STAR Monthly Meeting– March 25, 2021
Chesapeake Bay Program

Science Needs:
Land Use Methods and Metrics Outcome

Peter Claggett[1], Labeeb Ahmed[1], Jacob Czawlytko[2], Jarlath O'Neil-Dunne[3], Sarah McDonald[1], Patrick McCabe[2], Sean MacFaden[3], Rachel Soobitsky[2], and Renee Thompson[1]

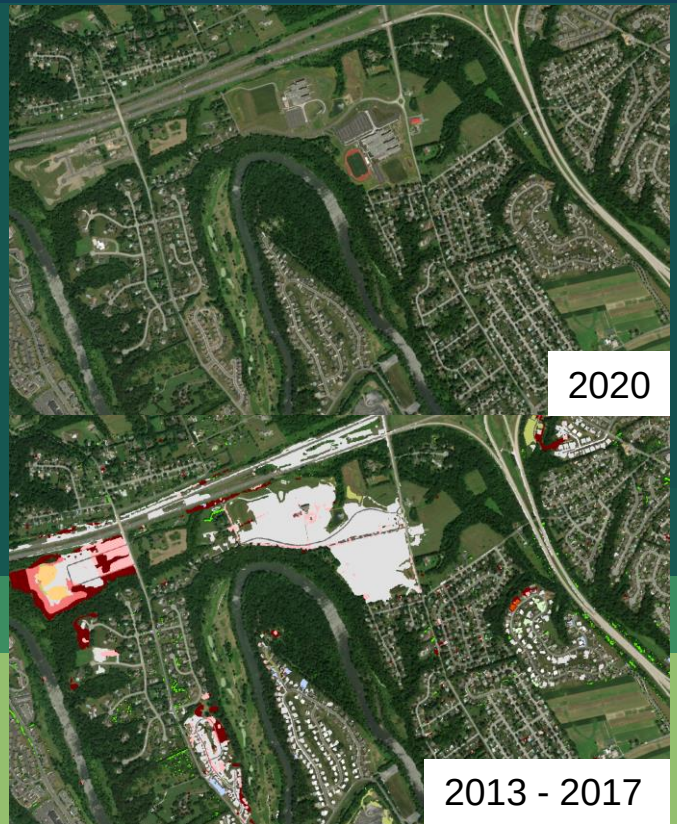
[1] Lower Mississippi-Gulf Water Science Center, U.S. Geological Survey, Annapolis, MD 21403
[2] Chesapeake Conservancy, Annapolis, MD 21403
[3] Spatial Analysis Laboratory, University of Vermont, Burlington, VT 05405

Through the Chesapeake Bay Watershed Agreement*, the Chesapeake Bay Program has committed to…*

https://blog.nature.org/science/2016/09/08/energy-sprawl-is-the-largest-driver-of-land-use-change-in-the-u-s/

Outcome*:* Assess and understand the impacts of land use change on watersheds, habitats, and communities at a scale relevant to county-level decision-makers.

Through the Chesapeake Bay Watershed Agreement*, the Chesapeake Bay Program has committed to…*

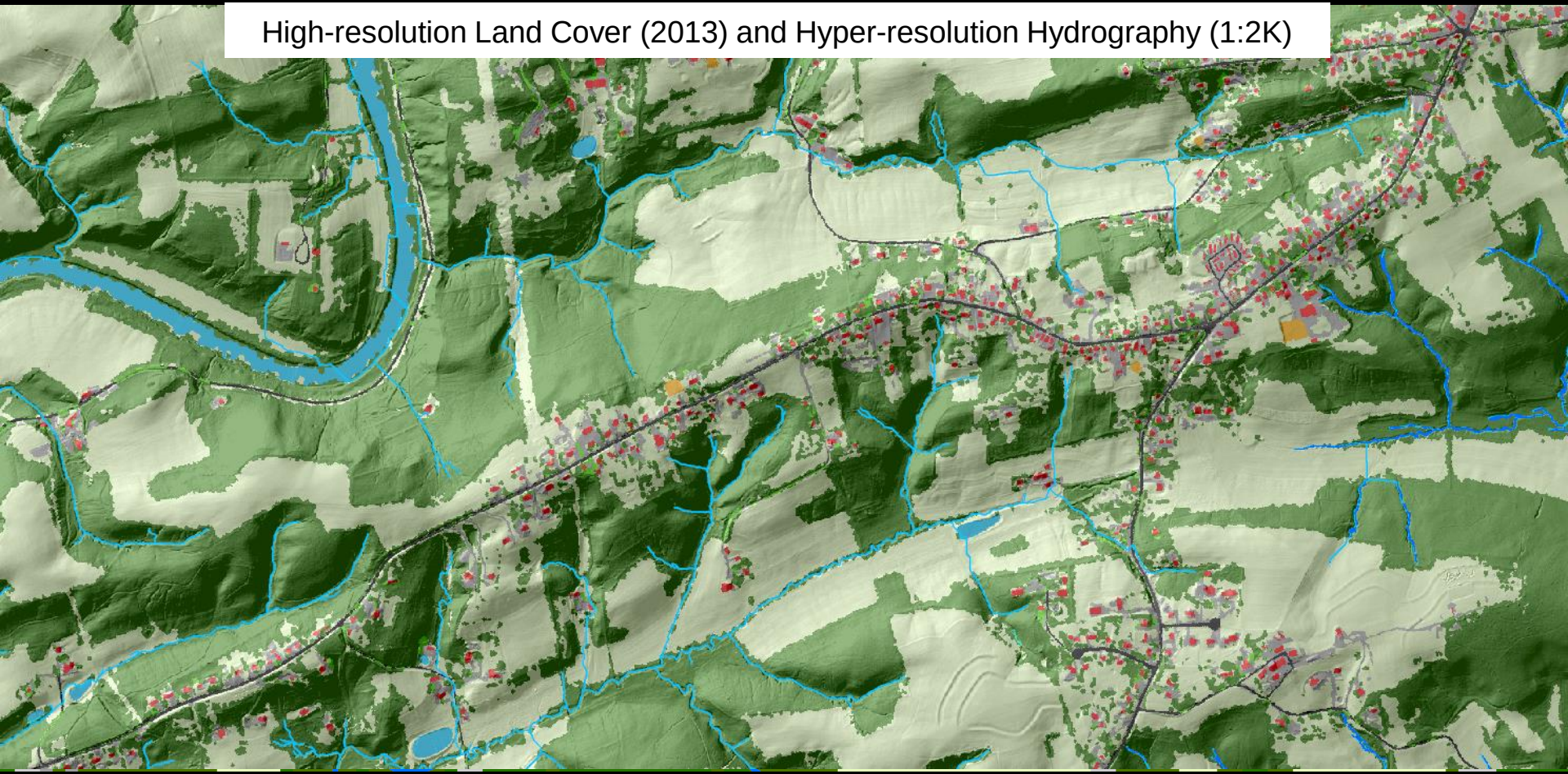


1. Measure rate of farmland, forest and wetland conversion, and the extent and rate of change in impervious surface coverage.

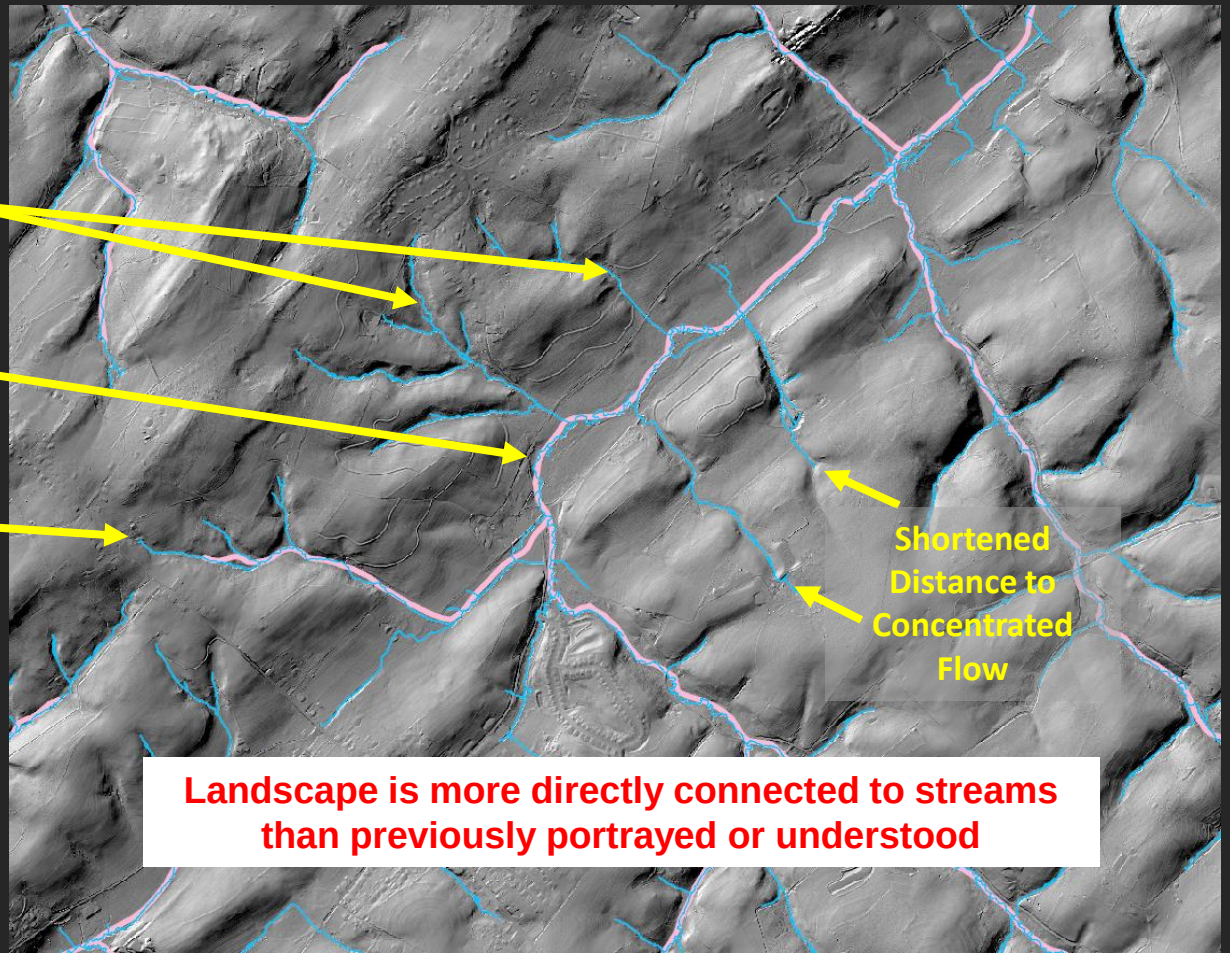
2. Quantify the potential impacts of land conversion to water quality, healthy watersheds and communities.

3. Launch a public awareness campaign to share this information with citizens, local governments, elected officials and stakeholders.

High-resolution Land Cover (2013) and Hyper-resolution Hydrography (1:2K)



Hyper-resolution Hydrography



Chesapeake Bay Program Land Use Classification (64 classes)

1. Water (8)
- 1.1 Lentic
  - 1.1.1 Estuary (tidal)
  - 1.1.2 Lakes & Ponds
- 1.2 Lotic
  - 1.2.1 Streams
    - 1.2.1.1 Open Channel
    - 1.2.1.2 Tree Canopy over Channel
    - 1.2.1.3 Culverted/ Buried Channel
  - 1.2.2.Ditches
    - 1.2.2.1 Open Ditch
    - 1.2.2.2 Tree Canopy over Ditch
    - 1.2.2.3 Culverted/ Buried Ditch

2. Developed (12)
- 2.1 Impervious
  - 2.1.1 Roads
  - 2.1.2 Structures
  - 2.1.3 Other Impervious (Parking lots, driveways)
  - 2.1.4 Tree Canopy (TC) over Impervious
    - 2.1.4.1 TC over Roads
    - 2.1.4.2 TC over Structures
    - 2.1.4.3 TC over Other Impervious
- 2.2 Pervious
  - 2.2.1 Turf Grass
  - 2.2.2 Bare Developed
  - 2.2.3 Suspended Succession (rights-of-way)
    - 2.2.3.1 Barren
    - 2.2.3.2 Herbaceous
    - 2.2.3.3 Scrub-shrub
  - 2.2.4 Tree Canopy over Turf Grass

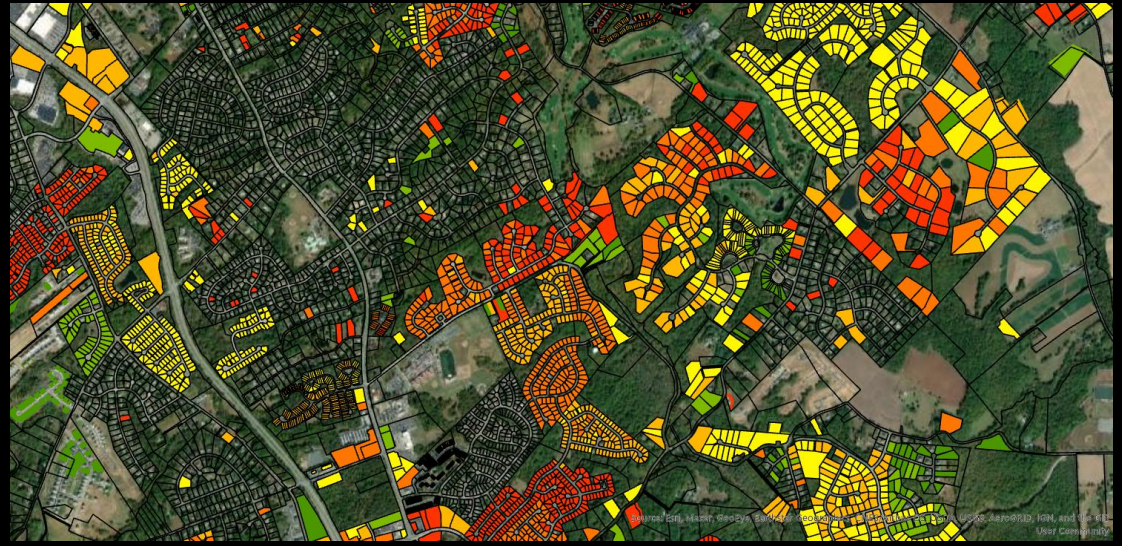
3. Forest (7)
- 3.1 Forest (>= 1 acre, 240-ft width)
- 3.2 Tree Canopy in Agriculture
- 3.3 Harvested Forest (<= 3 years)
  - 3.3.1 Barren
  - 3.3.2 Herbaceous
- 3.4 Natural Succession (> 3 years)
  - 3.4.1 Barren
  - 3.4.2 Herbaceous
  - 3.4.3 Scrub-shrub

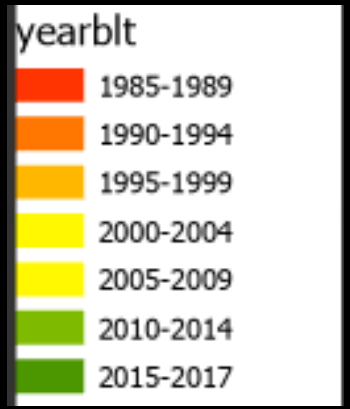
4. Production (16)
- 4.1 Agriculture
  - 4.1.1 Cropland
    - 4.1.1.1 Barren
    - 4.1.1.2 Herbaceous
  - 4.1.2 Pasture
    - 4.1.2.1 Barren
    - 4.1.2.2 Herbaceous
  - 4.1.3 Orchard/vineyard
    - 4.1.3.1 Barren
    - 4.1.3.2 Herbaceous
    - 4.1.3.3 Scrub-shrub
  - 4.1.4 Idle/Fallow
    - 4.1.4.1 Barren
    - 4.1.4.2 Herbaceous
    - 4.1.4.3 Scrub-shrub
- 4.2 Solar fields
  - 4.2.1 Impervious
  - 4.2.2 Pervious
    - 4.2.2.1 Barren
    - 4.2.2.2 Herbaceous
    - 4.2.2.3 Scrub-shrub
- 4.3 Extractive (active mines)
  - 4.3.1 Barren
  - 4.3.2 Impervious

5. Wetlands and Water Margins (21)
- 5.1 Tidal
  - 5.1.1 Barren
  - 5.1.2 Herbaceous
  - 5.1.3 Scrub-shrub
  - 5.1.4 Tree Canopy
  - 5.1.5 Forest
- 5.2 Riverine (Non-tidal)
  - 5.2.1 Headwater
    - 5.2.1.1 Barren
    - 5.2.1.2 Herbaceous
    - 5.2.1.3 Scrub-shrub
    - 5.2.1.4 Tree Canopy
    - 5.2.1.5 Forest
  - 5.2.2 Floodplain
    - 5.2.2.1 Barren
    - 5.2.2.2 Herbaceous
    - 5.2.2.3 Scrub-shrub
    - 5.2.2.4 Tree Canopy
    - 5.2.2.5 Forest
- 5.3 Terrene/Isolated (Non-tidal)
  - 5.3.1 Barren
  - 5.3.2 Herbaceous
  - 5.3.3 Scrub-shrub
  - 5.3.4 Tree Canopy
  - 5.3.5 Forest
- 5.4 Bare shore

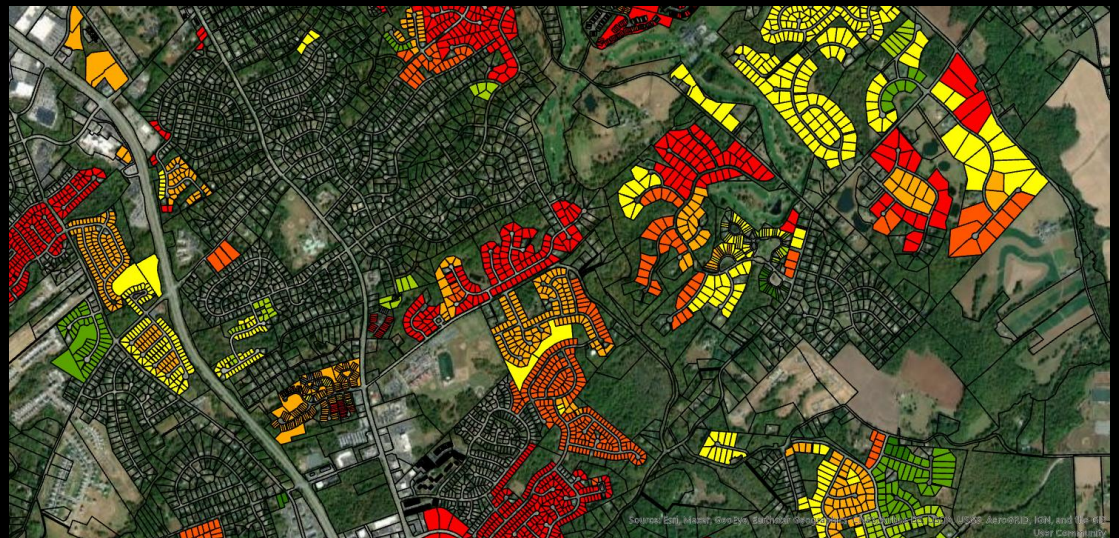
Parcel-Level Deconstruction of Urban Development (1985 – 2017)

Year-Built Attributes from Tax Records





Year-Built Attributes from USGS' LCMAP*



* Land Change, Monitoring, Assessment, and Projection (LCMAP)

Science Planned

What is already planned and resourced.

Baseline Information

USGS will co-publish data and an interpretive paper with CIC and UVM on high-res land use characteristics and change in the Chesapeake Bay Watershed to contextualize the nature of observed changes in impervious cover, turf grass, forests, wetlands (loss only), tree canopy, and agriculture (2021/2022).

Baseline Information

USGS will incorporate the 2013 and 2017 land use data into the Phase 6 Watershed Model and Chesapeake Healthy Watersheds Assessment (2021 – 2024).

Baseline Information

USGS will co-publish a paper with UMBC and CIC on land use characteristics and change along hyper-resolution streams (2022 – 2023).

Science Needs

What information gaps exist that need support.

Hydrologic/ Water Quality Impacts

How do the increased density of streams and corresponding decrease in overland flow-path length affect our interpretation and modeling of how land use and land use change affect nutrient processing and stream flow?

Communication Tools

Online tools are needed to assess changes in impervious cover, turf grass, forests, wetlands (loss only), tree canopy, and agriculture, for any user-specified geography (e.g., user-drawn polygons, Census Tracts, Municipalities, etc.)

- Output a standardized set of graphs and interpretive text tailored to graph content.
- Adapt to report changes along concentrated flow paths in 2023.

Informing Decisions

How can land use and land use change information best be communicated to select targeted audiences to inform land use and land conservation decisions?

Community Impacts

What is meant by “communities” for this outcome?

Census Places? Zip codes? Low-income, minority places?

How does land use composition and land change impact those communities?

Percent tree canopy, percent impervious cover, etc.
Note: lack of development could be a negative impact?

Field Research Needs

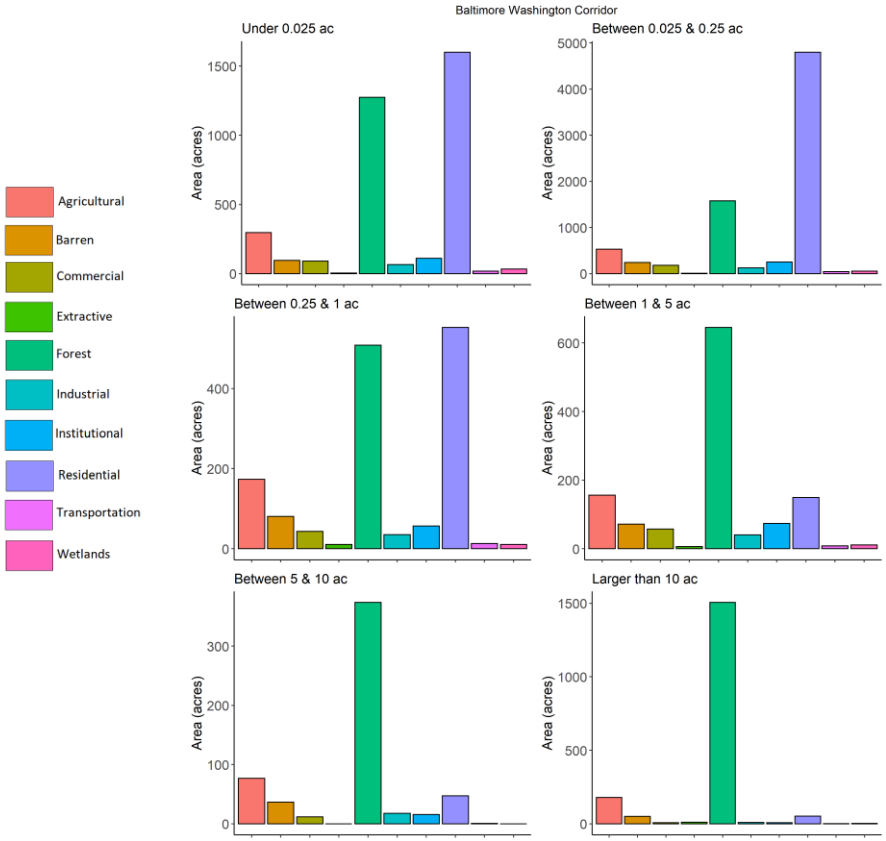
What's causing changes in land use and what are the management implications of those changes?

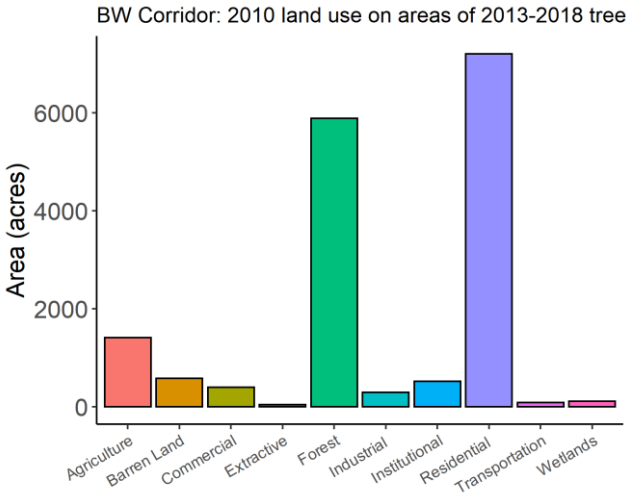
Example #1: What proportion of tree canopy loss is ephemeral, associated with natural mortality vs permanent removal. (Iris Allen's work with MD-DNR)

Example #2: Is agriculture increasing anywhere? If so, where and why?

Prince George's County Tree Canopy Loss

2010 Land use on areas of TC loss - BW






USGS
science for a changing world