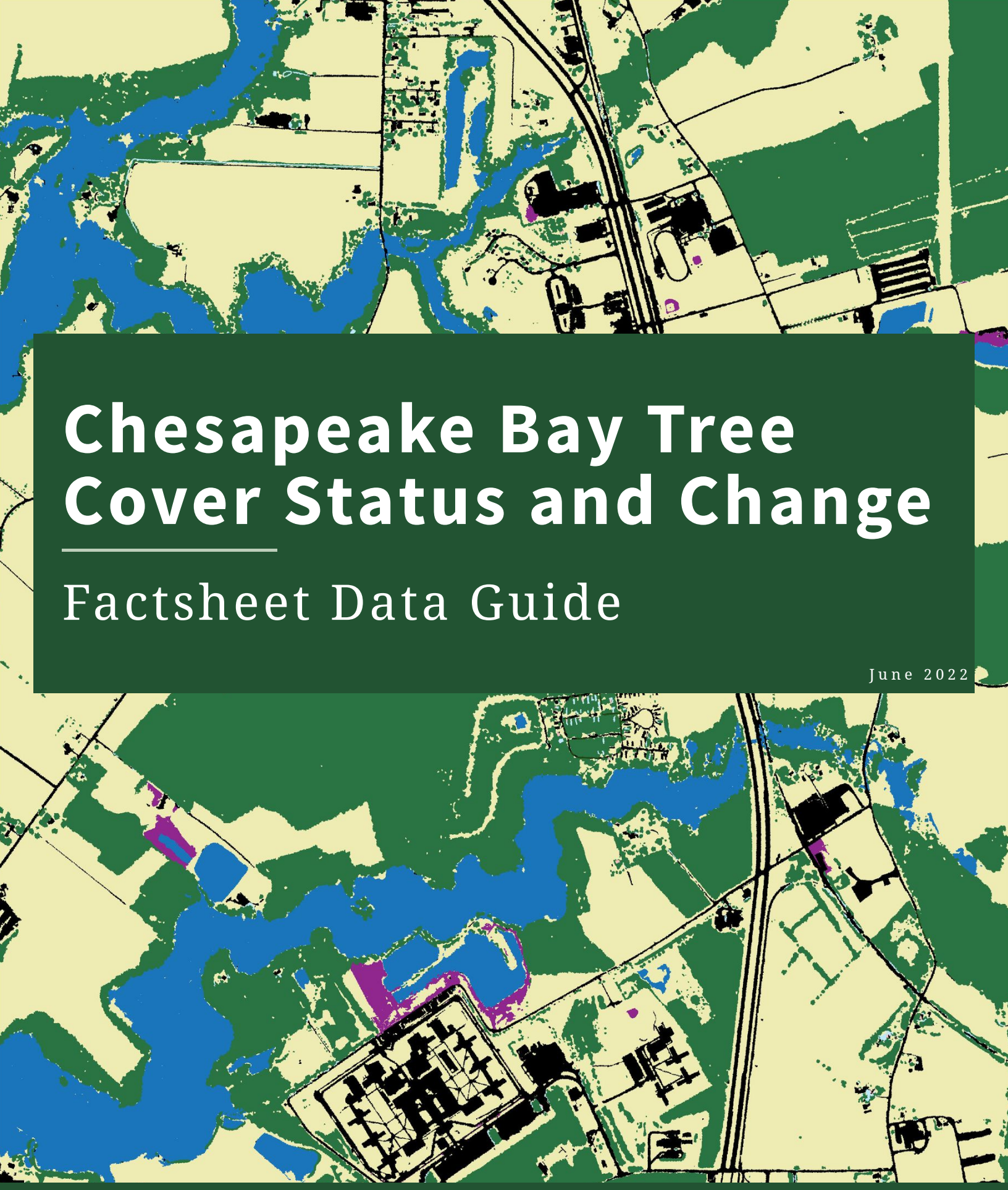


Chesapeake Bay Tree Cover Status and Change

Factsheet Data Guide

June 2022

Why do trees matter?

Trees provide numerous public benefits in the form of ecosystem services. Ecosystem services refer to all the ways we benefit from healthy natural systems such as improving air quality, reducing stormwater runoff, sequestering carbon, regulating temperature, providing wildlife habitat and much more.

Why map tree cover?

It is important to map tree cover to monitor changes over time and detect trends that can inform management decisions. This information can be used to improve access to ecosystem services, decide where new trees should be planted, and ensure healthy tree cover for future generations.

Sections

About the Data

The Chesapeake Conservancy's Conservation Innovation Center, University of Vermont Spatial Analysis Lab, and the U.S. Geological Survey are working together to create very-high resolution land use and land cover (LULC) datasets for the Chesapeake Bay watershed.

These data will be used to describe LULC conditions and change over time. The data are foundational, authoritative, and transformative to the Bay restoration effort. They are foundational because they inform most outcomes in the 2014 Chesapeake Bay Watershed Agreement and will serve as the basis for developing the next generation of watershed models. They are authoritative due to their accuracy and transparency; any person viewing the data can recognize features and areas of interest and compare them to their local knowledge. They are transformative because they will ultimately change the way restoration and conservation actions are implemented, enabling both to be targeted at a fine scale to locations where they will be most effective.

Moreover, establishing accurate trends in impervious cover, forests, and tree canopy will enable the Chesapeake Bay Program Partners to improve the efficiency and effectiveness of stormwater and forest management activities. The data are being developed for the years 2013/2014, 2017/2018, and 2021/2022 and derived from aerial imagery coupled with a variety of ancillary datasets.

See Land Use Classification Methods documentation

Land Cover Change Mapping

Land Cover Mapping Workflow

1 Preliminary Road Mapping

New or modified roads were digitized manually using the 2013/2014 and 2017/2018 National Agricultural Imagery Program (NAIP) Imagery as reference imagery. The digitized layer with new, modified, or removed roads was then used in subsequent modeling routines to guide change detection for the Impervious class.

2 Object Based Image Analysis

Automated feature extraction was performed in eCognition, state-of-the-art software for performing object-based image analysis. This technique groups pixels that form meaningful landscape objects, providing a more realistic, contextual representation of features than by looking at pixels individually.

3 Modeling Scenarios

All mapping was performed at the county/municipality level. The narrow extent was necessary due to the large size of the high-resolution imagery mosaics and varying data availability by region for Light Detection and Ranging (LiDAR), NAIP imagery, and vector GIS datasets. After assessing the availability and quality of the inputs for each county, a specific modeling scenario was identified and coded into an eCognition rule set that executed the complete mapping workflow.

4 Change Detection Classes

To represent change across the analysis period, the original 12-class classification scheme was expanded to include all types of change that were likely to occur in the Chesapeake Bay Watershed. Change types with a low probability of occurrence or classes that could not be mapped effectively with the available data were excluded.

5 Automated Feature Extraction

2013/2014 land cover was revised from the original land cover map in order to avoid false change estimates resulting from differences in techniques between the two studies. After finalizing the revised 2013/2014 map, the LiDAR, imagery, and thematic datasets available for 2017/2018 were used to perform change detection, assigning altered 2013/2014 features to one or more of the change classes to explicitly track individual land-cover conversions.

Data Types

2013/2014 Land Cover

The original 1-meter resolution 2013/2014 land cover was used as a starting point for all subsequent analyses.

NAIP Imagery

National Agriculture Imagery Program (NAIP) imagery acquired by the USDA Farm Services Agency allowed for high resolution land-cover classification.

LiDAR

Where available, LiDAR facilitated mapping and differentiation of tree canopy and buildings.

Thematic GIS Datasets

Thematic GIS datasets developed by individual municipalities, including building footprints, roads, parking lots, sidewalks, and water bodies, informed improvements to the original 2013/2014 land cover and subsequent change analysis to 2017/18. To address the lack of Emergent Wetlands class in the 2013/2014 land cover for Virginia, NOAA's Coastal Change Program (C-CAP) land cover and NOAA's tidal shore elevation data were used as guides for mapping tidally-influenced wetlands.

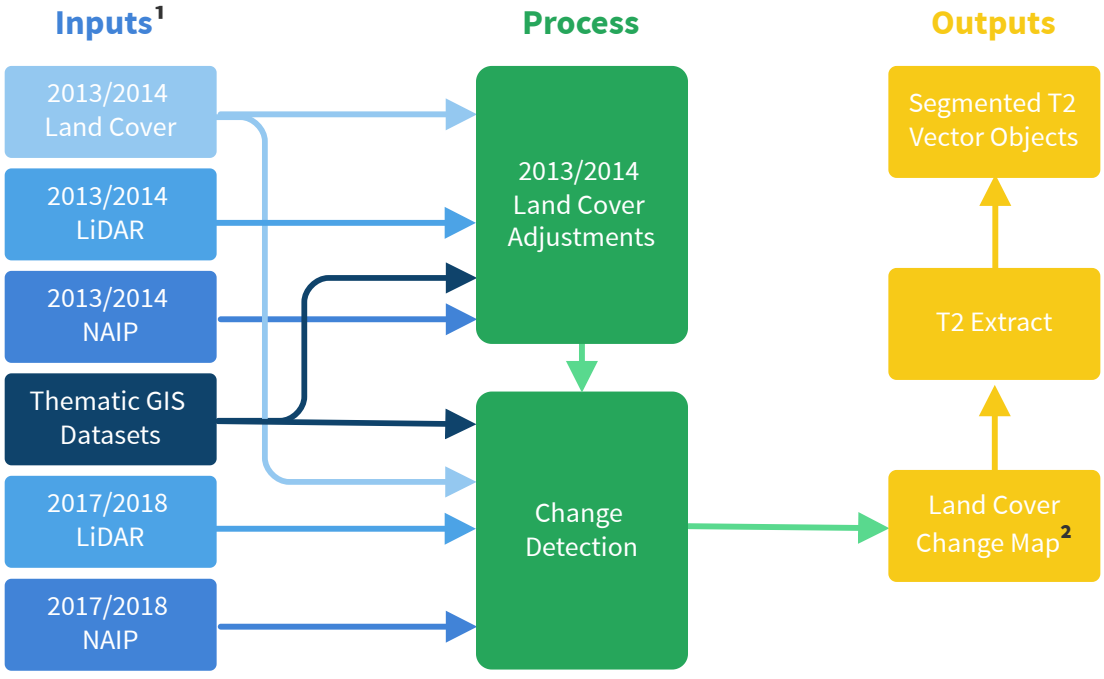
Change Mapping

1 2013/2014 Land Cover Adjustments

The mapping workflow initially focused on improving the 2013/2014 land cover land cover, where necessary, using the available data inputs to add features omitted from parts of the original layer and to remove erroneous ones. This step was important to avoid false change estimates.

2 Change Detection

After finalizing the revised 2013/2014 map, NAIP and LiDAR imagery coupled with thematic datasets available for the 2017/2018 timeframe were used to detect changes in land cover from 2013/2014 to 2017/2018.

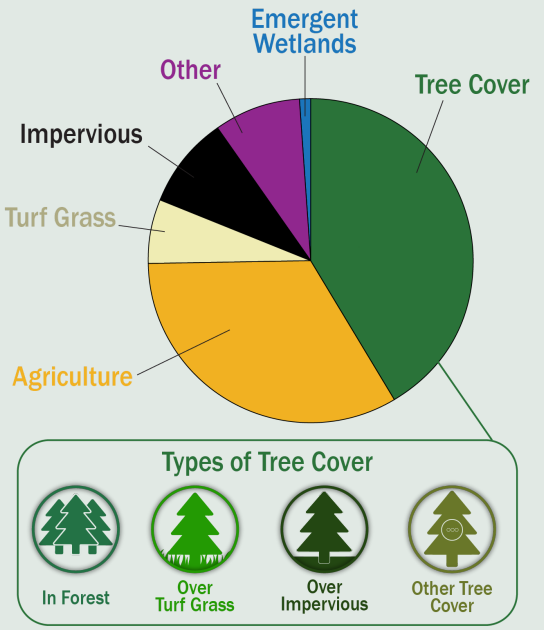


[1] Represents the best possible scenario, actual data inputs varied by county based on availability

[2] Land-cover change detection map can be reclassified to yield T1 and T2 maps

Land Use Classification

The very-high resolution land cover and change data described in Section 2 are combined with ancillary datasets to generate the land use datasets used in Chesapeake Bay Program modeling tools. A team at the Chesapeake Bay Program led by US Geological Survey and the Chesapeake Conservancy, with stakeholder input from many groups including the Chesapeake Land Use Workgroup and Forestry Workgroup, developed a detailed 54 class land use dataset for the watershed.



Class Definitions

The following provides the official definitions for some of the major land use classes that are summarized in the County Tree Cover Status & Change Fact Sheets. Please note that the fact sheet's land use/land cover pie chart is a land-based summary; the area classified as "Water" is intentionally excluded to generate land-based tree cover percentages.

Tree Cover includes

Forest (FORE) = All contiguous patches of trees ≥1 acre in extent with a patch width ≥240-ft somewhere in the patch. The 240-ft girth references potential altered microclimate conditions extending inwards up to 120-ft from the patch edge. The forest understory is assumed to be undisturbed/unmanaged. Forests that are also wetlands are included in this class.

Tree Canopy over Turf Grass (TCTG) = Trees within 30-ft of structures or adjacent turf grass and other impervious in rural wooded areas and within 60-ft of structures or adjacent turf grass and other impervious in more developed areas. The understory in these areas is assumed to be turf grass or otherwise altered through compaction, removal of surface organic material, and/or fertilization.

Tree Canopy over Impervious Surfaces (TCIS) = Tree Cover that overlaps with roads, structures, or other impervious surfaces rendering them partially or completely invisible from above.

Tree Canopy, Other (TCOT) = All trees that do not qualify as "Forest" but are presumed to have an undisturbed/unmanaged understory. Such areas include narrow windbreaks adjacent to cropland and roads and tree canopy patches not qualified as "forest" that are fully surrounded by agriculture. Wetlands with "other tree canopy" are included in this class.

Agriculture includes

Cropland (CROP) = Barren and low vegetation lands on large parcels that are mapped as cropland in the 2018 Cropland Data Layer

Pasture/Hay (PAST) = Barren, low vegetation, and scrub shrub lands on large parcels that are mapped as pasture in the 2019 National Land Cover Dataset or the 2018 Cropland Data Layer

Turf Grass includes

Turf Grass (TURF) = Low vegetation lands that have been altered through compaction, removal of organic material, and/or fertilization. These include Low vegetation lands within small, developed parcels ($\leq$ 1 acre with $\geq$ 93 m^2 of impervious cover), recreational fields, and other turf-dominated land uses (e.g., cemeteries, shopping centers, golf courses, airports, hospitals, amusement parks).

Non-Forested Wetland includes

Tidal Wetlands, Non-forested (TDLW) = All wetlands mapped as estuarine or marine according to National Wetlands Inventory (NWI) plus any adjacent freshwater emergent wetlands, and emergent wetlands mapped from high-resolution imagery outside VA must be within 1-ft of adjacent tidal water elevations derived from NOAA's Sea Level Rise dataset.

Riverine Wetlands, Non-forested (RIVW) = National Wetlands Inventory (NWI) non-pond, non-lake wetlands, emergent wetlands along streams mapped from high-resolution imagery outside Virginia, state designated wetlands, and potential non-tidal wetlands (for Pennsylvania only) located within the FEMA designated 100-year floodplain, DEM-aligned 1:24,000 scale buffered stream network, SSURGO hydric or frequently flooded soils.

Terrene Wetlands, Non-forested (TERW) = National Wetlands Inventory (NWI) non-pond, non-lake wetlands, emergent wetlands mapped from high-resolution imagery outside Virginia, state designated wetlands, and state potential non-tidal, non-floodplain wetlands (for Pennsylvania only). These are spatially isolated wetlands on ridges and slopes that are most prevalent in the coastal plain where streams may originate from wetland complexes.

Impervious includes

Impervious Structures (IMPS) = Human-constructed objects made of impervious materials that are greater than approximately 2 meters in height. Houses, malls, and electrical towers are examples of structures.

Impervious, Other (IMPO) = Human-constructed surfaces through which water cannot penetrate, and that are below approximately 2 meters in height, e.g., sidewalks, parking lots, runways, solar panels, rail lines, and some private roads. Barren, low vegetation, scrub-shrub, and emergent wetland cover types within 3 meters of rail lines were reclassed to impervious surfaces and included in this class.

Other includes

Pervious Developed, Other (PDEV) = Barren lands in developed parcels and barren or low vegetation lands that may represent the early stages of development, utility rights-of-way, portions of road rights-of-way, landfills, and the pervious portions of solar fields adjacent to panel arrays.

Harvested Forest (HARF) = Barren and low vegetation resulting from recently cleared forests and other tree canopy in association with a timber harvest permit (DE, MD, PA, VA, WV) or having a land use history of forest rotation since the mid 1980's. Timber harvest permit data were not reported to the Chesapeake Bay Program by either New York or the District of Columbia.

Natural Succession (NATS) = Barren, herbaceous, or scrub-shrub lands that are not classed as cropland, pasture, turf grass, or pervious developed. These areas are presumed to be undergoing either natural or managed succession and will eventually become forested although this process may take years to complete. Abandoned mine lands are included.

Extractive (EXTR) = Barren lands and impervious surfaces within quarries, surface mines, and other surficial excavation sites.

Estimating the value of ecosystem services with i-Tree

Ecosystem services are often difficult to account for but are important to consider in community planning. This analysis used i-Tree Landscape models which are part of the i-Tree forestry assessment suite of tools developed by the USDA Forest Service and partners. Using the very high-resolution land cover data for 2017/2018, these models helped quantify the monetary value of some of the tangible benefits of tree cover: air pollution removal, stormwater runoff reduced, and carbon sequestered.

i-Tree Outputs

Factors used to estimate pollution removal in terms of g/m2 tree cover include: leaf area index, percent evergreen trees, weather, population, and pollution data for carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter (PM2.5, PM10).

Air Pollution Removal

The estimated value of the air pollution reduction is based on local health impact estimates from the US EPA BenMap model.

Estimates for the volume of stormwater intercepted, transpired, and evaporated are based on total tree cover, height, canopy percentage, crown width, leaf area indices and local weather data.

Reduced Runoff

The value of avoided runoff is estimated using the i-Tree Eco model which uses the US national average dollar value of $0.008936/gallon based on studies of stormwater control and treatment costs.

Carbon storage and sequestration values are calculated separately for forested and non-forested land cover classes. Carbon sequestration for trees in non-forest areas is estimated using values from urban forests (Nowak et al. 2013)

Carbon Sequestration

The value of carbon sequestration for forested regions is estimated at $188 per metric ton based on the social cost of carbon (Interagency Working Group, 2016)

Additional Resources

Chesapeake Land Use/Land Cover Datasets and Tools

Links to all of these resources and the full set of county fact sheets (and municipal, when available) can be found on the Chesapeake Tree Canopy Network Understand Your Canopy Page.

GIS Datasets

The local Tree Cover Status & Change Fact Sheets are just a starting point for understanding what is happening with tree canopy at the community scale. We encourage those with GIS expertise to download and utilize the actual Land Use and Change datasets as a foundation for further analysis of planting opportunities and information on gains and losses. The land use data can be overlaid with parcel data and local land use/zoning data to identify areas of existing and potential tree canopy on different types of **private lands** (low/medium/high density residential, commercial, industrial, etc.) and **public lands** (street tree/rights-of way, parks, schools, Homeowner Association common spaces, etc.). Further prioritization of areas to conserve or expand tree canopy can be achieved by overlaying available data layers related to social, economic or environmental priorities (see equity tools on next page).

For a local example of using similar data to assess and communicate tree canopy changes over time, see the District of Columbia Tree Canopy Change Story Map (2006-2020).

Land Use Change Matrices

For each county that is in or adjacent to the Chesapeake Bay watershed, a Land Use Change matrix is available showing acres of change between each combination of land uses in 2013/2014 and 2017/2018. Although it takes some time to familiarize yourself with the land use codes and matrix format, the product condenses a rich amount of land use change information in one table.

See here for details on interpreting Land Use Change Matrices

Map Viewers

[Insert Map viewer screen shot here when available]

For those who want to simply view and explore the data online, map viewers are available for the 2017/2018 land use data, as well as the land use change data (2013/2014 – 2017/2018) on the Chesapeake Conservancy website. [add link when available]

Equity Mapping Tools

There are a number of mapping tools available for exploring demographic information and environmental justice data layers. The following tools are a good starting point.

- Tree Equity Score
- Climate and Economic Justice Screening Tool (beta version)
- EPA's Environmental Justice Screening & Mapping Tool (EJ Screen)
- Chesapeake Bay Environmental Justice & Equity Dashboard

Other Resources

Local Government Curriculum

Capitalizing on the Benefits of Trees (link under development)

State Tree Resource Guides

Funding

Financing Urban Tree Canopy Programs (Guidebook for Local Governments in the Chesapeake Bay Watershed); available on our Funding Page

Schools

Trees and Schools: Growing the Connection (A Resource Guide for Chesapeake Communities); available with other resources on our Schools Page

Policy

Making Your Community Forest-Friendly: A Worksheet for Review of Municipal Codes and Ordinances

Public Health

HealthyTrees Healthy Lives Website

Case Studies

Vibrant Cities Lab (National Urban Forestry Hub)

Our Community Spotlight Page

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