Land Use/Land Cover at the Chesapeake Bay Program

Sarah McDonald (she/her)

U.S. Geological Survey, Lower Mississippi-Gulf WSC (USGS-LMG), Chesapeake Bay Program Office (CBPO)

STAR Meeting
June 29, 2023

Chesapeake Bay 1-Meter Land Data Products

1. Land Cover (12-classes): 2013/14, 2017/18
2. Land Use (54-classes): 2013/14, 2017/18

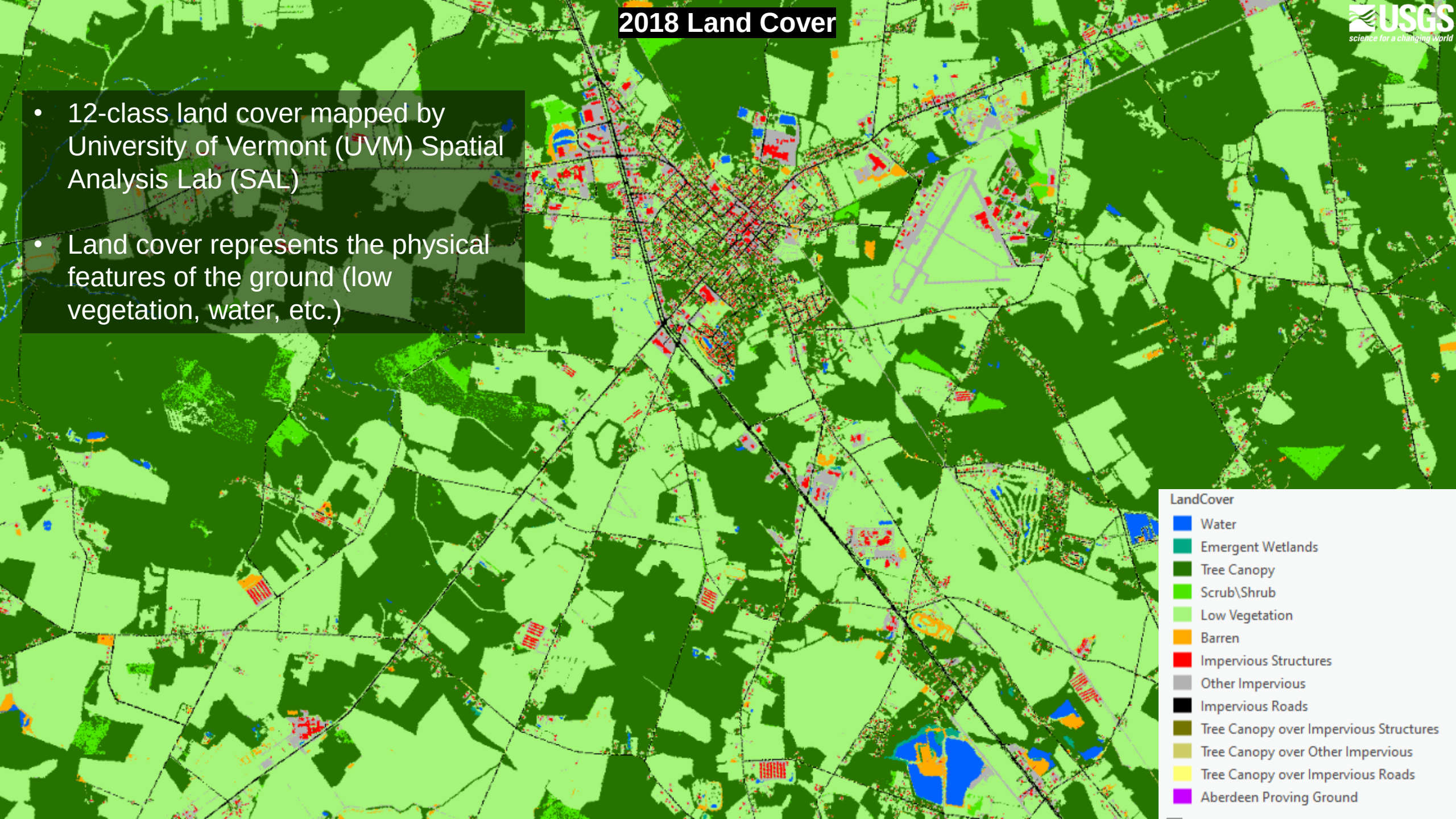
- In June 2022, Land Use (2017/18) and Land Use Change (2013/14-2017/18) was released for the 206-county region within, intersecting, and adjacent to the watershed.
  - Available at the state scale on ScienceBase: https://doi.org/10.5066/P981GV1L
  - Available at the county scale on Chesapeake Conservancy website: https://www.chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/lulc-data-project-2022/

- In 2024, 2021/22 Land Use will be released with retrospectively updated 2017/18 and 2013/14 and change.


2018 National Agriculture Imagery Program (NAIP)
USGS
science for a changing world

2018 Land Cover

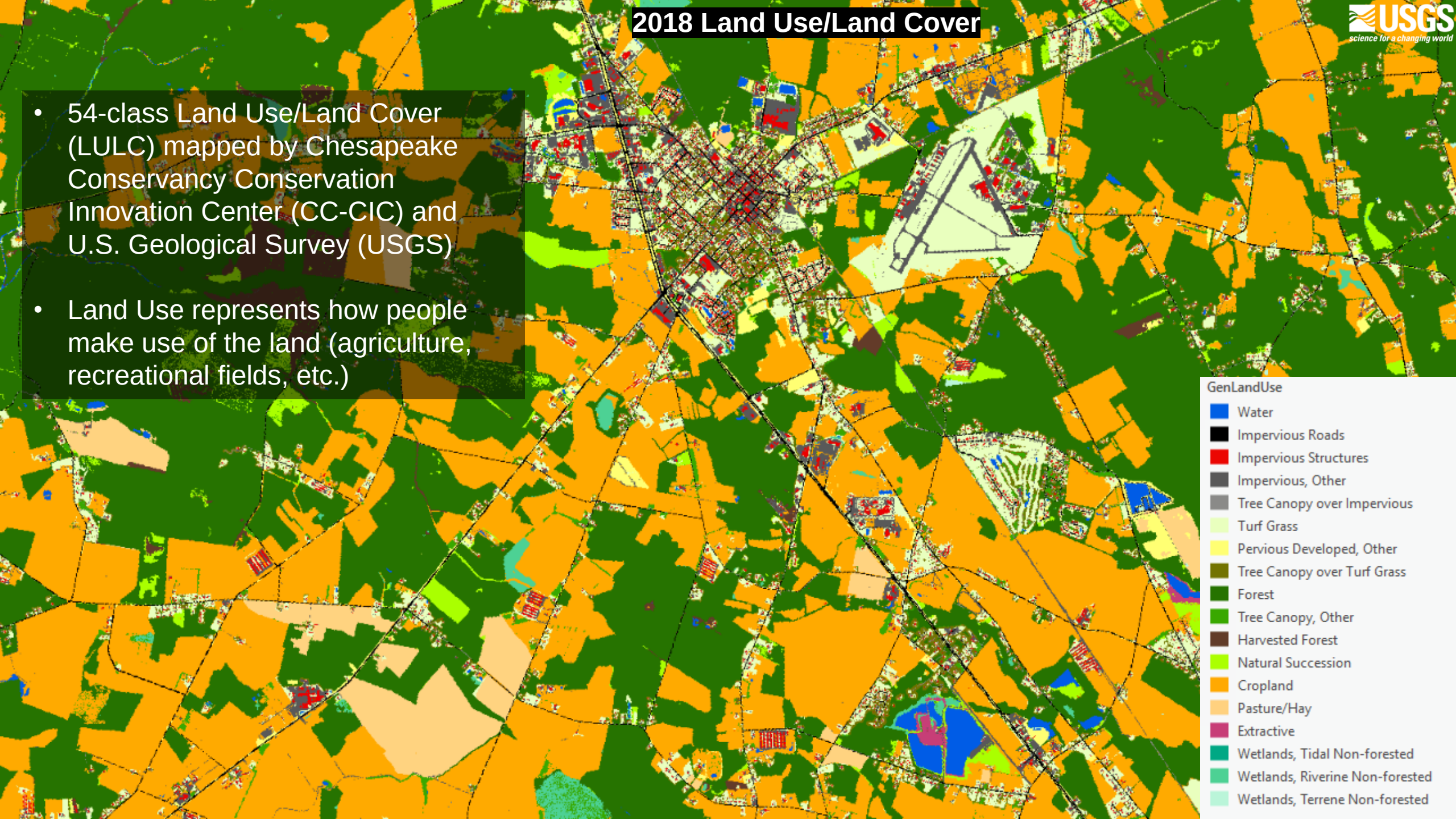
- 12-class land cover mapped by University of Vermont (UVM) Spatial Analysis Lab (SAL)
- Land cover represents the physical features of the ground (low vegetation, water, etc.)



2018 Land Use/Land Cover

- 54-class Land Use/Land Cover (LULC) mapped by Chesapeake Conservancy Conservation Innovation Center (CC-CIC) and U.S. Geological Survey (USGS)

- Land Use represents how people make use of the land (agriculture, recreational fields, etc.)



CBP Land Use/Cover Classification (54 classes mapped in 2022 Ed., 64 planned for 2024 Ed.)

1. Water (11)

- 1.1 Estuarine / Marine
- 1.2 Lentic (fresh)
  - 1.2.1. Lakes and reservoirs
  - 1.2.2 Riverine ponds
  - 1.2.3 Terrene ponds
- 1.3 Lotic (fresh)
  - 1.3.1 Channels

2. Developed (12)

- 2.1 Impervious
  - 2.1.1 Roads
  - 2.1.2 Structures
  - 2.1.3 Other Impervious
  - 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 Transitional- barren
  - 2.2.3 Suspended Succession
    - 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. Forested (7)

- 3.1 Forest (>= 1 acre, 240-ft width)
- 3.2 Other Tree Canopy
- 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 (17)

- 4.1 Agriculture
  - 4.1.1 Cropland
    - 4.1.1.1 Barren
    - 4.1.1.2 Herbaceous
  - 4.1.2 Pasture/Hay
    - 4.1.2.1 Barren
    - 4.1.2.2 Herbaceous
    - 4.1.2.3 Scrub-shrub
  - 4.1.3 Orchard/vineyard
    - 4.1.3.1 Barren
    - 4.1.3.2 Herbaceous
    - 4.1.3.3 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 (16)

- 5.1 Tidal
  - 5.1.1 Barren
  - 5.1.2 Herbaceous
  - 5.1.3 Scrub-shrub
  - 5.1.4 Other Tree Canopy
  - 5.1.5 Forest
- 5.2 Riverine (Non-tidal)
  - 5.2.1. Barren
  - 5.2.2 Herbaceous
  - 5.2.3 Scrub-shrub
  - 5.2.4 Other Tree Canopy
  - 5.2.5 Forest
- 5.3 Terrene/Isolated (Non-tidal)
  - 5.3.1 Barren
  - 5.3.2 Herbaceous
  - 5.3.3 Scrub-shrub
  - 5.3.4 Other Tree Canopy
  - 5.3.5 Forest
- 5.4 Bare shore

CBP Land Use/Cover General 18-Class Classification

1. Impervious, Roads
- 2.1 Impervious
  - 2.1.1 Roads

2. Impervious, Structures
- 2.1 Impervious
  - 2.1.2 Structures

3. Impervious, Other
- 2.1 Impervious
  - 2.1.3 Other Impervious
- 4.2 Solar fields
  - 4.2.1 Impervious

4. Tree Canopy Over Impervious
- 2.1 Impervious
  - 2.1.4 Tree Canopy over Impervious

5. Turf Grass
- 2.2 Pervious, Developed
  - 2.2.1 Turf Grass

6. Tree Canopy over Turf Grass
- 2.2 Pervious. Developed
  - 2.2.4 Tree Canopy over Turf Grass

7. Pervious Developed, Other
- 2.2 Pervious. Developed
  - 2.2.2 Transitional- barren
  - 2.2.3 Suspended Succession
- 4.2 Solar fields
  - 4.2.2 Pervious

8. Forest (all)
- 3.1 Forest (non-wetland)
- 5.1 Tidal
  - 5.1.5 Forest (>= 1 acre, 240-ft width)
- 5.2 Riverine (Non-tidal)
  - 5.2.5 Forest (>= 1 acre, 240-ft width)
- 5.3 Terrene/Isolated (Non-tidal)
  - 5.3.5 Forest (>= 1 acre, 240-ft width)

9. Tree Canopy, Other
- 3.2 Other Tree Canopy
- 5.1 Tidal
  - 5.1.4 Other Tree Canopy
- 5.2 Riverine (Non-tidal)
  - 5.2.4 Other Tree Canopy
- 5.3 Terrene/Isolated (Non-tidal)
  - 5.3.4 Other Tree Canopy

10. Harvested Forest
- 3.3 Harvested Forest (<= 3 years)

11. Natural Succession
- 3.4 Natural Succession (> 3 years)
- 5.4 Bare shore, Water Margins

12. Wetlands, Tidal non-forested
- 5.1 Tidal Wetlands
- 5.1.1 Barren
- 5.1.2 Herbaceous
- 5.1.3 Scrub-shrub

13. Wetlands, Riverine Non-forested
- 5.2 Riverine Wetlands (Non-tidal)
- 5.1.1 Barren
- 5.1.2 Herbaceous
- 5.1.3 Scrub-shrub

14. Wetlands, Terrene Non-forested
- 5.3 Terrene/Isolated Wetlands (Non-tidal)
- 5.1.1 Barren
- 5.1.2 Herbaceous
- 5.1.3 Scrub-shrub

15. Extractive
- 4.3 Extractive (active mines)
  - 4.3.1 Barren
  - 4.3.2 Impervious

16. Cropland
- 4.1 Agriculture
  - 4.1.1 Cropland
  - 4.1.3 Orchard/vineyard

17. Pasture/Hay
- 4.1 Agriculture
  - 4.1.2 Pasture/Hay

18. Water
- 1.1 Estuarine/ Marine
- 1.2 Lentic
- 1.3 Lotic

USGS science for a changing world

Land Use/Land Cover Change: Frederick, Maryland

2013 NAIP

2018 NAIP

Land Use/Land Cover Change: Frederick, Maryland

USGS science for a changing world

Land Cover Change

Land Use Change

Land Use/Land Cover Change: Frederick, Maryland

Land Cover Change

Land Cover no change (low vegetation)

Land Use Change

Cropland to Turf Grass

2013/14-2017/18	ROAD	IMPS	IMPO	TCIS	TURF	TCTG	PDEV	FORE	TCOT	HARF	NATS	CROP	PAST	EXTR	TDLW	RIVW	TERW	WATR	Decrease
ROAD	0	14	338	696	74	66	206	138	75	1	17	11	14	4	0	2	0	2	1,657
IMPS	1	0	937	508	277	88	143	7	2	1	37	75	84	2	0	0	0	1	2,165
IMPO	516	3,173	0	1,587	4,334	305	1,288	166	60	102	785	652	1,331	1	21	25	5	35	14,386
TCIS	42	485	690	0	2,446	0	1,599	0	0	181	408	98	184	6	3	7	1	1	6,149
TURF	0	828	5,558	0	0	8,514	1,089	107	106	21	127	3	8	725	0	0	0	0	17,085
TCTG	13	930	4,143	11	11,096	0	783	0	0	93	422	246	539	9	0	0	0	2	18,286
PDEV	1,130	4,377	6,865	0	15,251	49	0	304	33	221	417	142	79	1,270	0	0	0	101	30,241
FORE	1,161	2,764	8,918	732	13,096	28,221	28,107	0	22,046	175,564	81,474	19,557	23,186	4,066	1,381	5,568	193	297	416,330
TCOT	123	952	2,339	0	2,068	2,032	2,341	0	0	788	2,278	3,075	4,566	386	108	250	27	42	21,375
HARF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NATS	63	149	477	0	3,481	371	826	76,425	4,389	4,295	0	546	356	501	0	0	0	1,090	92,968
CROP	500	3,018	8,369	0	4,031	165	2,514	11,299	3,088	1,367	2,069	0	126	1,182	0	0	0	780	38,509
PAST	307	2,253	9,607	0	6,562	185	3,857	13,163	8,984	1,631	4,035	123	0	1,232	0	0	0	402	52,340
EXTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDLW	2	4	91	0	1	0	0	1,746	162	8	0	0	0	0	0	0	0	73	2,087
RIVW	9	31	104	0	167	0	0	7,499	512	208	0	0	0	20	0	0	0	156	8,707
TERW	2	9	43	0	41	2	28	629	86	11	11	16	5	15	0	0	0	36	933
WATR	2	5	130	0	51	15	65	75	153	0	66	71	73	213	28	22	7	0	975
Increase	3,872	18,991	48,610	3,535	62,975	40,010	42,846	111,558	39,695	184,491	92,147	24,616	30,550	9,634	1,541	5,874	232	3,017	724,192
Totals																			
TotIncrease	3,872	18,991	48,610	3,535	62,975	40,010	42,846	111,558	39,695	184,491	92,147	24,616	30,550	9,634	1,541	5,874	232	3,017	
TotDecrease	1,657	2,165	14,386	6,149	17,085	18,286	30,241	416,330	21,375	0	92,968	38,509	52,340	0	2,087	8,707	933	975	
Net	2,215	16,827	34,224	(2,615)	45,890	21,723	12,605	(304,772)	18,319	184,491	(821)	(13,893)	(21,790)	9,634	(546)	(2,833)	(701)	2,042	

18-Class Change Matrix for the CBW

2013/14-2017/18	ROAD	IMPS	IMPO	TCIS	TURF	TCTG	PDEV	FORE	TCOT	HARF	NATS	CROP	PAST	EXTR	TDLW	RIVW	TERW	WATR	Decrease
ROAD	0	14	338	696	74	66	206	138	75	1	17	11	14	4	0	2	0	2	1,657
IMPS	1	0	937	508	277	88	143	7	2	1	37	75	84	2	0	0	0	1	2,165
IMPO	516	3,173	0	1,587	4,334	305	1,288	166	60	102	785	652	1,331	1	21	25	5	35	14,386
TCIS	42	485	[illegible]	0	[illegible]6	0	1,599	0	0	181	408	98	184	6	3	7	1	1	6,149
TURF	0	828	5,558	0	0	8,514	1,089	107	106	21	127	3	8	725	0	0	0	0	17,085
TCTG	13	930	4,143	11	11,096	0	783	0	0	93	422	246	539	9	0	0	0	2	18,286
PDEV	1,130	4,377	6,865	0	15,251	49	0	304	33	221	417	142	79	1,270	0	0	0	101	30,241
FORE	1,161	2,764	8,918	732	13,096	28,221	28,107	0	22,046	175,564	81,474	19,557	23,186	4,066	1,381	5,568	193	297	416,330
TCOT	123	952	2,339	0	2,068	2,032	2,341	0	[illegible]	[illegible]788	2,278	3,075	4,566	386	108	250	27	42	21,375
HARF	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0	0	0	0
NATS	63	149	477	0	3,481	371	826	76,425	4,389	4,295	0	546	356	501	0	0	0	1,090	92,968
CROP	500	3,018	8,369	0	4,031	165	2,514	11,299	3,088	1,367	2,069	0	126	1,182	0	0	0	780	38,509
PAST	307	2,253	9,607	0	6,562	185	3,857	13,163	8,984	1,631	4,035	[illegible]	[illegible]32	0	0	0	0	402	52,340
EXTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDLW	2	4	91	0	1	0	0	1,746	162	8	0	0	0	0	0	0	0	73	2,087
RIVW	9	31	104	0	167	0	0	7,499	512	208	0	0	0	20	0	[illegible]	0	156	8,707
TERW	2	9	43	0	41	2	28	629	86	11	11	16	5	15	0	0	0	36	933
WATR	2	5	130	0	51	15	65	75	153	0	66	71	73	213	28	22	7	[illegible]	975
Increase	3,872	18,991	48,610	3,535	62,975	40,010	42,846	111,558	39,695	184,491	92,147	24,616	30,550	9,634	1,541	5,874	232	3,017	724,192
Totals																			
TotIncrease	3,872	18,991	48,610	3,535	62,975	40,010	42,846	111,558	39,695	184,491	92,147	24,616	30,550	9,634	1,541	5,874	232	3,017	
TotDecrease	1,657	2,165	14,386	6,149	17,085	18,286	30,241	416,330	21,375	0	92,968	38,509	52,340	0	2,087	8,707	933	975	
Net	2,215	16,827	34,224	(2,615)	45,890	21,723	12,605	(304,772)	18,319	184,491	(821)	(13,893)	(21,790)	9,634	(546)	(2,833)	(701)	2,042	

Developed

Natural

Production

Wetlands

Water

18-Class Change Matrix for the CBW

2013/14-2017/18	ROAD	IMPS	IMPO	TCIS	TURF	TCTG	PDEV	FORE	TCOT	HARF	NATS	CROP	PAST	EXTR	TDLW	RIVW	TERW	WATR	Decrease
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PDEV	1,130	4,377	6,865	0	15,251	49	0	304	33	221							0	101	30,241
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TCOT	123	952	2,339	0	2,068	2,032	2,341	0	0	788	2						27	42	21,375
HARF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NATS	63	149	477	0	3,481	371	826	76,425	4,389	4,295	0	546	356	501	0	0	0	1,090	92,968
CROP	500	3,018	8,369	0	4,031	165	2,514	11,299	3,088	1,367	2,069	0	126	1,182	0	0	0	780	38,509
PAST	307	2,253	9,607	0	6,562	185	3,857	13,163	8,984	1,631	4,035	123	0	1,232	0	0	0	402	52,340
EXTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDLW	2	4	91	0	1	0	0	1,746	162	8	0	0	0	0	0	0	0	73	2,087
RIVW	9	31	104	0	167	0	0	7,499	512	208	0	0	0	20	0	0	0	156	8,707
TERW	2	9	43	0	41	2	28	629	86	11	11	16	5	15	0	0	0	36	933
WATR	2	5	130	0	51	15	65	75	153	0	66	71	73	213	28	22	7	0	975
Increase	3,872	18,991	48,610	3,535	62,975	40,010	42,846	111,558	39,695	184,491	92,147	24,616	30,550	9,634	1,541	5,874	232	3,017	724,192
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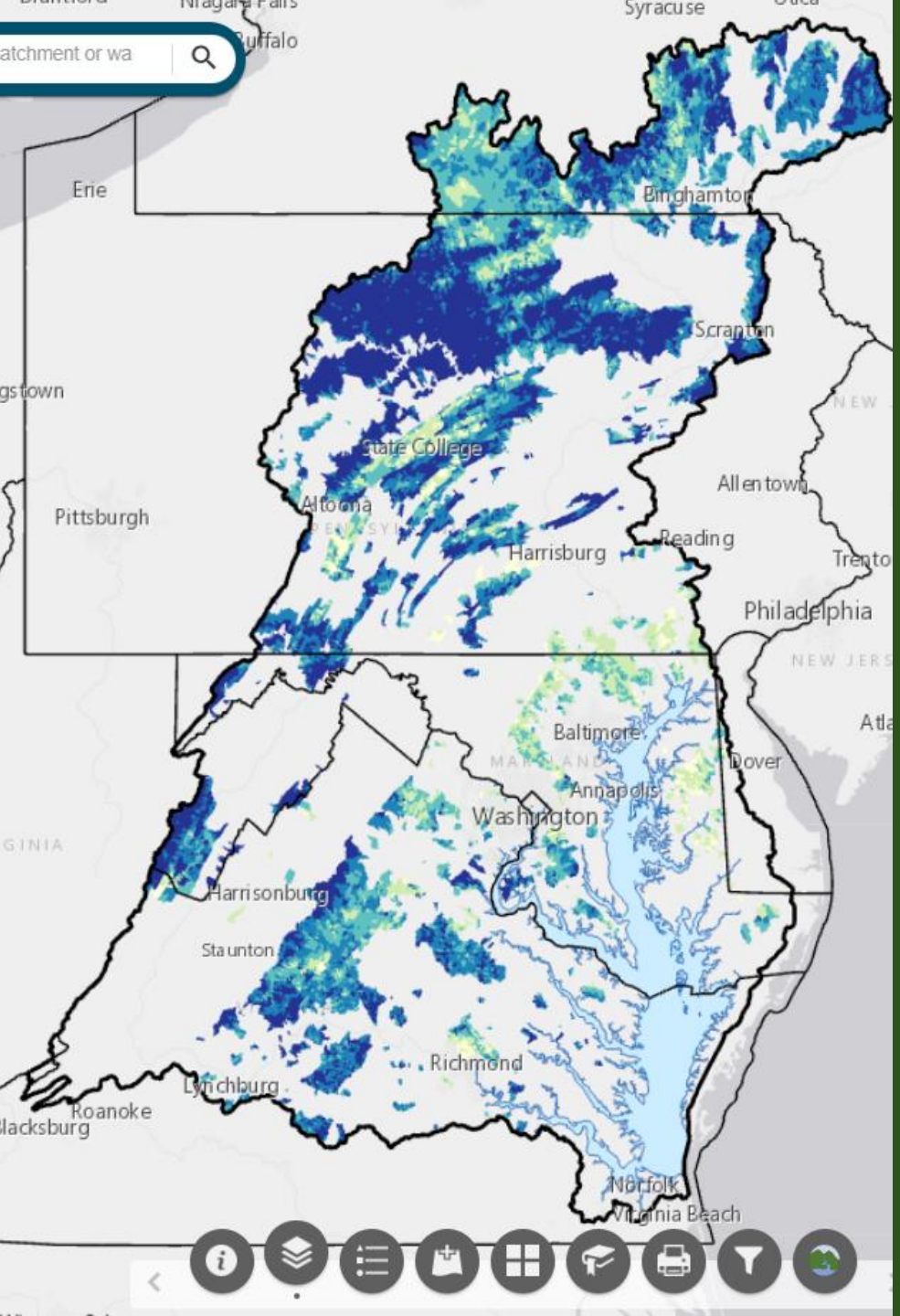
TotDecrease	1,657	2,165	14,386	6,149	17,085	18,286	30,241	416,330	21,375	0	92,968	38,509	52,340	0	2,087	8,707	933	975	
Net	2,215	16,827	34,224	(2,615)	45,890	21,723	12,605	(304,772)	18,319	184,491	(821)	(13,893)	(21,790)	9,634	(546)	(2,833)	(701)	2,042	

Forest to Harvested Forest

Largest transition in the watershed

18-Class Change Matrix for the CBW



Chesapeake Healthy Watersheds Assessment 2.0 (HWGIT)

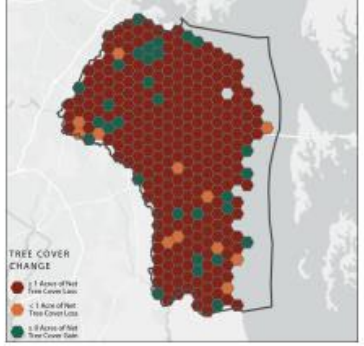
Goals:

1. Identify healthy waters and watersheds.
2. Understand factors affecting watershed health.

- Built a predictive model to assess watershed health using 106 metrics, including geomorphology, habitat, hydrology, landscape condition, land use change, and water quality metrics.
  - Utilized 26 landscape and land use change metrics derived from the 1-meter LULC and LULC change data

- CHWA 2.0 to be released in August 2023

- CHWA 1.0:
  - https://gis.chesapeakebay.net/healthywatersheds/assessment

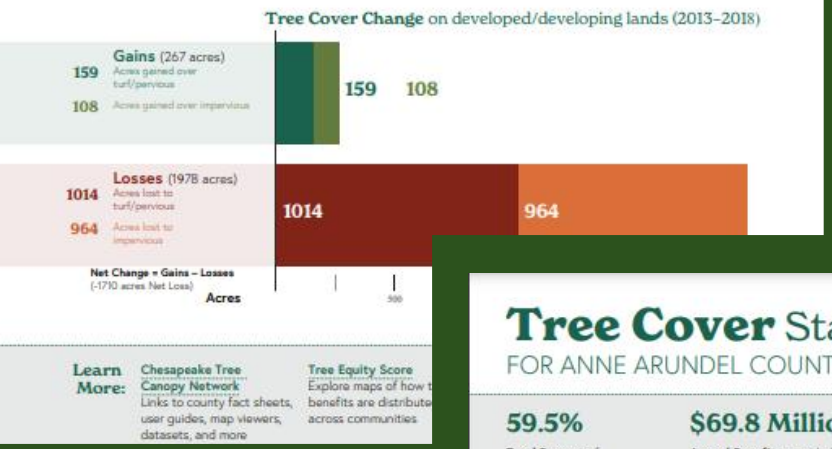


shows where your county has lost and gained tree cover from 2013 to 2018, focusing on land that is already or newly developed.

Tree cover can be lost quickly due to human activities (e.g., construction) or natural events (e.g., severe weather).

Tree cover can be gradually increased through tree planting and natural regrowth, but these gains may take 10-15 years to be detected in high resolution imagery.

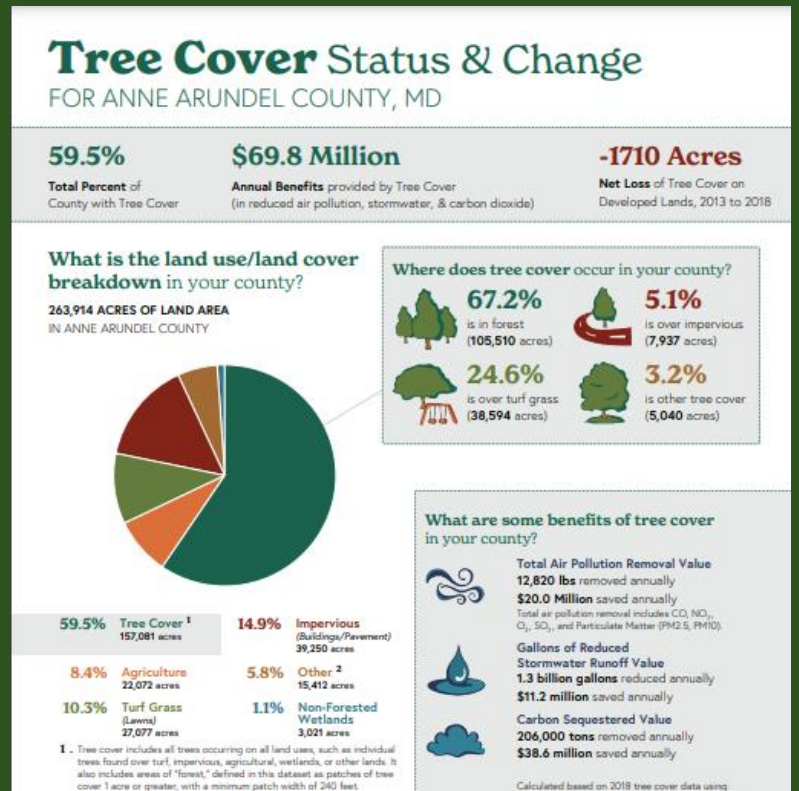
Since mature, healthy trees provide significantly greater community benefits than newly planted trees, it is important to both preserve existing tree cover and seek opportunities to grow new trees and forests. Local land use planning, ordinances, and tree programs play a critical role!



Learn More:

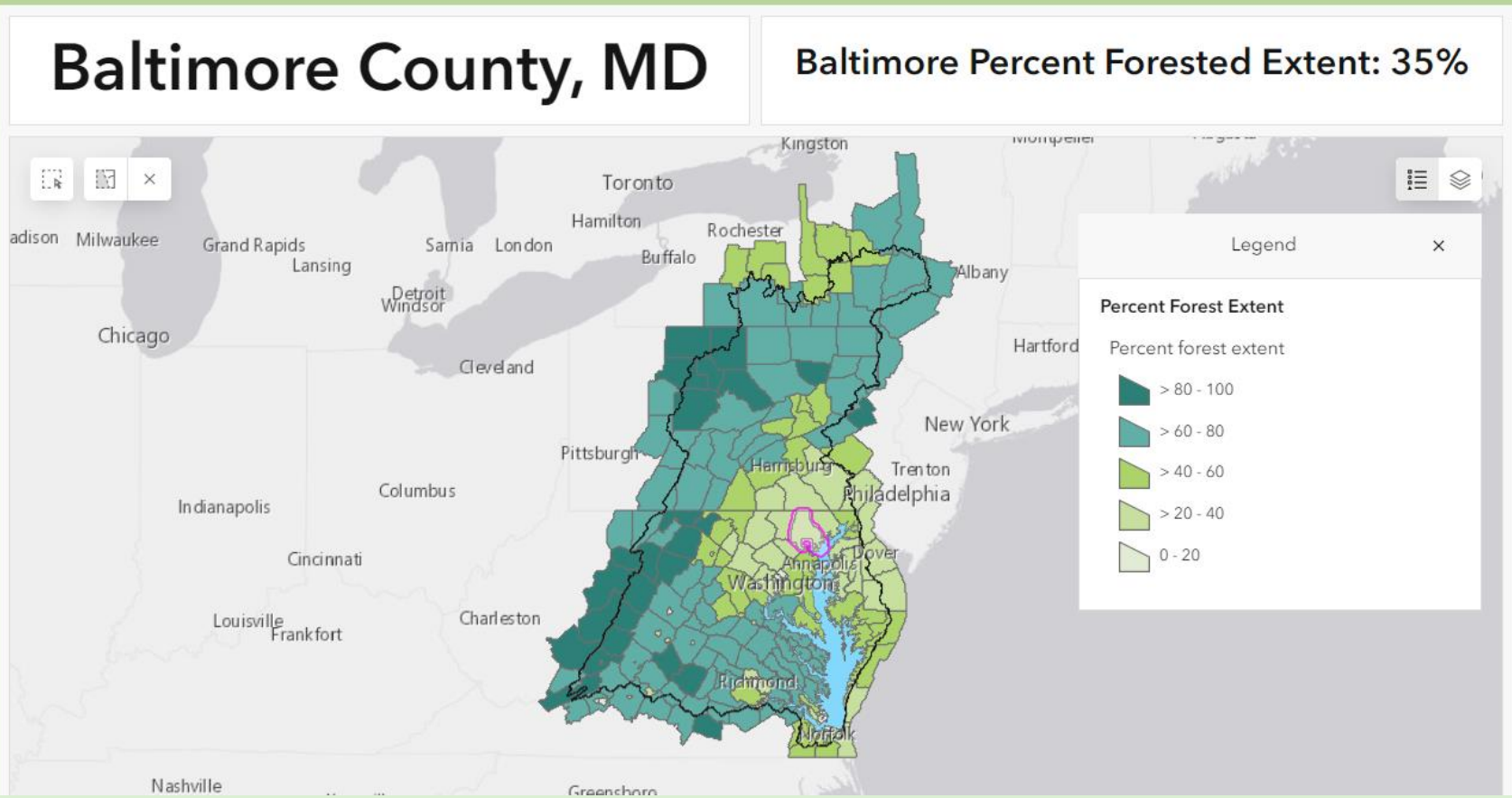
Chesapeake Tree Canopy Network
Links to county fact sheets, user guides, map viewers, datasets, and more

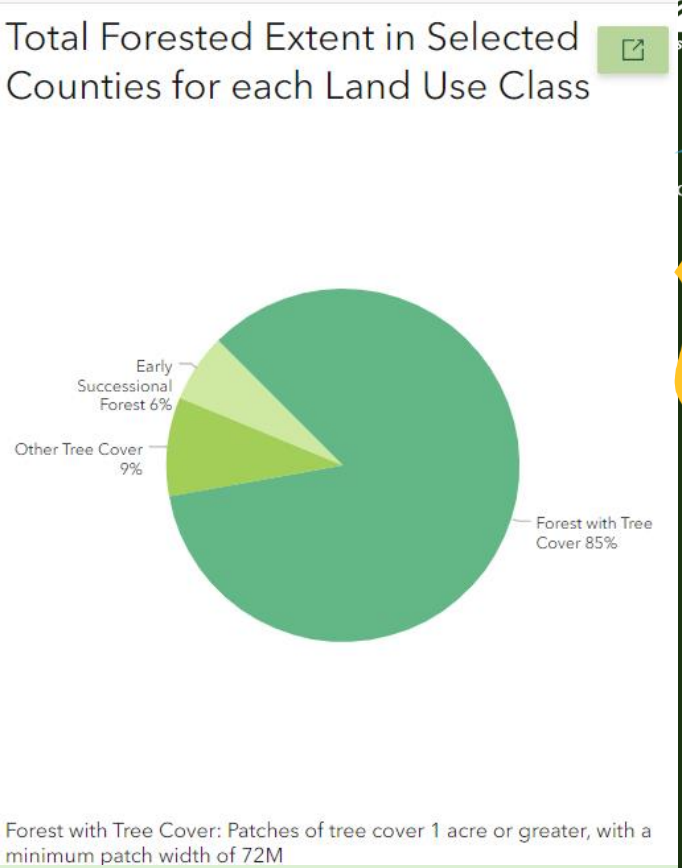
Tree Equity Score
Explore maps of how t benefits are distribute across communities



Tree Cover Status and Change Fact Sheets (FWG, Alliance for the Chesapeake Bay)

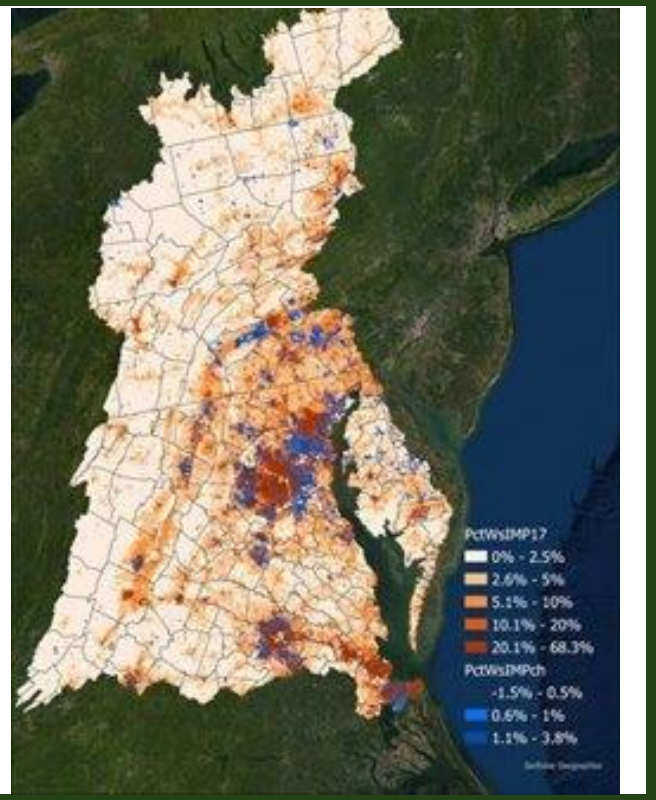
- County-scale fact sheets about the status and trends of Tree Cover.
- Includes actionable information, including the annual benefits of tree cover for the county by:
  - carbon sequestration
  - Air pollution removal
  - Reduced stormwater runoff.
- https://chesapeaketrees.net/understand-your-canopy/

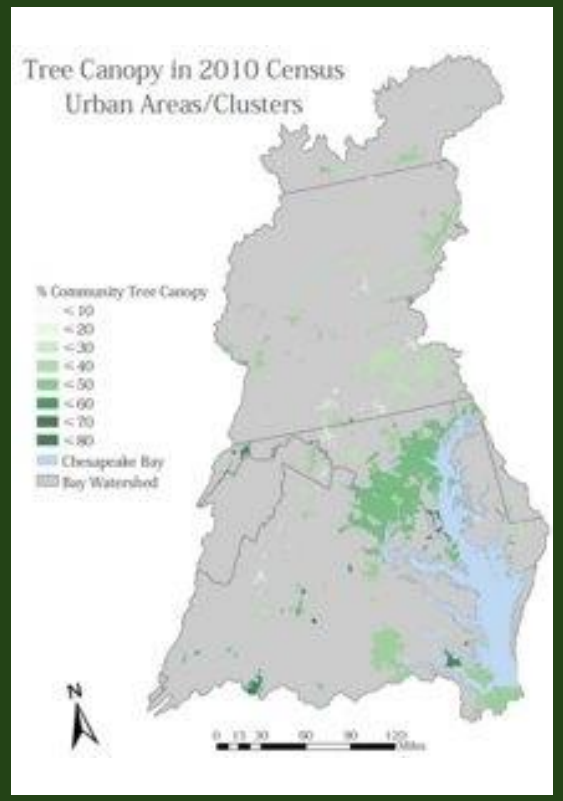




State of the Chesapeake Forests 2.0 (FWG)

- Update to the 2006 State of the Chesapeake Forests report as a story map
- The first phase (summer 2023) uses the 1-meter LULC to answer questions such as:
  - Where does the watershed have forests and tree cover?
  - How much forest and tree cover is in the watershed?
  - How are forests and tree cover changing?
- The second phase is planned to include forest and tree cover in the riparian zone.





Land Use Methods and Metrics (LUMM) Outcome (LUWG, FWG)

- Outcome: Assess and understand the impacts of land use change on watersheds, habitats, and communities at a scale relevant to county-level decision-makers.
- So far, community tree cover (Tree Canopy Outcome) and impervious surface indicators have been approved.
- More indicators to come over the next year!
  - Natural lands
  - Land conversion from farmland, forest, and wetlands to development
  - Effective impervious cover
  - Riparian indicators
- Data Access:
  - https://www.chesapeakeprogress.com/conserved-lands/land-use-methods-and-metrics-development
  - https://www.chesapeakeprogress.com/abundant-life/tree-canopy

Maryland Forest Technical Study (External Partners)

- Study that assessed forest and tree canopy change at the county scale using the 1-meter LULC.
- Compared trends in the LULC change and other mapped data to goals, policies, and legislation, including the Forest Conservation Act and the Chesapeake Bay Watershed agreement.
- Access to the report: https://www.chesapeakeconservancy.org/mdforeststudy2022

Technical Study on Changes in Forest Cover and Tree Canopy in Maryland

November 2022

Harry R. Hughes CENTER FOR AGRO-ECOLOGY

COLLEGE OF AGRICULTURE & NATURAL RESOURCES

Chesapeake Conservancy

University of Vermont Spatial Analysis Lab

Other Use Cases

- MS4 analysis required for the Chesapeake Bay Pollutant Reduction Plan update
- Regional green infrastructure work.
- Create local land use and local planning or County Comprehensive plans
- Long range planning updates by forest resources management agencies, which is required by the latest USDA Farm Bill. The updates are known as State Forest Action Plans.
- Create tree canopy percentages for every town, park, and HOA community in DE.
- Audubon used the land cover as a reference layer in their Christmas Bird Count by dashboard
- Estimating forest, targeting tree plantings, estimating tree planting opportunities on various ownerships, riparian buffer potential, etc.
- Prioritize and direct conservation efforts and work for long term Brook Trout benefits
- Map potential community garden sites in cities
- Tributary Reports
- Explain drivers of water quality trends
- Check and balance on “Accounting for Growth”
- Land use is linked to distribution, abundance and resiliency of SAV
- Targeting conservation
- Understanding watershed trends and vulnerability
- Informs trends in forest and riparian areas
- USGS Chesapeake Regional Assessments

Discussion Questions

1. Do you use high resolution land use/land cover data products to support your outcome?
2. What projects are ongoing that this data might help inform?
3. What do you need to use the land use/land cover data in your projects?
    a) How can STAR help?

Contact

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Chesapeake Bay Program
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