# High-resolution Land Use and Hydrography Data to Inform the Phase 7 Watershed Model

**Peter R. Claggett[1], Labeeb Ahmed[1], Matthew Baker[4], Jacob Czawlytco[2], Sean MacFaden[3], Sarah McDonald[1], Jarlath O'Neil-Dunne[3], David Saavedra[2], and Rachel Soobitsky[2]**

1 Presenting Author, Lower Mississippi-Gulf Water Science Center, U.S. Geological Survey, Annapolis, MD 21403
2 Chesapeake Conservancy, Annapolis, MD 21403
3 University of Vermont Spatial Analysis Laboratory, Burlington, VT 05405
4 University of Maryland, Baltimore County, Baltimore, MD 21250

**Modeling Workgroup Quarterly Meeting**
**April 6, 2021**

U.S. Department of the Interior
U.S. Geological Survey

# Disclaimer

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# One-meter Resolution Products Relevant to Phase 7 Model

<u>Land Use</u>: 2013, 2017, and 2021; 60+ classes; accurate change over time.

2017-18 data highlights: addition of lakes/ponds, solar fields, and orchards/vineyards; improved mapping of tidal and non-tidal wetlands
Planned public release date: December 2021

2021-22 data highlights: addition of open channel, tree canopy over channel, and animal operations.
Planned public release date: June 2023

<u>Hydrography</u>: 2-D raster (discontinuous), 1-D polyline (continuous)

Features: streams, rills/gullies, agricultural ditches, roadside ditches, floodplains (from FACET), floodplain depressions, detention features, headwater wetlands, other.

Attributes: width, bank height, flow permanence, stream order, drainage area

Planned public release date: June 2024 (draft products will be available in 2022-23)

# CBP 2017 Land Use Classification (27 macro-classes, version 1)

## 1. Water (3)
1.1 Lentic
- 1.1.1 Estuary (tidal)
- 1.1.2 Lakes & Ponds

1.2 Lotic
- 1.2.1 Streams

## 2. Developed (8)
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

2.2 Pervious
- 2.2.1 Turf Grass
- 2.2.2 Bare Developed
- 2.2.3 Suspended Succession (rights-of-way)
- 2.2.4 Tree Canopy over Turf Grass

## 3. Forest (4)
3.1 Forest (>= 1 acre, 240-ft width)
3.2 Tree Canopy in Agriculture
3.3 Harvested Forest (<= 3 years)
3.4 Natural Succession (> 3 years)

## 4. Production (7)
4.1 Agriculture
- 4.1.1 Cropland
- 4.1.2 Pasture
- 4.1.3 Orchard/vineyard

4.2 Solar fields
- 4.2.1 Impervious
- 4.2.2 Pervious

4.3 Extractive (active mines)

## 5. Wetlands and Water Margins (5)
5.1 Tidal
5.2 Riverine (Non-tidal)
- 5.2.1 Headwater
- 5.2.2 Floodplain

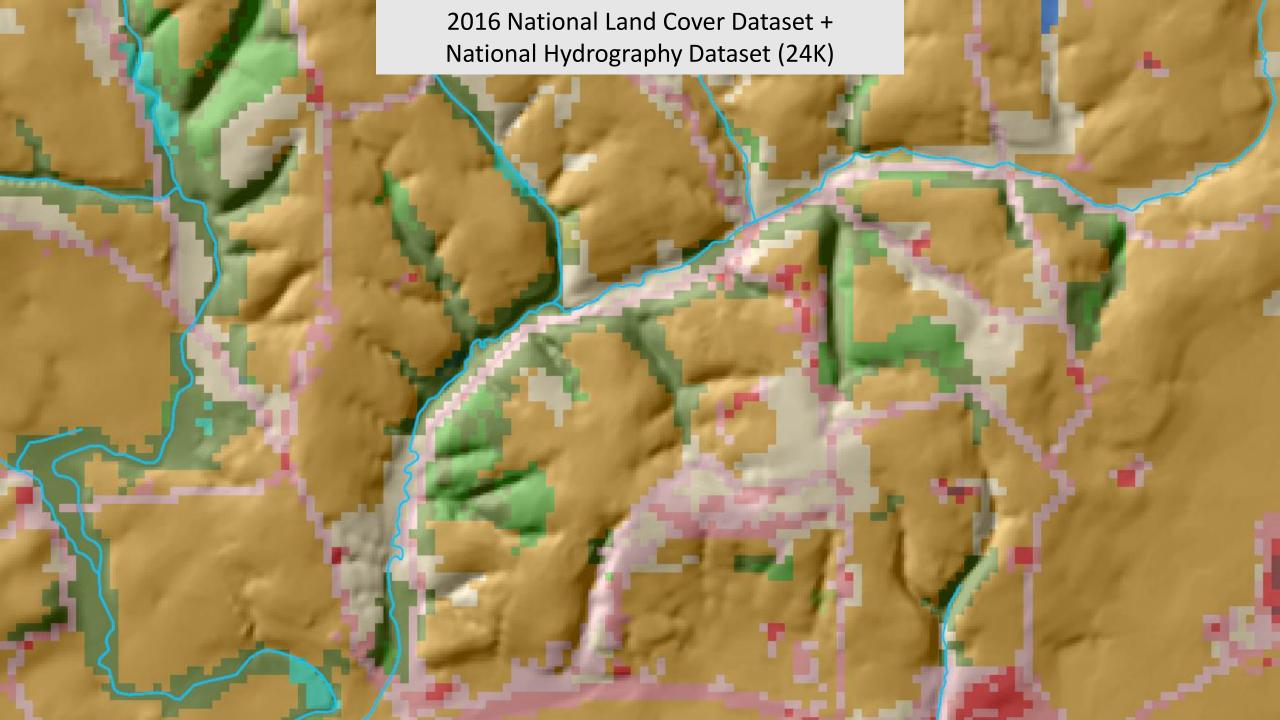5.3 Terrene/Isolated (Non-tidal)
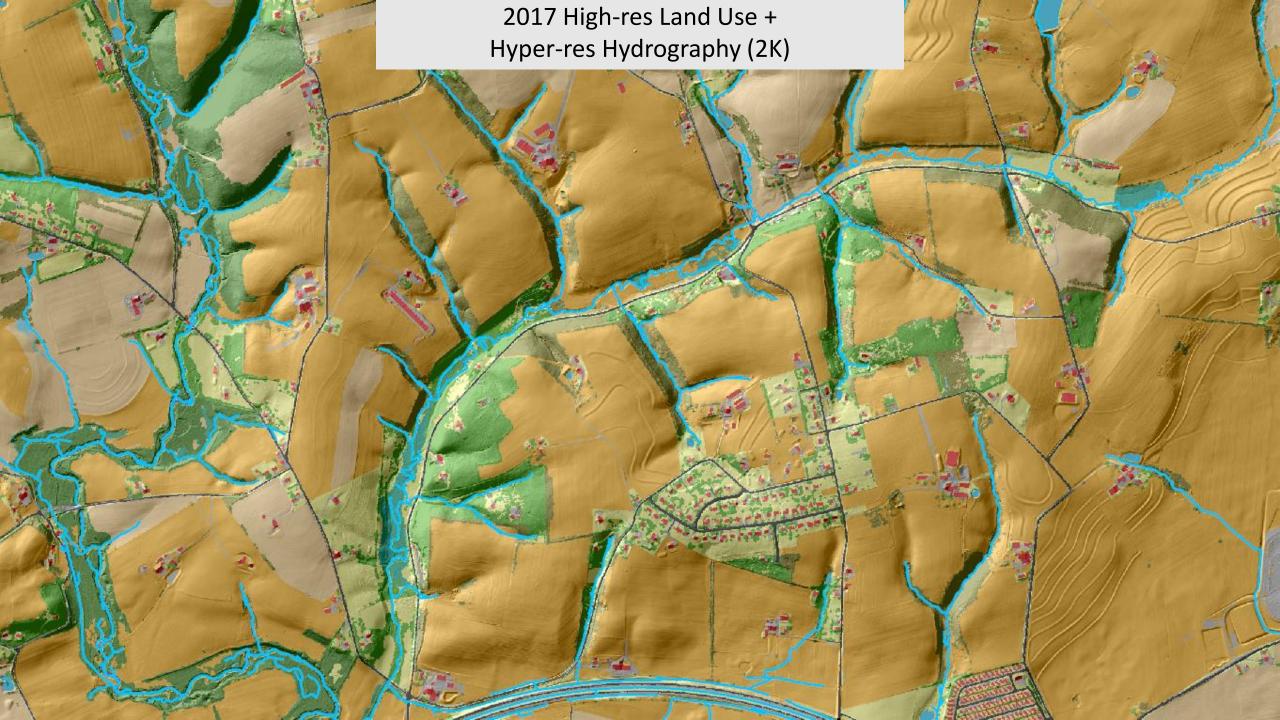5.4 Bare shore

# CBP Final 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 Animal Operations (TBD)
  - 4.1.4.1 Impervious
  - 4.1.4.2 Barren
  - 4.1.4.3 Herbaceous

### 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
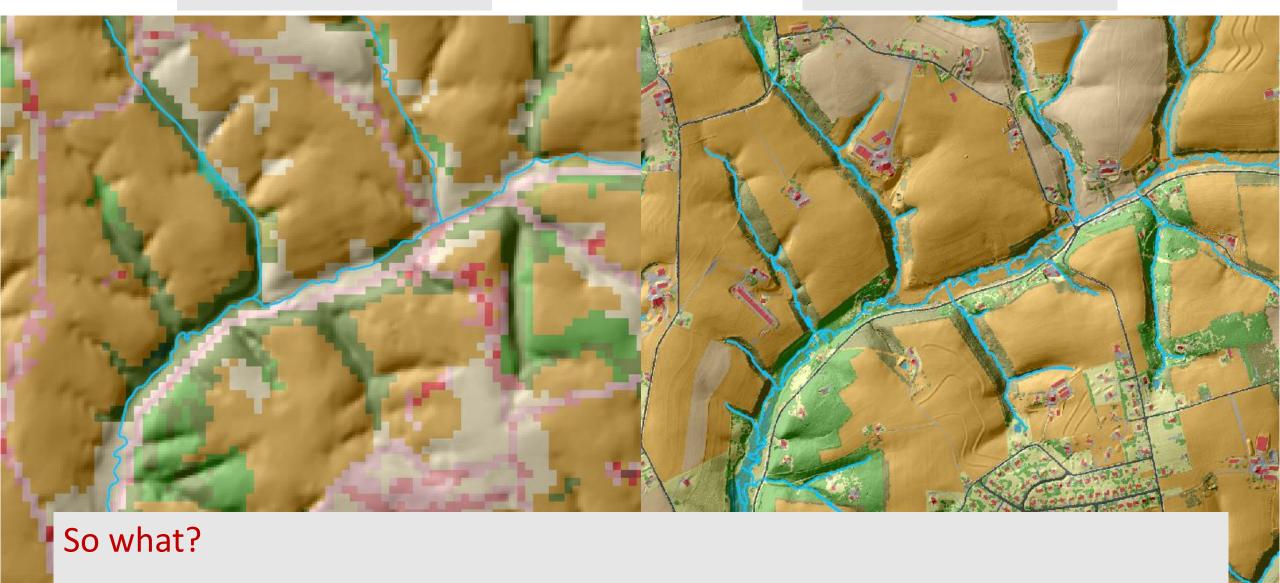
# Parcel Segments: the key to classifying high-resolution land use

2016 National Land Cover Dataset +
National Hydrography Dataset (24K)

2017 High-res Land Use +
Hyper-res Hydrography (2K)

30-meter Resolution

1-meter Resolution

So what?
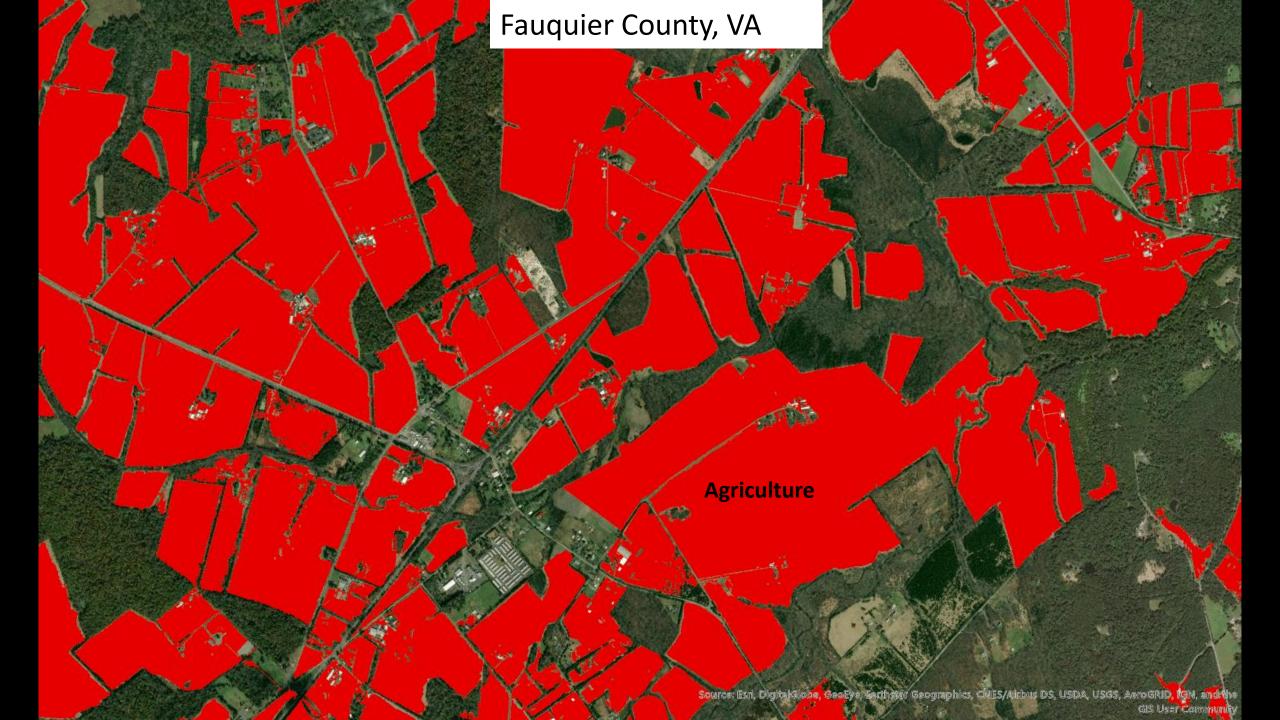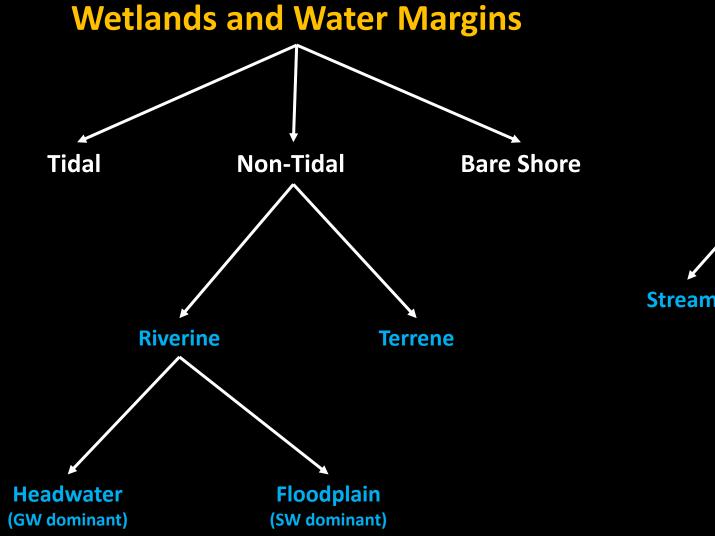
Finer-scale representation of sources and sinks of TN, TP, and TSS.

Fauquier County, VA

Agriculture
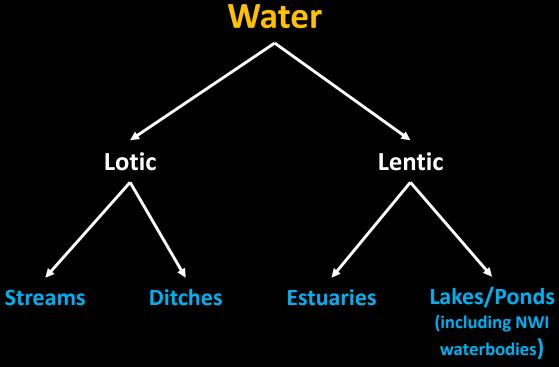
# Comparing the Census of Agriculture and High-res Land Use
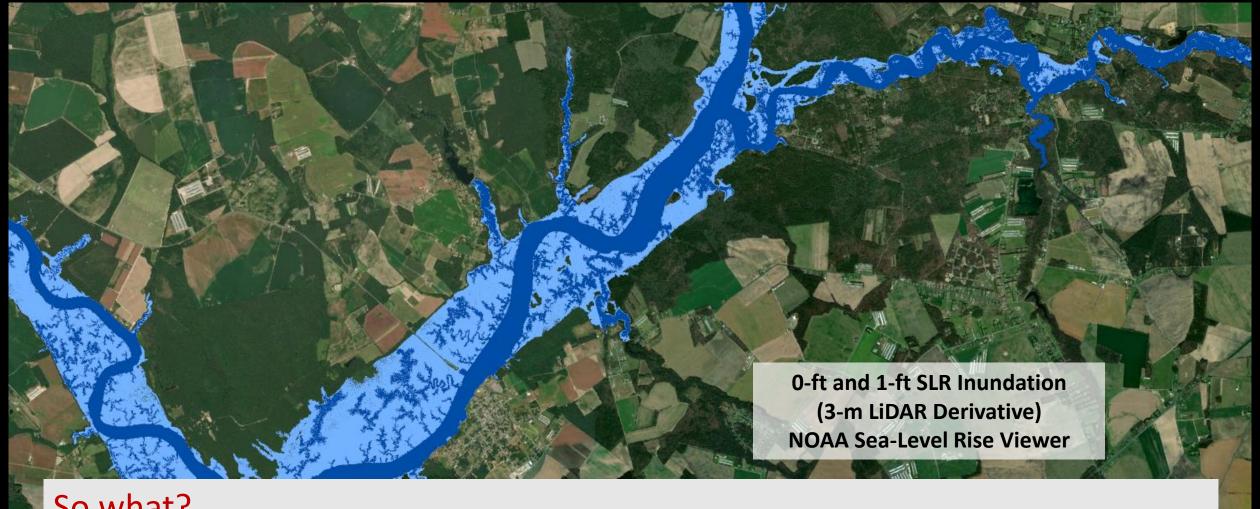
| FIPS | CNTY_NAME | Census AG_17 | Map AG_17 |
|------|-----------|--------------|-----------|
| 10005 | SUSSEX | 238,450 | 234,831 |
| 24005 | BALTIMORE | 56,655 | 60,696 |
| 24035 | QUEEN ANNES | 131,656 | 118,952 |
| 24045 | WICOMICO | 61,747 | 59,732 |
| 36017 | CHENANGO | 82,944 | 109,915 |
| 42015 | BRADFORD | 167,068 | 231,889 |
| 42033 | CLEARFIELD | 28,875 | 104,169 |
| 42041 | CUMBERLAND | 141,157 | 116,748 |
| 42071 | LANCASTER | 325,806 | 304,277 |
| 51015 | AUGUSTA | 213,135 | 145,181 |
| 51073 | GLOUCESTER | 14,370 | 13,027 |
| 51107 | LOUDOUN | 83,858 | 55,791 |
| 54003 | BERKELEY | 44,859 | 32,009 |
| 54031 | HARDY | 76,819 | 37,251 |
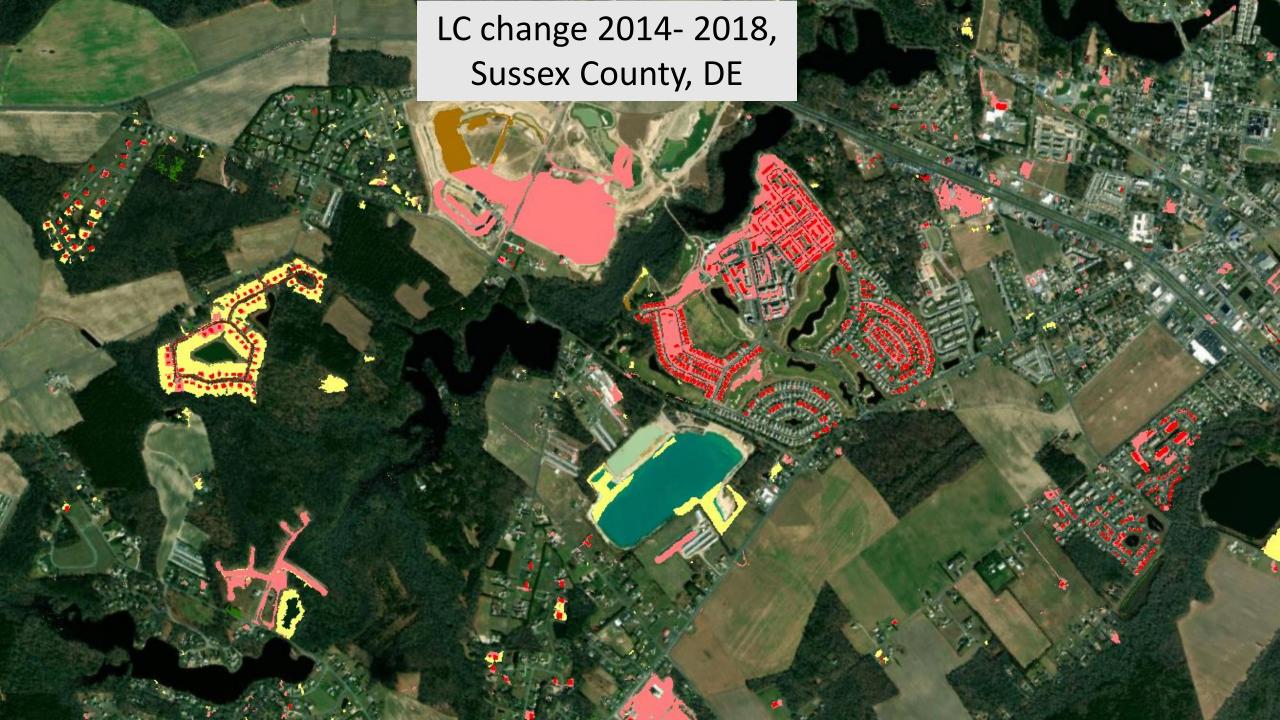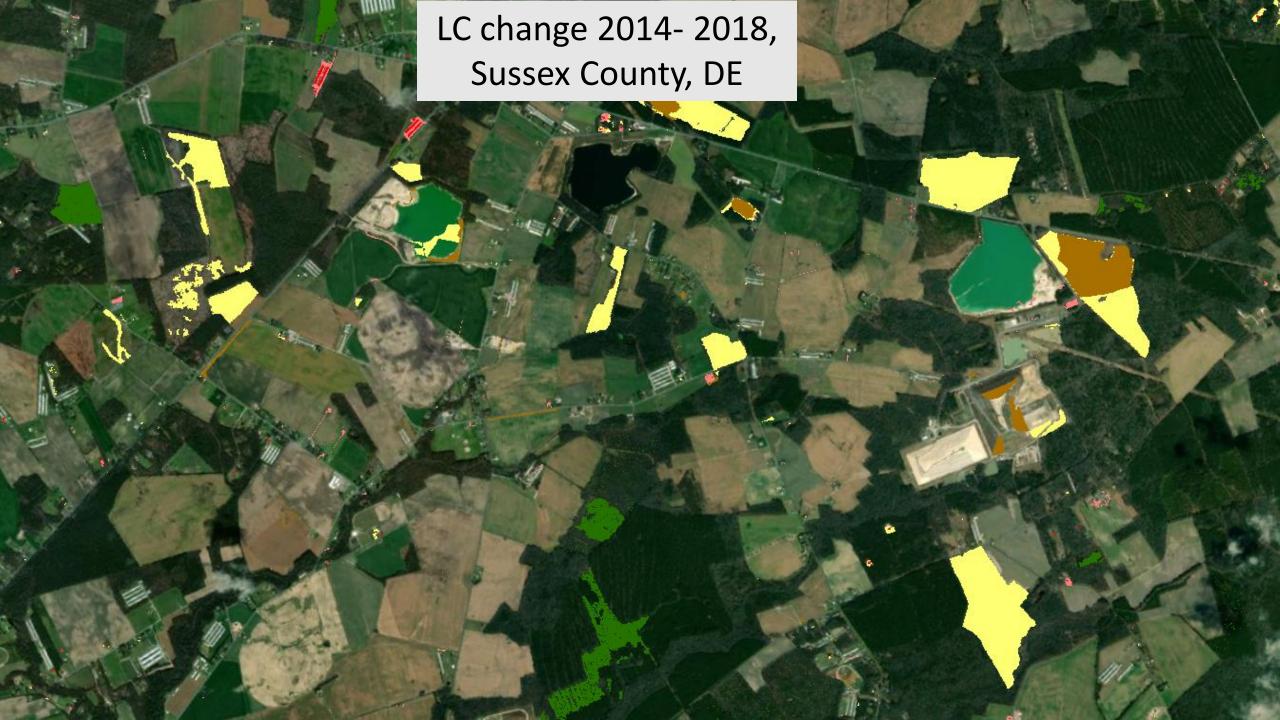
**Tidal Wetlands: Maryland and Delaware Wetland Datasets**

0-ft and 1-ft SLR Inundation
(3-m LiDAR Derivative)
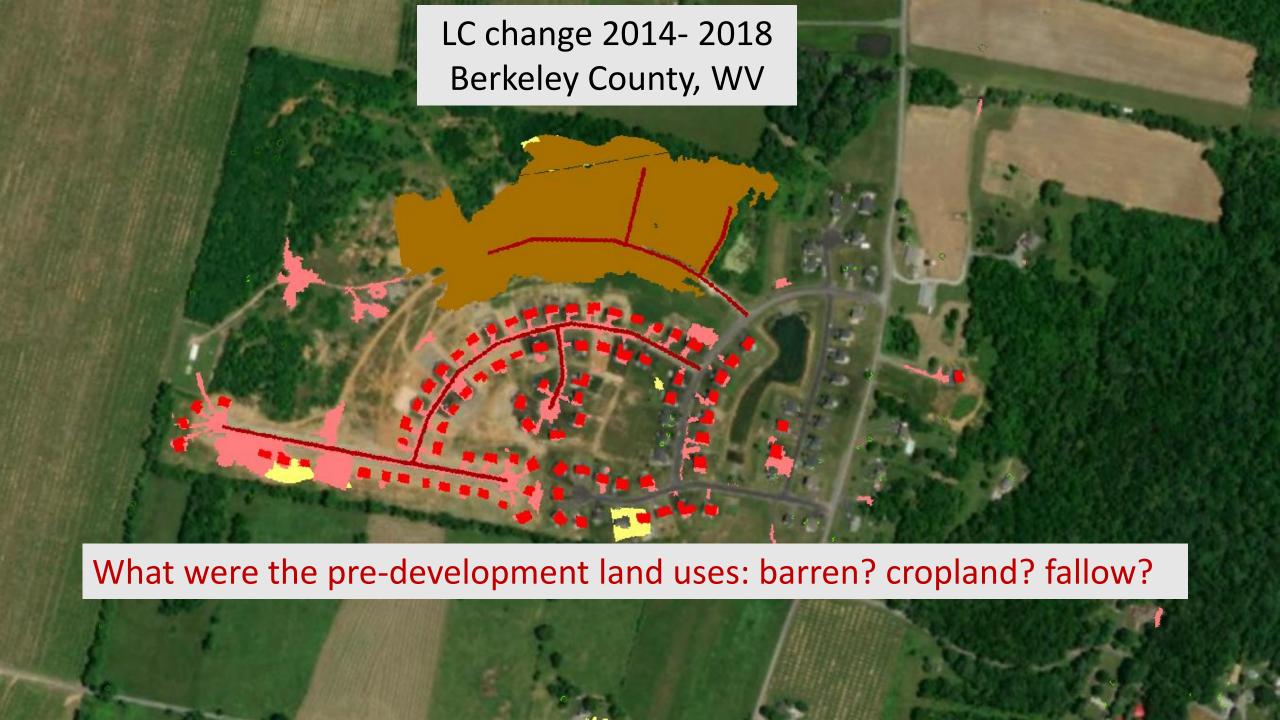NOAA Sea-Level Rise Viewer

So what?

Increased area of tidal wetlands = decreased land area in Watershed Model

LC change 2014- 2018, Sussex County, DE

LC change 2014- 2018,
Sussex County, DE

LC change 2014- 2018
Berkeley County, WV

What were the pre-development land uses: barren? cropland? fallow?

2007

2011

© 2021 Google

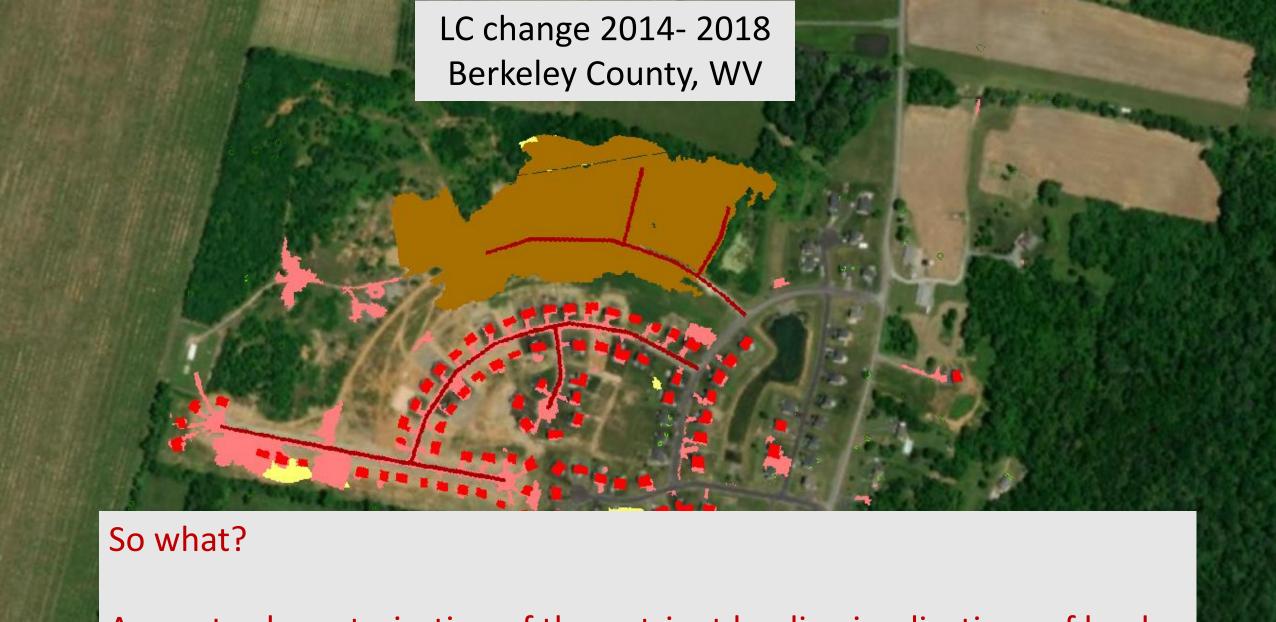Google Earth

2017

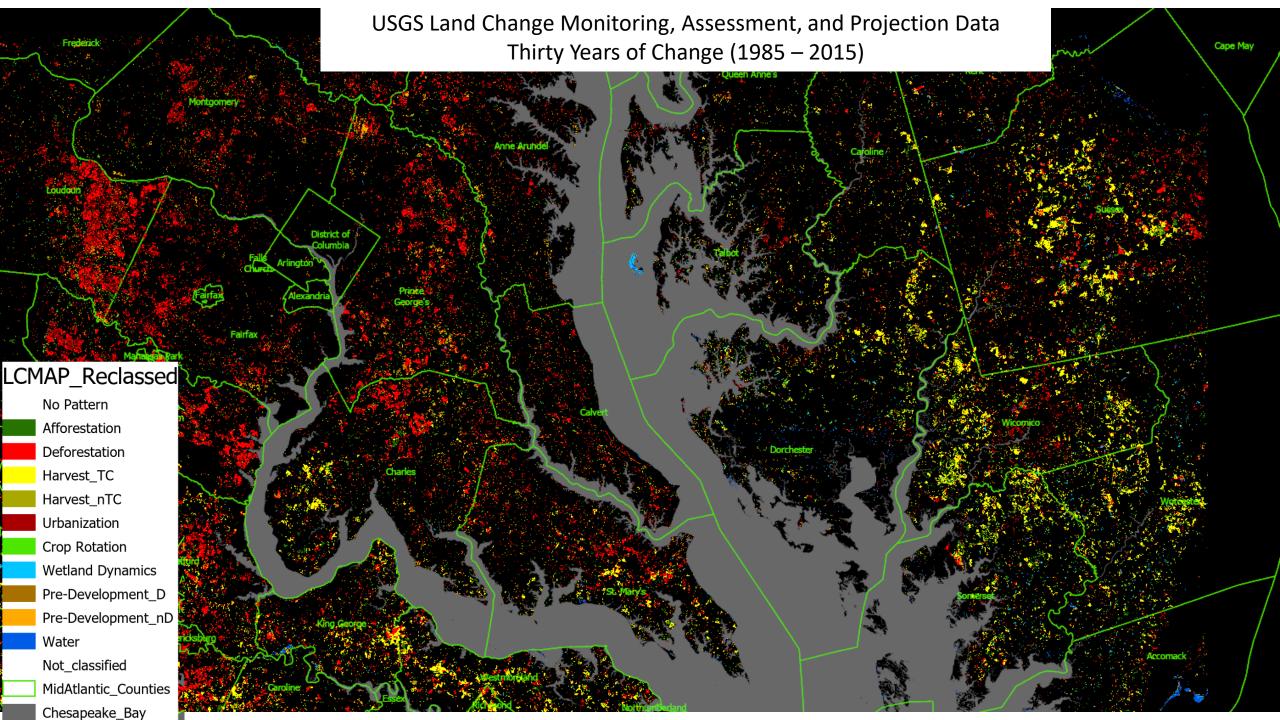Google Earth

LC change 2014- 2018
Berkeley County, WV

So what?
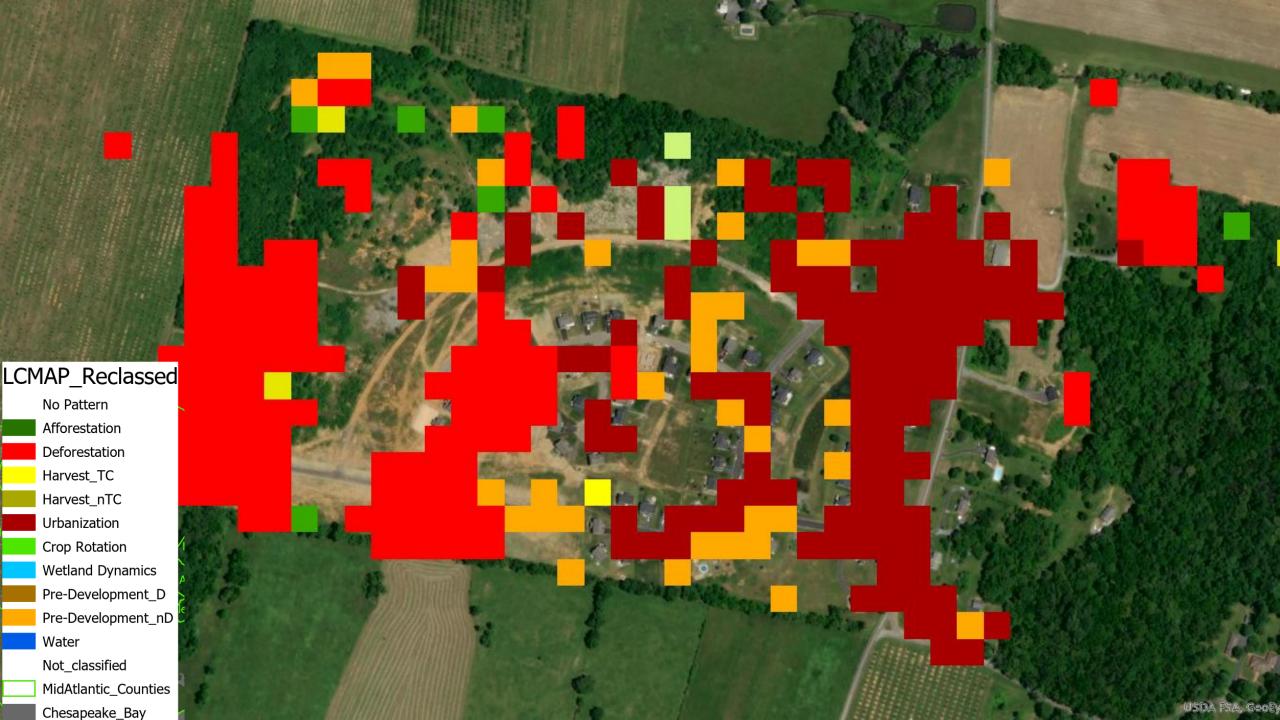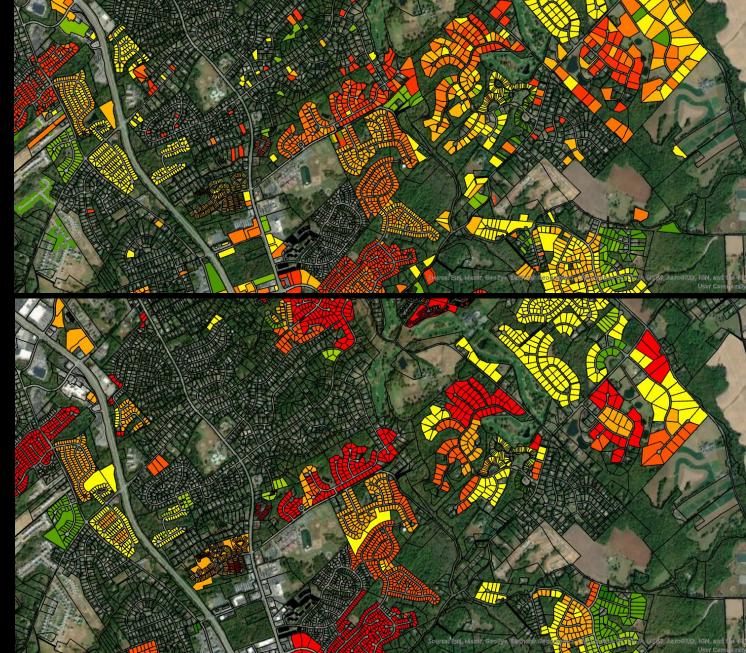
Accurate characterization of the nutrient loading implications of land use change requires understanding land use history: 1980's to present.

USGS Land Change Monitoring, Assessment, and Projection Data
Thirty Years of Change (1985 – 2015)

**LCMAP_Reclassed**

- No Pattern
- Afforestation
- Deforestation
- Harvest_TC
- Harvest_nTC
- Urbanization
- Crop Rotation
- Wetland Dynamics
- Pre-Development_D
- Pre-Development_nD
- Water
- Not_classified
- MidAtlantic_Counties
- Chesapeake_Bay

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**Parcel-Level Assessment of Historical Land Use: 1985 - 2017**

Year-Built Attributes from Tax Records

Year-Built Attributes from USGS' LCMAP

yearblt

- 1985-1989
- 1990-1994
- 1995-1999
- 2000-2004
- 2005-2009
- 2010-2014
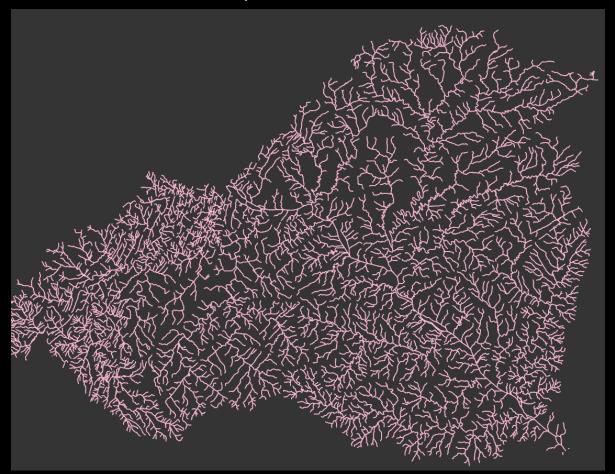- 2015-2017

# Hyper-Resolution Hydrography

1. Lidar elevation
2. Valley-scale geomorphons
3. Channel-scale geomorphons
4. Extract valley network
5. Extract channels using valley network
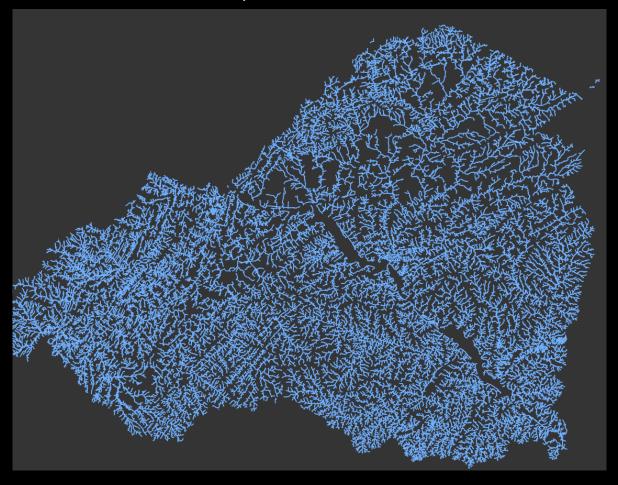6. QAQC channel skeleton
7. Connect stream network

# Alternative Stream Resolutions
## Lower Susquehanna Example
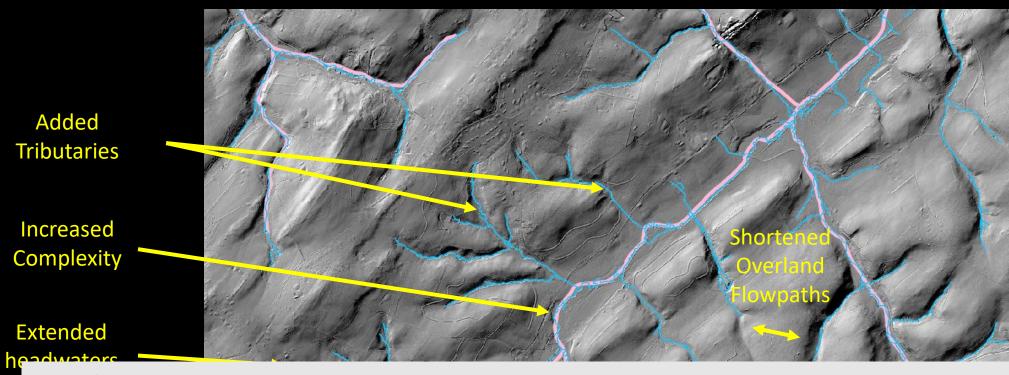
National Hydrography Dataset, 1:24,000
6,923.6 km

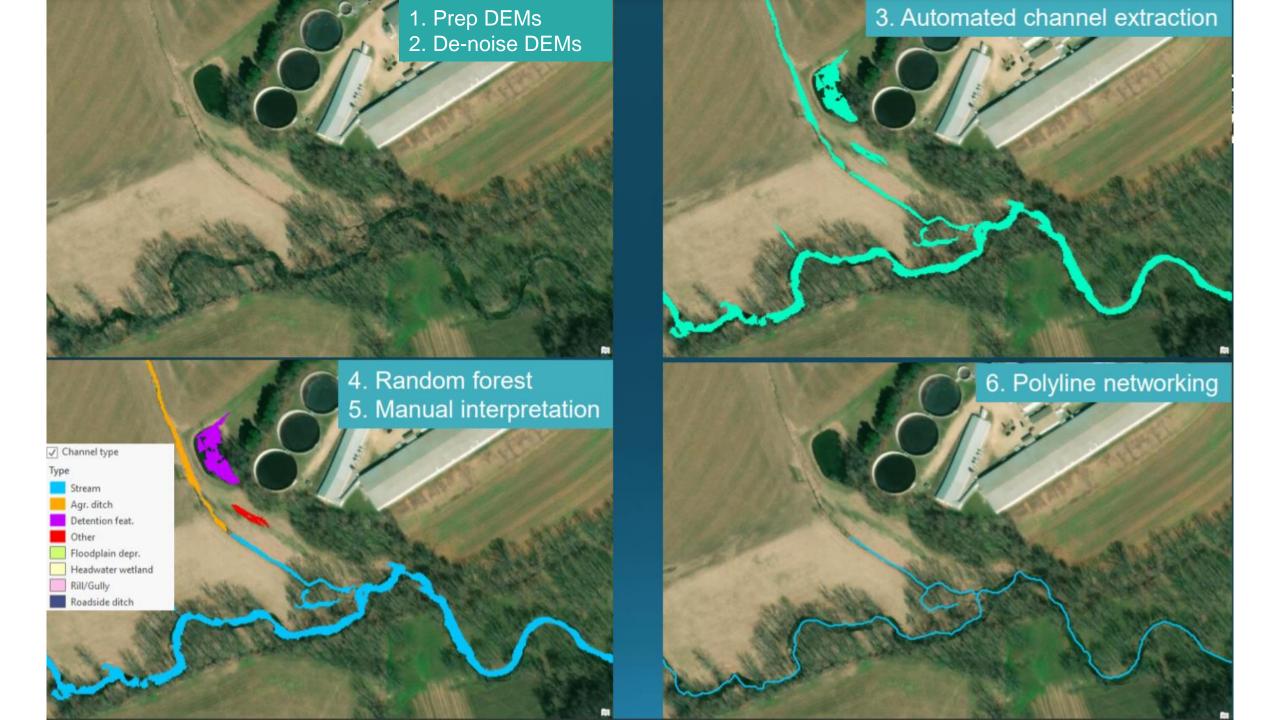CBP Hyper-Resolution Streams, 1:2000
16,784.6 km

# Why the 2x difference in stream length?



Added Tributaries

Increased Complexity

Extended headwaters

Shortened Overland Flowpaths

So what?

- Increased travel time within concentrated flow paths
- Decreased travel time over/through land

What are the nutrient/sediment transport and transformation implications of these data?
Will Phase 7 be sensitive to these changes?

1. Prep DEMs
2. De-noise DEMs

3. Automated channel extraction

4. Random forest
5. Manual interpretation

6. Polyline networking

Channel type

Type
- Stream
- Agr. ditch
- Detention feat.
- Other
- Floodplain depr.
- Headwater wetland
- Rill/Gully
- Roadside ditch

# Floodplain Mapping (FACET)
Patuxent River @ HW 50

**Step 1:** Identify active floodplain extent in field based on topography, vegetation, evidence of recent flooding (e.g. fine sediment deposits, debris deposits aligned perpendicular to the channel), and flood stage magnitudes at nearby stream gages

**Step 2:** Identify HAND threshold aligning with field-measured floodplain extent at each field site

**Step 3:** Predictive linear model related HAND height thresholds to drainage area and physiographic province

science for a changing world