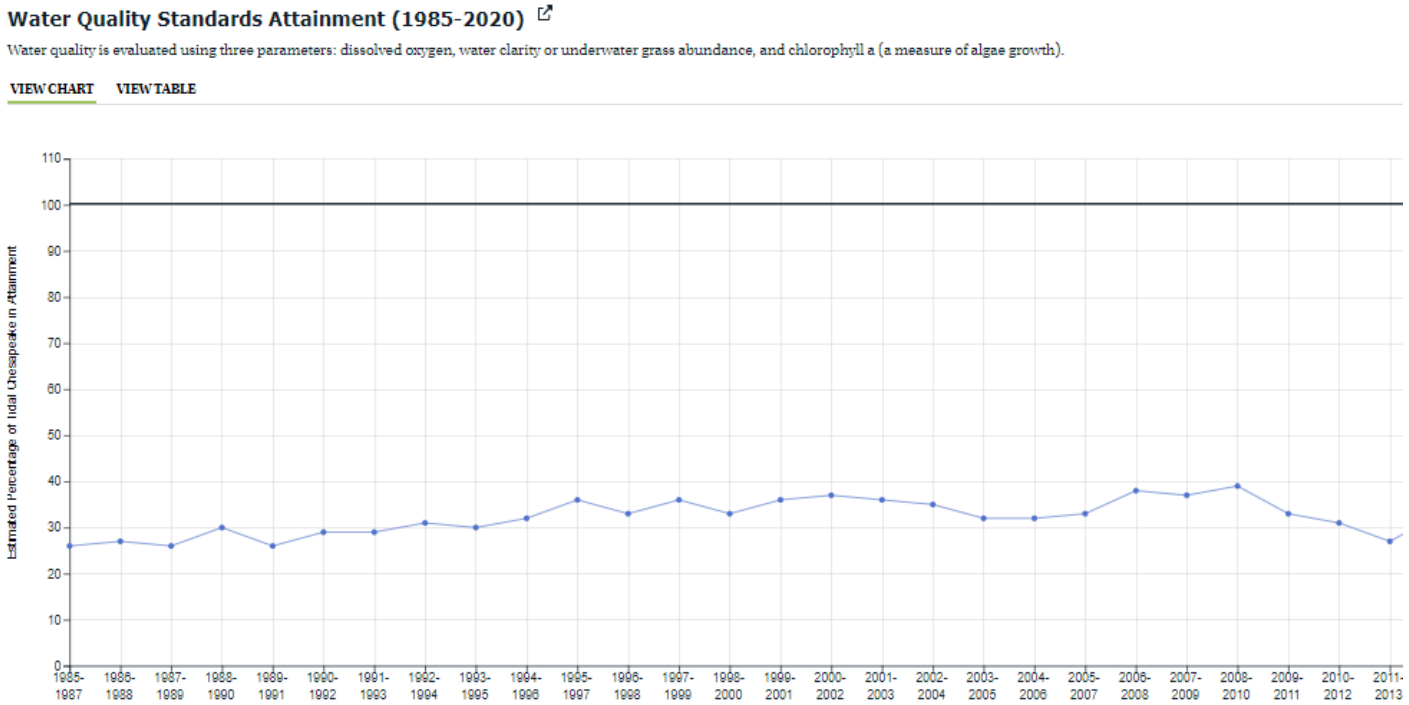


https://cast.chesapeakebay.net/PublicReports/CompareMap

Ultimately, Progress Is Reflected in the Monitoring Data

https://www.chesapeakeprogress.com/clean-water/water-quality



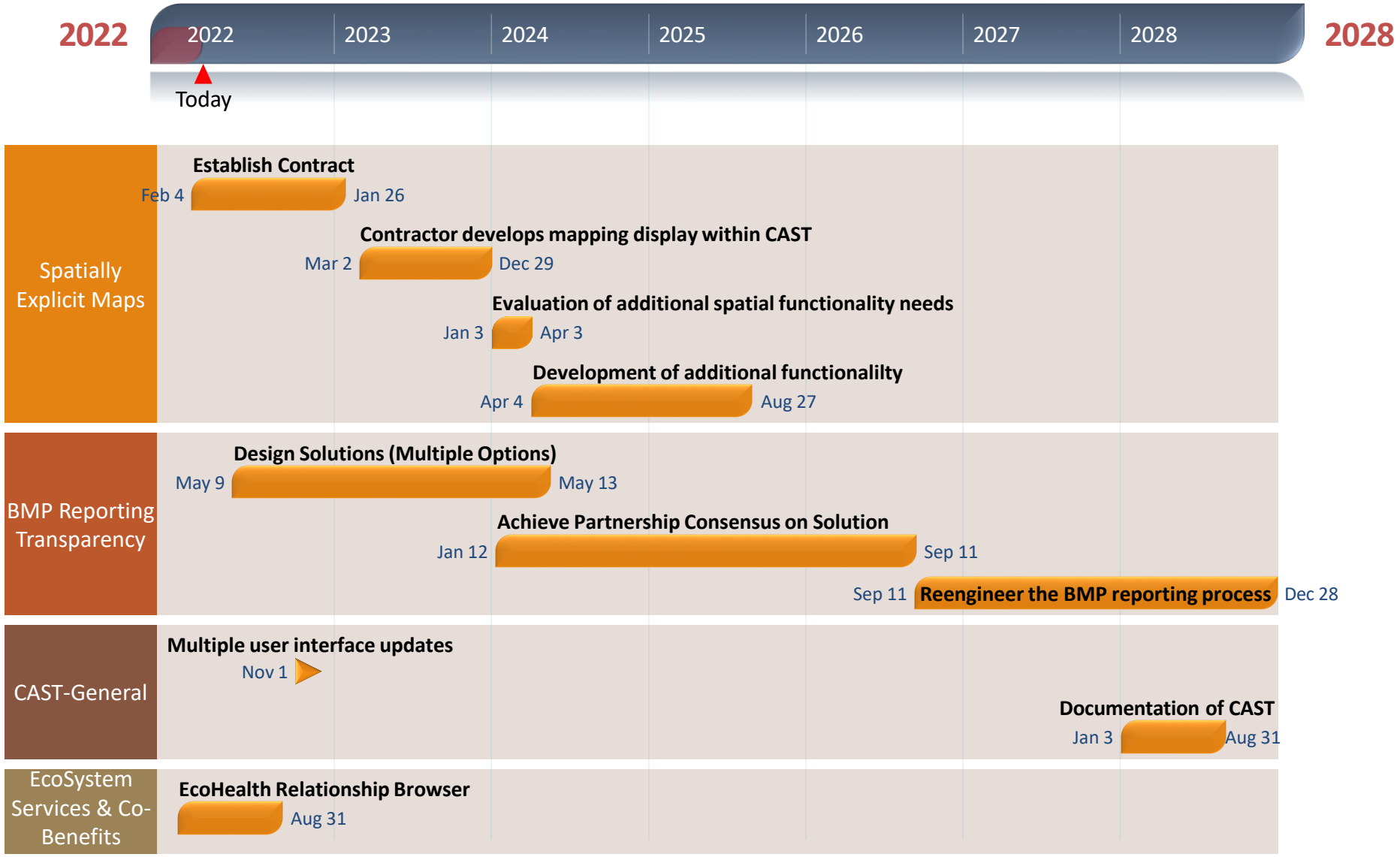


Planned CAST Enhancements

- Improved transparency in BMP annual reporting
- BMP Benefits and Eco-System Services
- Integrating land use views in CAST

CAST Timeline

*contingent on funding and staff availability



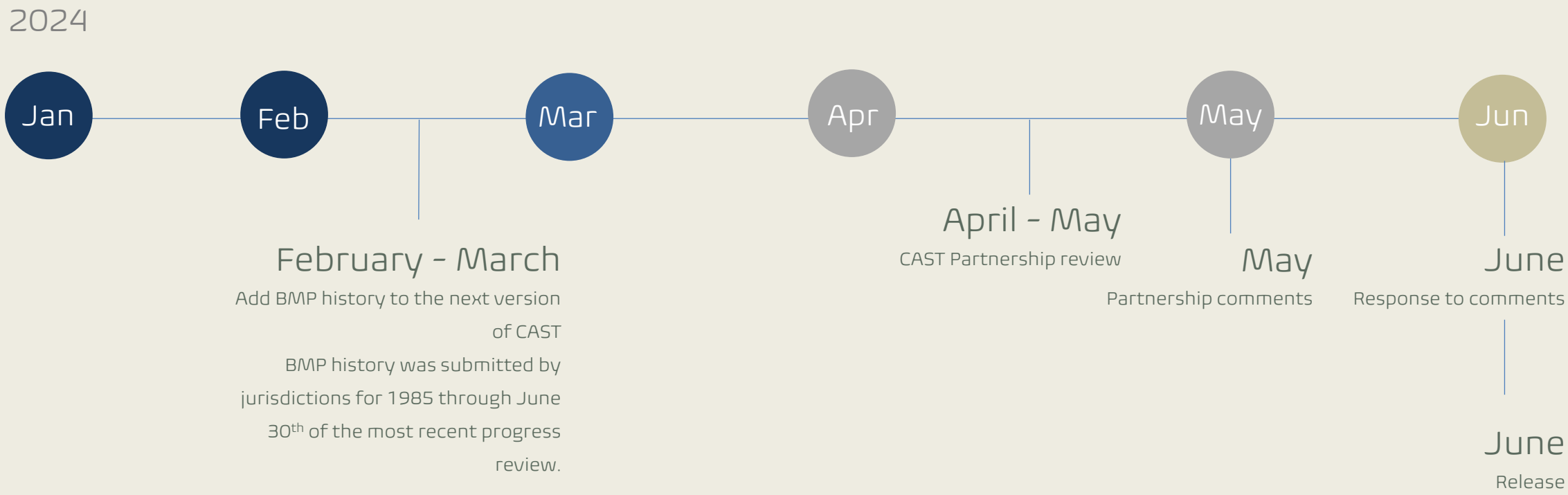
Updating CAST

- Scientific methods and data evolve over time, so new methods and data must be incorporated into its modeling tools.
- It was decided that with the development of each jurisdiction's milestones, the partnership would hold the assumptions set at the beginning of that 2-year milestone period constant. (Decision: WQGIT Dec. 2015 and Management Board Jan. 2016)
- Land uses are predicted at the beginning of the milestone period and these projections are not changed. At the end of the two years, new data approved by the partnership is incorporated into past and present progress runs.
  - BMP updates
  - Land use
  - Crop acres and yields
  - Animal numbers
- By holding assumptions constant for the milestone period and updating with new data and information every two years, the model more accurately reflects what is happening on the ground.

https://cast.chesapeakebay.net/Documentation/ModelDocumentation

CAST Update Deadlines

CAST Update Deadlines



Differences between CAST and Dynamic Watershed Model

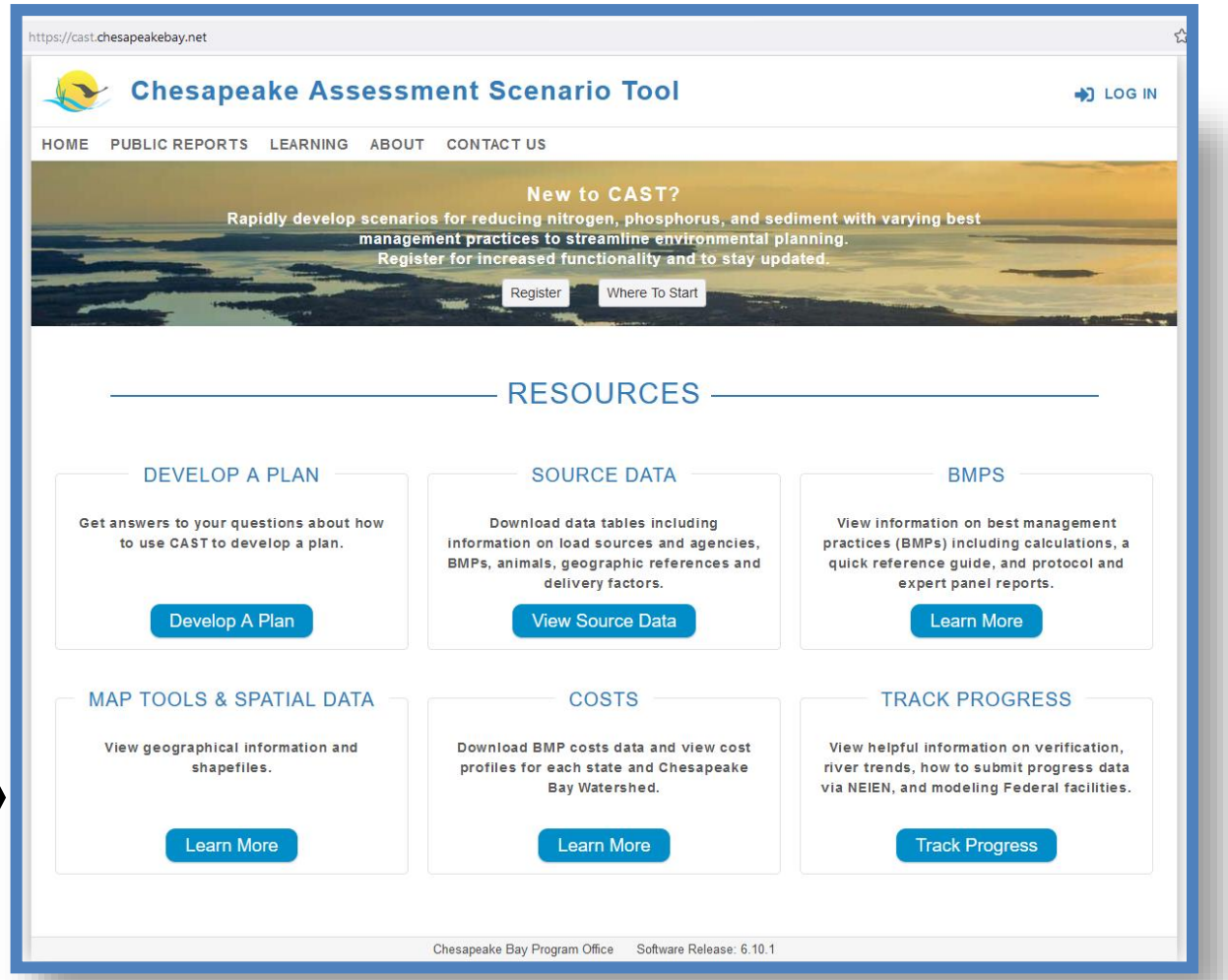
Dynamic Watershed Model

Incorporates the following in the calibration process and produces the data used in CAST

- Assess lag times in UNEC, and Modflow
- Determines river delivery factors
- Supplies average hydrology (storm/baseflow inches per year)
- Provides hourly input the Estuarine model

Data Analyses used in CAST

- Phase 5.3.2 for average loads and nitrogen sensitivity
- USGS Sparrow regression model for average loads, nitrogen sensitivity, land to water and stream delivery factors
- USDA CEAP/APEX Chesapeake model for average loads and nitrogen sensitivity
- APLE for phosphorus sensitivity
- RUSLE (equation, not software product) for sediment edge of field loads



- CAST is the model used for assessing impacts of BMPs
- CAST incorporates data from the time-variable, Dynamic Watershed Model

Resources Available

- CAST Home Page
  - Developing Plans includes steps, goals, co-benefits, financing resources
- CAST Contact Us for one-on-one user support
- CAST Learning
  - User Documentation > Getting Started
  - Free Training Videos
  - Monthly live webinars
- CAST BMP information in Source Data
- Official model documentation
- BMP cost data

Contact Us!

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