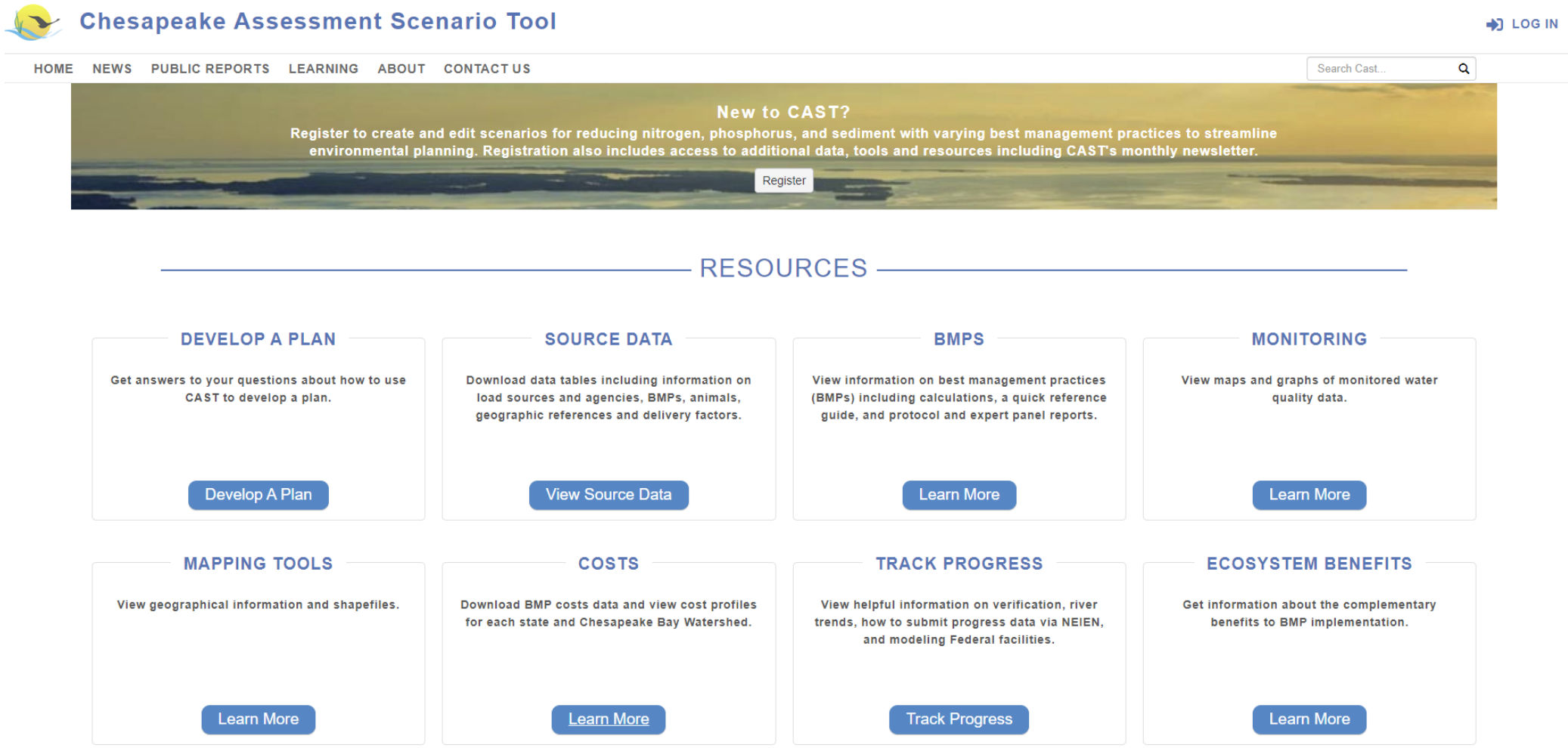


Mapping Capabilities in CAST

OLIVIA DEVEREUX

JANUARY 25, 2023

Current Use of CAST

- Tracking
  - Accounting and visualization of BMPs implemented to meet the Bay TMDL, data imported from NEIEN
- Planning
  - To meet the Bay TMDL
  - MS4 permits
  - Conservation districts
  - Local TMDL development, milestones, and plans

- Serves all stakeholders connected to on the ground restoration work
- Primary
  - Major jurisdictions responsible for WIPs, Milestones, and Annual Progress
- Secondary
  - MS4s
  - Local planners
  - Watershed groups
  - Grantees who need to justify load reductions
  - Conservation districts

Land Use Data

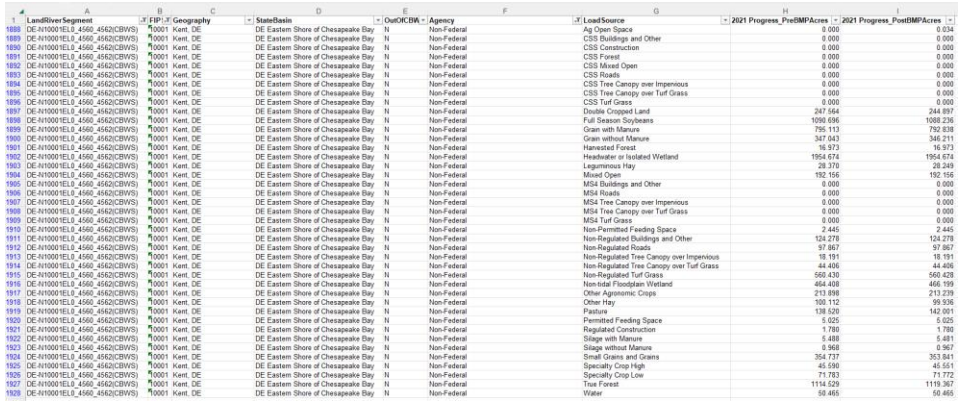
Multiple data sources are used to create the land use in CAST

- USGS's Land Data Team mapped data provide the basis to which additional data are fit
- Jurisdictions provide additional data for harvested forest and construction acres
- USDA's publicly available crop, pasture, and hay acres are used to inform the agricultural land uses

The final land use is tabular and not spatially explicit

Methods are documented in Section 5 of the CAST and Dynamic Watershed Model documentation

- https://cast-content.chesapeakebay.net/documents/5%20Land%20Use%202020%2003%20Draft.pdf



	A	B	C	D	E	F	G	H	I
1	LandRiverSegment	FIP	Geography	StateBasin	OutOfCBW	Agency	LoadSource	2021 Progress_PreBMPAcres	2021 Progress_PostBMPAcres
1888	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Ag Open Space	0.000	0.034
1889	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	CSS Buildings and Other	0.000	0.000
1890	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	CSS Construction	0.000	0.000
1891	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	CSS Forest	0.000	0.000
1892	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	CSS Mixed Open	0.000	0.000
1893	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	CSS Roads	0.000	0.000
1894	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	CSS Tree Canopy over Impervious	0.000	0.000
1895	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	CSS Tree Canopy over Turf Grass	0.000	0.000
1896	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	CSS Turf Grass	0.000	0.000
1897	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Double Cropped Land	247.564	244.897
1898	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Full Season Soybeans	1090.696	1088.236
1899	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Grain with Manure	795.113	792.838
1900	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Grain without Manure	347.043	346.211
1901	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Harvested Forest	16.973	16.973
1902	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Headwater or Isolated Wetland	1954.674	1954.674
1903	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Leguminous Hay	28.370	28.249
1904	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Mixed Open	192.156	192.156
1905	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	MS4 Buildings and Other	0.000	0.000
1906	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	MS4 Roads	0.000	0.000
1907	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	MS4 Tree Canopy over Impervious	0.000	0.000
1908	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	MS4 Tree Canopy over Turf Grass	0.000	0.000
1909	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	MS4 Turf Grass	0.000	0.000
1910	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Non-Permitted Feeding Space	2.445	2.445
1911	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Non-Regulated Buildings and Other	124.278	124.278
1912	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Non-Regulated Roads	97.867	97.867
1913	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Non-Regulated Tree Canopy over Impervious	18.191	18.191
1914	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Non-Regulated Tree Canopy over Turf Grass	44.406	44.406
1915	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Non-Regulated Turf Grass	560.430	560.428
1916	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Non-tidal Floodplain Wetland	464.408	466.199
1917	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Other Agronomic Crops	213.898	213.239
1918	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Other Hay	100.112	99.936
1919	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Pasture	138.520	142.001
1920	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Permitted Feeding Space	5.025	5.025
1921	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Regulated Construction	1.780	1.780
1922	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Silage with Manure	5.488	5.481
1923	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Silage without Manure	0.968	0.967
1924	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Small Grains and Grains	354.737	353.841
1925	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Specialty Crop High	45.590	45.551
1926	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Specialty Crop Low	71.783	71.772
1927	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Tree Forest	1114.529	1119.367
1928	DE-N10001EL0_4560_4562(CBWS)	10001	Kent, DE	DE Eastern Shore of Chesapeake Bay	N	Non-Federal	Water	50.465	50.465

Geographic Scales for Planning

CURRENT

- Chesapeake Bay Watershed
- County
- HUC-4, 6, 8, 10, and 12s
- Land-river segments
- State
- Major basin
- Chesapeake Bay Segments
- Virginia Planning District Commissions
- Virginia Soil Conservation Districts and District Areas

PROPOSED USING 1 OR 10-METER DATA

- Point
- Line
- Polygon
- Plus, all current geographies for planning and reporting

Link BMP Planning to Explicit Land Use

+ Add BMP

Add BMP

*Required field

Geographic Scale * Select Geographic Scale

Geographic Area * Select Geographic Area

Agency * Select Agency

BMP * Select BMP

Secondary BMP * Select BMP

Load Source * Select Load Source

Unit * Select Unit

Amount *

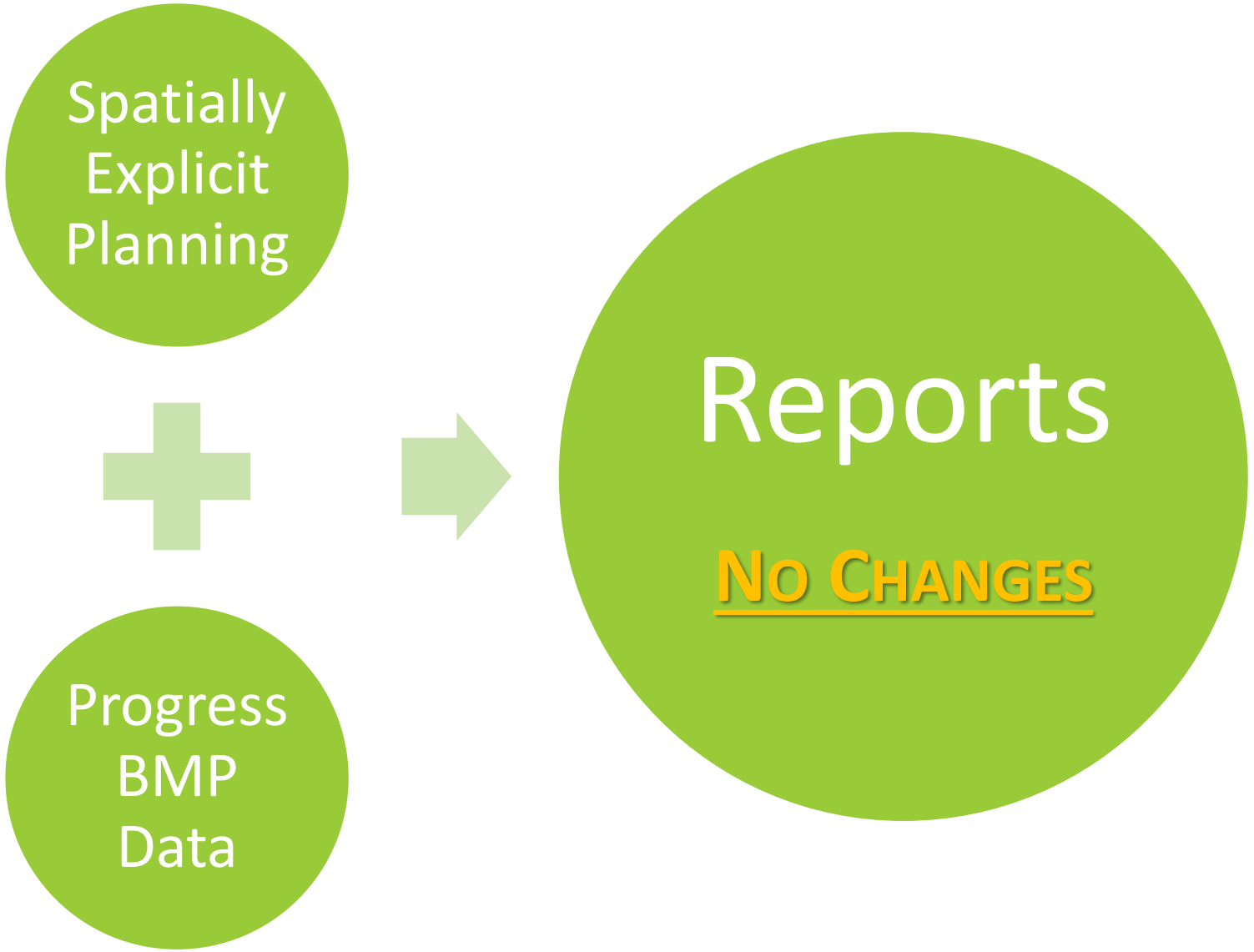
Add Cancel

Objectives for Planning Scenarios

- ✓Help users gain confidence in the CAST land use and resulting load estimates
- ✓Refine planning for field and project scales while increasing users' ability to target BMPs
- ✓Facilitate best use of the next version of the Dynamic Watershed Model and accompanying version of CAST, the static version of that model.
  - ✓The Modeling Team already has downscaled the hydrology to the National Hydrography Dataset Plus High Resolution, Version 2 (NHD+) (https://www.usgs.gov/core-science-systems/ngp/national-hydrography/nhdplus-high-resolution).
  - ✓The Modeling Team also has a methodology for the stream bed and bank loads that makes better use of upland delivery to streams for the same NHD+ scale (G. Noe, USGS, presentation to the Modeling Team, 9/22/2020).

- ✓Long term goal
  - ✓Coupling the finer scale hydrologic model and stream delivery with the spatially explicit land use would allow better crediting of BMPs that have upland benefits. Currently, a proportion of all upland land uses in a sector are credited.
  - ✓With these finer scale data, BMPs like buffers can have upland effects credited to the actual land use that drains to the buffered stream area. This also opens the door to temporal definition of BMPs in CAST, which currently is part of NEIEN.

Impact on CAST Results



Users can continue to access annual progress tracking data that does not include the spatially explicit information.

TN, TP, TSS, and cost results can continue to be provided in the current format since the data can be stored at specific geographic scales including latitude and longitude rather than land-river segments.

Approach for Displaying 1-meter dataset

Develop a new API service specific to the Chesapeake 1-meter dataset

Use zonal algorithms that are easily parallelizable and can manage large queries through a distributed data processing cluster

To work in an online tool, develop an algorithm using the number of vertices of an area of interest, as opposed to area dependent

The Fast-Zonal Statistics (FZS) API is labeled “fast” because to determine the zonal sum for a polygon over a raster surface, only the cells which intersect the boundary of the polygon must be traversed rather than all the interior cells. This means that computationally the approach scales much better with increased data resolution as the FZS algorithm is constant in relation to the length (meters) of the polygon perimeter rather than its area (meters square). (Haag et al. 2020, https://www.sciencedirect.com/science/article/pii/S0098300419306697)

Approach decreases the processing time to seconds.

Visualization of the 1-meter data could be achieved through a separate map tiling service

Available Spatially Explicit Data Sources

The land data team has impervious and land cover mapped for 1984, 1992, 2001, 2006, 2011, at 30-meter resolution (https://www.mrlc.gov/data#:~:text=The%20National%20Land%20Cover%20Database%20%28NLCD%29%20provides%20nationwide,and%20land%20cover%20change%20data%20for%20the%20Nation).

The 2013 data are mapped at 1 meter and 10-meter resolution (https://www.sciencebase.gov/catalog/item/557b238fe4b0c350d7b9abb8).

The 2017 data are available at the 1 meter and 10-meter resolutions.

These data are incorporated into the tabular land use, but cannot be queried or visualized at the original scale of either the 1-meter or the 10-meter resolution in CAST.

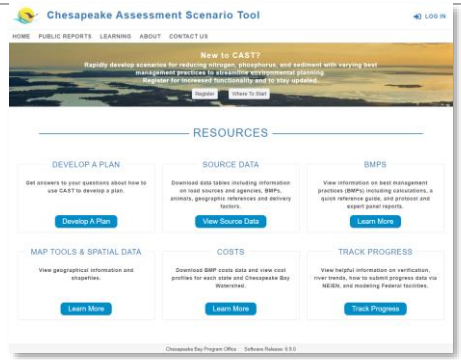
First step is to show explicit land use for 2017, then build the explicit land use for all years.

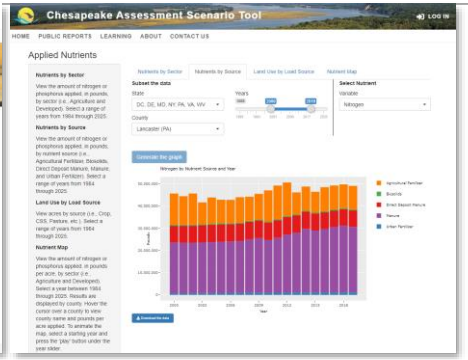
Benefit to Restoration Professionals

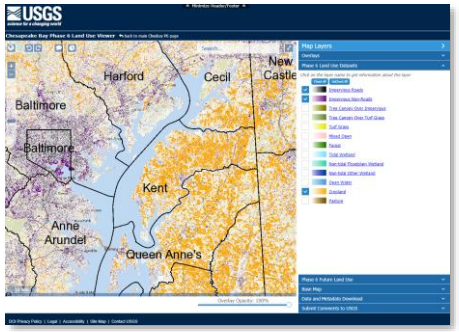
Using the spatially explicit land cover data in CAST is expected to enhance CAST users' ability to **improve water quality and focus measured outcomes to smaller geographic scales**.

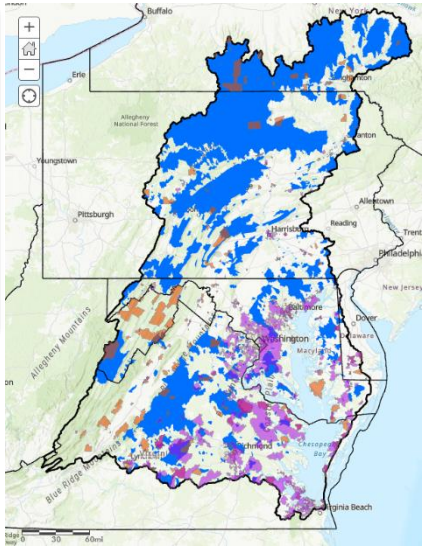
This enhancement will help CAST be understood and supported by non-technical people, which will **expand usage of CAST to conservation project members, farmers, and farm advisors**.

This enhancement will **negate the need for urban planners to convey their site-specific geographic information** to the more general tabular geographics currently available.









Currently, the data are available, but not integrated.

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

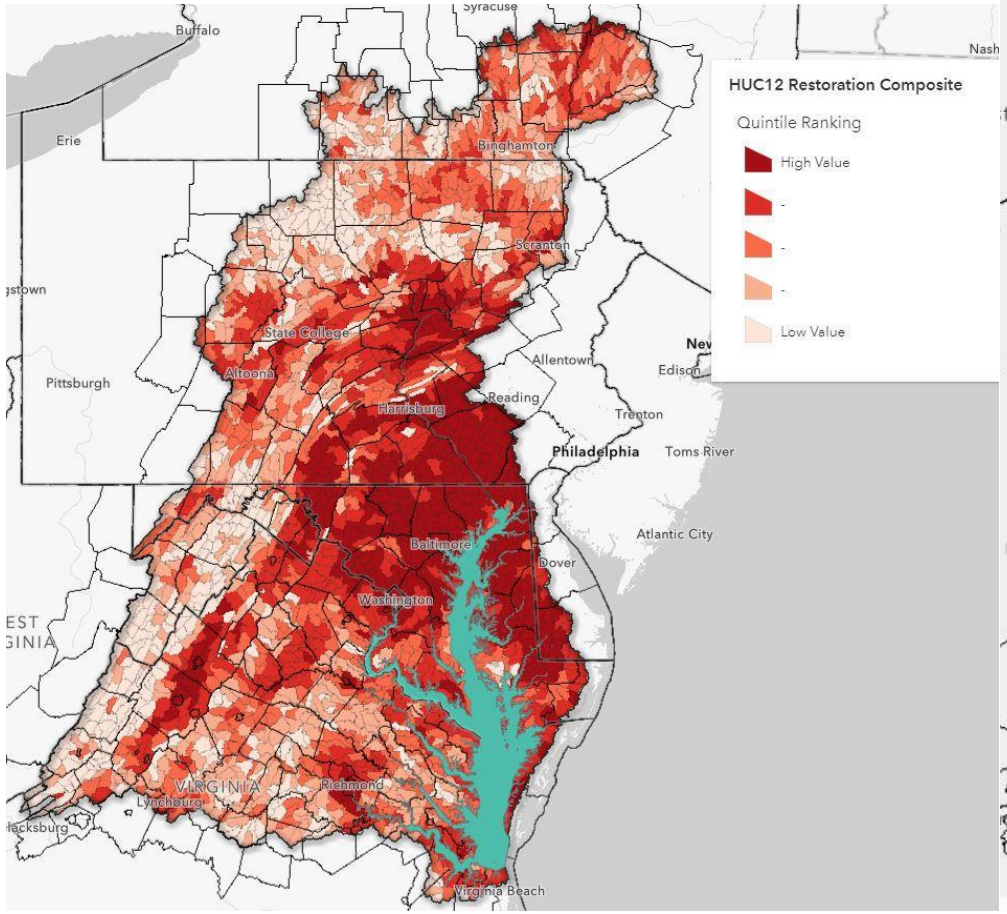


Figure 4 shows the composite restoration map of places where multiple outcomes can be met for water-quality improvements, toxic contaminants, and habitat connectively. These outcomes were selected by the GITs.

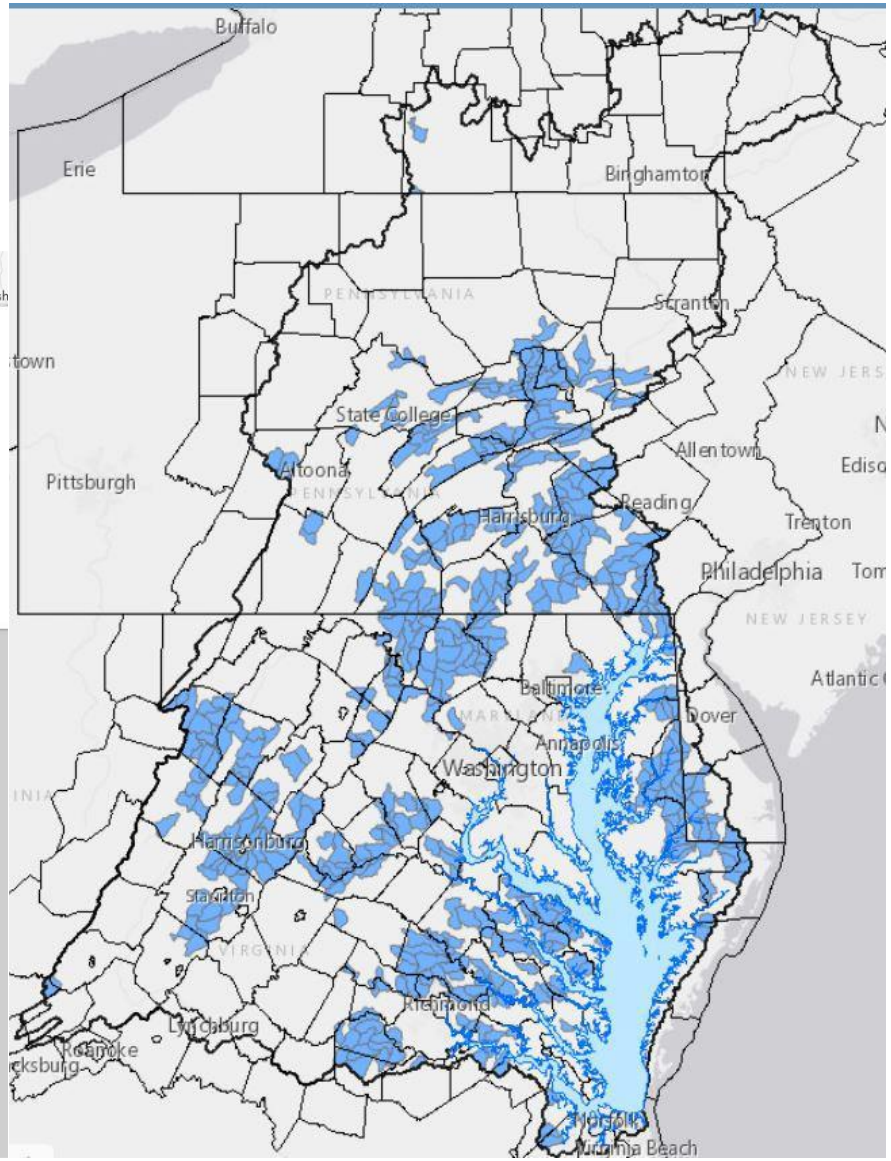


Figure 3. Ranking by states for places to get the highest reduction of nitrogen loading to the Bay and local water-quality improvements (from the Chesapeake Agricultural Priority Watersheds tool).

CAST Timeline

*contingent on funding and staff availability