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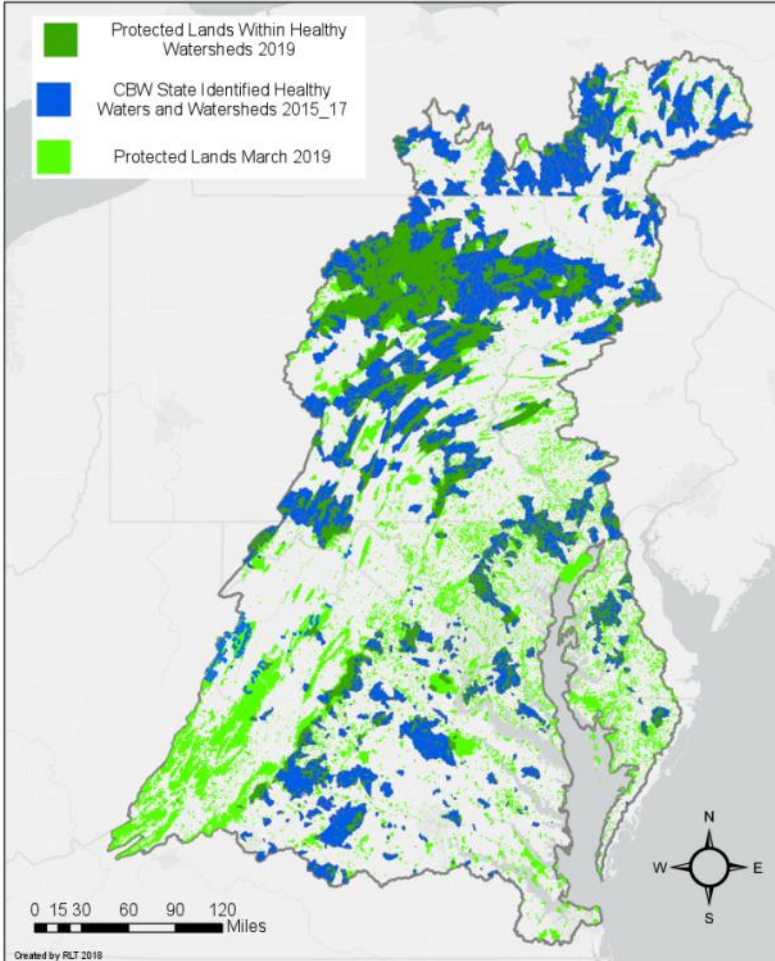
SESSION 7. TRACKING, EVALUATING, REPORTING COMMUNICATION AND PROTECTION

CHESAPEAKE HEALTHY WATERSHEDS ASSESSMENT

State Identified Healthy Waters and Watersheds (2017) and Protected Lands (2019)



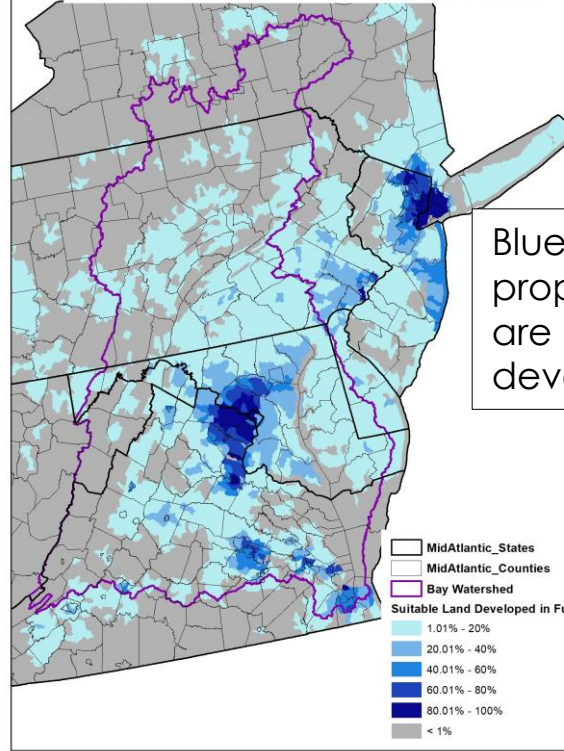
- Protected Lands Within Watersheds 2019
- CBW State Identified Healthy Waters and Watersheds 2015_17
- Protected Lands March 2019



Created by RLT 2018

PROTECTION AND VULNERABILITY

Year 2050 Development Pressure, Chesapeake Bay Watershed



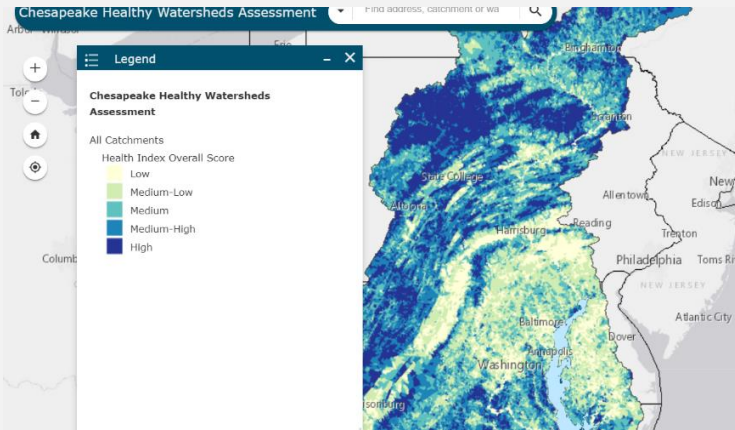
Blue tints represent the proportion of lands that are threatened by future development



CHESAPEAKE HEALTHY WATERSHEDS ASSESSMENT

Compiled metrics characterizing multiple aspects of watershed health and landscape stressors to inform potentially vulnerable and/or resilient catchments.

Providing data and information to support strategies to protect and maintain healthy watersheds.





Landscape Condition

Subindex score:

Metric values

- % Natural Land Cover (Ws)*
- % **Forest in Riparian Zone (Ws)**
- Population Density (Ws)
- **Housing Unit Density (Ws)**
- Mining Density (Ws)
- % **Managed Turf Grass in Hydrologically Connected Zone (Ws)***
- **Historic Forest Loss (Ws)**



Hydrology

Subindex score:

Metric values

- % Agriculture on Hydric Soil (Ws)
- % **Forest (Ws)***
- % Forest Remaining (Ws)
- % Wetlands Remaining (Ws)
- % Imperviousness Cover (Ws)*
- Road Stream Crossing Density (Ws)
- % **Wetlands (Ws)***



Habitat

Subindex Score:

Metric values

- National Fish Habitat Partnership (NFHP) Habitat Condition Index (Catchment)
- % **Natural Connectivity (Catchment)**
 - **Habitat Condition Index – Local**
 - **Habitat Condition Index – Network**
 - **Habitat Condition Index – Cumulative**



Geomorphology

Subindex Score:

Metric values

- Dam Density (Ws)
- % Vulnerable Geology (Ws)
- Road Density in Riparian Zone (Ws)
- % Impervious in Riparian Zone (Ws)*



Water Quality

Subindex score:

Metric values

- % of Stream Length Impaired (Catchment)
- **Estimated Nitrogen Load from SPARROW Model (lbs/acre/yr) (Ws)**
- **Nitrogen, Phosphorus, and Sediment Load from Chesapeake Bay Model, by Sector (Ws)**



Biological Condition

Subindex score:

Metric values

- **Outlet Aquatic Condition Score (Catchment)**

CHESAPEAKE HEALTHY WATERSHEDS ASSESSMENT

----- - CONDITION METRICS

gis.chesapeakebay.net/healthywatersheds/imagemaps/healthindex.html

Bold = new metrics

*** = from CBP high-resolution land use/cover**

CHESAPEAKE HEALTHY WATERSHEDS ASSESSMENT - VULNERABILITY METRICS



Land Use Change

Metric values

- % Increase in Development (Catchment)
- Recent Forest Loss (Ws)
- % Protected Lands (Ws)



Wildfire

Metric value

- % Wildland Urban Interface (Ws)



Water Use

Metric values

- Agricultural Water Use (Catchment)
- Domestic Water Use (Catchment)
- Industrial Water Use (Catchment)

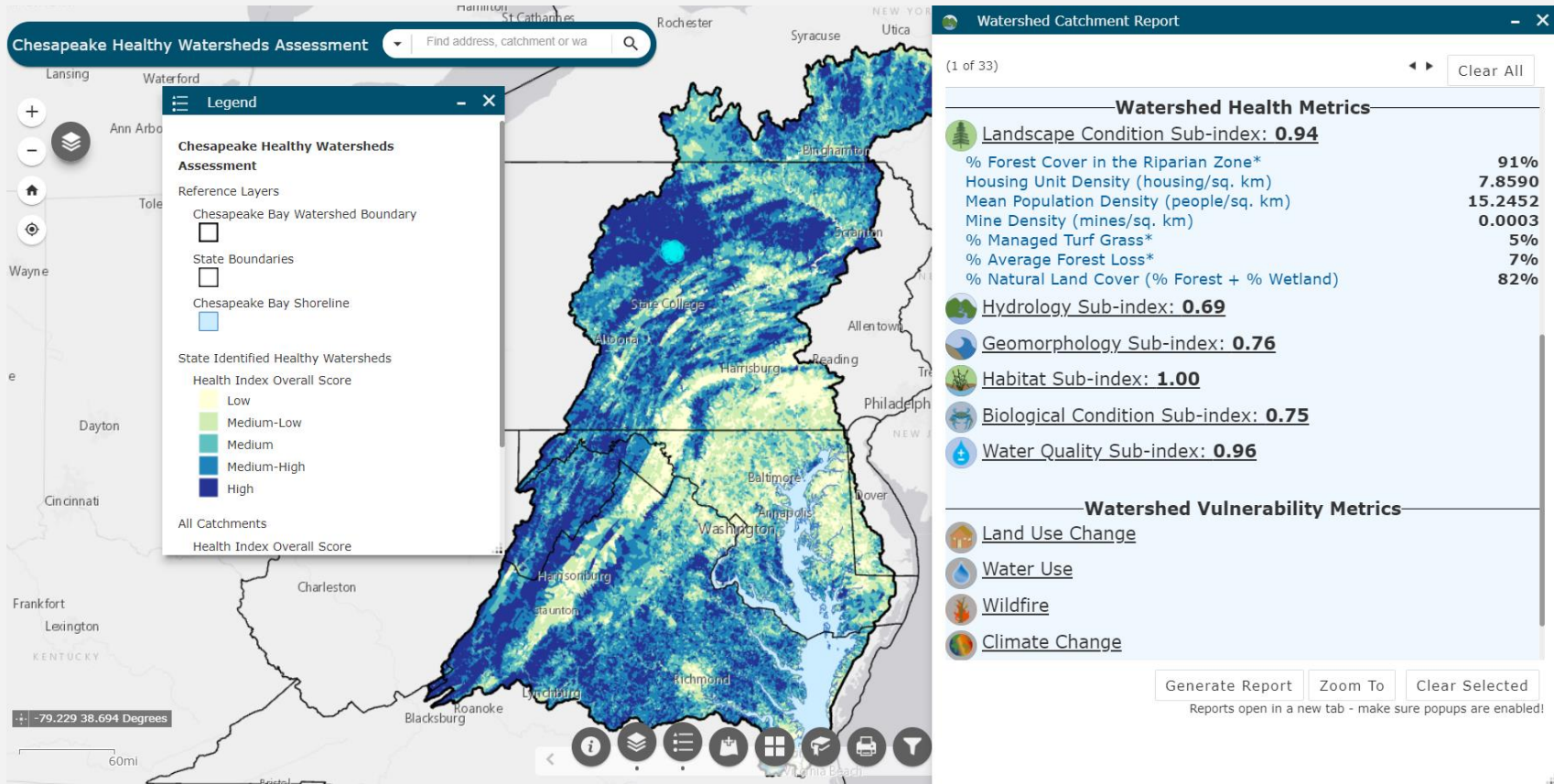


Climate Change

Metric values

- Brook Trout Occurrence – current (Catchment)
- Change in Probability of Brook Trout Occurrence with 6 C Temperature change (Catchment)
- NALCC Climate Stress Indicator (Catchment)

DATA VISUALIZATION NEEDS & INTERESTS



MARYLAND HEALTHY WATERSHEDS ASSESSMENT



Refine and customize the CHWA for application to Maryland



Evaluate statistical relationships between landscape indicators and on-the-ground (or better yet...in-thestream!) diagnostic measures of stream condition



Develop approach that can be replicated in other jurisdictions using state, local, or regional data



Provide new tool to support management of healthy watersheds (Tier II waters)





MARYLAND
HEALTHY
WATERSHEDS
ASSESSMENT
METRIC
SELECTION

- Candidate watershed health metrics in five categories
- Input from partners and project advisory team
- Primarily regional and state data
- Criteria for selecting candidate metrics included
 - relevance to characterizing watershed health and vulnerability
 - availability of data
 - consistency with other Bay Program efforts
 - appropriate spatial scale and resolution to support catchment-scale metrics
 - spatial coverage
 - appropriate temporal period

OVERLAYS

- Some data not available at catchment scale, used instead as overlays providing context, for example:
 - Source water protection areas
 - Coldwater protection areas
 - Environmental justice indicators
 - Specific locations of protected lands

Management Application	Data Source
Climate Adaptation	Maryland DNR Wetland Adaptation
Source Water Protection	EPA Source Water data
Source Water Protection	MD: Community Water System's Surface Intake Watersheds
Source Water Protection	MD: Wellhead Protection Areas
Diversity, Equity, Inclusion and Justice (DEIJ)	CBP Environmental Justice and Equity Dashboard (Beta): demographic and socioeconomic data such as % persons of color, % low-income population, % linguistically isolated; social vulnerability index
Diversity, Equity, Inclusion and Justice (DEIJ)	MD Park Equity Mapping Tool: includes demographic and socioeconomic data such as proximity to public park space, concentration of low-income populations, concentration of non-white population, concentration of linguistically isolated population, and walkability
Fish Migration	Maryland DNR: Fish Barriers
Coldwater Stream Protection	Maryland DNR: Coldwater Resources
Coldwater Stream Protection	Maryland DNR: Springs
Resource Protection	Maryland DNR: Blue Infrastructure - High Priority Blue Infrastructure Shorelines and Watersheds
Resource Protection	CBP Protected Lands data
Resource Protection	Vulnerable Geology
Habitat Protection	Forest Health
Habitat Protection	Black Duck

NEW METRICS FOR MD HWA AND BEYOND

Active and Abandoned Mines

Chesapeake Conservancy,
Conservation Innovation
Center



Streambank Erosion, Streambank Change, and Sediment Flux

USGS Florence Bascom
Geoscience Center

Forest Habitat

USGS CBP



MBSS Stronghold Watersheds

MD DNR

Maryland Biodiversity Conservation Network (BioNet)

MD Natural Heritage
Program

Recent and Projected Future Land Change

USGS CBP

Flow Alteration

USGS Eastern Ecological
Science Center, Leetown
Research Laboratory

Conductivity

USGS South Atlantic Water
Science Center



Stream Impairments

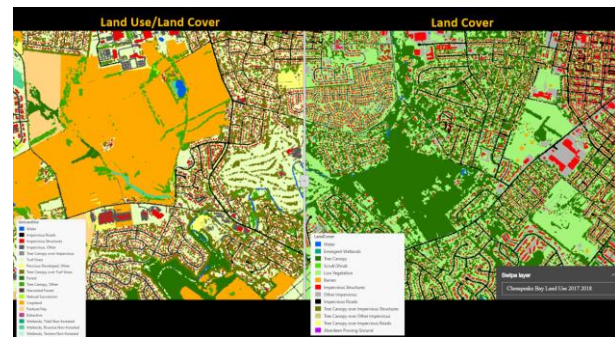
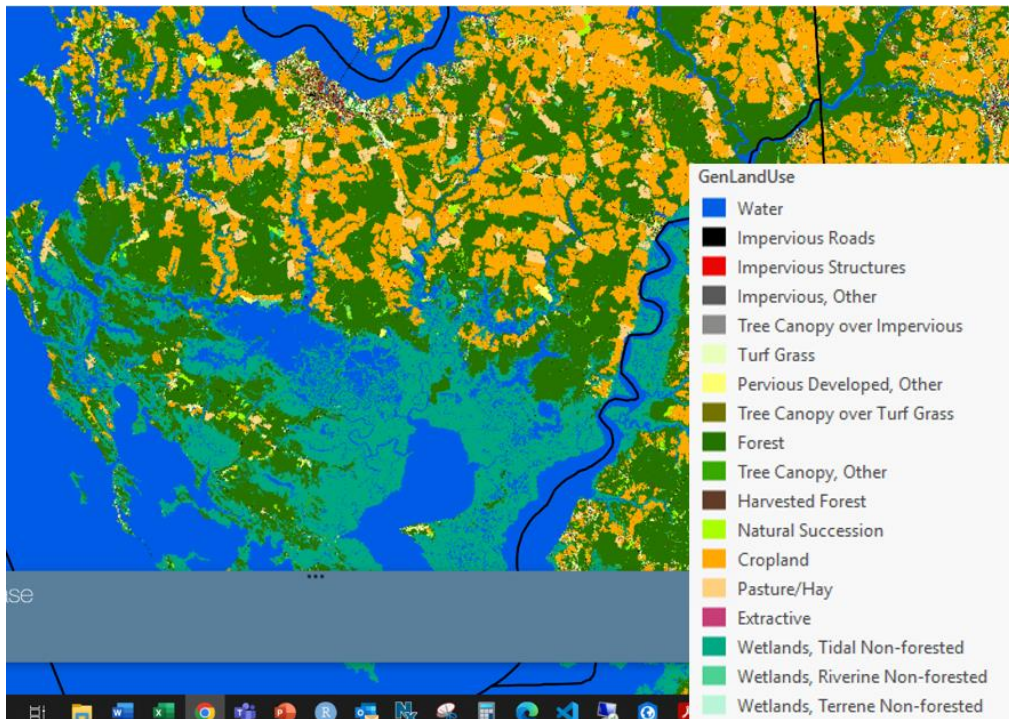
Maryland Integrated
Report, MDE



USGS SPARROW sector specific loads (manure, fertilizer, urban wastewater, atmospheric, septic) for TN, TP, Sediment

Maryland Fire Priority Areas

MD DNR Forest Service



One-Meter Resolution Land Use/Land Cover Data for the Chesapeake Bay Watershed

Peter Claggett¹, Labeeb Ahmed¹, Jacob Czawlytko², Sean MacFaden³, Patrick McCabe², Sarah McDonald¹, Emily Mills², Jarlath O'Neill-Dunne¹, Rachel Soobitsky², and Katie Walker²

¹ Lower Mississippi-Gulf Water Science Center, U.S. Geological Survey
² Chesapeake Conservancy's Conservation Innovation Center
³ University of Vermont's Spatial Analysis Laboratory

HIGH RES LU/LC
WATERSHED
HEALTH METRICS

% Natural Land Cover in Watershed

% Tree Canopy in Riparian Zone in Watershed

% Natural Land in Riparian Zone in Watershed

% Impervious Cover in Watershed

% Effective Impervious Cover in Watershed

% Managed Turf Grass

% Forest in Watershed

% Wetlands in Watershed

% Impervious in Riparian Zone in Watershed

% Forest Habitat in Watershed

HIGH RES LU/LC
WATERSHED HEALTH
METRICS (CATCHMENT
AND UPSTREAM
WATERSHED AREA)

**Annual
Rate of
Land Use
Change
2013/14-
2017/18**

% Annual forest change

**% Annual impervious
change**

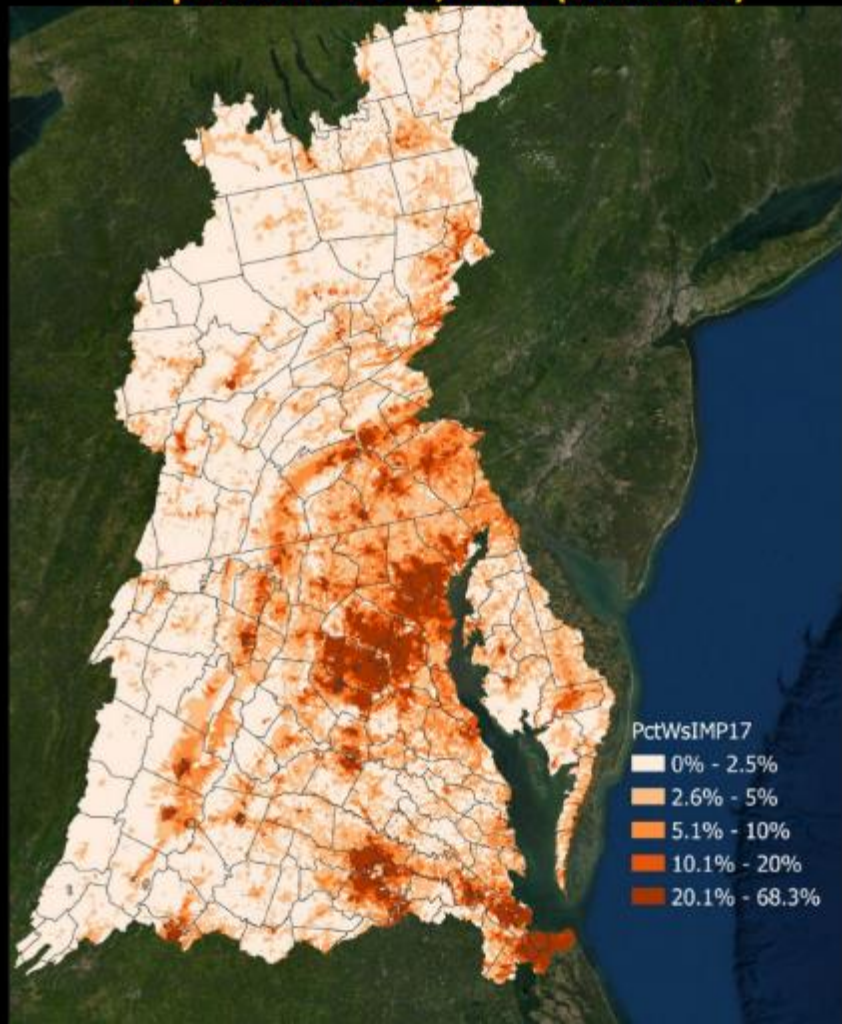
**Projected
Land Use
2035**

% impervious, projected

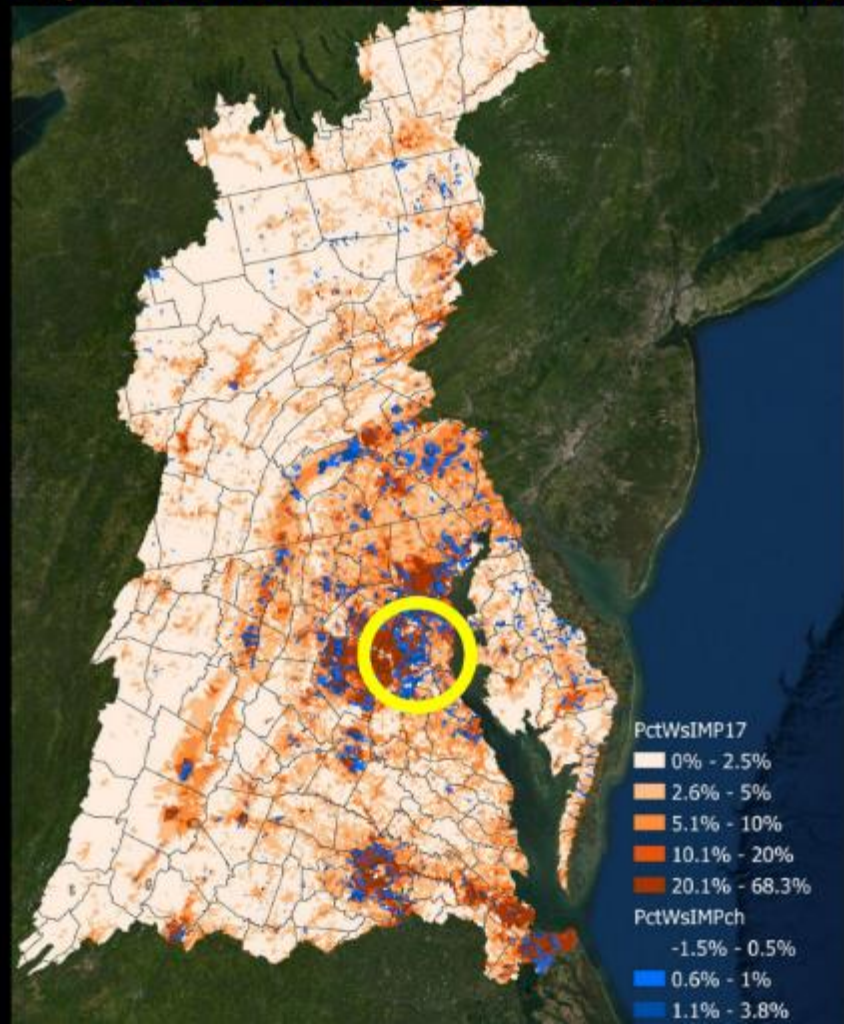
% natural land

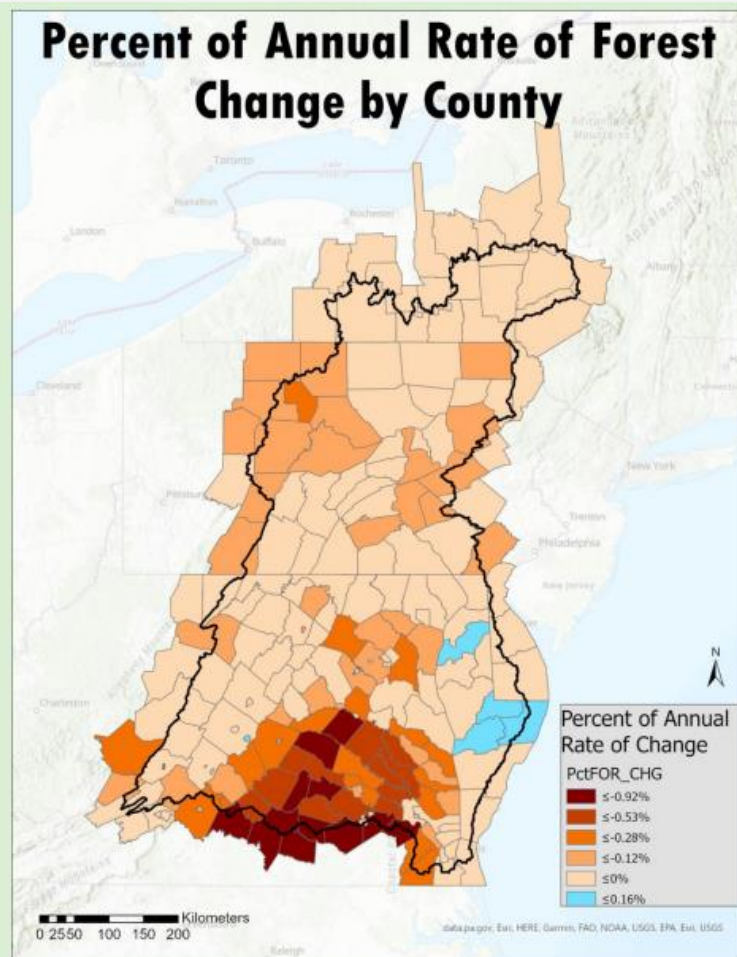
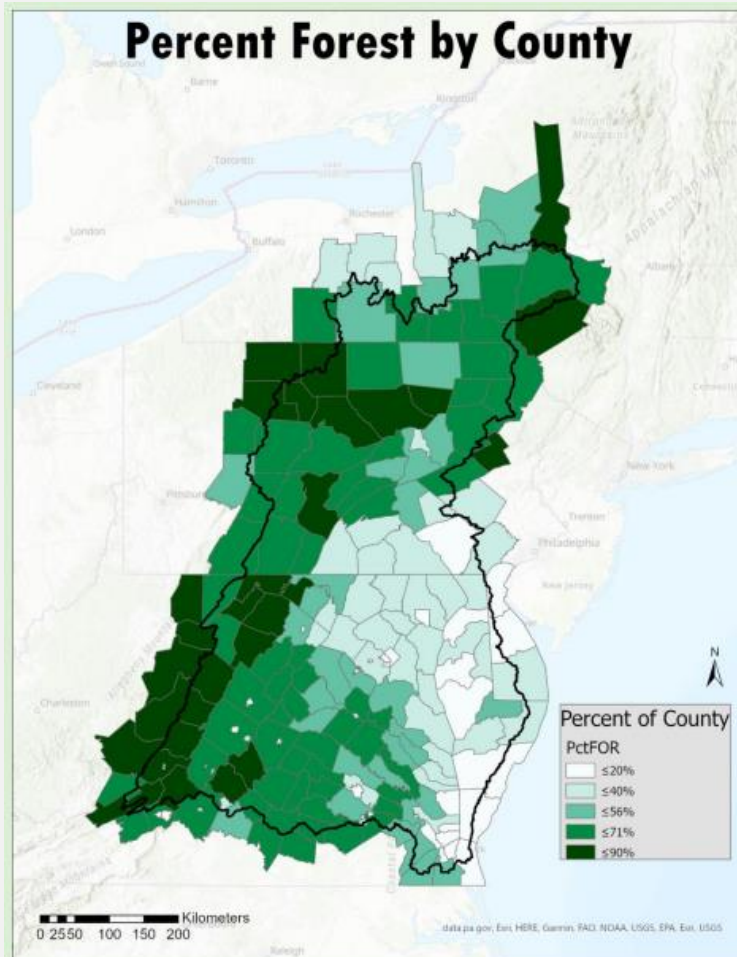
% agriculture

Impervious Cover, 2017 (accum. %)



Impervious Cover Change, 2013-17 (accum. %)

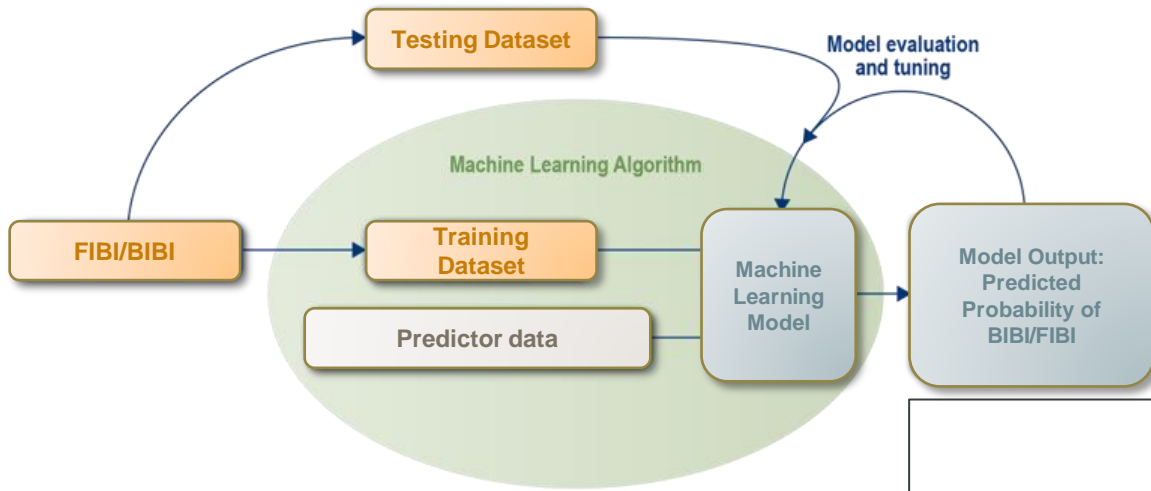




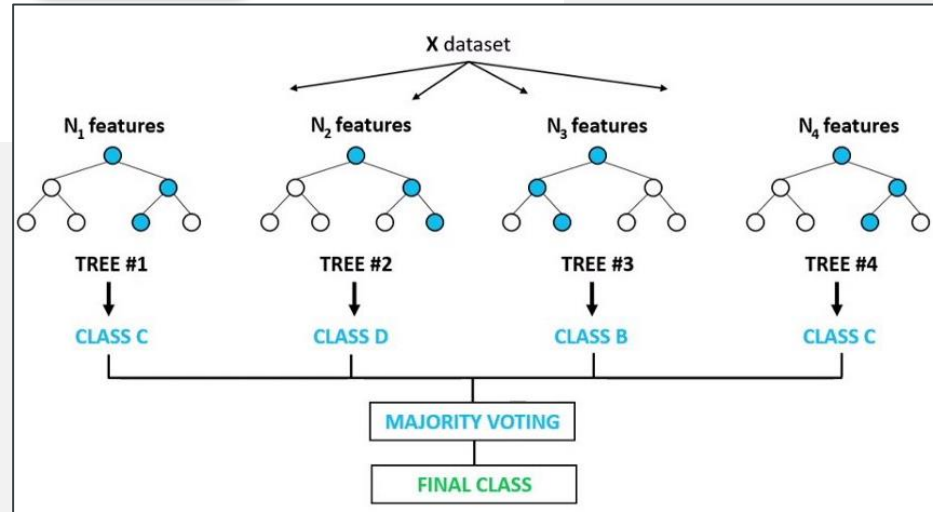
Maps and change data provided by Sarah McDonald, USGS, CBP

TESTING PREDICTIVE POWER OF METRICS

- Built Random Forest models to assess which watershed condition metrics were the best predictors of stream condition
- Maryland Biological Stream Survey
 - >5,000 samples since 1990s
 - Monitoring of non-tidal stream communities – both benthic macroinvertebrate and fish Indices of Biotic Integrity (IBI)
 - IBIs as response variables



RANDOM FOREST MODEL



APPLYING THE HEALTHY WATERSHED ASSESSMENTS

Providing data to support management decision-making, particularly for maintaining the health of watersheds

- Assess current watershed condition
- Track condition over time
- Provide early warning signs – vulnerability to degradation
- Identify resiliency – ability to sustain good watershed health in spite of stressors

MANAGEMENT APPLICATIONS AND ADDITIONAL STAKEHOLDERS OF THE CHESAPEAKE AND MARYLAND HWAS INCLUDE:



Coordination with CBP's Fish Habitat Assessments



Source water protection (drinking water)



Engagement with local governments to inform land use decisions



Assessing landscape factors affecting fish habitat in non-tidal and tidal watersheds




Identifying areas of brook trout populations susceptible to climate shifts



Examining/quantifying stressors affecting stream health (not just in healthy watersheds)



Supporting land trusts and other organizations managing protected lands



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Photos: Will Parson, Chesapeake Bay Program