Using Local Land Use/Cover Data to inform the Chesapeake Bay TMDL

Peter Claggett, Renee Thompson, Quentin Stubbs, and Fred Irani

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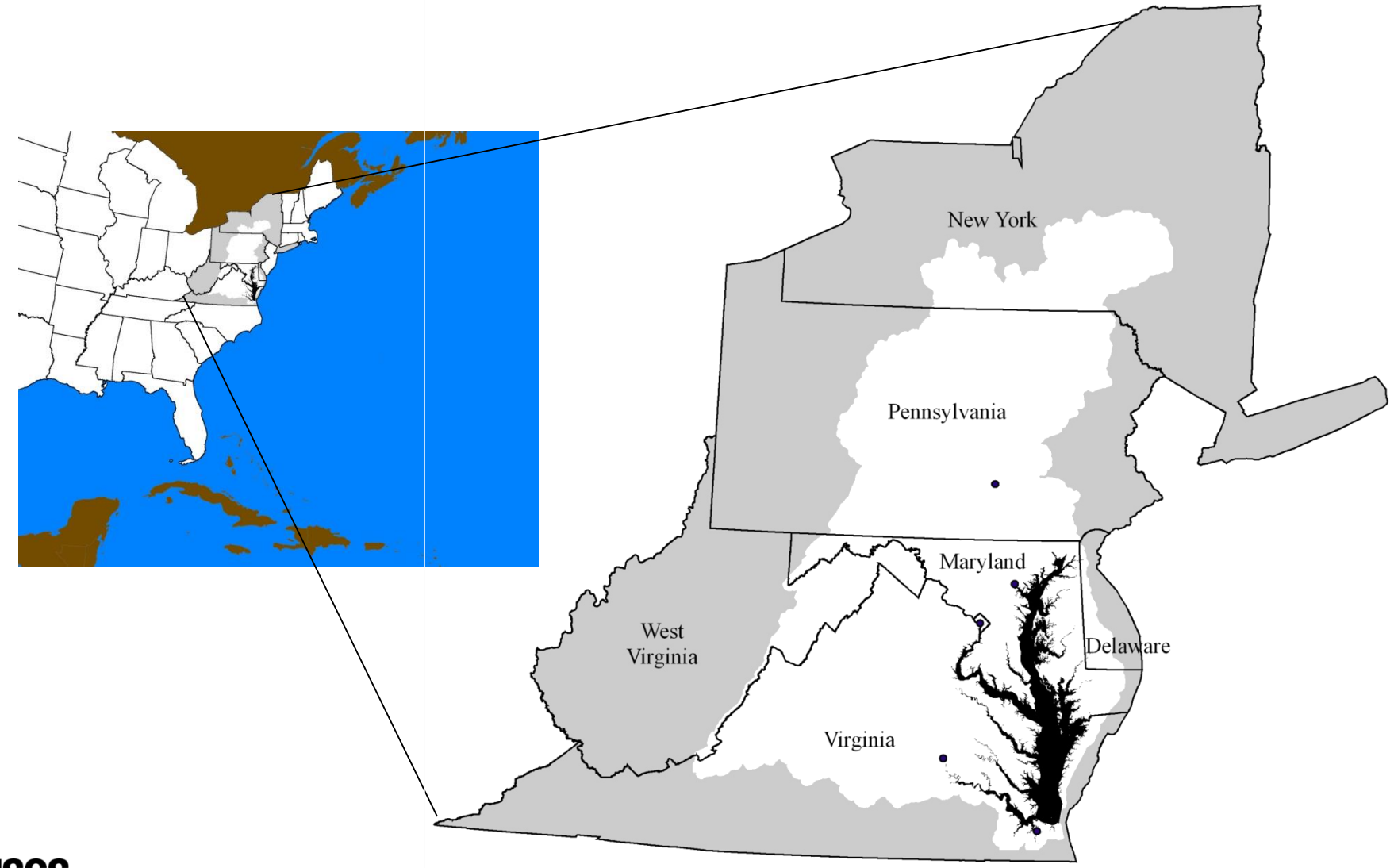
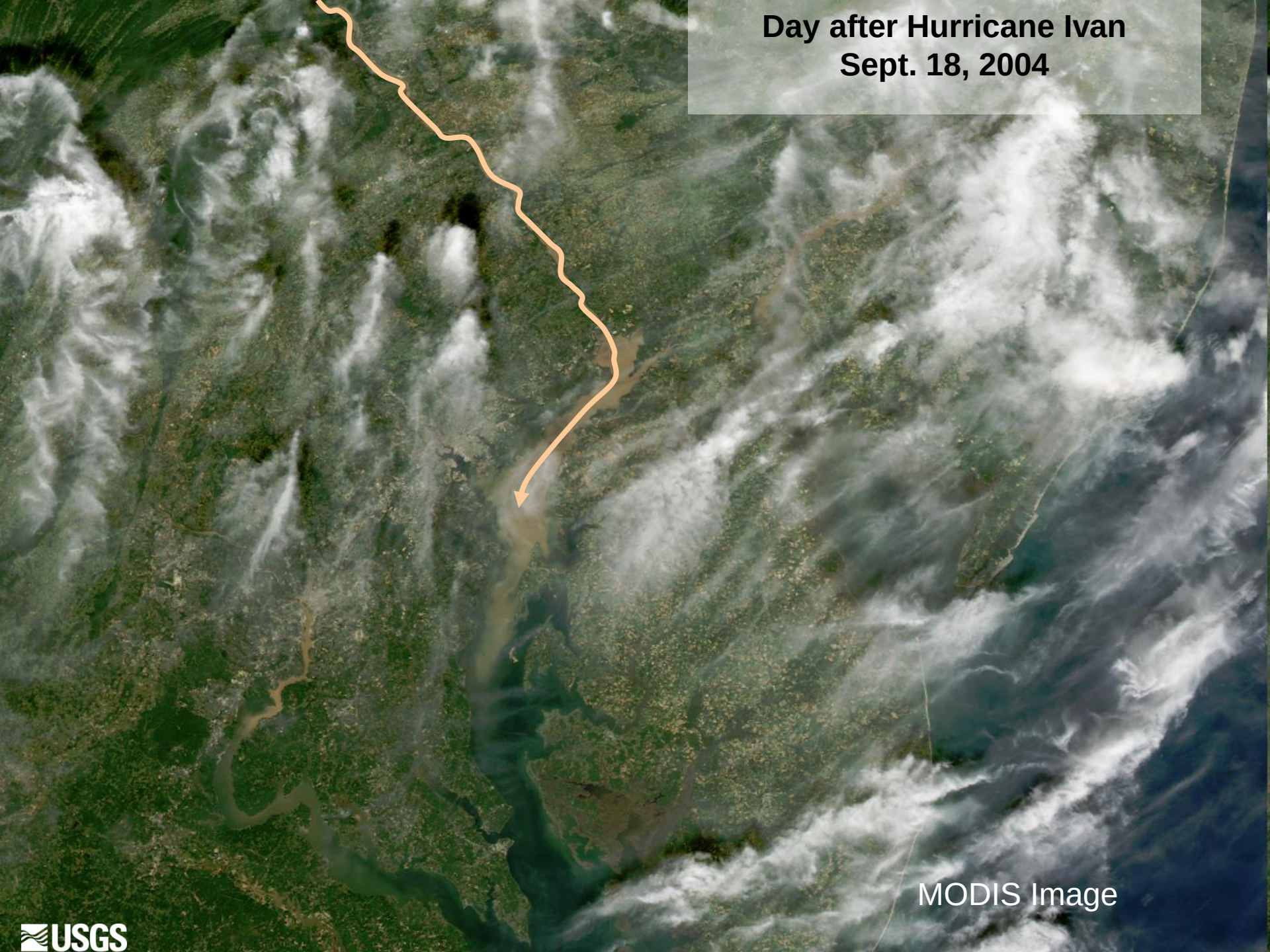
Land Data Team
USGS Chesapeake Bay Program Office

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

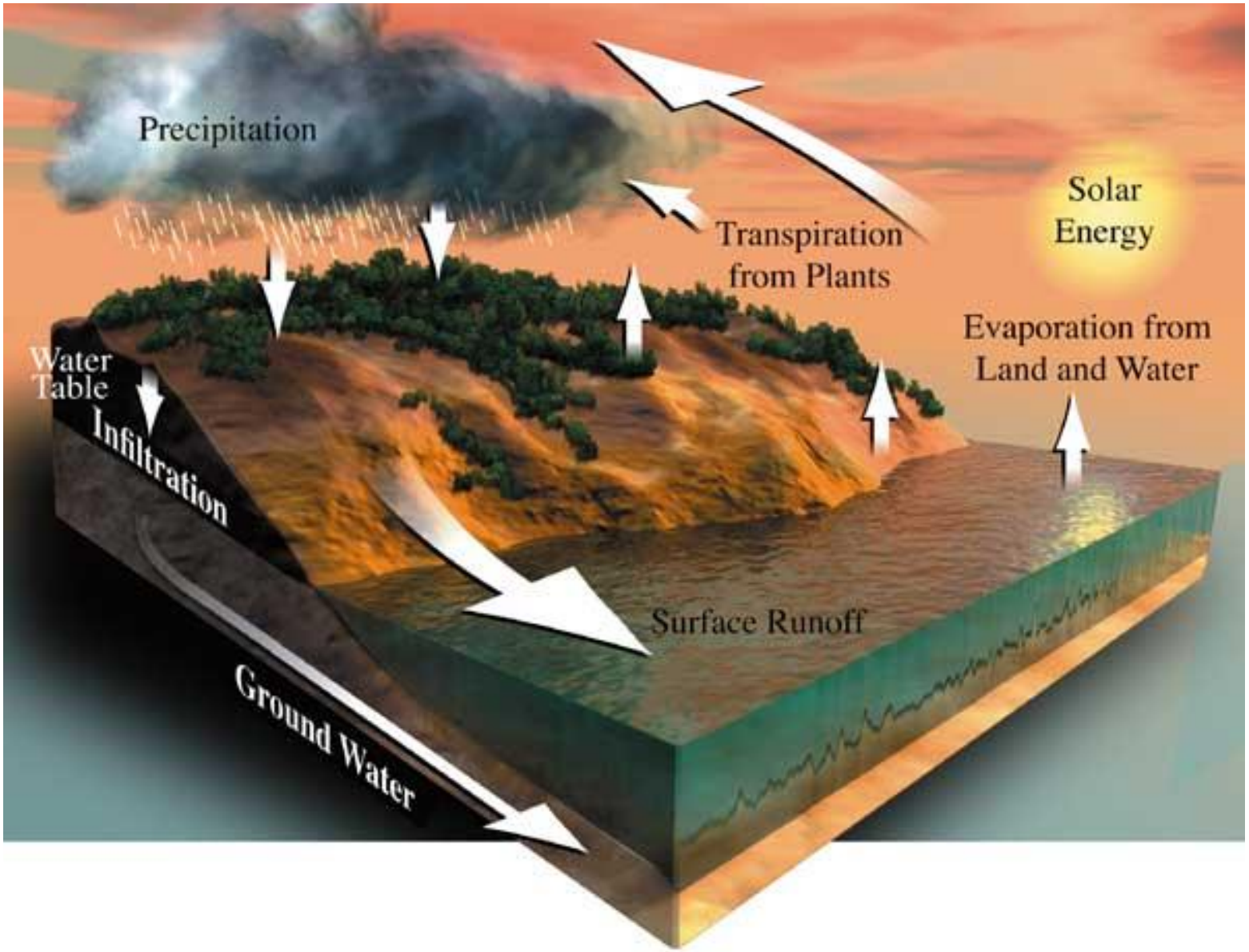
Chesapeake Bay Watershed, U.S.A.



USGS

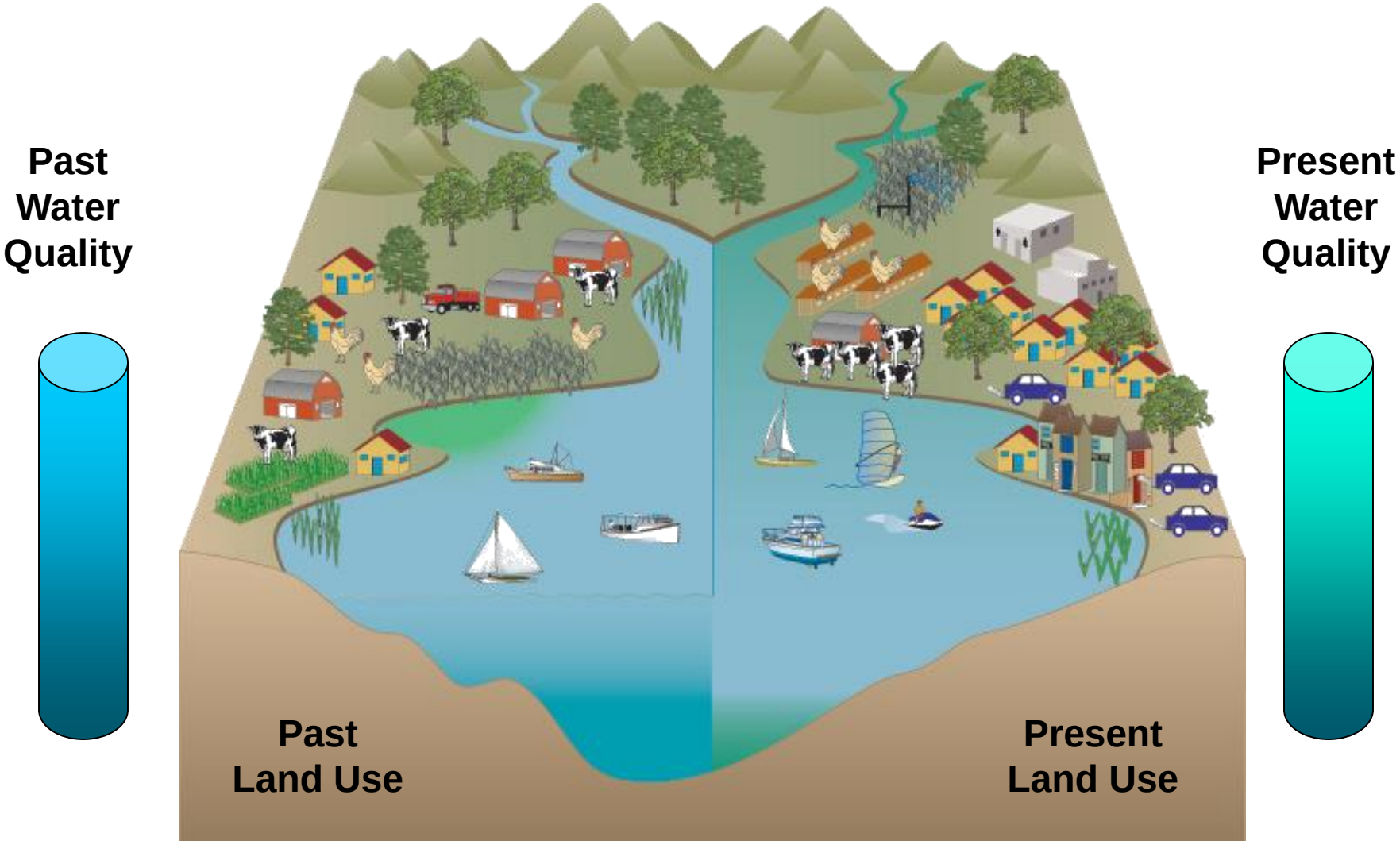

Day after Hurricane Ivan
Sept. 18, 2004
MODIS Image
USGS

Land Cover Changes Impact the Chesapeake Bay



Land Change in the Chesapeake Bay Watershed

- population growth and urbanization
- agricultural intensification and regionalization
- rotational clearing of forests



Chesapeake Bay 2017 Mid-Point Assessment

2010 TMDL

2025 All Practices Implemented

Goal: Determine whether the implementation of the CBP Partnership's restoration strategies by 2025 will achieve water quality standards in the Bay.

Objective: Make this determination based on the best available science data, tools, BMPs, and lessons-learned.

#1 Priority: improve accuracy of land use/cover data.

Best available data = county & municipal level land use, land cover, parcels, sewer service areas, zoning, and other relevant information.

Land Use vs. Land Cover

- Low-density Residential
- Transportation
- Agriculture
- Rural conservation

- Impervious surfaces
- Tree canopy
- Herbaceous
- Barren

Phase 6 Land Uses

- Impervious-Roads
- Forests
- Turf Grass
- Open Space

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P6 Developed Land Uses

Impervious Roads (IR): paved and unpaved roads and bridges.

Impervious Non-Roads (INR): buildings, driveways, sidewalks, parking lots, runways and some private roads.

Construction (CON): reported acreage of land with Erosion & Sediment Control permits.

Extractive (XTR): estimated acreage of disturbed/active, abandoned and reclaimed mines.

Turf Grass (TG): all herbaceous lands within 200m of roads in developed areas that have an average lot size <=5 acres.

P6 Natural Land Uses

Forest (FOR): contiguous patches of trees and shrubs, >= 1 acre, assumed to have an unmanaged understory

Harvested Forest (HAR): state reported annual acres harvested at the county level.

Disturbed Forest (DIS): monitored average annual extent of disturbed forest (via insect, fire damage).

Tree Canopy (TCH, TCIR, TCINR): small fragments of trees or shrubs overhanging herbaceous and impervious surfaces.

P6 Natural Land Uses (continued)

Wetlands (TWET, FWET, HWET): National Wetlands Inventory (NWI) non-pond, non-lake wetlands divided into tidal, floodplain, and headwater subclasses based on NWI attributes and landscape position

Water (WAT): All waterbodies mapped by the National Hydrography Dataset, NWI ponds & lakes, and the National Land Cover Dataset (Open Water). Assumes all single-line streams are 15' wide.

Open Space (OS): non-fertilized herbaceous and non-forest scrub/shrub that is justifiably not turf or extractive (e.g., beaches, vacant lots, transmission line right-of-ways, junkyards, fairgrounds, gravel roads, railroads).

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P6 Agricultural Land Uses

Cropland (CRP): leftover areas of rural herbaceous lands with majority crops according to the Cropland Data Layer 2008 – 2013.

Pasture/Hay (PAS): leftover areas of rural herbaceous lands with majority pasture/hay according to the Cropland Data Layer 2008 – 2013.

Specialty Crops (SPC): leftover areas of rural herbaceous lands with majority specialty crops according to the Cropland Data Layer 2008 – 2013.

Note: that there are a total of 18 different agricultural land use classes but only three types are mapped. The others are derived from information reported in the USDA Census of Agriculture.

Local data for Lancaster County downloaded from PASDA

Shapefile Name	Type	Potential P6 application
LanCo_TrainStations	Point File	
DEMPts	Points	
Railroad	Line	
Buildings2005	Polygon	Impervious Non-Roads
Drives2008	Polygon	Impervious Non-Roads
ParkingLots2008	Polygon	Impervious Non-Roads
RoadEdge2008	Polygon	Impervious Roads
Quarries	Polygon	Extractive
Act319Parcels	Polygon	
LanCo_Easements	Polygon	
LanCo_AgSecurityZones	Polygon	
LanCo_FloodZones	Polygon	
LanCo_LandCover2008	Polygon	
LanCo_Muni	Polygon	
LanCo_ParksAnd_Rec	Polygon	
LanCo_UGS_VGA	Polygon	
LanCo_Zoning	Polygon	
lanpa2008	30m grid	
LanCoZoning	Polygon	
LancasterCountyLulc201403	Polygon	"Developed Area" Mask
Landcover_2010_lanc	1m grid	Impervious Non-Roads (buildings), Forests, Tree Canopy

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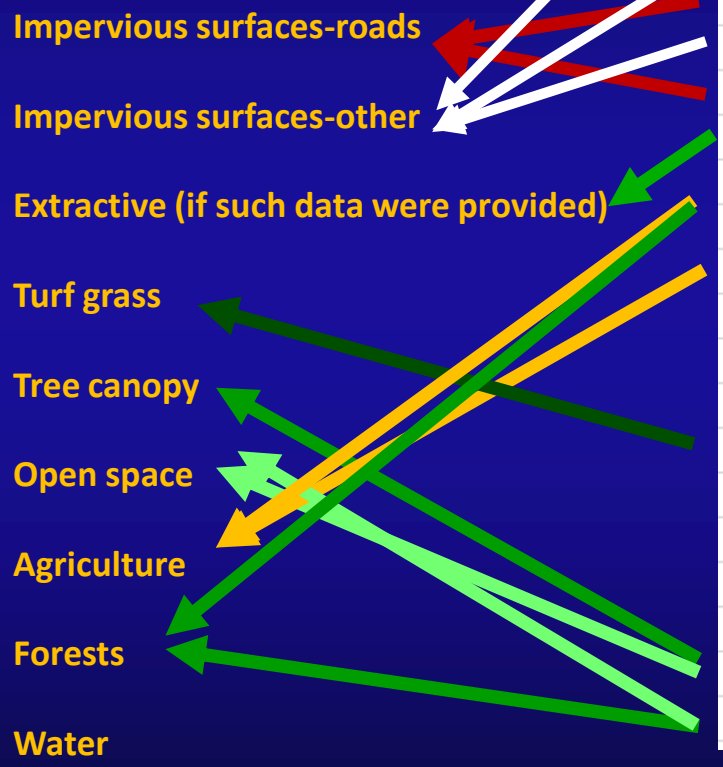
Local Data and Phase 6 crosswalk

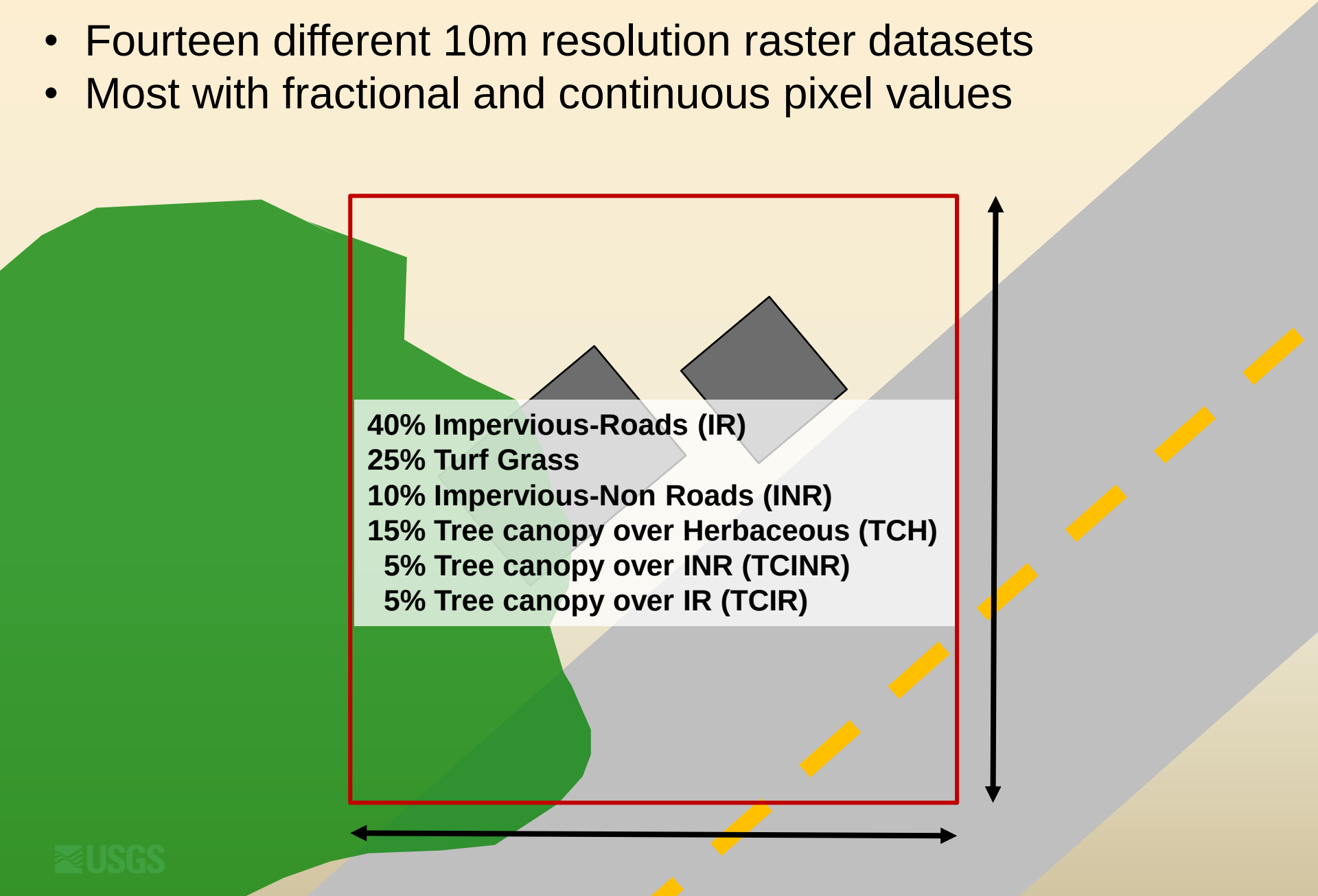


Shapefile Name	Type	Potential P6 application
LanCo_TrainStations	Point File	1.1.2 Buildings, parking lots, etc.
DEMPts	Points	
Railroad	Line	1.1.1 Roads
Buildings2005	Polygon	1.1.2 Buildings, parking lots, etc.
Drives2008	Polygon	1.1.2 Buildings, parking lots, etc.
ParkingLots2008	Polygon	1.1.2 Buildings, parking lots, etc.
RoadEdge2008	Polygon	1.1.1 Roads
Quarries	Polygon	1.4 Extractive
Act319Parcels	Polygon	3.1 Forest OR Ag depending on attribute table
LanCo_Easements	Polygon	
LanCo_AgSecurityZones	Polygon	
LanCo_FloodZones	Polygon	
LanCo_LandCover2008	Polygon	
LanCo_Muni	Polygon	
LanCo_ParksAnd_Rec	Polygon	
LanCo_UGS_VGA	Polygon	
LanCo_Zoning	Polygon	
lanpa2008	30m grid	
LanCoZoning	Polygon	
Lancover_2010Lancaster	1m grid	Direct use along with other data, aggregate to 10m
LancasterCountyLulc201403	Polygon	Develop Urban Footprint

USGS

Phase 6 Land Use Database

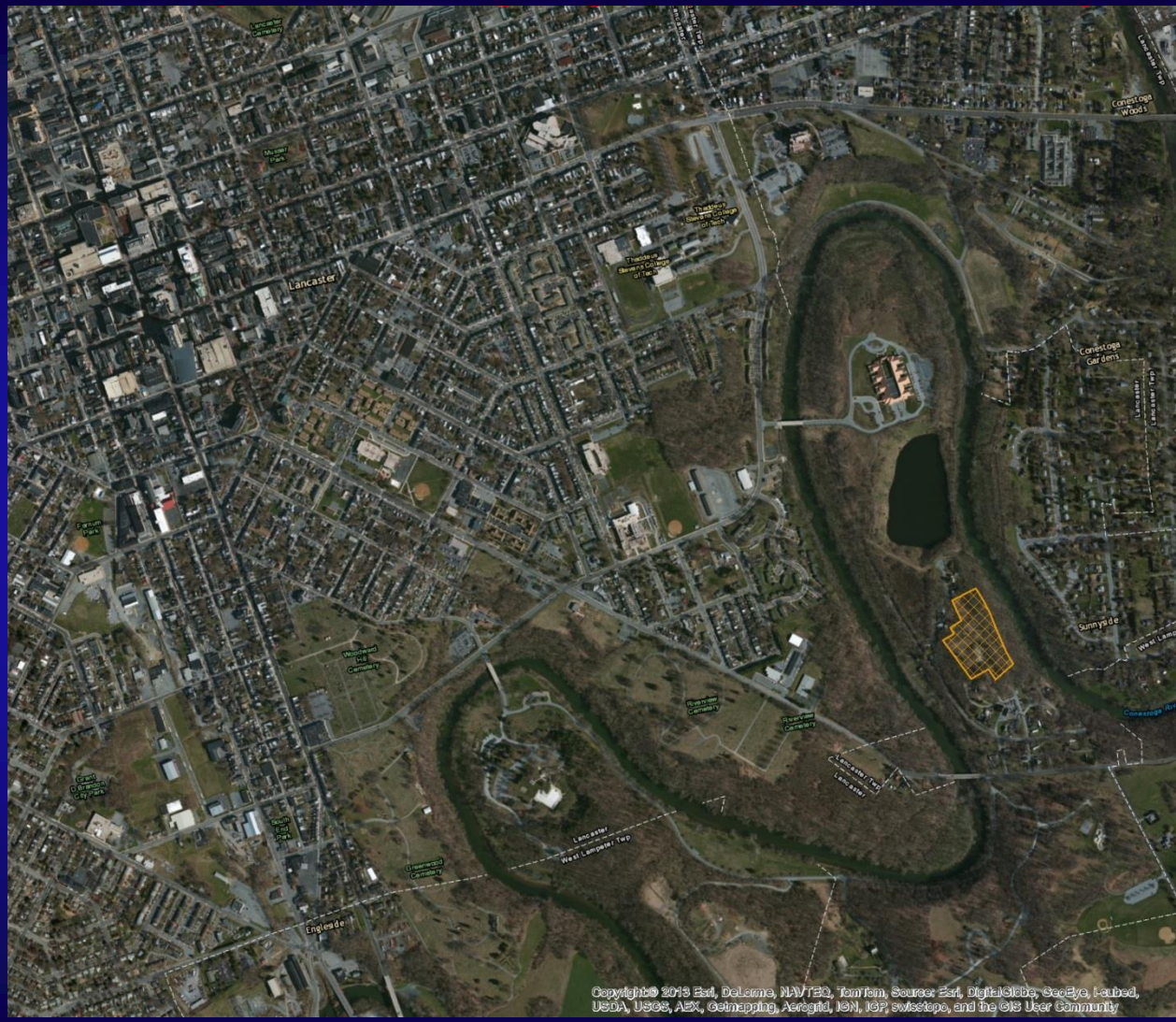
- Fourteen different 10m resolution raster datasets
- Most with fractional and continuous pixel values



Lancaster City (SE)

Local Data

- 1 m Land Cover 2010
- Polygon buildings 2005 (converted to 1m)
- Polygon road edge 2008 (converted to 1m)
- Drives (private drives and driveways) 2008 (converted to 1m)
- Quarries



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Impervious Roads

Local Data

- Polygon road edge 2008 (converted to 1m)
- Aggregated to 10m

= Impervious Roads (IR) Land Use Layer

USGS

Impervious Non-Roads

Local Data

- Drives (private drives and driveways) 2008
- Polygon buildings 2005
- Polygon parking lots
- Land cover “buildings” and “other paved”
- Merged together
- Aggregated to 10m

= Impervious Non-Roads (INR) Land Use Layer

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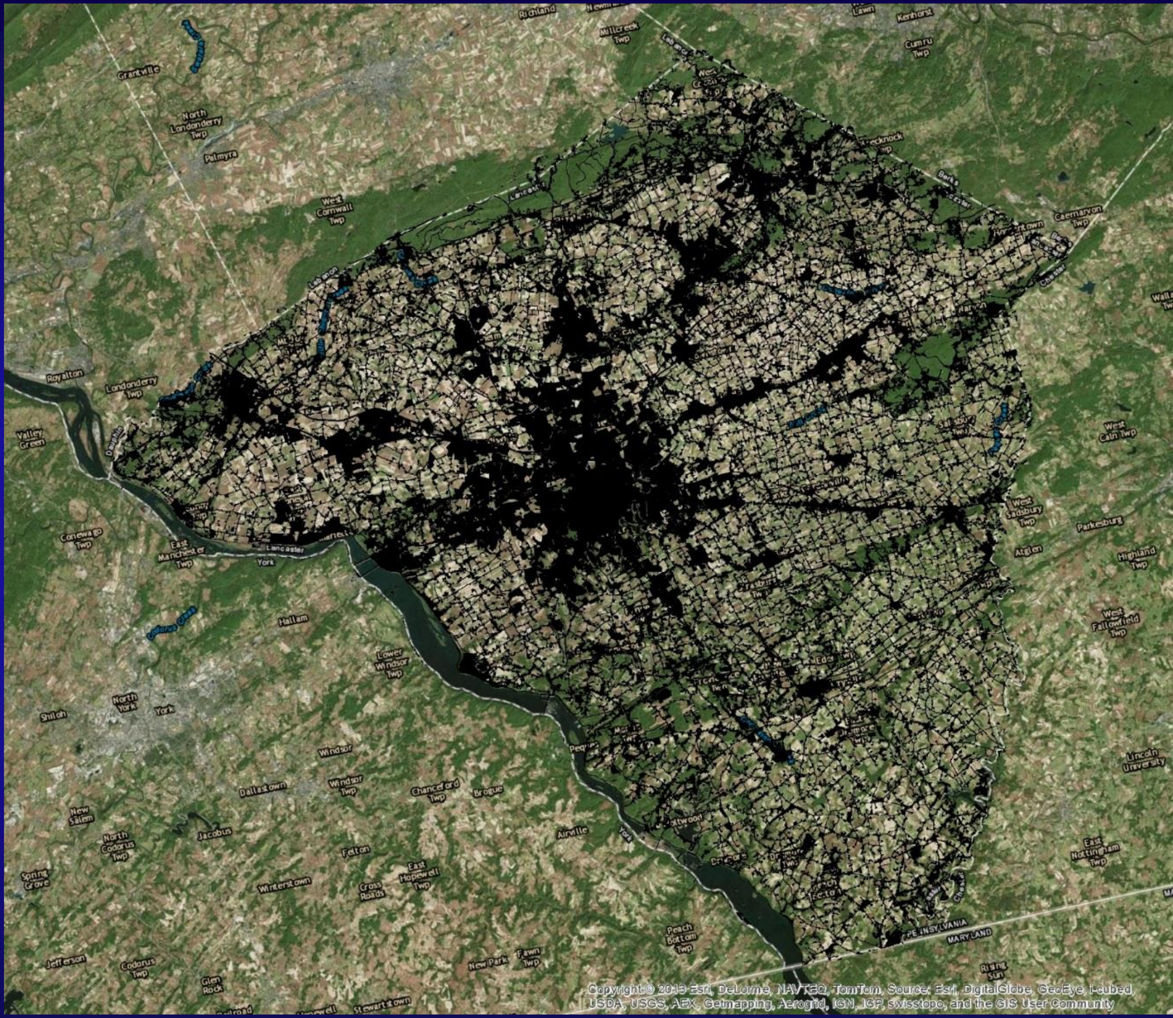
Developed "Mask" or Turf Mask

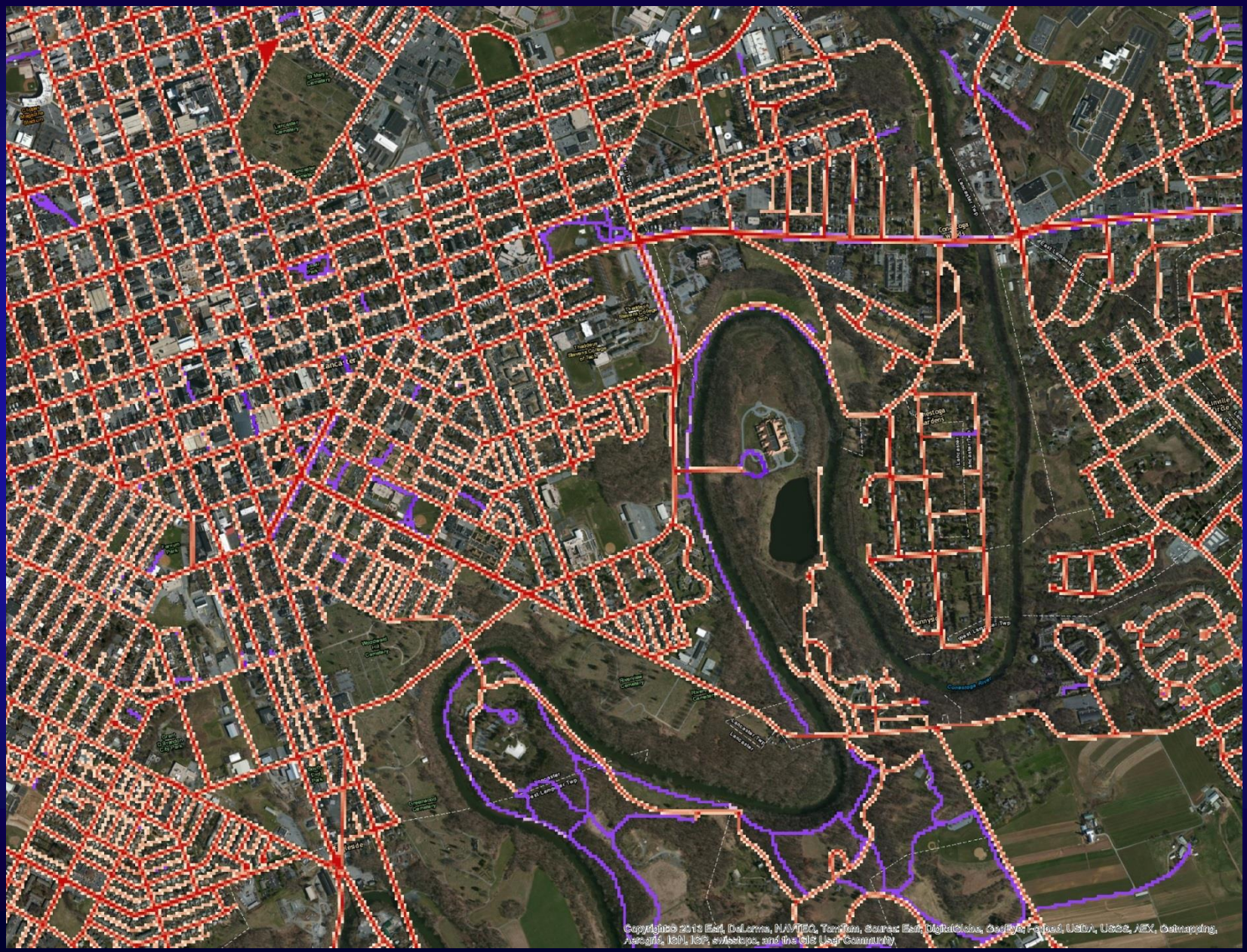


10 m IR and INR layers were combined to create a "impervious_mask"

local land use data and information related to whether the parcel is *residential (including very low density residential), commercial, industrial, institutional, recreational, and urban open space land uses*

= Developed Mask

Local vs. Regional Data: Roads



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Local vs. Regional Data: Impervious Non-Roads

USGS

Local vs. Regional Data: Forest and Tree Canopy

USGS

Local Data Request

- Land use (circa 1985 – 2014) – or zoning
- Land cover
- Parcel (tax) boundaries (ideally attributed with land use)
- Sewer service areas (polygons served by Wastewater Treatment Plants)
- Stormwater regulated areas (Municipal Separate Storm Sewer Systems)
- Protected lands
- Planned or permitted developments
- Planned/permitted roads on new alignment

P6 Land Use Development Schedule

Apr 2015:	Complete regional land use dataset using nationally available data (P6 Land Use Database v1)
May 31, 2015:	Complete integration of local land use data (P6LU_v2)
Jun-Jul 2015	State and local jurisdictions review land use data (six weeks)
Aug 2015	CBPO responds to comments on P6LU_v2 data
Sep 1, 2015	Submit P6LU_v2 to CBP Modeling Team
Sep'15 - May'16:	Incorporate additional local data and high-res land cover into P6 Land Use Database v3.
Jan – Jul 2016:	Rolling jurisdictional review of P6LU_v3 and CBPO response to comments.
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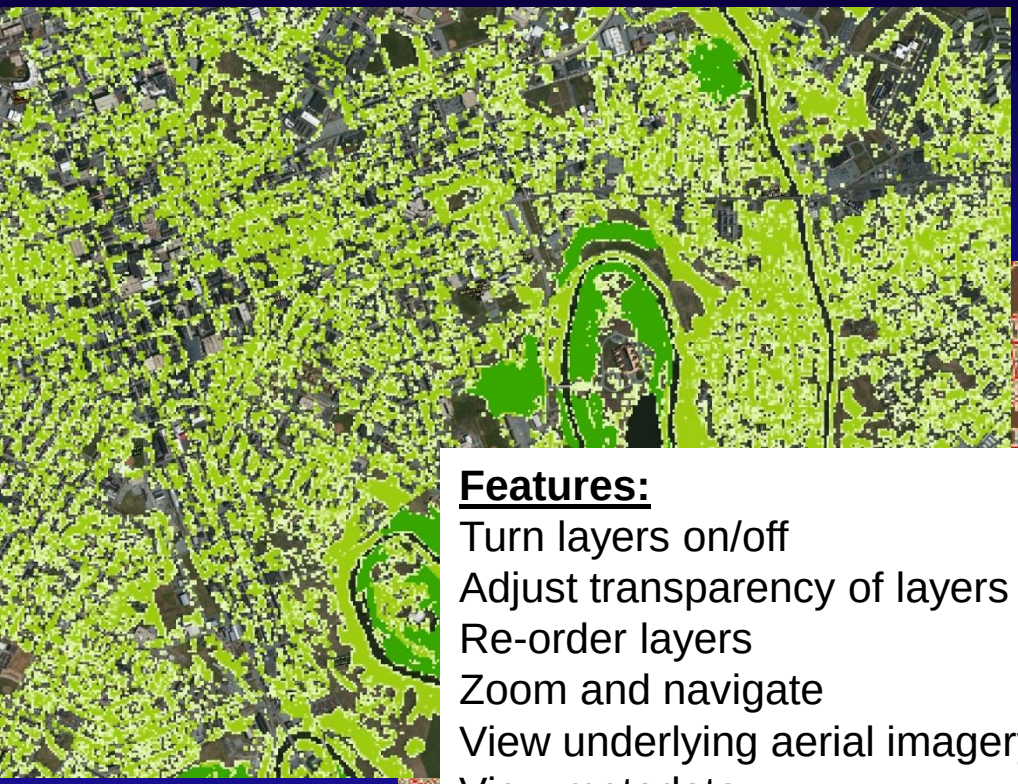
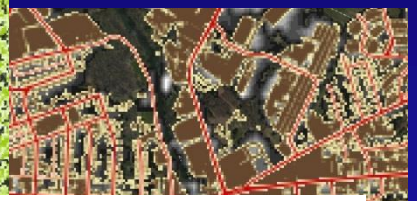
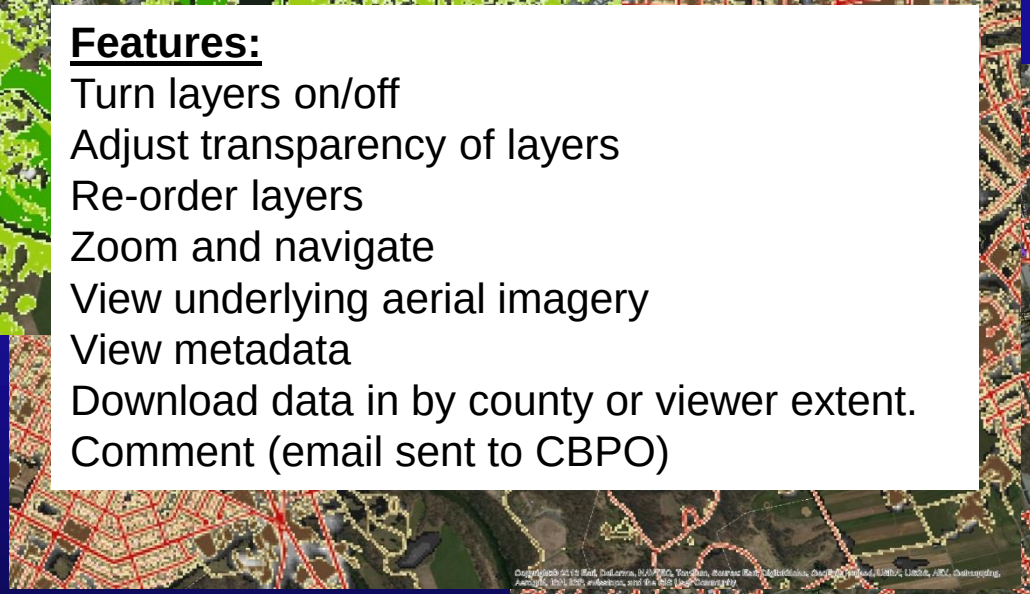
Phase 6 Land Use WebViewer (for jurisdictional review)







Features:

Turn layers on/off
Adjust transparency of layers
Re-order layers
Zoom and navigate
View underlying aerial imagery
View metadata
Download data in by county or viewer extent.
Comment (email sent to CBPO)

USGS

Questions?

Ongoing Questions

- Accounting for roadways (e.g. impervious and gravel/dirt) that sit under tree canopy;
- Variations in types of open space
- Separate loading rates for wetlands
- Metrics to differentiate forest from tree canopy
- Calculating stream width with DEM

Comparison of P6 Local v Regional Land Use Lancaster County, PA

Class	Local	Regional
Impervious Roads:	13,511	15,993
Impervious Non-Roads:	40,167	38,128 (39% inferred)
Tree Canopy over grass:	61,016	34,541
Forests	76,651	119,993

USGS