Chesapeake Bay Program
A Watershed Partnership

Accounting for Growth in the Bay TMDL: Conservation Plus BMPs

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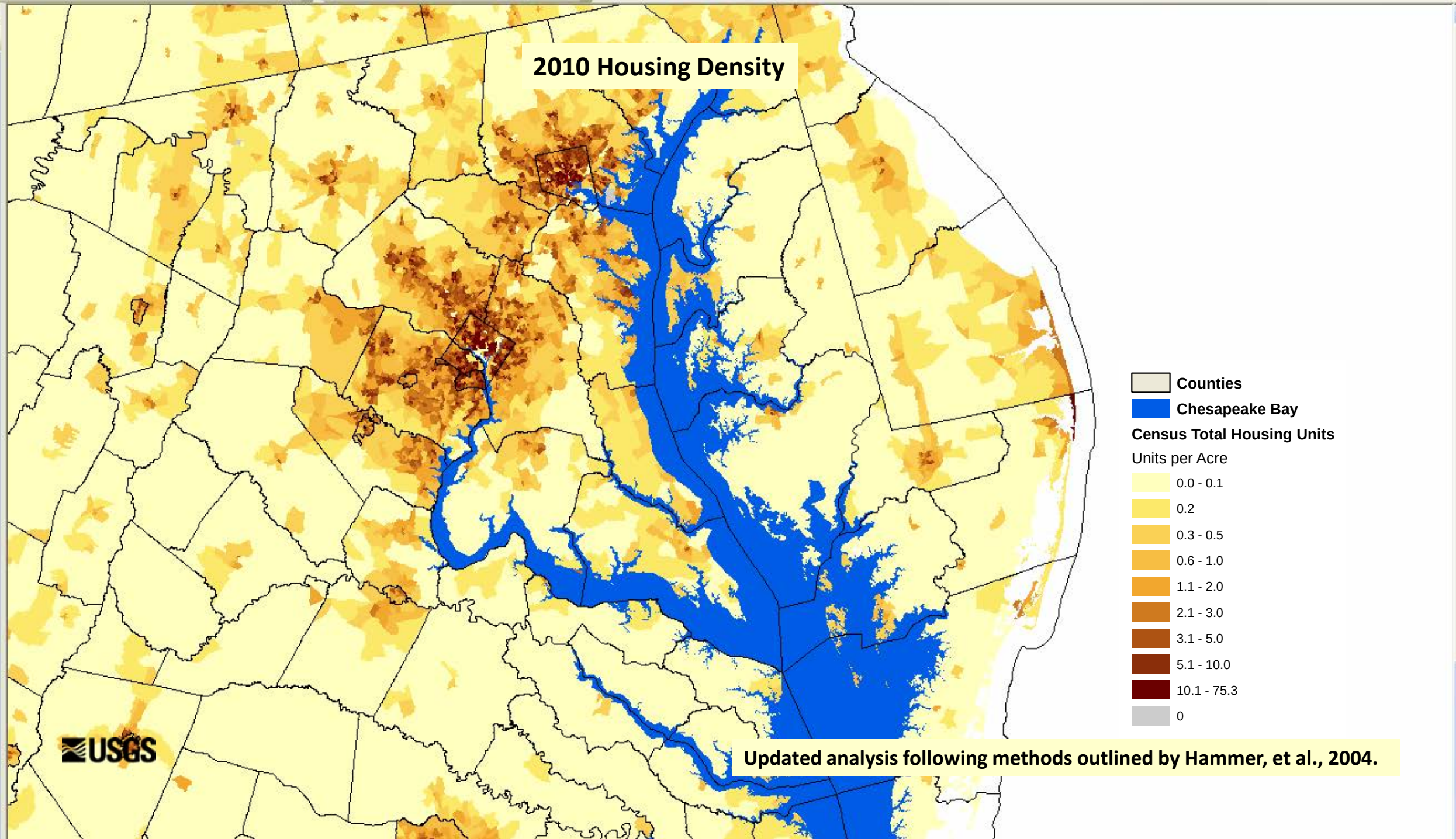
March 27, 2018
Maryland Environmental Trust Roundtable


2010 Housing Density
Counties
Chesapeake Bay
Census Total Housing Units
Units per Acre
0.0 - 0.1
0.2
0.3 - 0.5
0.6 - 1.0
1.1 - 2.0
2.1 - 3.0
3.1 - 5.0
5.1 - 10.0
10.1 - 75.3
0
USGS
Updated analysis following methods outlined by Hammer, et al., 2004.

Crediting Land Conservation and Planning in the Bay TMDL

Reducing non-point sources of pollution to the Bay requires:

1. Changing land cover conditions; or

2. Changing land management; or

3. Installing engineered solutions to reduce pollution.

Land conservation can improve water quality by:

1. Including the installation, monitoring, and maintenance of Best Management Practices (BMPs) on conserved lands (e.g., planting trees in the riparian zone);

2. Reducing the future conversion of land to more polluting land uses e.g., placing an easement on land that would otherwise be developed.
    - Displacing growth from low to high-density areas
    - Reducing development capacity below demand

3. Targeting conservation in areas which have a disproportionate impact on the Bay.

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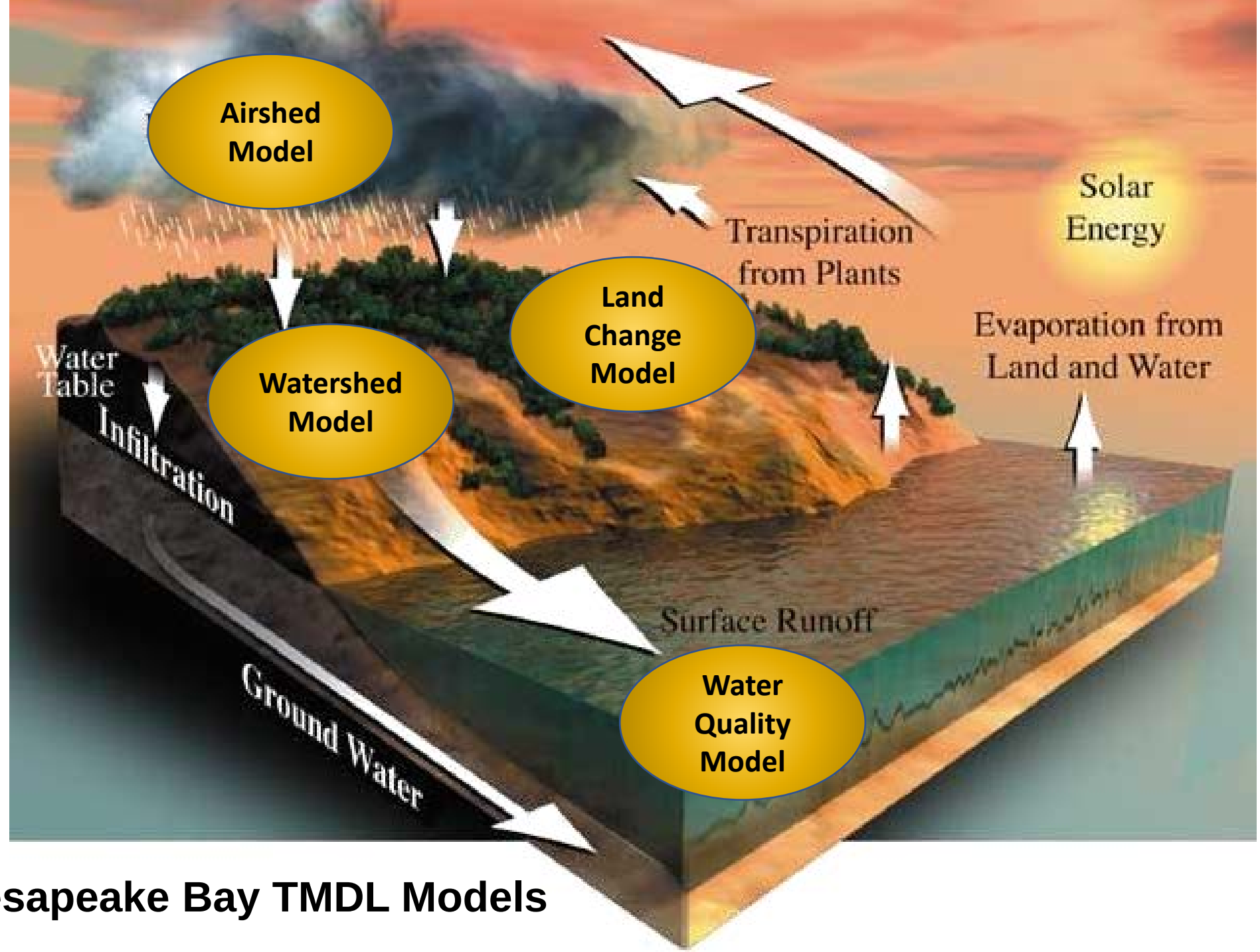
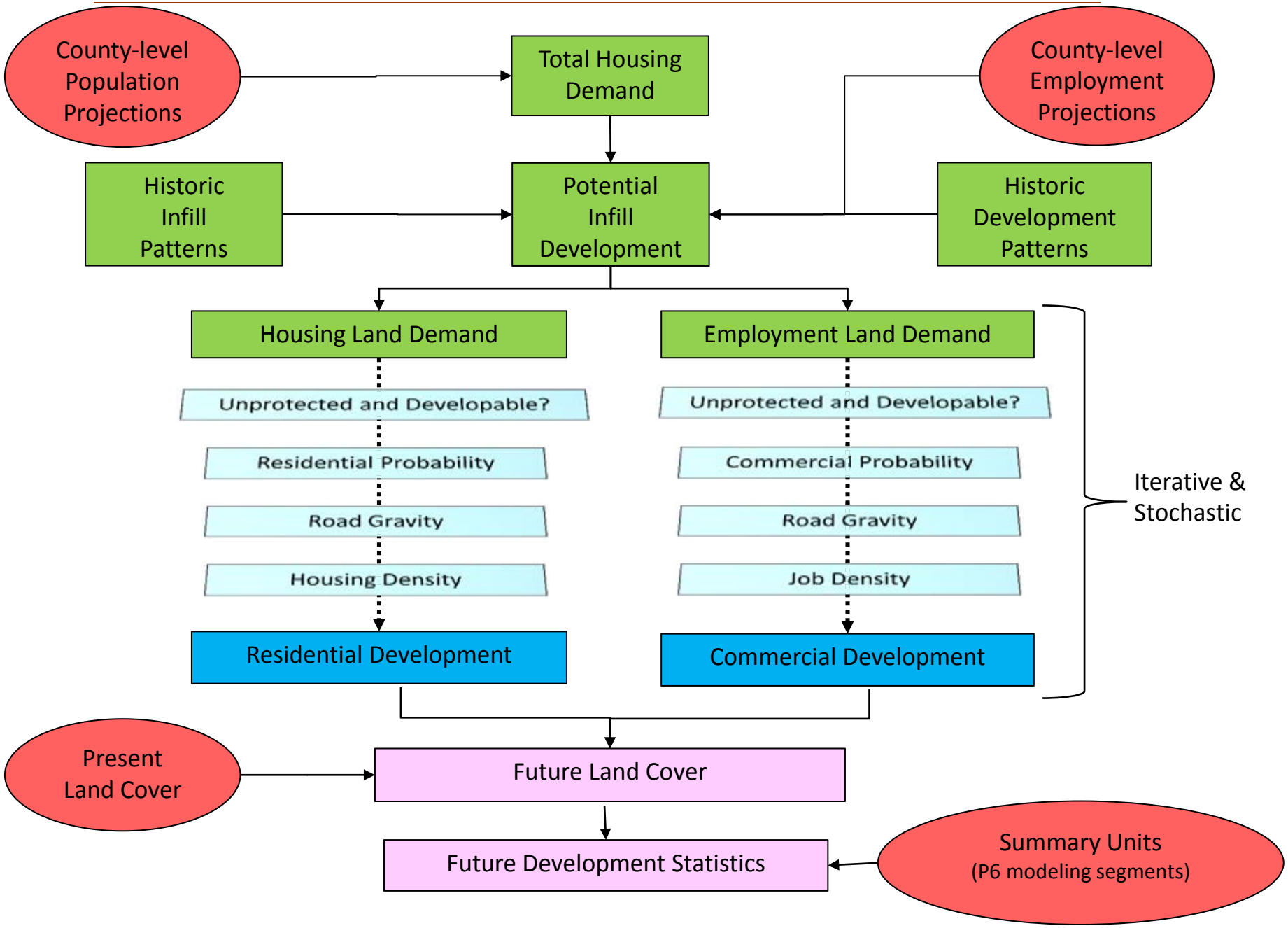
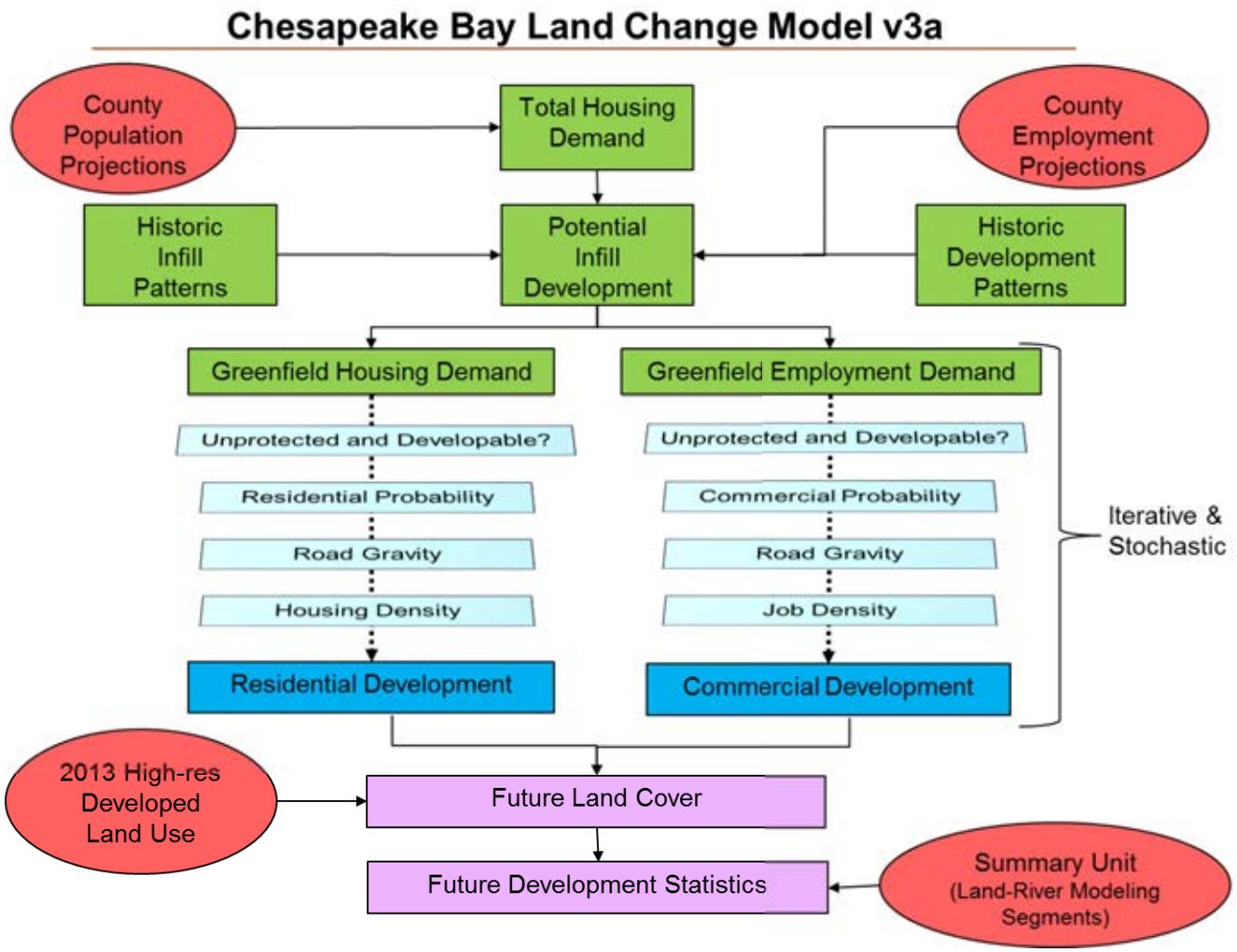


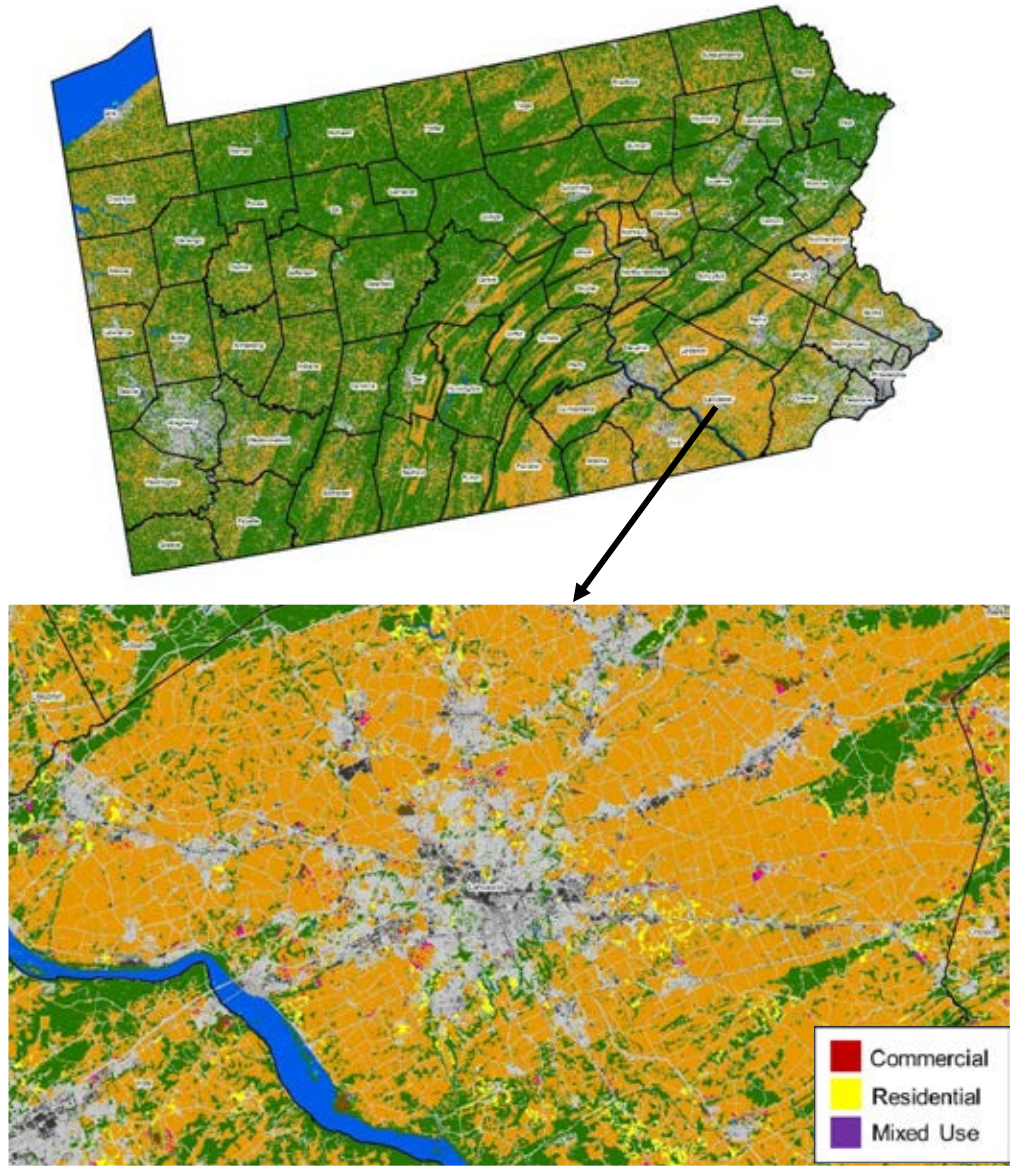
Chesapeake Bay TMDL Models

Chesapeake Bay Land Change Model v3a

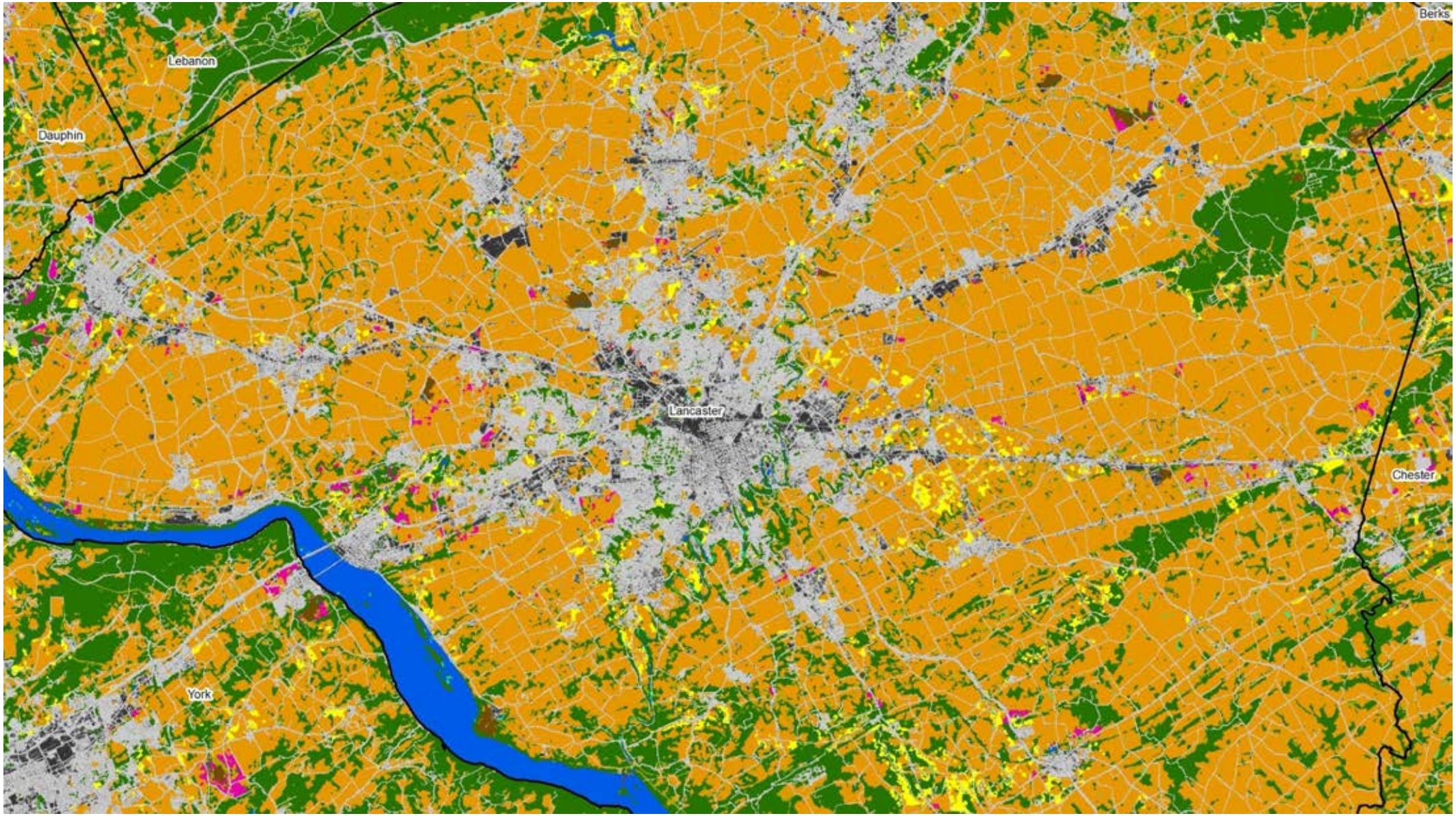


Partnership's Chesapeake Bay Land Change Model

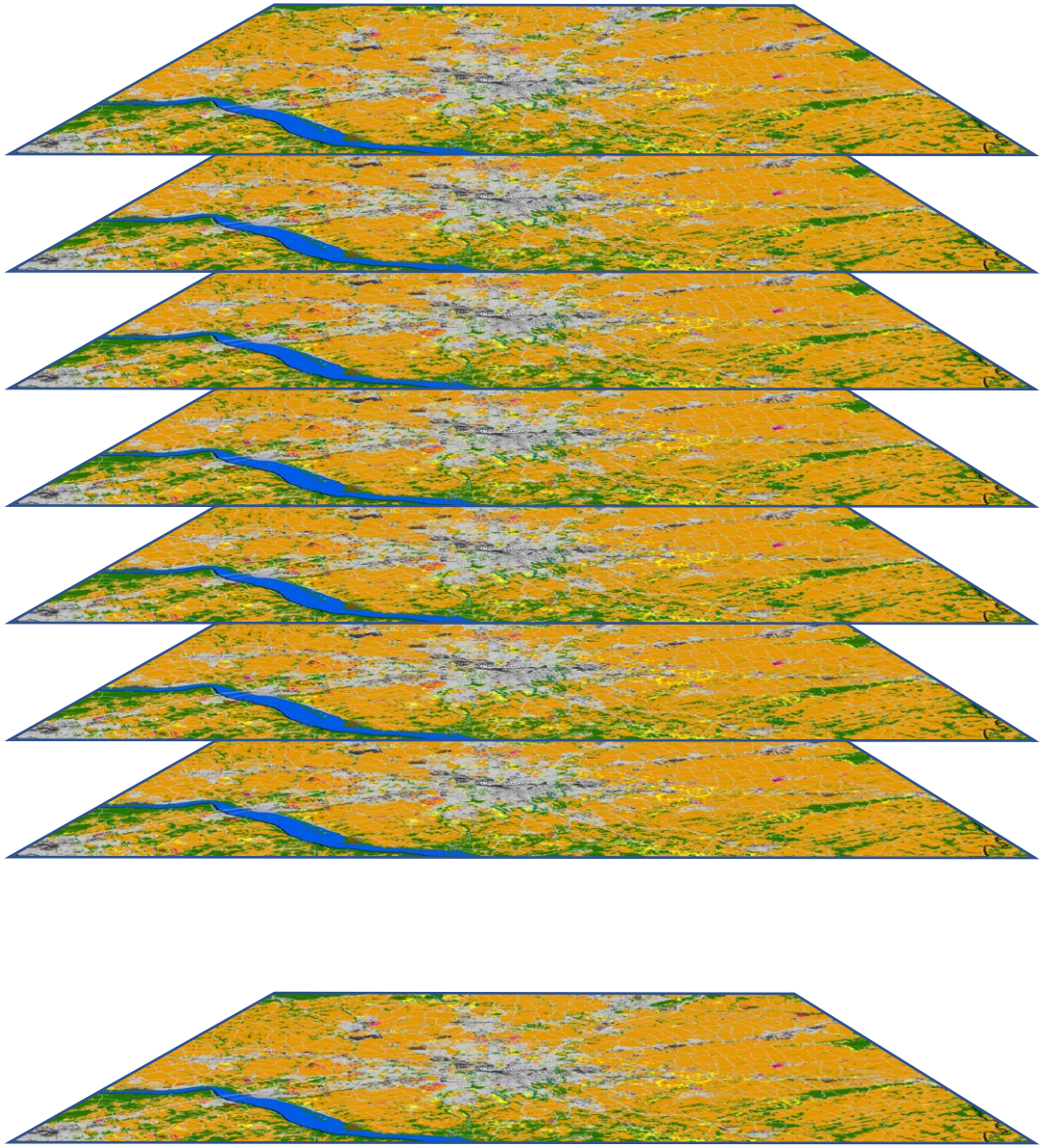




Assessing Uncertainty at Local Scales



Assessing Uncertainty at Local Scales



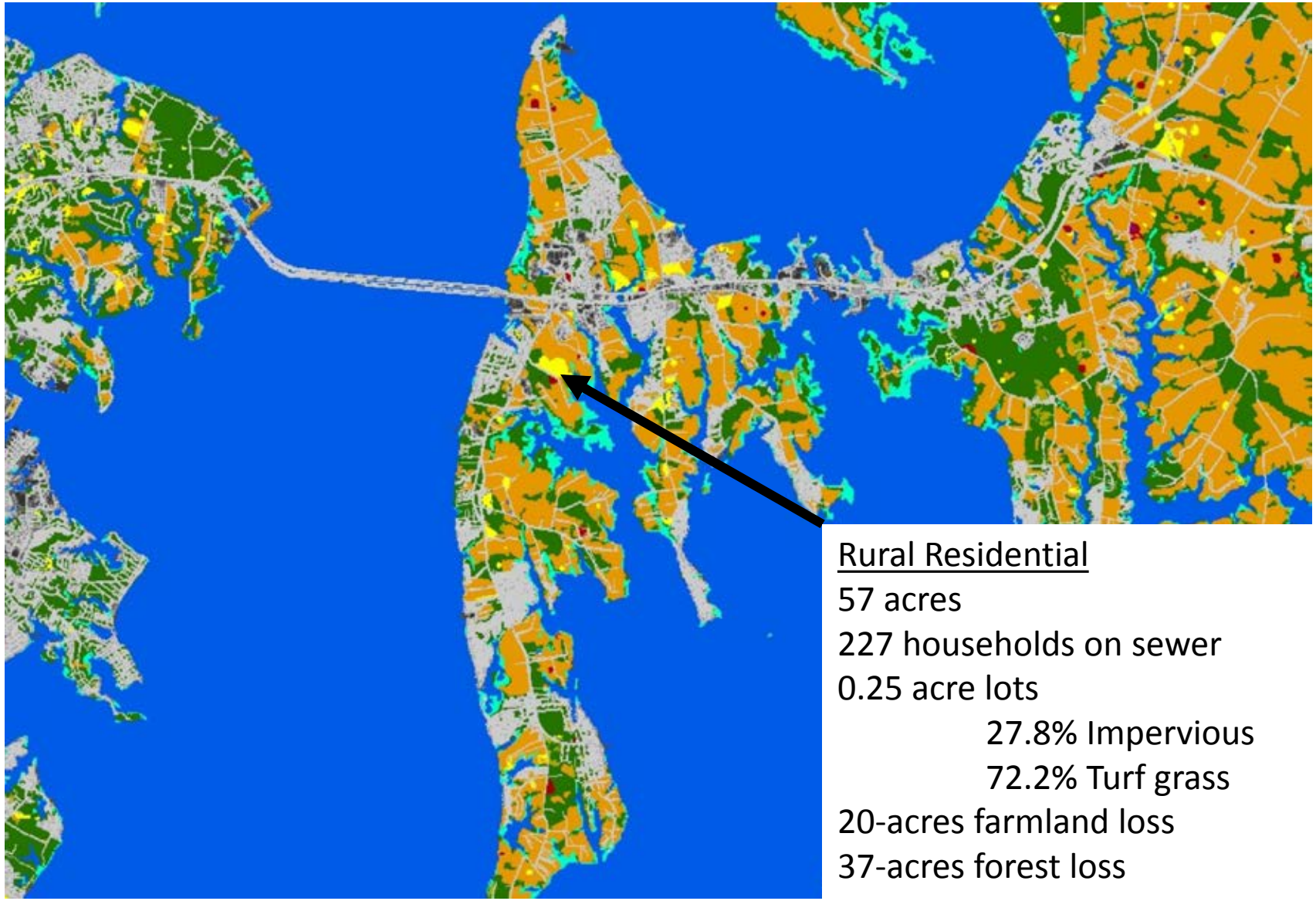
Every county is simulated 101 times for each scenario and target year, i.e., 2025.

Average of simulations by land-river segment = future development

Relative Standard Deviation = estimate of uncertainty

Land Change Model Outputs

- Impervious surface and turf grass expansion
- Forest conversion to development
- Farmland conversion to development
- Future population on sewer and septic

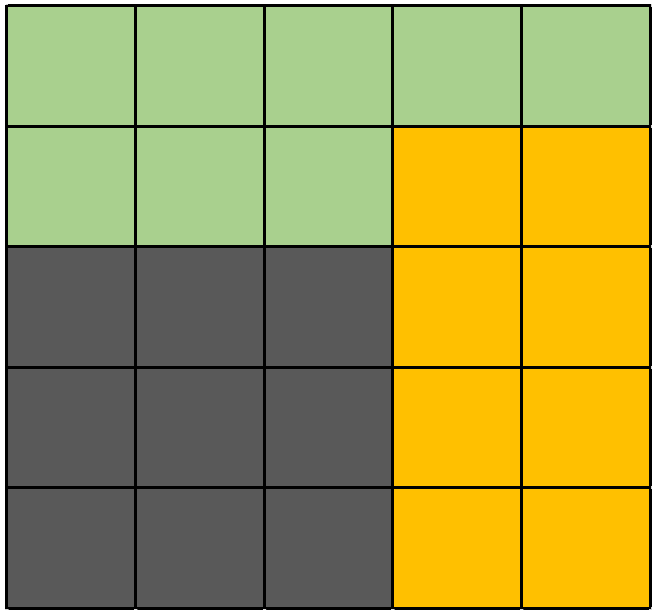


<u>Rural Residential</u>
57 acres
227 households on sewer
0.25 acre lots
27.8% Impervious
72.2% Turf grass
20-acres farmland loss
37-acres forest loss

Conservation Effects on Future Land Use (hypothetical example)

Land Area = 25 cells

9 cells developed
8 cells forest
8 cells farmland



No Conservation Scenario

Greenfield Capacity = 46 units

22 units on forests
24 units on farmland

2 units	2 units	2 units	2 units	2 units
4 units	4 units	4 units	4 units	2 units
			4 units	2 units
			4 units	2 units
			4 units	2 units

Units = housing units

No Conservation Scenario

Future Demand for Growth = 12 units

New Development = 3-6 cells

2 units	2 units	2 units	**2 units**	2 units
4 units	4 units	**4 units**	**4 units**	**2 units**
			4 units	2 units
			4 units	2 units
			4 units	2 units

Iteration #1 (of 101)

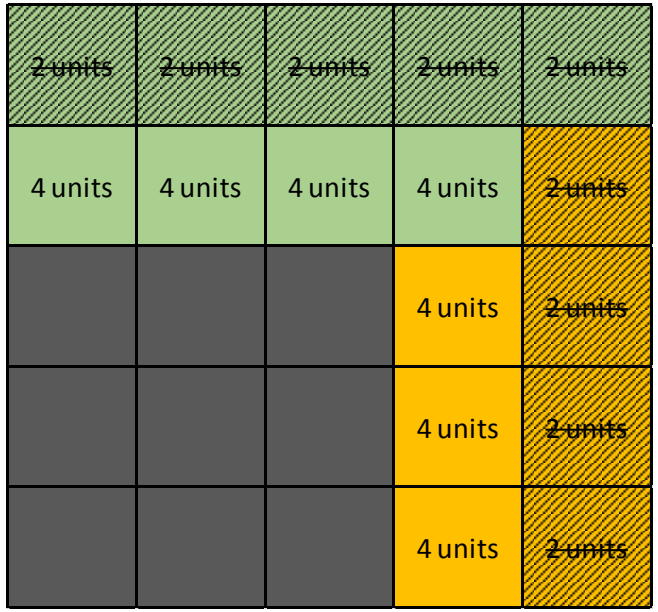
Conservation Scenario #1: conserve all low-density lands

Conservation Scenario #1

Greenfield Capacity = 28 units

12 units remaining on forest lands
16 units remaining on farmland

18 units of reduced capacity

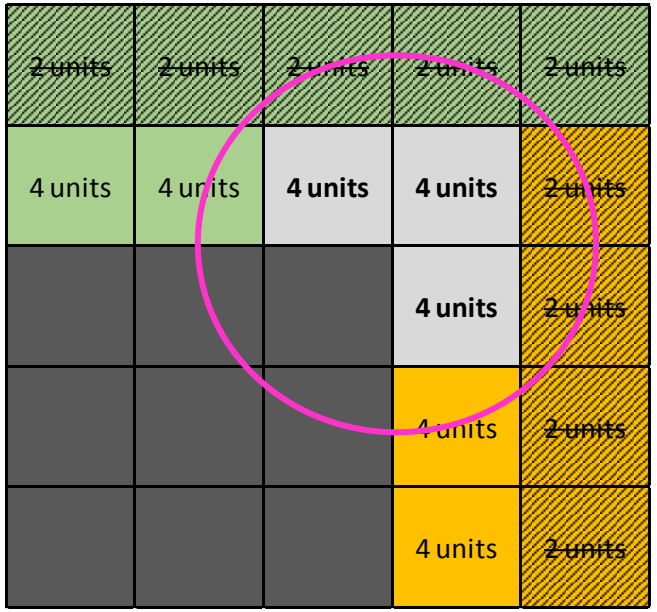


Conservation Scenario #1

Future Demand for Growth = 12 units

Development = 3 cells

Avoided development = 1-3 cells



Iteration #1 (of 101)

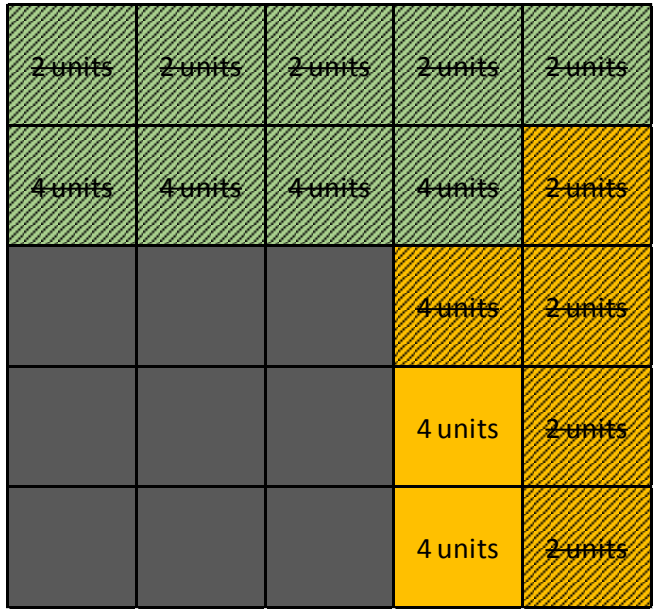
Conservation Scenario #2: reduce capacity below demand

Conservation Scenario #2

Greenfield Capacity =
8 units

No units remaining on forest lands
8 units remaining on farmland

38 units of reduced capacity

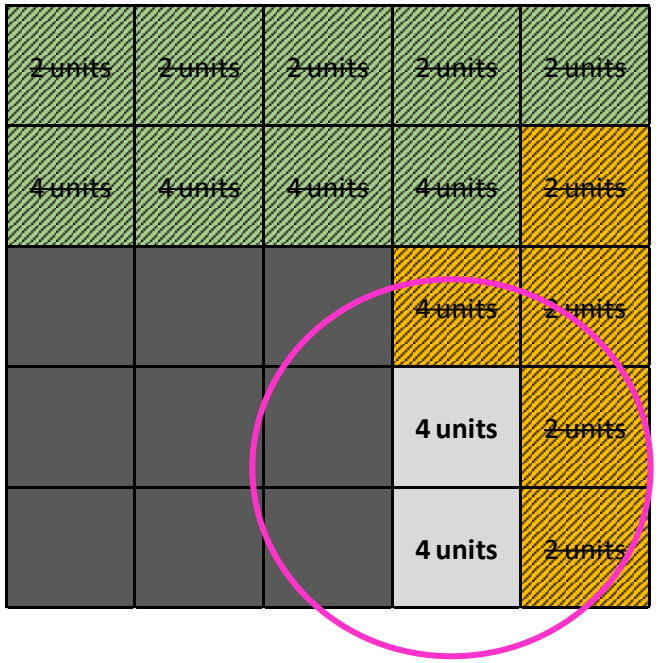


Conservation Scenario #2

Future Demand for Growth =
12 units

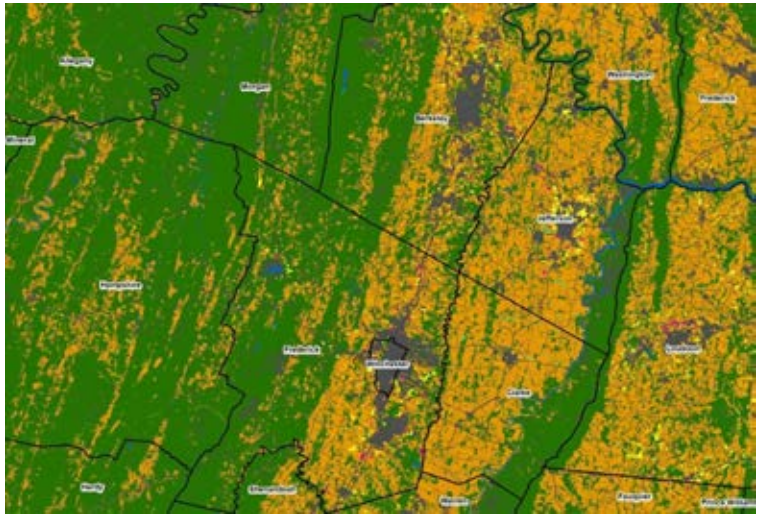
Development = 2 cells

Avoided development = 2-4 cells

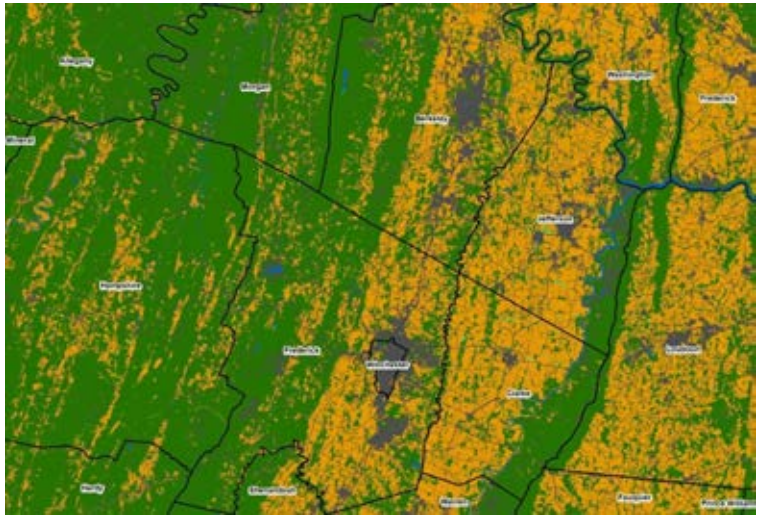


Crediting Land Conservation and Planning in the Bay TMDL

2025 Land Use (Conservation Scenario)



2025 Land Use (Mapped from Aerial Imagery)

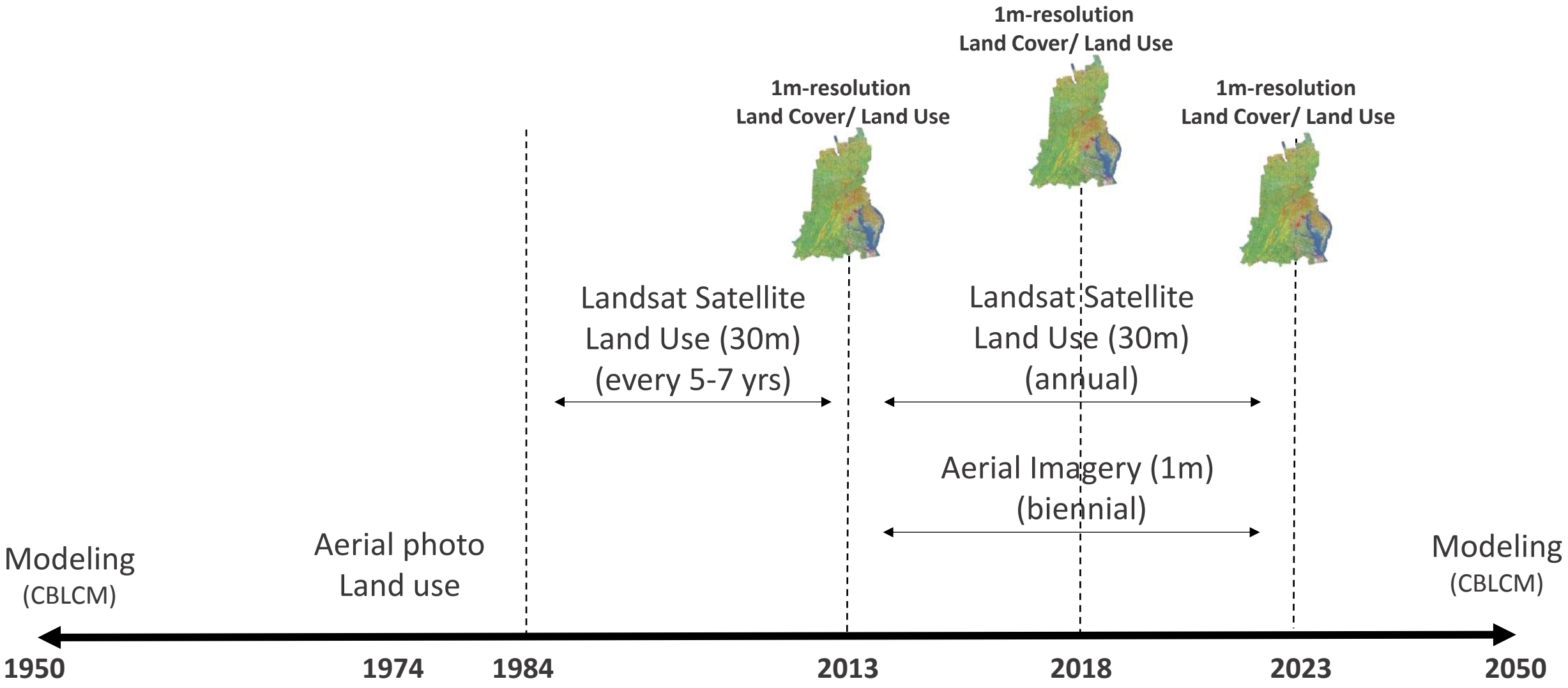


Difference = credit afforded to all actions in the Conservation Scenario

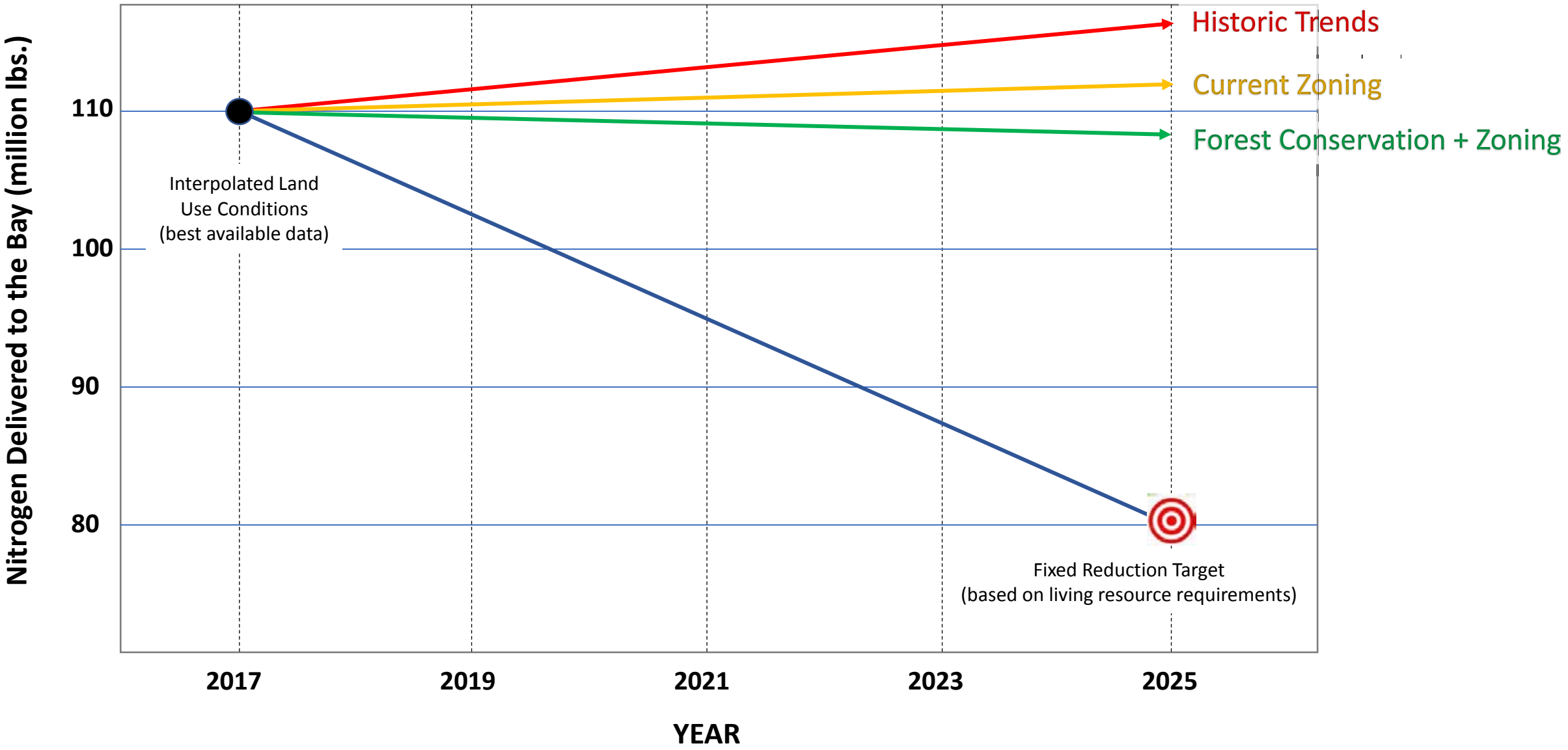
- Estimated credit based on modelled contribution towards meeting the pollution reduction goals established for each state, state-basin, or county (scale may vary by state).

- Actual credit based on monitored changes in land use and reported BMPs.

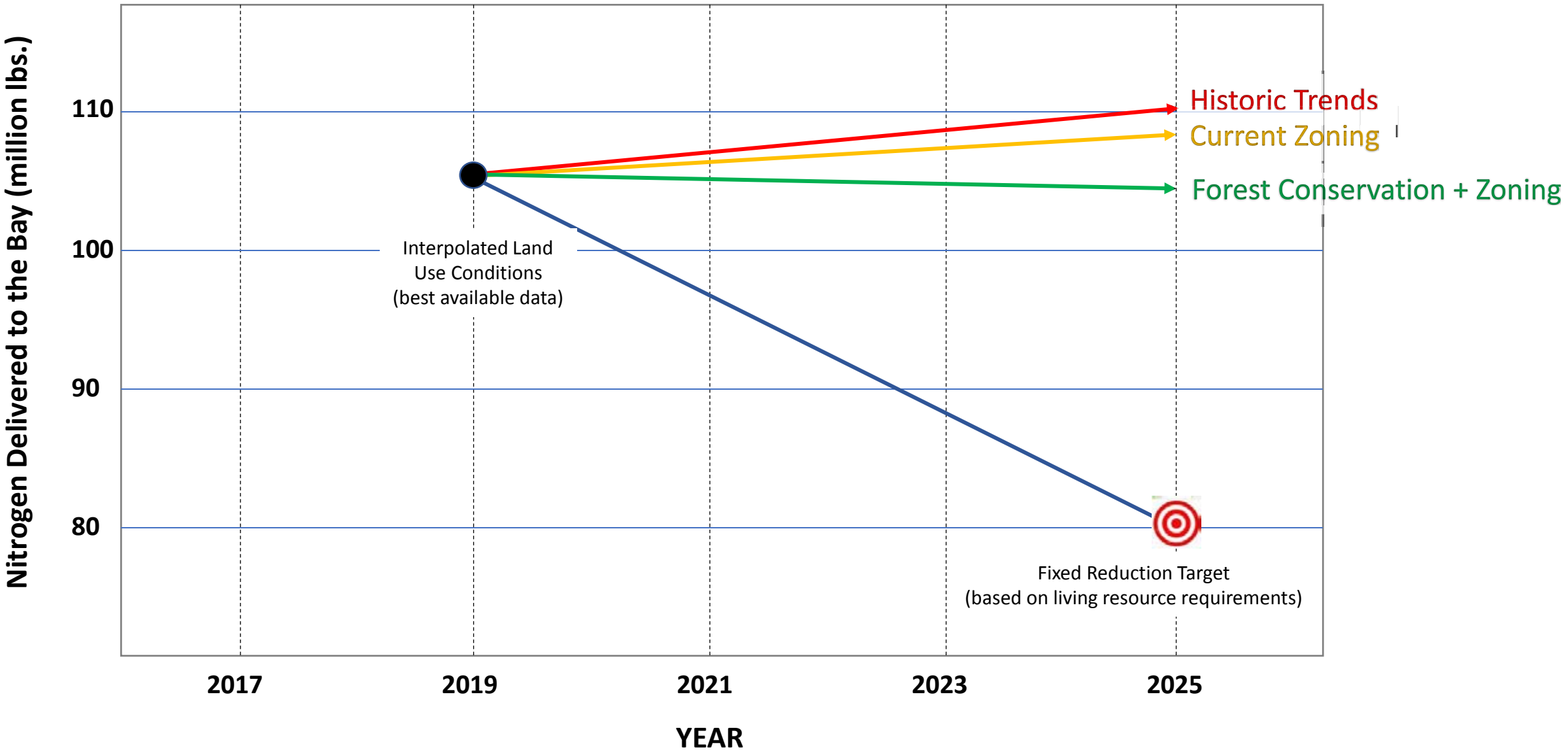
Monitoring & Modeling Land Cover/Use Change



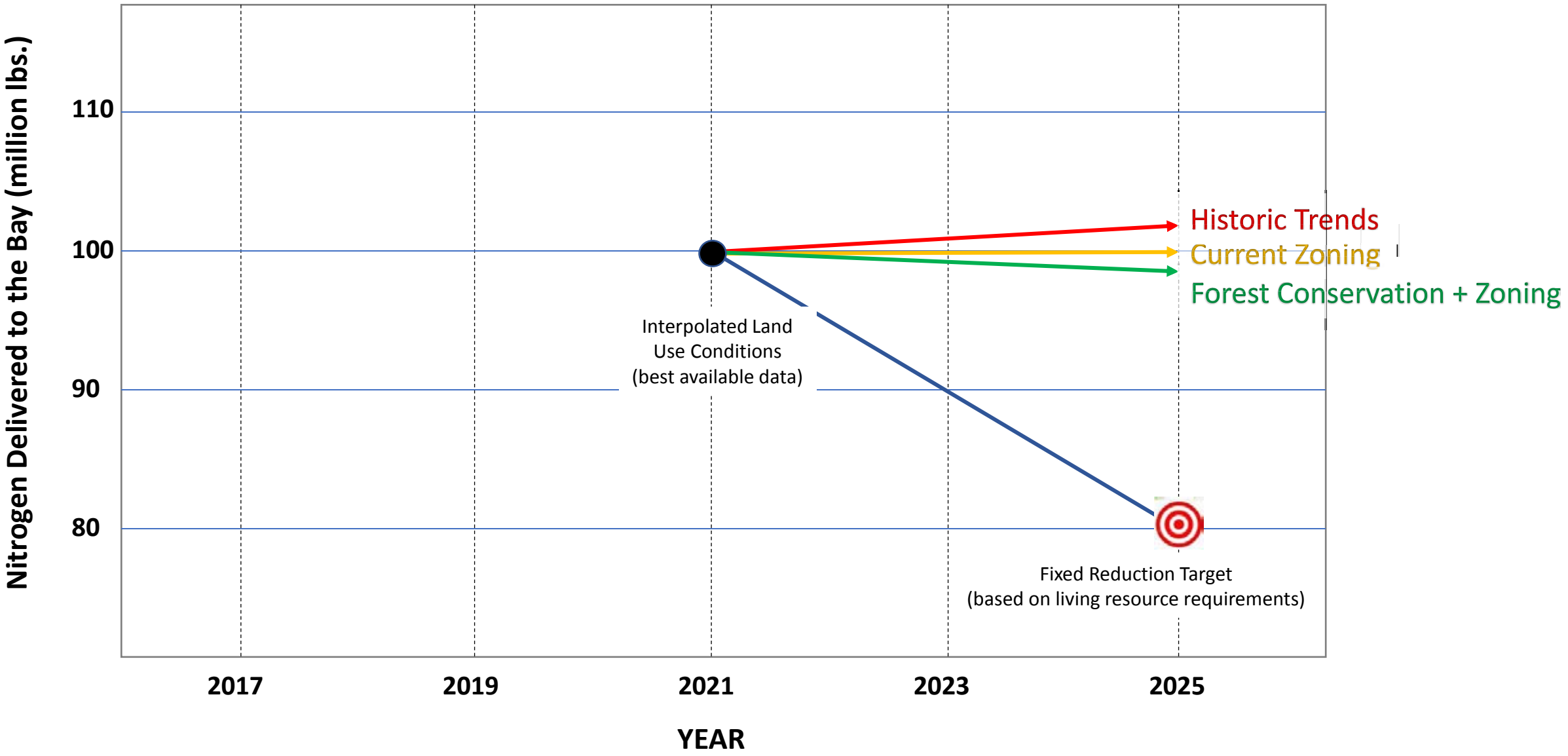
Accounting for Growth in 2017 (Phase III Watershed Implementation Plans)



Accounting for Growth in 2019 (Progress and Milestones)



Accounting for Growth in 2021 (Progress and Milestones)



Chesapeake Bay Future Scenarios

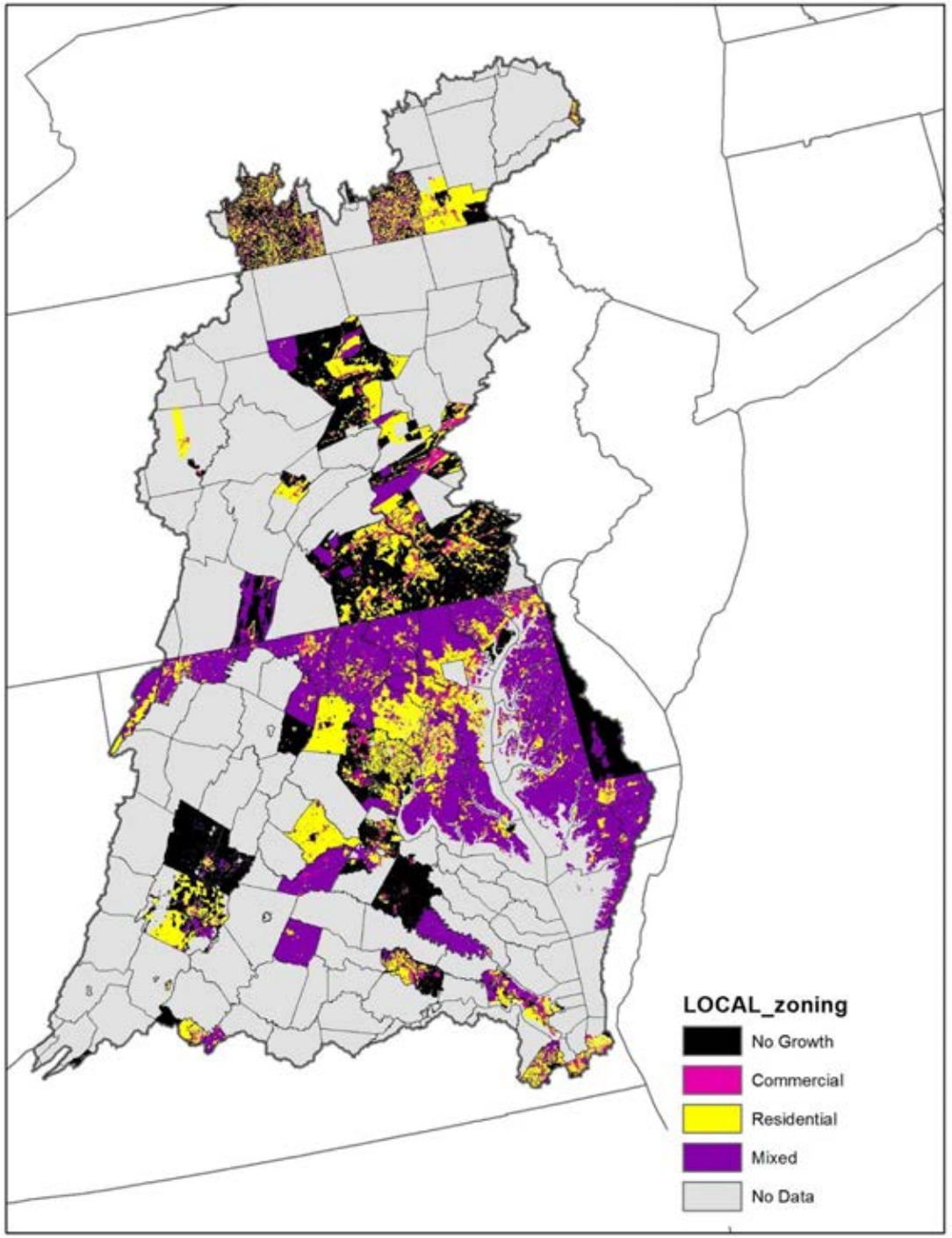
Historic Trends:

Continuation of historic development patterns and constraints as existed over the 2000's. Includes the best available regional and local data representing current conditions.

Current Zoning:

Same as Historic Trends with the addition of local zoning, increased infill rates (MD counties), and expanded sewer service areas (Jefferson and Berkeley Counties, WV) to reflect current constraints on new development and reported rates of growth on septic. The Chesapeake Bay Program Partners adopted this scenario as the representing the most probable conditions in 2025 and therefore serves as a baseline for evaluating the effects of land use planning and land conservation BMPs.

Extent of Local Zoning Data



Collected by CBP from local and state agencies, 2013 - 2017

“Conservation Plus” Family of Scenarios

The “Conservation Plus” family of scenarios represents a variety of land conservation, land use planning, and policy actions that will directly or indirectly affect future patterns of development.

Three thematic scenarios emerged from the list of plausible actions that are of interest to CBP jurisdictions and can be simulated consistently throughout the Chesapeake Bay watershed:

1. Forest Conservation
2. Growth Management
3. Agriculture and Soil Conservation

Alternative Future Thematic Scenarios

Forest Conservation (with or without zoning):
Organizations and governments proactively pursuing a variety of actions to conserve forests and wetlands which provide the greatest benefits to wildlife, human safety, and water quality. Example priority areas include riparian zones, shorelines, large contiguous forest tracts, and other high-priority forest conservation areas.

Growth Management (with or without zoning):
Organizations and governments proactively pursuing a variety of actions to encourage growth in areas with supporting infrastructure. Example priority areas include undeveloped or under-developed areas with adequate existing roads, wastewater, and water supply infrastructure.

Agriculture and Soil Conservation (with or without zoning):
Organizations and governments proactively pursuing a variety of actions to conserve farmland and productive soils. Example priority areas include agricultural districts, prime farmland, farmland of state importance, floodplains, and other high-priority farmland conservation areas.

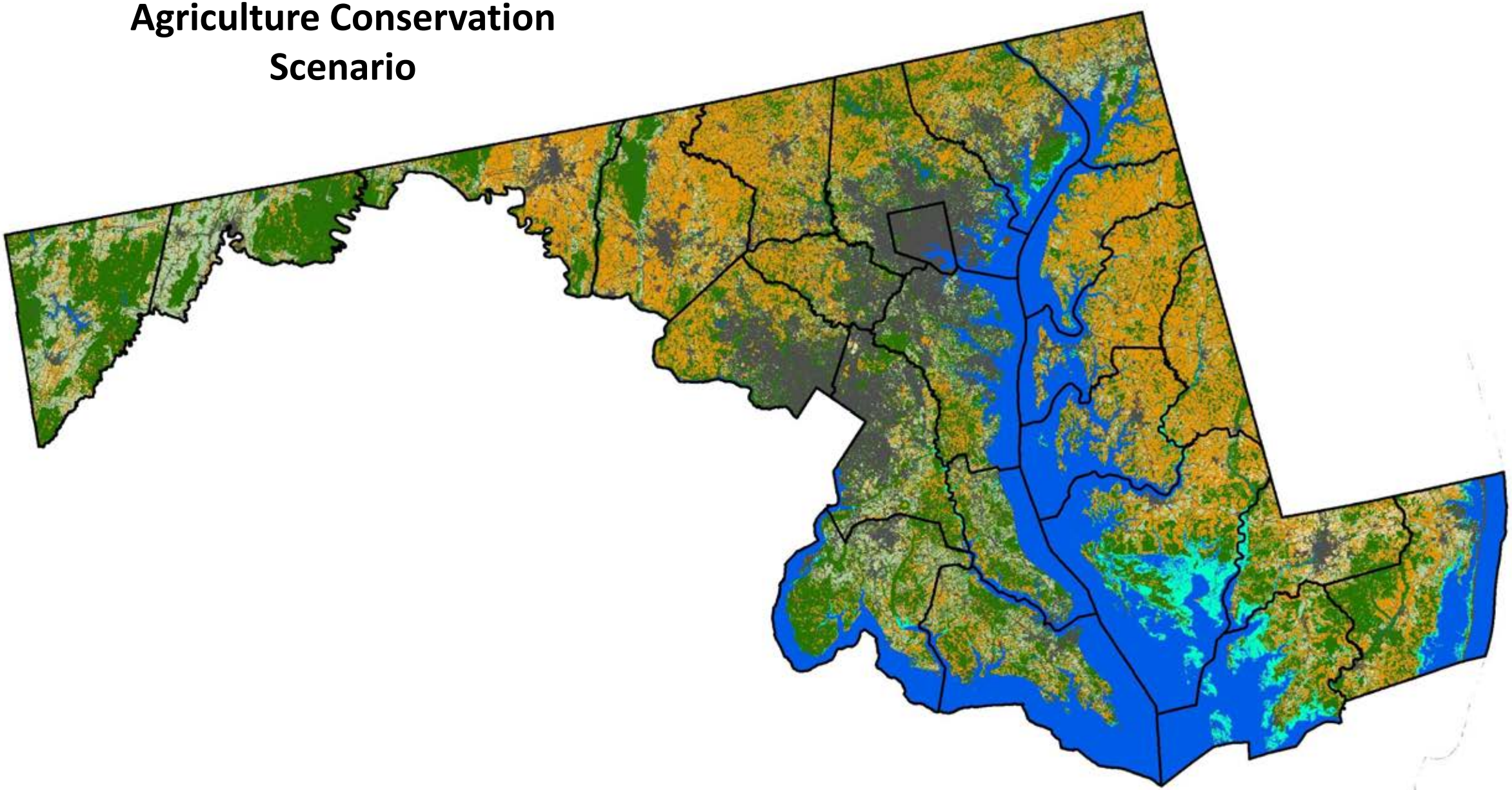
Chesapeake Bay Watershed Scenario Elements

- Conserve riparian zones (default width = 30m)
- Conserve wetlands (NWI, State Designated Wetlands, and Potential Conservable Wetlands (PA only))
- Conserve all lands subject to inundation due to sea level rise (default = 1m rise by the year 2100)
- Conserve all lands surrounding National Wildlife Refuges (default = 1 mile buffer)
- Conserve all large forest tracts (default >= 250 acres)
- Conserve Bay shorelines (default = 305m buffer (~1000-ft) of the tidal Bay and Atlantic shorelines)
- Conserve all high-value forest and forested wetlands identified by the Chesapeake Conservation Partnership

- Increase proportion of growth occurring as infill/redevelopment (default = 10% per decade)
- Increase urban densities (default = 10% per decade)
- Increase proportion of urban vs rural growth (default = 10% per decade)
- Expand sewer service areas (default = ~1 mile))
- Avoid growth on all soils unsuitable for septic systems (based on depth to bedrock, drainage class, saturated hydraulic conductivity, and flood frequency)

- Conserve all farmland within designated Agricultural Districts
- Conserve all lands within the floodplain (default = 100-year recurrence interval)
- Conserve all lands with flooded soils (default = frequently flooded)
- Conserve all prime farmlands and farmland of state importance
- Conserve potential restorable wetlands (applies only to PA farmland)
- Conserve all high-value farmland identified by the Chesapeake Conservation Partnership

Agriculture Conservation Scenario



Thematic Scenario Results
2025 Land Use
Maryland

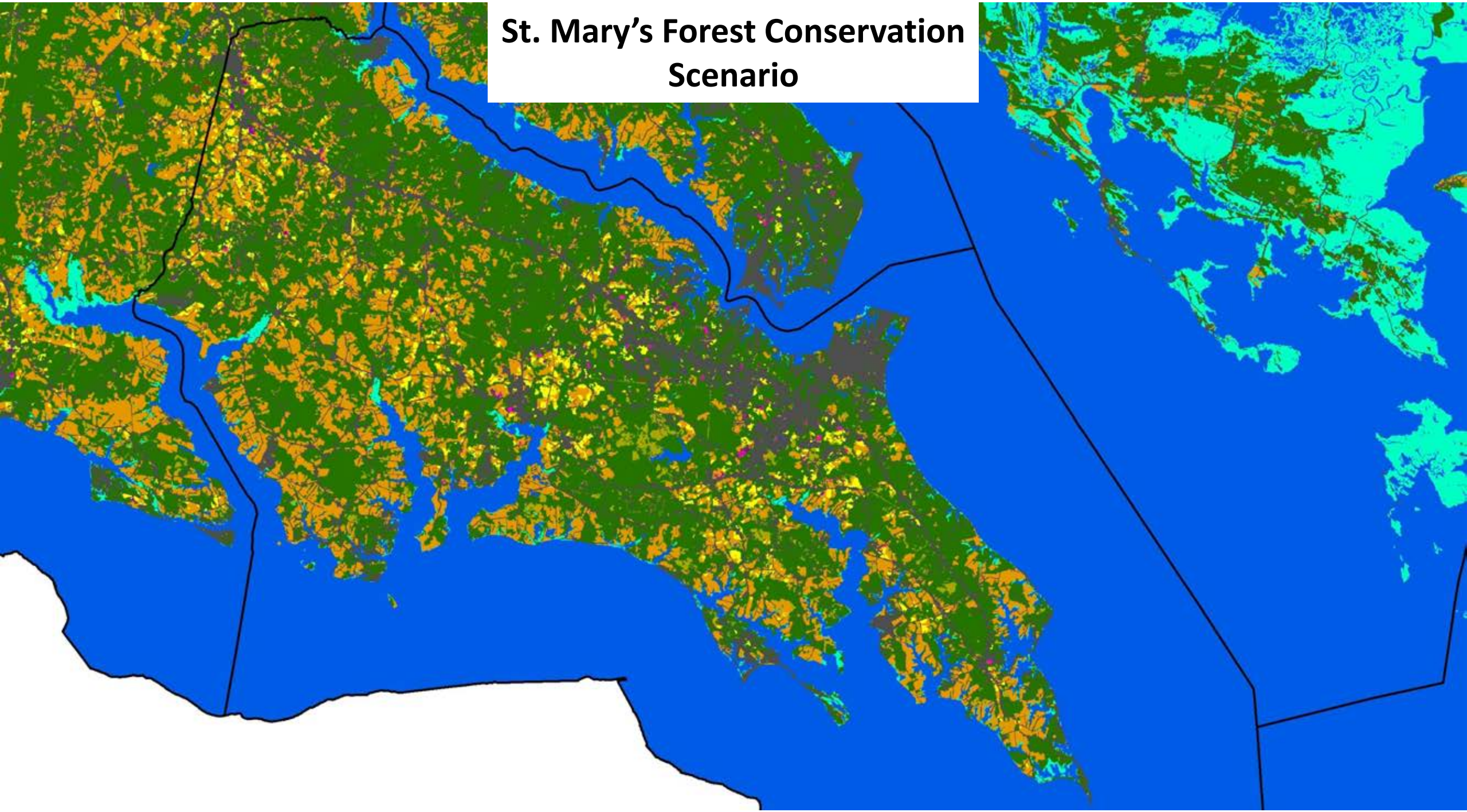
CBLCM Land Use (Maryland)					
Scenario	**Impervious**	**Pervious**	**Natural**	**Agriculture**	**Mixed Open**
Historic Trends (HT)	20,764	55,316	(35,737)	(35,235)	(5,136)
Forest Conservation (FCHT)	19,883	59,110	(25,074)	(46,709)	(7,212)
Growth Management (GMHT)	17,732	47,561	(27,709)	(32,649)	(4,953)
Agricultural Conservation (ACHT)	19,900	44,036	(53,781)	(8,668)	(1,467)
Current Zoning (CZ)	9,860	22,692	(16,559)	(14,135)	(1,867)
Forest Conservation with Zoning (FCCZ)	9,779	24,873	(11,994)	(19,758)	(2,903)
Growth Management with Zoning (GMCZ)	8,666	19,840	(13,393)	(13,313)	(1,807)
Agricultural Conservation with Zoning (ACCZ)	9,829	19,025	(24,738)	(3,543)	(577)

(negative values in parentheses)

Thematic Scenario Results
Wastewater
Maryland

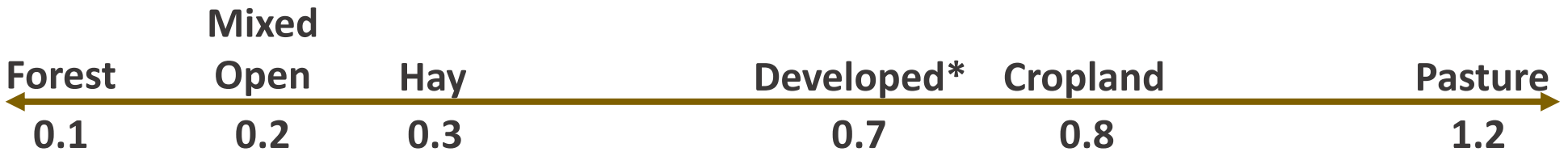
Maryland			
Scenario	**Septic_2025**	**Pop25_Septic**	**Pop25_Sewer**
Historic Trends (HT)	457,124	1,161,503	5,196,312
Forest Conservation (FCHT)	457,220	1,161,399	5,196,416
Growth Management (GMHT)	417,779	1,059,566	5,298,249
Agricultural Conservation (ACHT)	453,667	1,152,087	5,205,728
Current Zoning (CZ)	427,441	1,085,791	5,272,024
Forest Conservation with Zoning (FCCZ)	427,518	1,085,419	5,272,396
Growth Management with Zoning (GMCZ)	411,694	1,044,738	5,313,077
Agricultural Conservation with Zoning (ACCZ)	426,070	1,081,687	5,276,128

St. Mary's Forest Conservation Scenario



Relative Nutrient Export Rates

Nitrogen Export Rate (lbs/acre/yr)



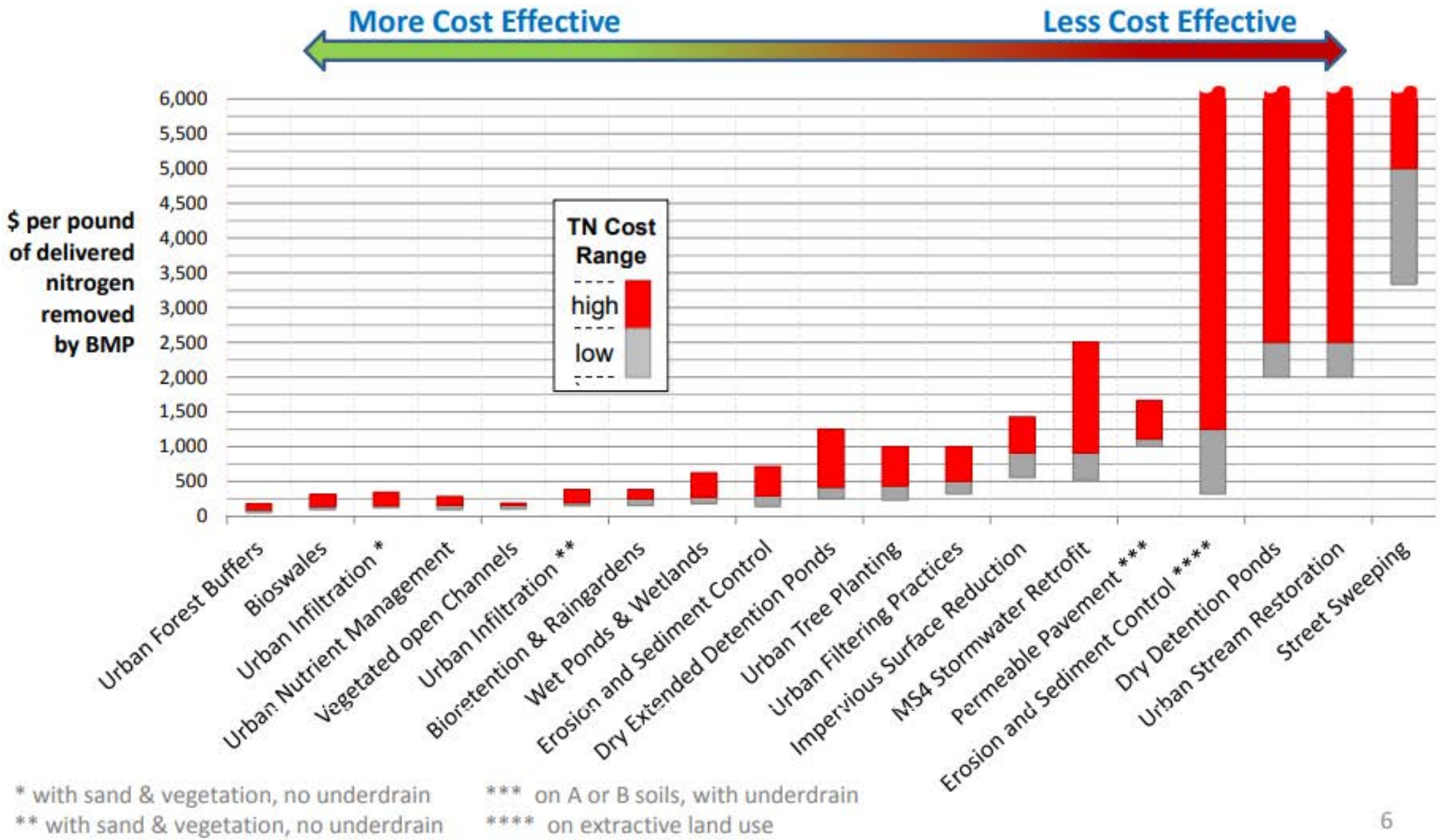
Phosphorus Export Rate (lbs/acre/yr)

* Includes impervious surfaces (roads, rooftops, parking lots), pervious surfaces (turf grass), and land under construction.

Potential Pollution Reductions Due to Conservation
St. Mary's County, Maryland

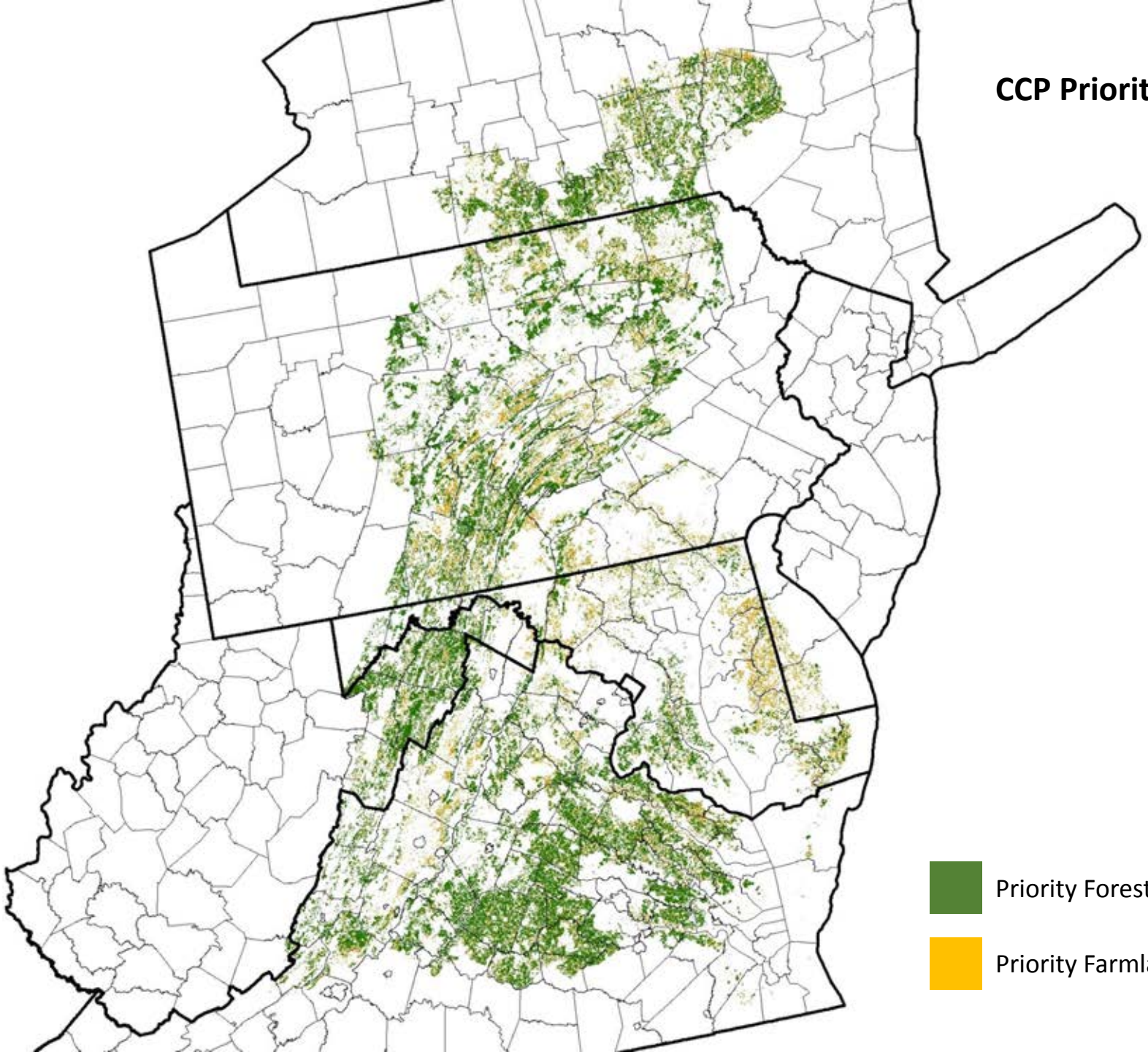
	Impervious	Pervious	Natural	Agriculture	Mixed Open	
FC vs HT	(185)	333	1,152	(1,107)	(193)	
Total Nitrogen (lbs/acre/yr)	9.8	5.9	1.8	26.0	3.5	
Difference in loads (lbs/yr)	(1,817)	1,966	2,074	(28,773)	(677)	(27,227)

	Impervious	Pervious	Natural	Agriculture	Mixed Open	
FC vs CZ	(89)	221	512	(548)	(96)	
Total Nitrogen (lbs/acre/yr)	9.8	5.9	1.8	26.0	3.5	
Difference in loads (lbs/yr)	(871)	1,304	922	(14,244)	(338)	(13,227)



* with sand & vegetation, no underdrain
** with sand & vegetation, no underdrain
*** on A or B soils, with underdrain
**** on extractive land use

http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/Regional_Meetings/Fall2013/presentations/Cost_Efficiency_WIP_Fall_Workshops_10312013.pdf

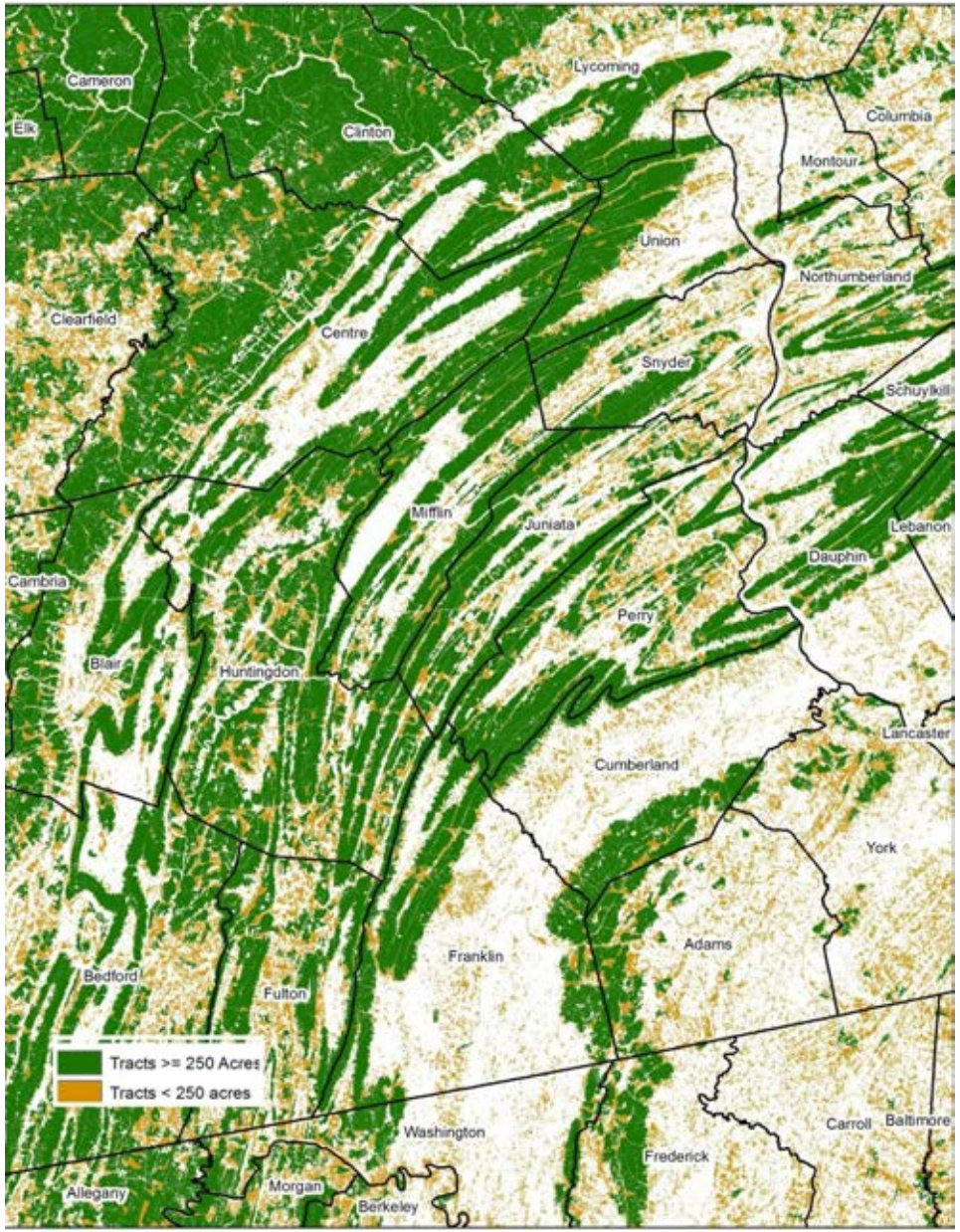


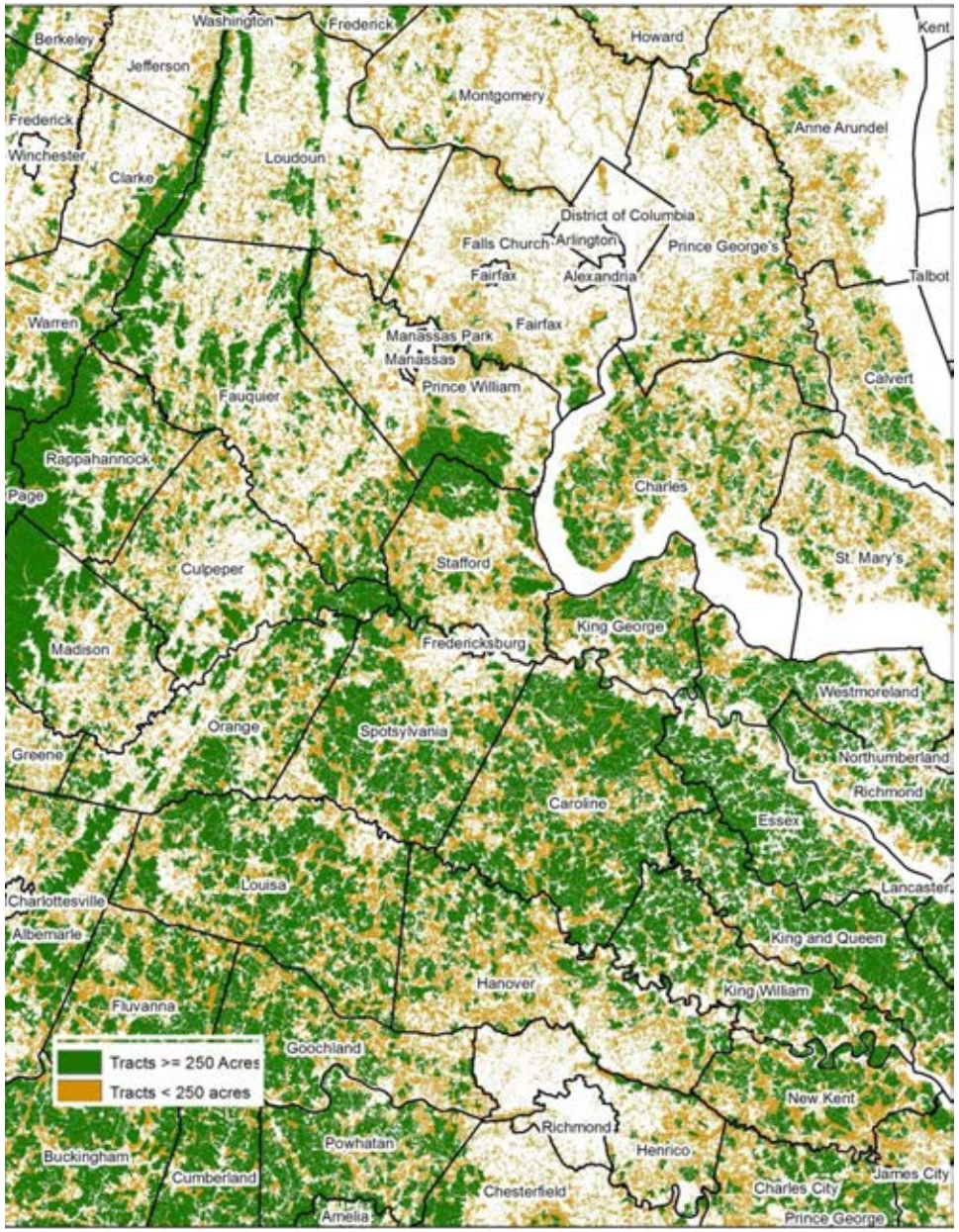
CCP Priority Lands Excluded From Growth

Priority Forest Lands (>= 13 composite score)

Priority Farmlands (>= 13 composite score)

250+ acre Forest/Wetland Patches



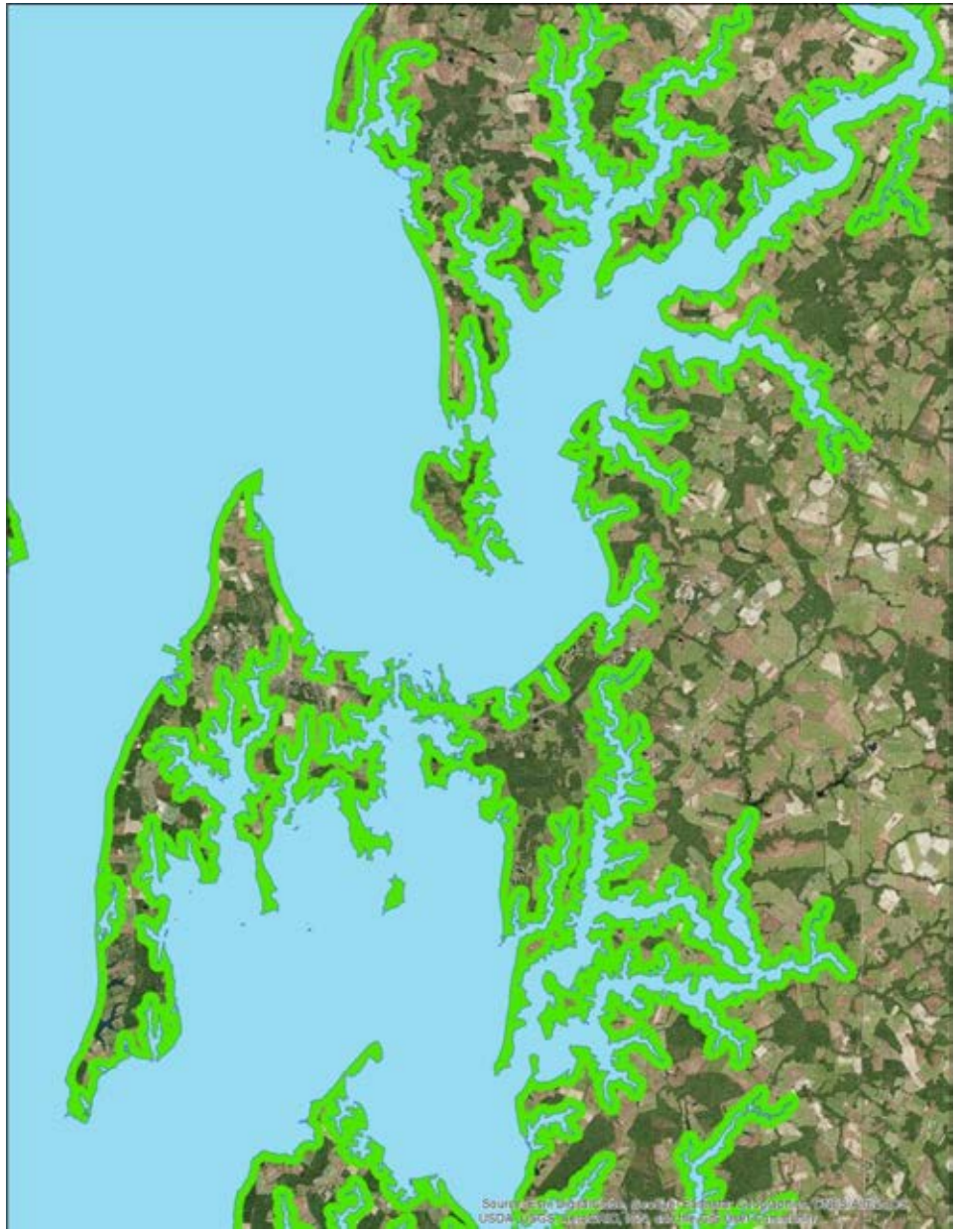


Riparian Forest Buffers (~30m)

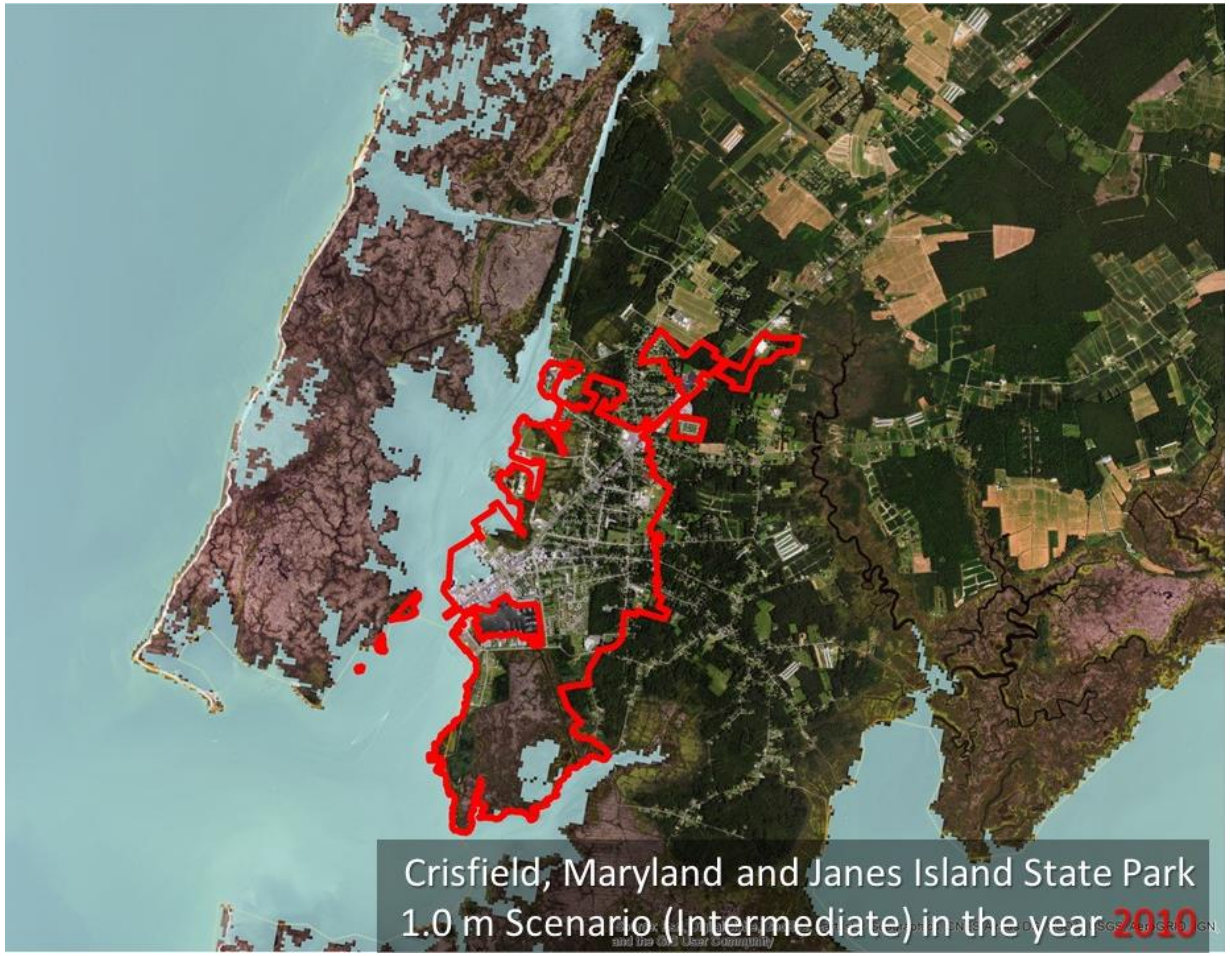
DEM-derived buffers

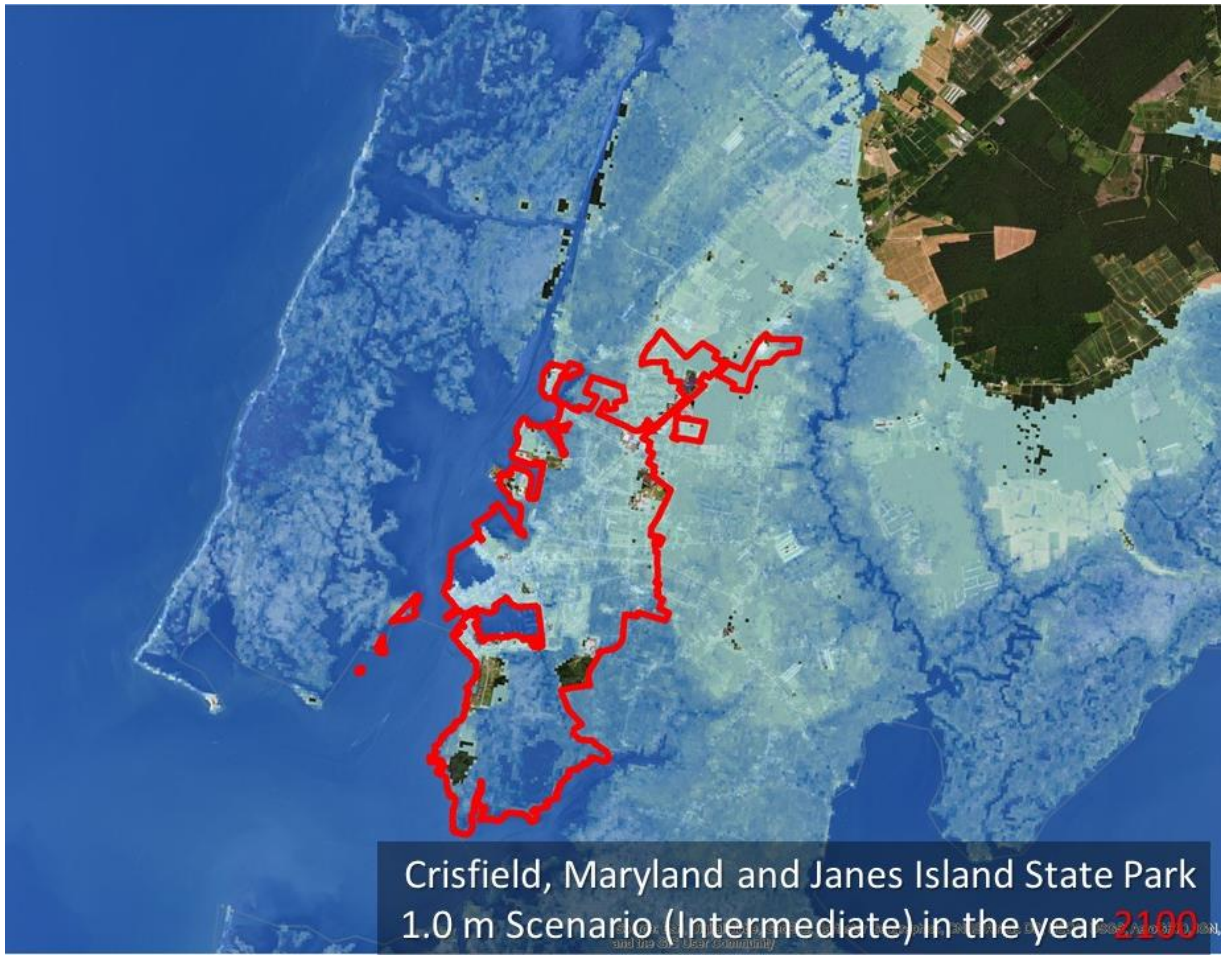
DEM-derived buffers + NHD (1:24K)

1000-ft Shoreline Buffer



1m Sea-Level Rise by 2100





State-Specific Scenarios

Pennsylvania (using “Current Zoning” scenario as baseline):

- Conserve riparian zones (default width = 30m)
- Conserve wetlands (NWI, State Designated Wetlands, and Potential Conservable Wetlands (PA only))
- Increase proportion of growth occurring as infill/redevelopment (default = 10% per decade)
- Increase urban densities (default = 10% per decade)
- Increase proportion of urban vs rural growth (default = 10% per decade)
- Expand sewer service areas (default = 1 mile buffer)
- Avoid growth on soils unsuitable for septic systems
- Stochastically simulate rate of forest conservation by County based on participation in state programs and land trust activities.
- Stochastically simulate rate of farmland conservation by County on participation in state programs and land trust activities.

Next Steps to Credit Conservation and Planning BMPs

- Complete State-specific Scenarios
- Simulate expected rates of forest and farmland conservation by county in PA and MD
- Translate conservation priority maps into future conservation probability maps
- Update the 1m-resolution land use/cover data using 2017 and 2018 imagery.
- Obtain annual rates of conservation, average sizes of conserved parcels, and contextual rules by County from DNR and the land trust community.


USGS
science for a changing world