Chesapeake Bay and Watershed report card 2019 indicators

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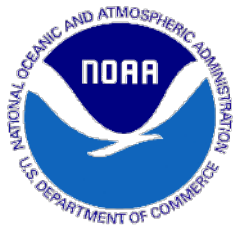
Thank you to everyone who has contributed!



Stakeholder engagement workshop

- Susquehanna River Basin Commission
- Harrisburg, PA
- January 7-8, 2020
- ~22 participants
- Federal, state, academic, nongovernmental organizations

What reporting regions could work?

- Tidal bay regions – 15 reporting regions that correspond to most areas of the watershed
- Factor in data density, indicator relevance at reporting region level, etc.

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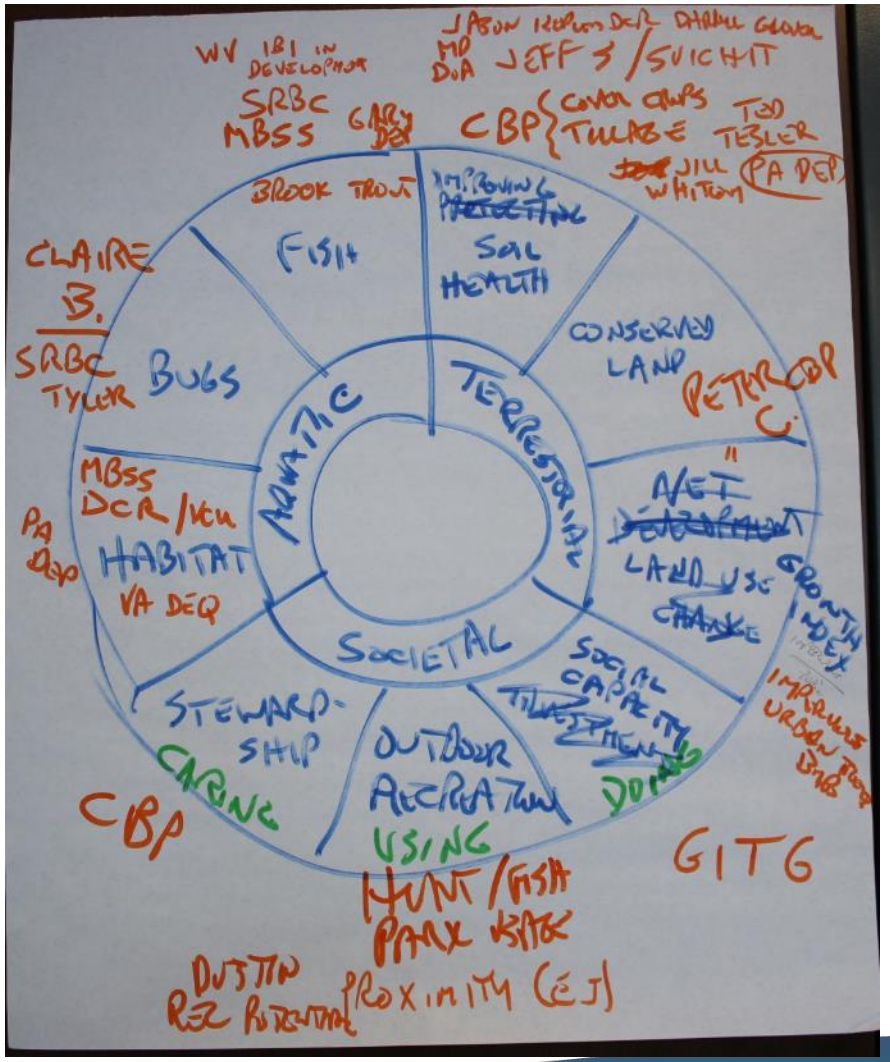
Proposed indicators and categories

- Aquatic
  - Chessie BIBI
  - Water quality
- Societal
  - Water-based economies
  - Tourism dollars
  - Recreation
    - Hunting and fishing
  - Stewardship
  - Diversity
- Terrestrial
  - Conserved land



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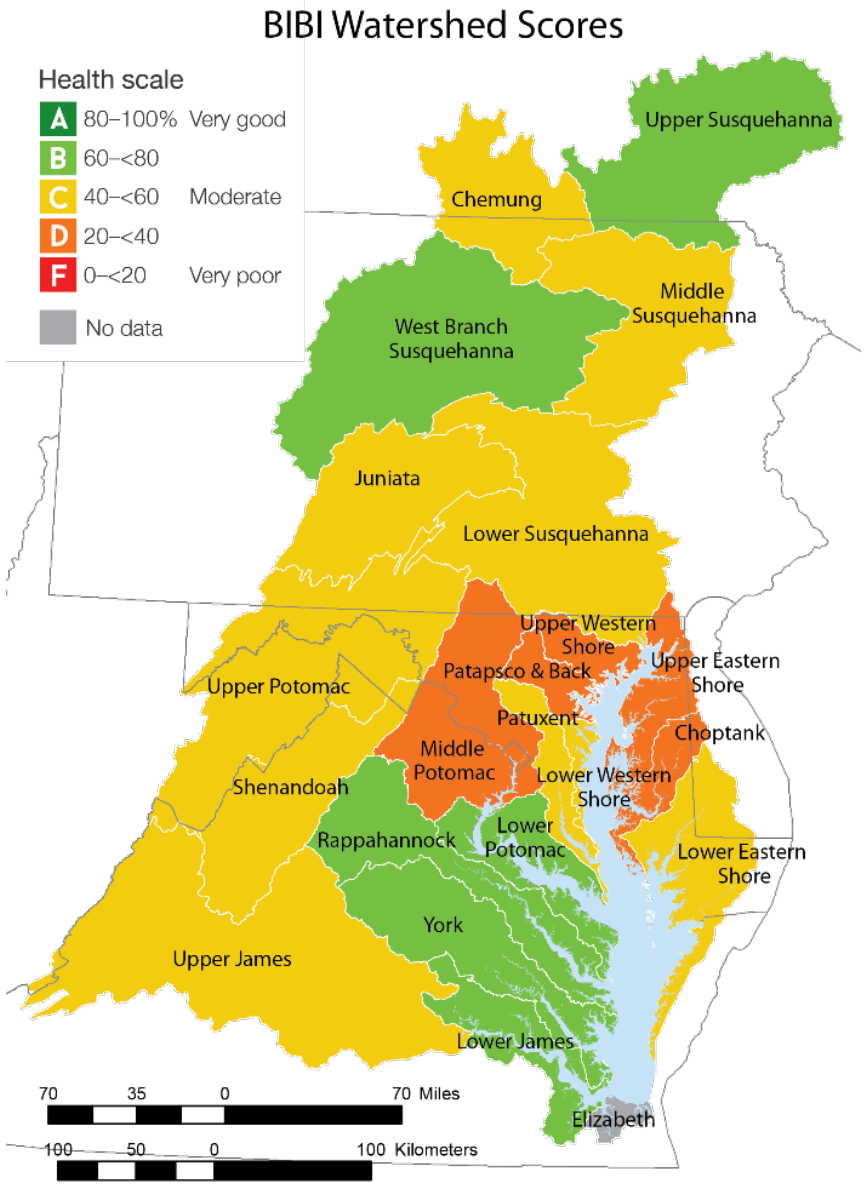
  - Recreation
    - Hunting and fishing
  - Stewardship
  - Diversity
- Terrestrial
  - Conserved land

BIBI – Scoring

- Data covers 2006-2011.
- No data in the Elizabeth region.

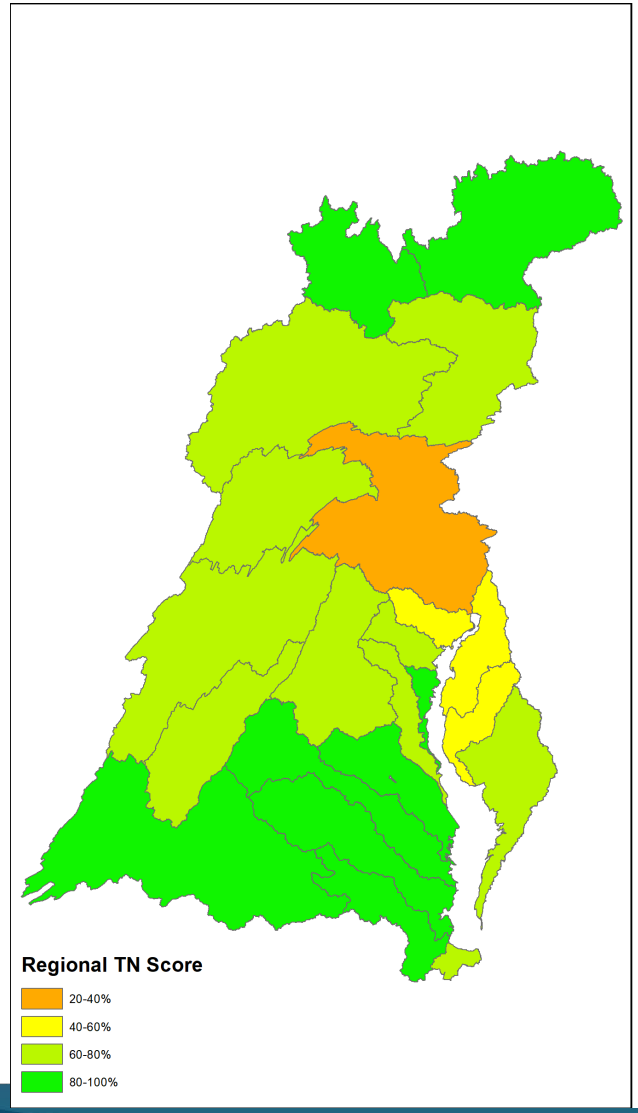
Region	BIBI Score
Chemung	53
Choptank	37
Elizabeth	ND
Juniata	54
Lower Eastern Shore	44
Lower James	61
Lower Potomac	63
Lower Susquehanna	45
Lower Western Shore	42
Middle Potomac	24
Middle Susquehanna	57
Patapsco and Back	33
Patuxent	43
Rappahannock	68
Shenandoah	42
Upper Eastern Shore	39
Upper James	56
Upper Potomac	48
Upper Susquehanna	61
Upper Western Shore	38
West Branch Susquehanna	65
York	63

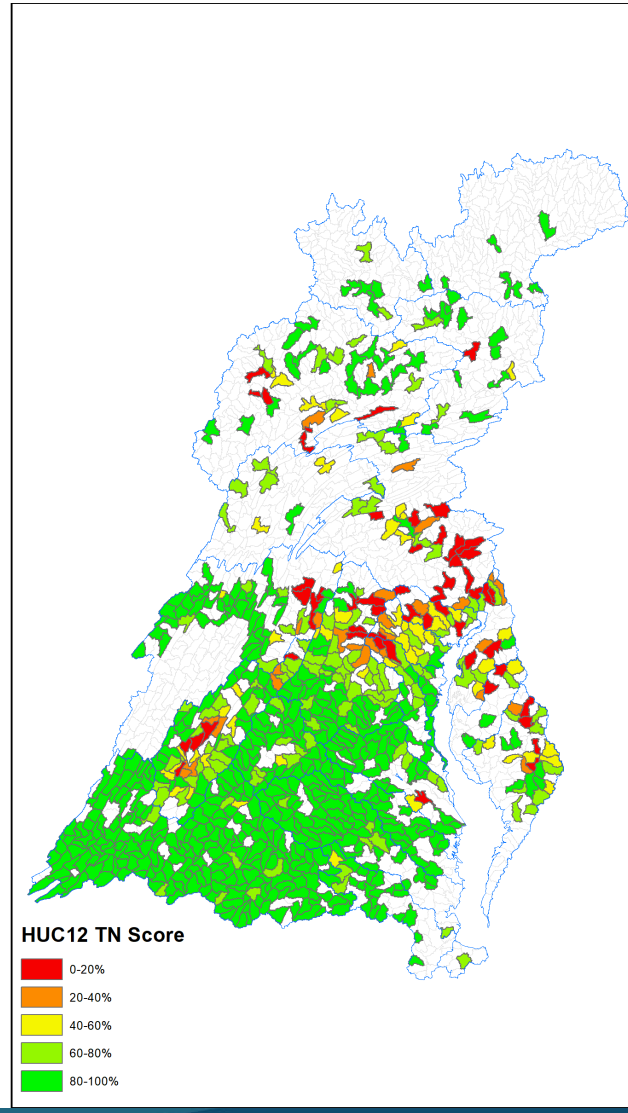


Total Nitrogen – Thresholds and Scores (mg/L)

- Scores are calculated for each station using the multiple threshold method, where thresholds are defined by bioregion.

Score	Piedmont, Ridge and Valley	Coastal Plain
5	< 0.64	< 0.82
4	≥ 0.64 - < 1.65	≥ 0.82 – < 1.52
3	≥ 1.65 – < 2.15	≥ 1.52– < 2.22
2	≥ 2.15 - < 2.65	≥ 2.22 - < 2.66
1	≥ 2.65	≥ 2.66

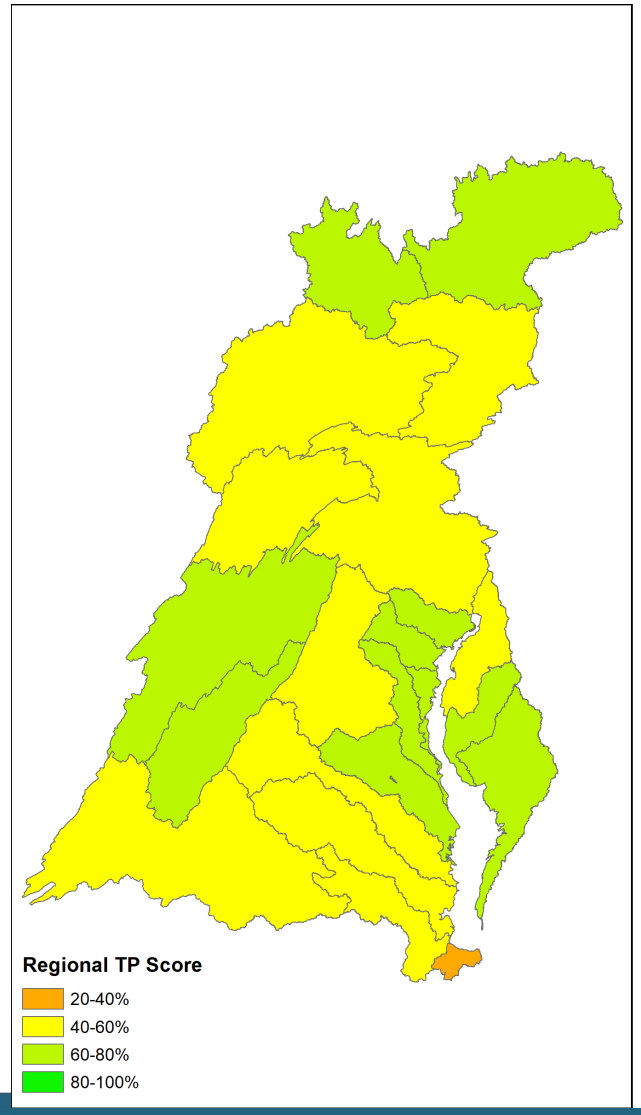


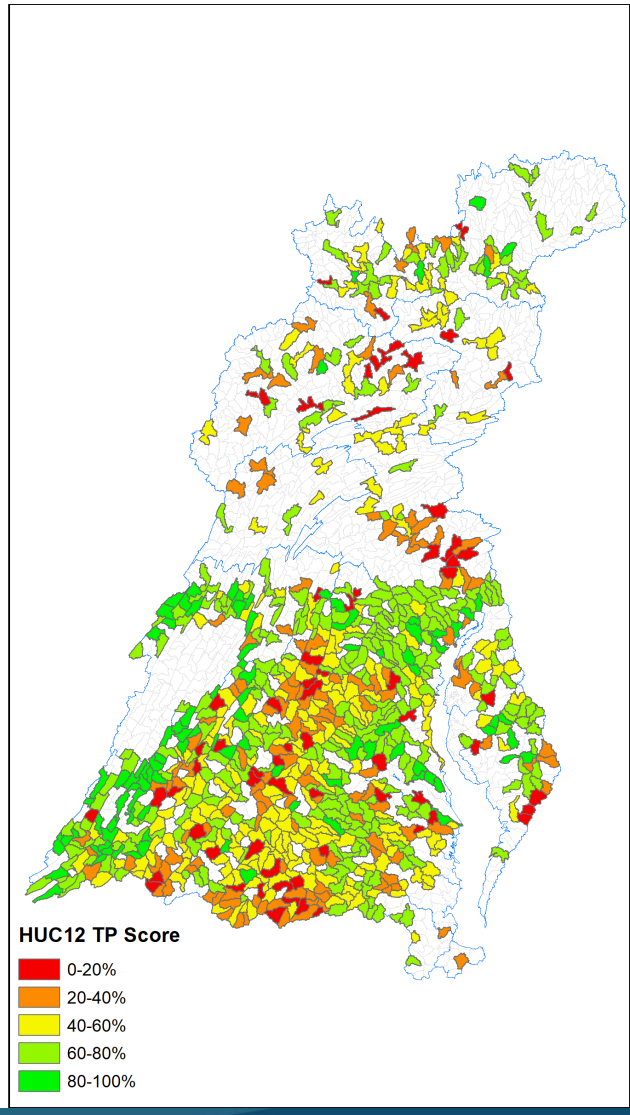


Total Phosphorus – Thresholds and Scores (mg/L)

- Scores are calculated for each station using the multiple threshold method, where thresholds are defined by bioregion.

Score	Piedmont, Ridge and Valley	Coastal Plain
5	< 0.01	< 0.02
4	≥ 0.01 - < 0.03	≥ 0.02 – < 0.06
3	≥ 0.03– < 0.06	≥ 0.06– < 0.09
2	≥ 0.06 - < 0.09	≥ 0.09 - < 0.12
1	≥ 0.09	≥ 0.12

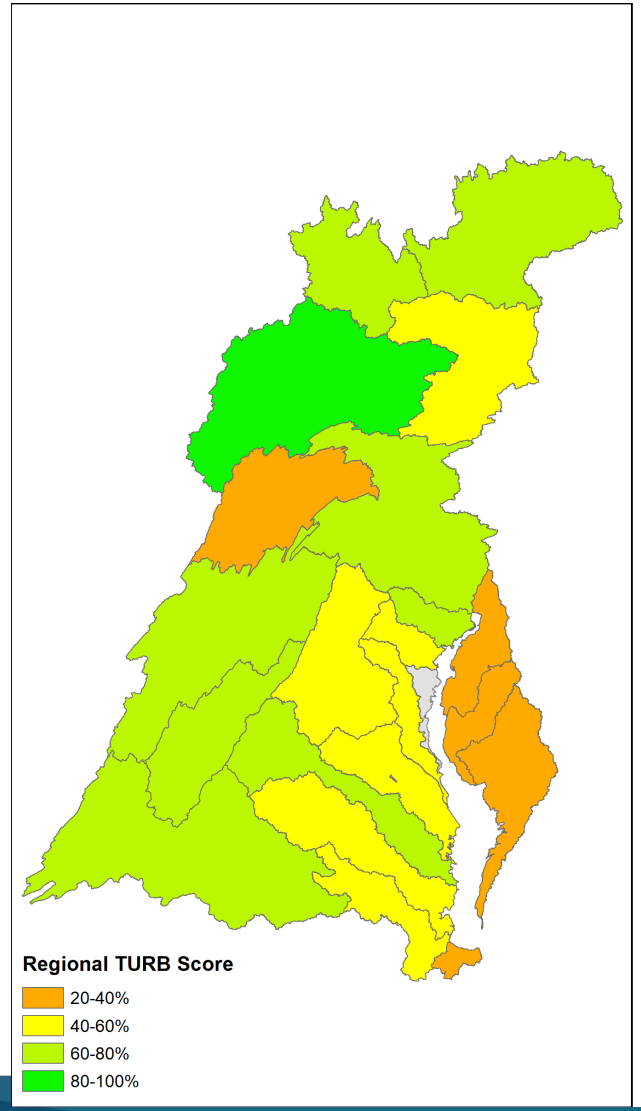


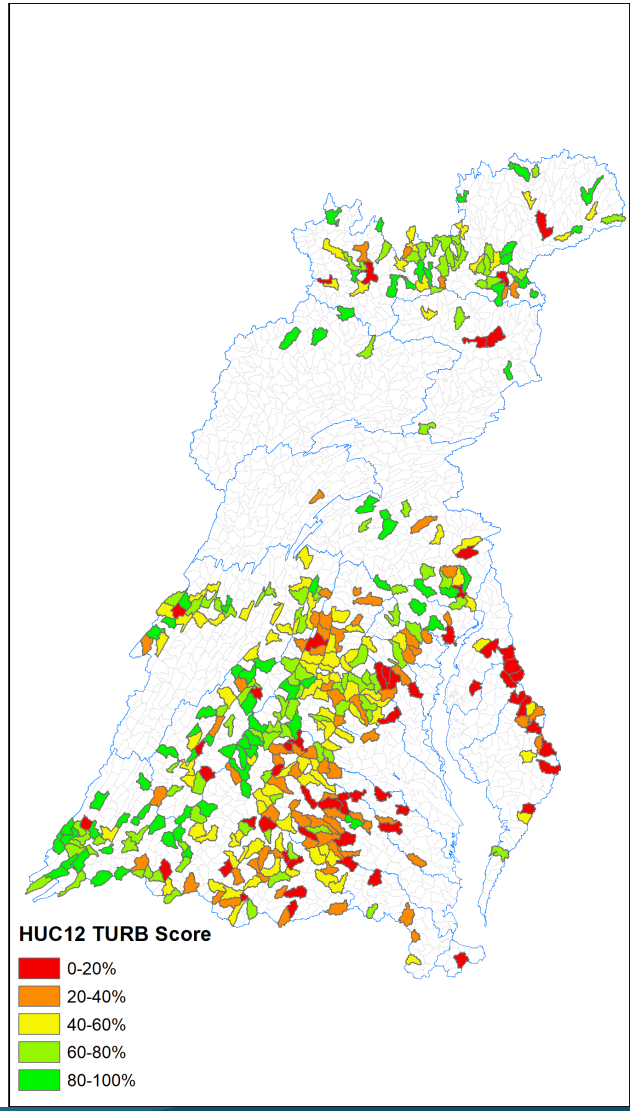


Turbidity – Thresholds and Scores (NTU)

- Scores are calculated for each station using the multiple threshold method.
- No Data was available for the Lower Western Shore Region

Turbidity (NTU)	Score
< 3	5
≥ 3 - < 4.75	4
≥ 4.75 – < 6.5	3
≥ 6.5 - < 8.25	2
≥ 8.25	1

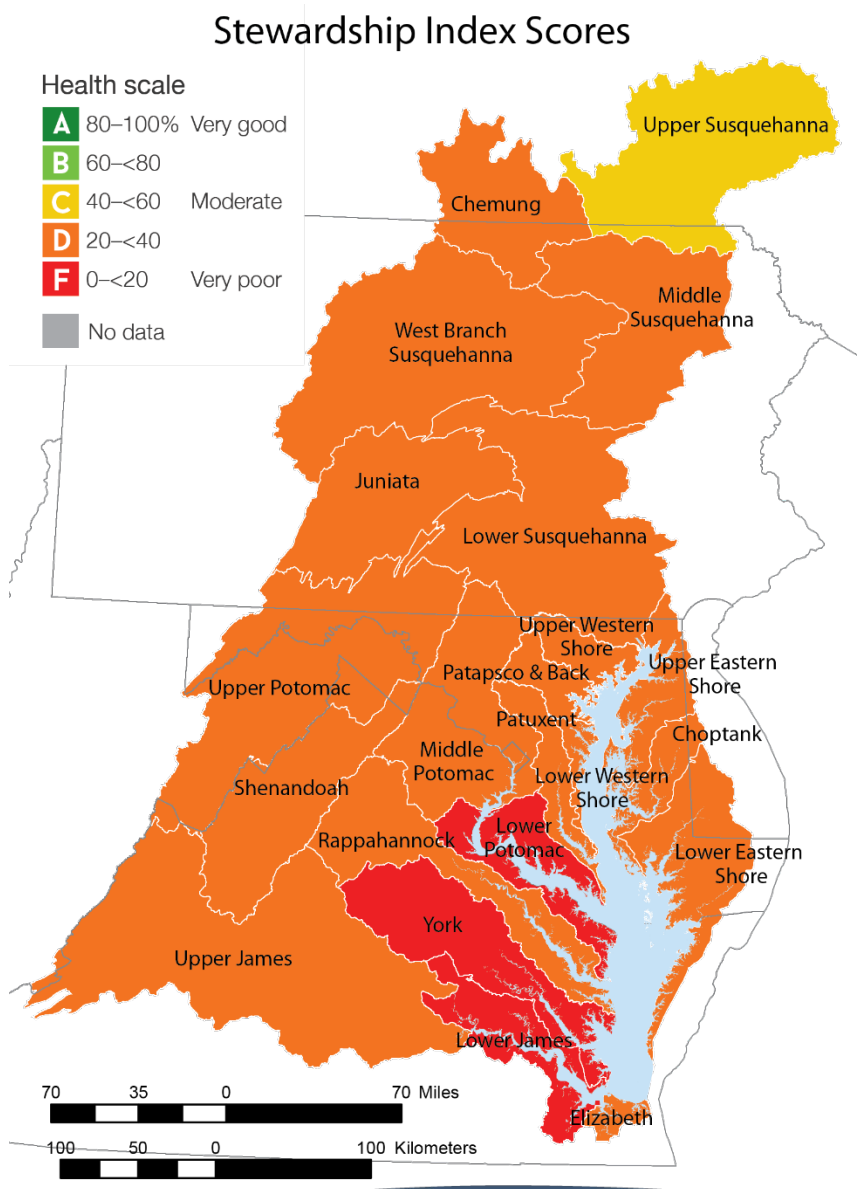




Stewardship Index – Results

- These results are consistent with Opinionworks
- The overall stewardship score they calculated was 24 out of 100 (all people all behaviors) for the entire watershed
- Is a 100% goal reasonable?

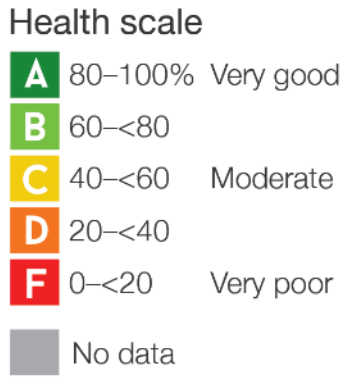
Region	Overall score
Chemung	28
Choptank	20
Elizabeth	26
Juniata	20
Lower Eastern Shore	28
Lower James	19
Lower Potomac	17
Lower Susquehanna	28
Lower Western Shore	26
Middle Potomac	30
Middle Susquehanna	30
Patapsco Back	26
Patuxent	20
Shenandoah	24
Upper Eastern Shore	29
Upper James	23
Upper Potomac	25
Upper Susquehanna	40
Upper Western Shore	20
West Branch Susquehanna	23
York	19



Hunting and Fishing Licenses – Scoring

- The state scores are area-weighted to the overall Chesapeake Bay Watershed score

State	Fishing License Score	Hunting License Score	Overall Score	Weighted score
DE	73%	99%	86%	1%
MD	26%	97%	62%	10%
NY	59%	75%	67%	6%
PA	40%	51%	45%	15%
VA	73%	77%	75%	26%
WV	12%	17%	15%	1%
DC	62%	N/A	62%	1%
Watershed	49%	69%		59%



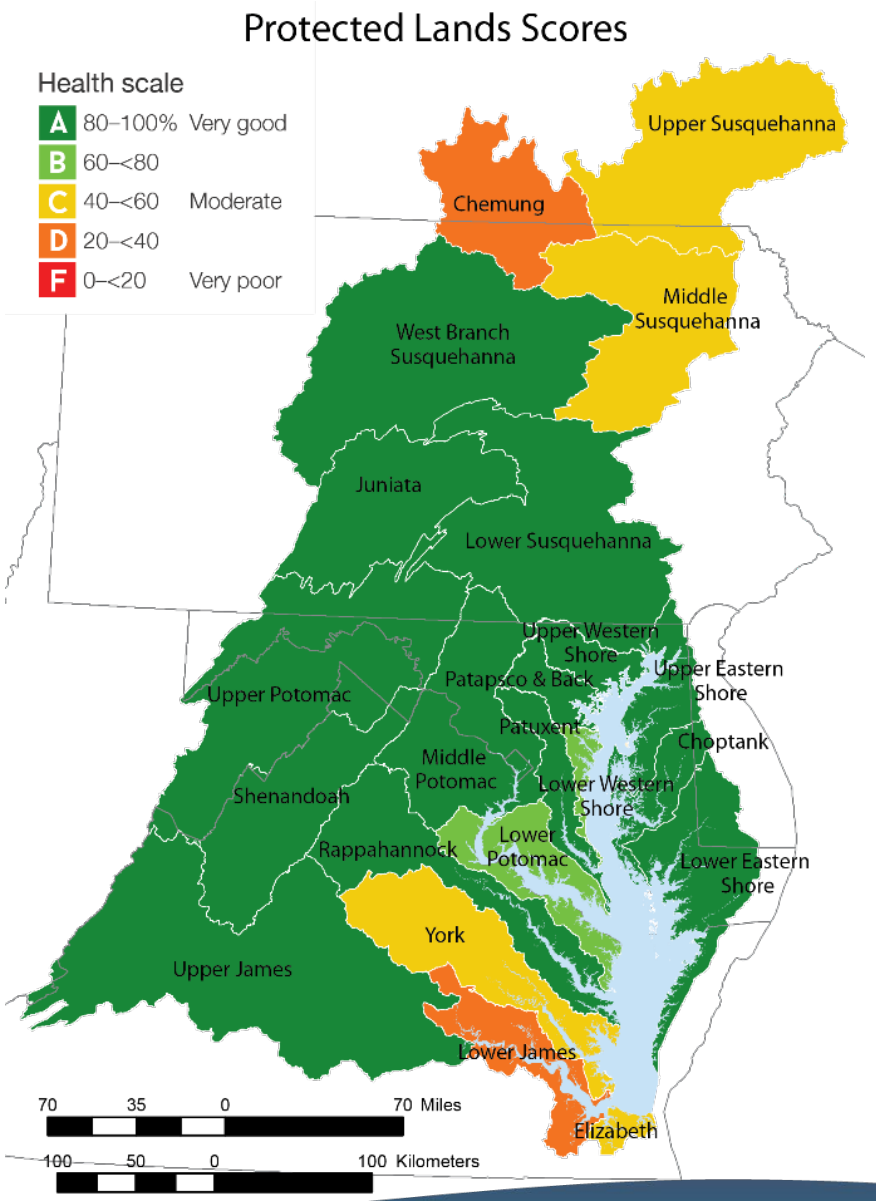
Protected Lands Indicator – Scoring

- Protected lands goal is an increase of 2 million acres from the amount reporting in 2010.
- Total protected lands goal is 9.8 million acres for the entire watershed (7.8 million + 2 million).
- This goal was divided over the 22 reporting regions with larger areas having a larger goal and smaller areas having a smaller goal.
- Each reporting region acreage was divided by its goal and multiplied by 100.
- This gave a score for each region.

Region	Protected lands Score
Chemung	32
Choptank	87
Elizabeth	49
Juniata	87
Lower Eastern Shore	100
Lower James	37
Lower Potomac	70
Lower Susquehanna	91
Lower Western Shore	68
Middle Potomac	100
Middle Susquehanna	53
Patapsco & Back	90
Patuxent	100
Rappahannock	85
Shenandoah	100
Upper Eastern Shore	100
Upper James	100
Upper Potomac	81
Upper Susquehanna	39
Upper Western Shore	100
West Branch Susquehanna	100
York	41

Protected Lands Indicator – Results

- Most scores are good. And many scores were 100%.
- Future work
  - We should develop goals for individual reporting regions that are more specific and not just dividing the overall goal by area.



Social Vulnerability Index – Background

- A measure of how able a community is to respond and bounce back from hazardous events such as a natural disaster, tornado or even disease outbreak.* Some measure of vulnerability are:
  - High poverty
  - Low percentage of vehicle access
  - Crowded households
- These measures give an idea of **a communities ability to prevent** human suffering and financial loss in the event of a disaster
- CDC explanation of 2016 variables here:
  - https://svi.cdc.gov/Documents/Data/2016_SVI_Data/SVI2016Documentation.pdf

*according to the CDC

Social Vulnerability Index – Data

- Using census data for total population of a tract and many different measures of vulnerability within that tract
- Years available: 2018, 2016, 2014, 2010, or 2000
- Summary variable measurements:

EPL_POV	Percentile Percentage of persons below poverty estimate
EPL_UNEMP	Percentile Percentage of civilian (age 16+) unemployed estimate

Theme Colors
Socioeconomic
Household Composition/Disability
Minority Status/Language
Housing/Transportation

RPL_THEME1	Percentile ranking for Socioeconomic theme summary
RPL_THEME2	Percentile ranking for Household Composition theme summary
RPL_THEME3	Percentile ranking for Minority Status/Language theme
RPL_THEME4	Percentile ranking for Housing/Transportation theme

RPL_THEMES	Overall percentile ranking

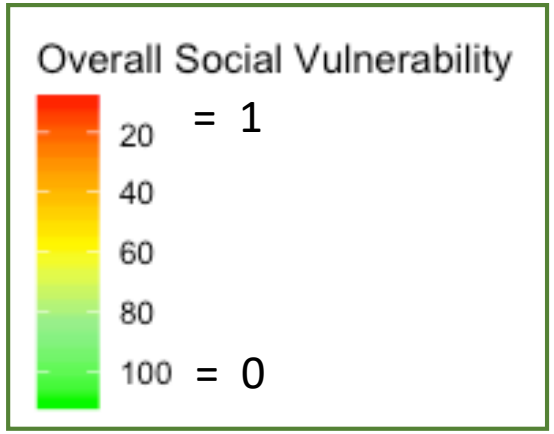
Social Vulnerability Index – Scoring

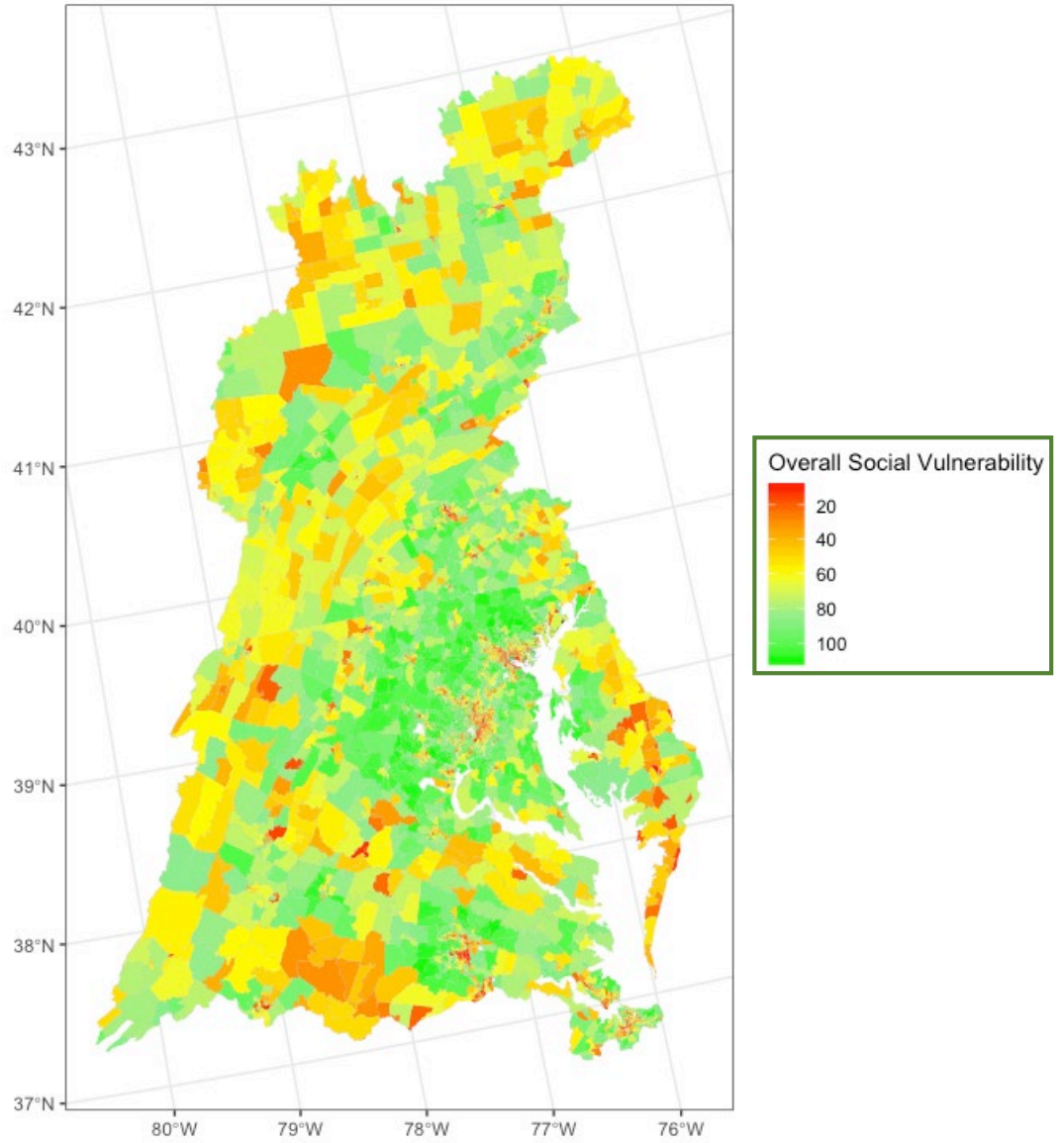
- The index uses census data to grade tracts against other tracts, essentially scaling the tracts from worst (1 – very vulnerable) to best (0 – not very vulnerable)
- CDC pulls variable from the American Community Survey:
  - 'b170001' – POVERTY STATUS IN THE PAST 12 MONTHS BY SEX BY AGE
  - Total people below the poverty estimate/estimate of total pop
  - "Poverty" is defined differently for each household depending on the number of people. 5 people with a total income of 32,000 a year is above the poverty line
  - Compare this to the rest of the tracts in the US, rank from 0-1

Social Vulnerability Index – Results

- Think about it in a few different ways, much of the data is currently scaled from 0-1
- 0 – not vulnerable
- 1 – very vulnerable

- Could translate to:

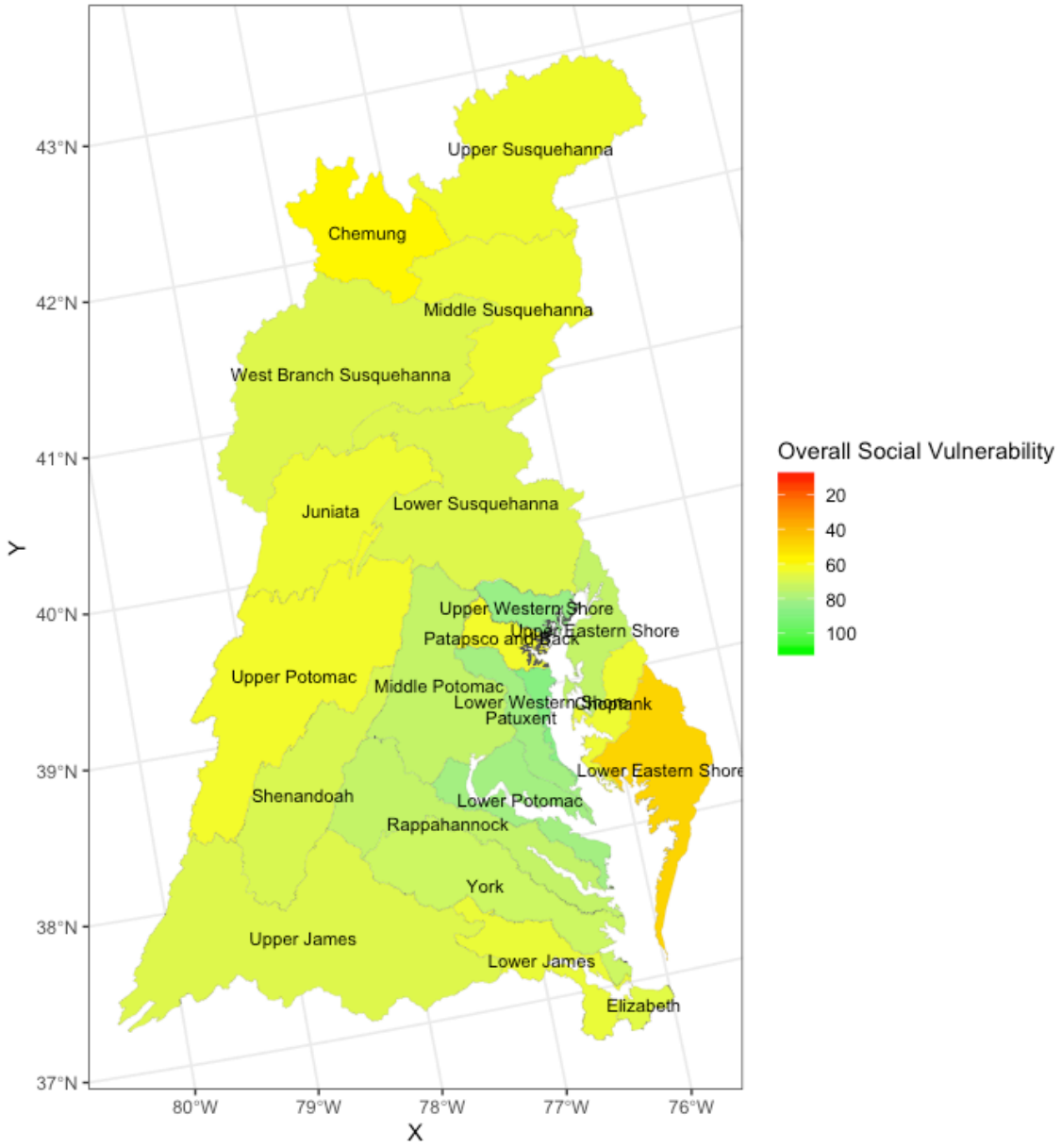




Social Vulnerability Index – Results

- Mean for each region for variable "RPL_THEMES" – or "Overall Social Vulnerability"

RegionName	mean_RPLTHEMES	mean_EPLPOV	mean_EPLUNEMP	RPLTHEMES_percent
Chemung	0.5144949	0.5556532	0.5412329	48.55051
Choptank	0.4622556	0.4702694	0.4176722	53.77444
Elizabeth	0.4319413	0.4607231	0.5152279	56.80587
Juniata	0.4608537	0.4902491	0.4161194	53.91463
Lower Eastern Shore	0.6158481	0.5697883	0.5140844	38.41519
Lower James	0.4497355	0.4464090	0.5128390	55.02645
Lower Potomac	0.2850458	0.2524754	0.3668331	71.49542
Lower Susquehanna	0.4190313	0.3856772	0.3981886	58.09687
Lower Western Shore	0.2196529	0.1924812	0.3885129	78.03471
Middle Potomac	0.3529248	0.3001305	0.4170803	64.70752
Middle Susquehanna	0.4594683	0.5157287	0.4718887	54.05317
Patapsco and Back	0.4678577	0.4711274	0.5334460	53.21423
Patuxent	0.2906423	0.2055476	0.4414351	70.93577
Rappahannock	0.3521257	0.3487673	0.4069212	64.78743
Shenandoah	0.4074723	0.4276429	0.3829840	59.25277
Upper Eastern Shore	0.3527081	0.3111516	0.3949871	64.72919
Upper James	0.4214015	0.4727480	0.4210330	57.85985
Upper Potomac	0.4709280	0.4599561	0.4950143	52.90720

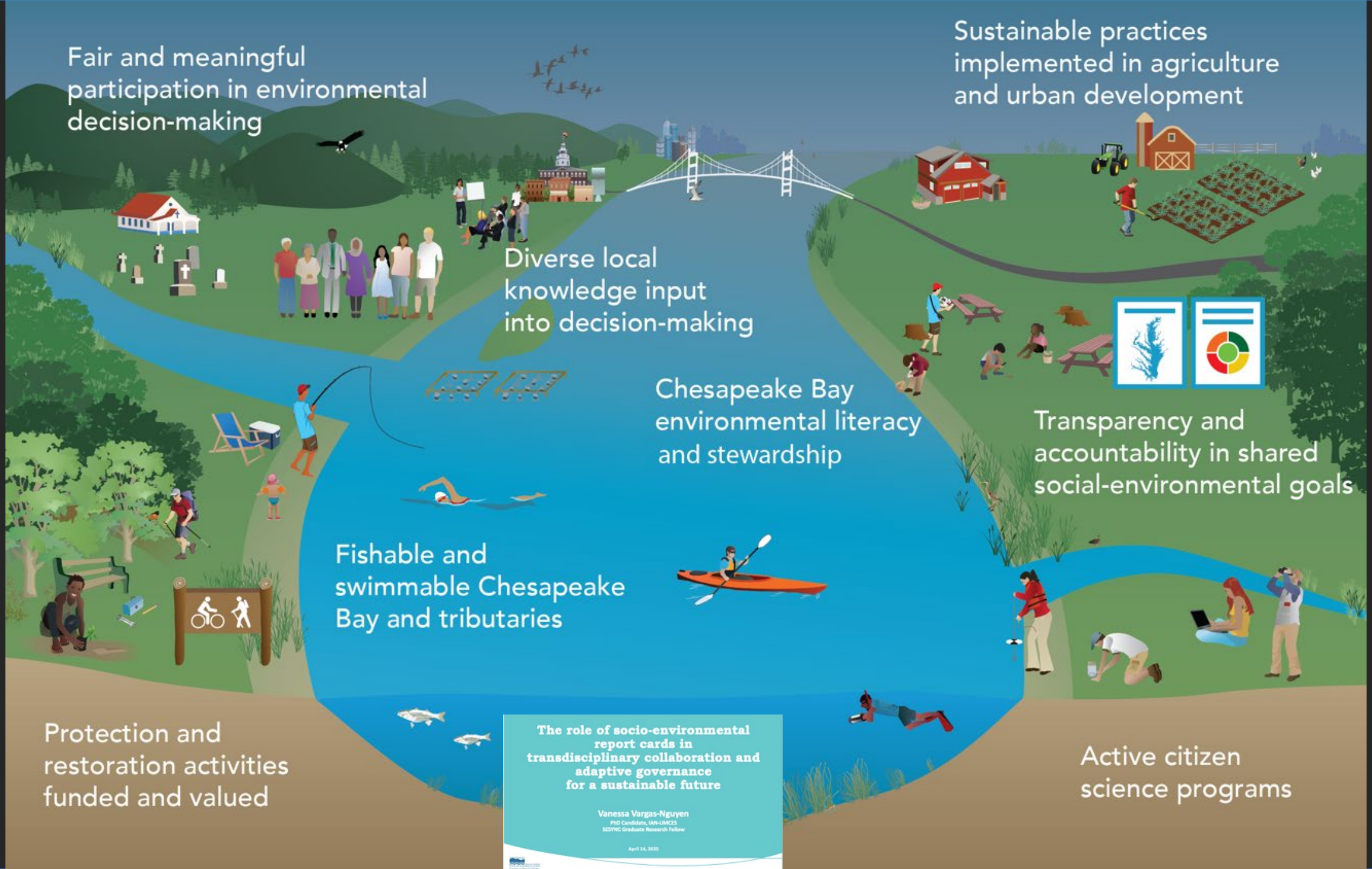


Tidal Indicators Preliminary Results

- Data is available for water quality and BIBI. SAV data should be available by May 1.
- Dissolved oxygen = 83% (-2%)
- Chlorophyll a = 26% (+4%)
- Water clarity = 10% (+3%)
- Total nitrogen = 39% (-5%)
- Total phosphorus = 76% (+4%)
- BIBI = 38% (-21%)
- SAV = ?
- Overall Bay Health Score = ?

Next steps

- Final data analysis of indicators included in 2019 report card
- QAQC
- Layout and website for 2019 report card
- Mid-May release – stay tuned!

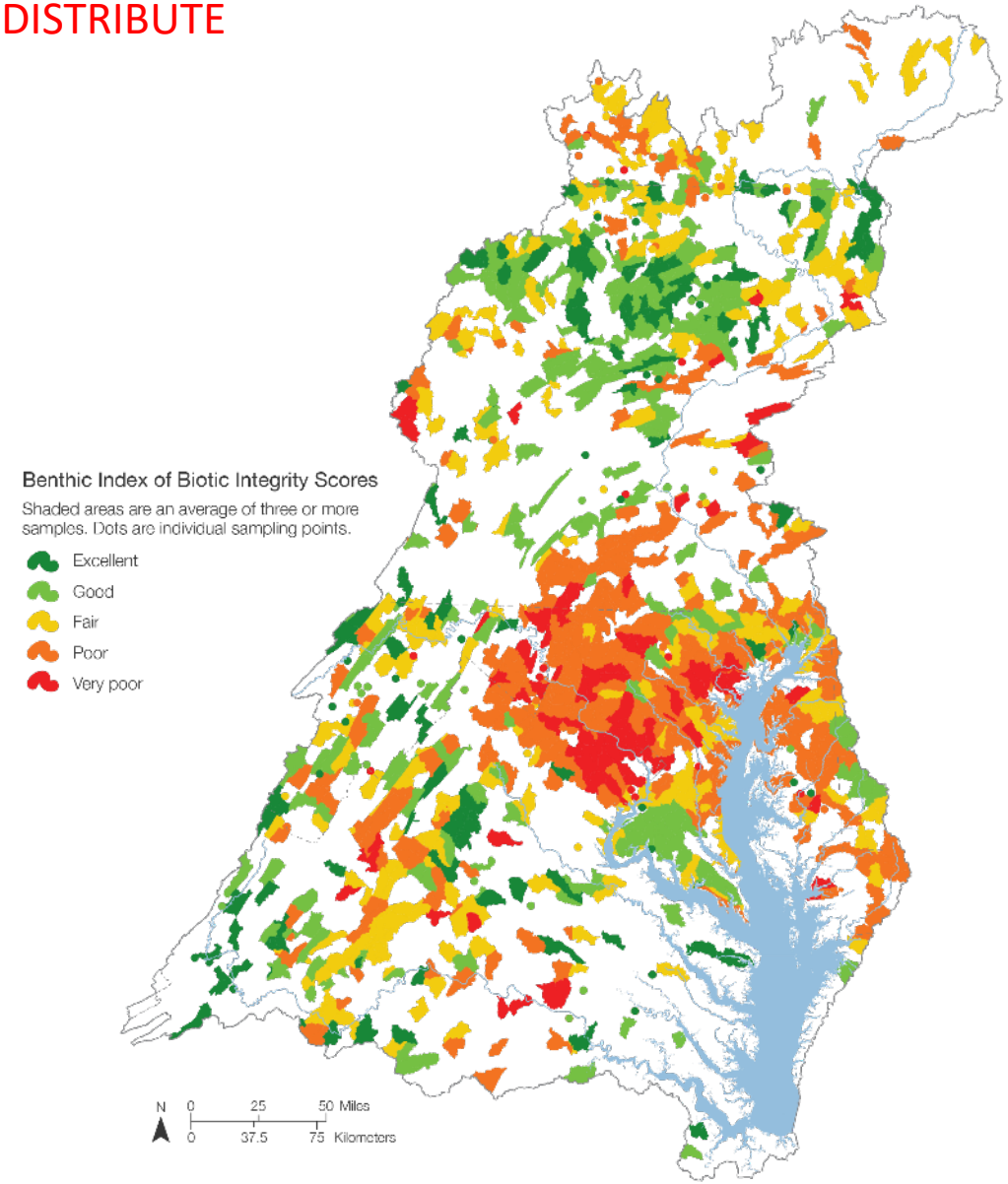

Fair and meaningful participation in environmental decision-making
Sustainable practices implemented in agriculture and urban development
Diverse local knowledge input into decision-making
Chesapeake Bay environmental literacy and stewardship
Transparency and accountability in shared social-environmental goals
Fishable and swimmable Chesapeake Bay and tributaries
Protection and restoration activities funded and valued
Active citizen science programs
The role of socio-environmental report cards in transdisciplinary collaboration and adaptive governance for a sustainable future
Vanessa Vargas-Nguyen
PhD Candidate, IAN-UMCES
SESYNC Graduate Research Fellow
April 14, 2020

Benthic Index of Biotic Integrity – Background

- BIBI data from Chessie BIBI (Chesapeake basin-wide index of biotic integrity for stream macroinvertebrates)
- Includes data from 2006-2011, only updated every 5 years
- Contacts: Claire Buchanan and Kelly Malone (ICPRB)
- https://www.potomacriver.org/focus-areas/aquatic-life/chessie-bibi-stream-health-indicator/

BIBI – Data

- In the 2018 report card we included this map of the BIBI scores by BIBI region and sampling point
- BIBI regions are an average of three or more samples



Benthic Index of Biotic Integrity – Data

- BIBI sample scores were divided by reporting region in ArcGIS
- Data was exported to excel
- BIBI scores by bioregion were converted to report card scoring scale
- For multiple BIBI samples in a HUC12, the scores were area weighted within the HUC12
- Scores for each HUC12 were averaged to the reporting region
- These methods were recommended by Claire Buchanan and her colleagues working on the Chessie BIBI.

Benthic Index of Biotic Integrity – Data

- BIBI scores by bioregion were converted to report card scoring scale
- Example of the UNP bioregion:

Table 5. Index scores used as thresholds to separate the narrative rating categories for the order-, family- and genus-level index scores. Thresholds were defined by the 50th, 25th, and 10th Reference percentiles and half of the value of the 10th percentile.

Narrative Rating Threshold:		Very Poor | Poor	Poor | Fair	Fair | Good	Good | Excellent
Bioregion Indices					
BLUE	Family	30.90	61.70	82.20	92.10
CA	Family	27.90	55.80	69.50	78.60
LNP	Family	35.20	70.30	80.20	91.30
MAC	Family	22.70	45.40	63.20	76.80
NAPU	Family	17.90	35.90	47.40	61.90
NCA	Family	15.70	31.50	56.30	78.70
NRV	Family	19.10	38.20	50.80	75.00
PIED	Family	30.30	60.60	73.20	81.80
SEP	Family	16.30	32.60	56.70	83.90
SGV	Family	29.90	59.90	66.00	76.50
SRV	Family	21.60	43.20	58.00	71.90
UNP	Family	31.30	62.60	69.90	80.50

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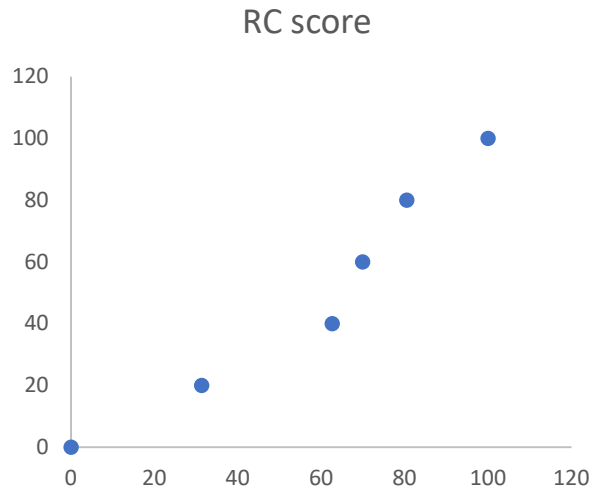
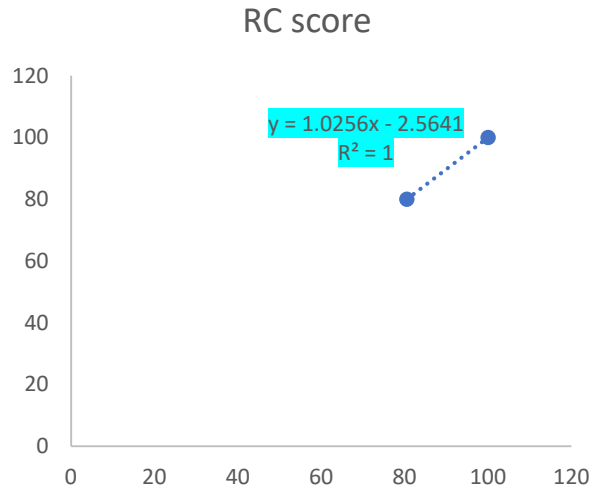
UNP	Family	31.30	62.60	69.90	80.50



UNP score	RC score	Equation
100	100	y = 1.0256x - 2.5641
80.5	80	y = 1.8868x - 71.887
69.9	60	y = 2.7397x - 131.51
62.6	40	y = 0.639x + 6E-14
31.3	20	y = 0.639x + 4E-15
0	0	



Total nitrogen, total phosphorus, turbidity

- Data acquired from:
  - The Chesapeake Bay Program Data hub
    - https://www.chesapeakebay.net/what/downloads/cbp_water_quality_database_1984_present
  - EPA Water Quality Data (WQX)
    - https://www.epa.gov/waterdata/water-quality-data-wqx
      - USGS State Water Quality programs
      - State Water Quality Programs
  - Chesapeake Monitoring Cooperative(CMC)
    - https://cmc.vims.edu/
- Data spans the time period of 2012-2017
- Water quality parameters:
  - Total Nitrogen (mg/L)
  - Total Phosphorus (mg/L)
  - Turbidity (NTU)
- Duplicate measurements between WQX and CBP database removed

TN, TP, & Turbidity – Scoring Methods

- Assign scores of 0-5 to each sampling value based on bio region
- Average the 0-5 scores for a station score
- Calculate HUC12 score by averaging the scores of each station in each HUC12
- Determine the percent area for each HUC12 in the Region with a score
- Multiply the HUC12 score(20* score) * (HUC12 .area/Region.area)
- Sum the resulting HUC12 score into an overall region score

Stewardship Index – Background

- Are citizens practicing behaviors that are beneficial to the watershed's health?
- Goal (chesapeakeprogress.com) - Increase the number and diversity of trained and mobilized citizen volunteers who have the knowledge and skills needed to enhance the health of their local watersheds.
- Contacts: Steve Raabe at OpinionWorks, Kacey Wetzel at Chesapeake Bay Trust, Amy Handen at Chesapeake Bay Program

Stewardship Index – Data

- Data comes from the 2017 Baseline Citizen Stewardship Indicator survey issued by OpinionWorks
  - ❖Link: https://www.chesapeakeprogress.com/engaged-communities/citizen-stewardship
- The survey provided a comprehensive dataset
  - 5000+ respondents
  - 32 Questions
- The index uses questions from three categories
  - Behaviorism – 20 questions
  - Volunteerism – 5 questions
  - Civic Engagement – 2 questions

Stewardship Index – Scoring

- We used OpinionWorks' Survey results to calculate regional scores, based on respondent ZIP codes
- We attempted to duplicate the methods that OpinionWorks established
- Weighting
  - ❖Each ZIP code was weighted according to 2010 Census populations
- We did not adjust the weight by demographics since we didn't have that information at the zip code level

Hunting and Fishing Licenses – Background

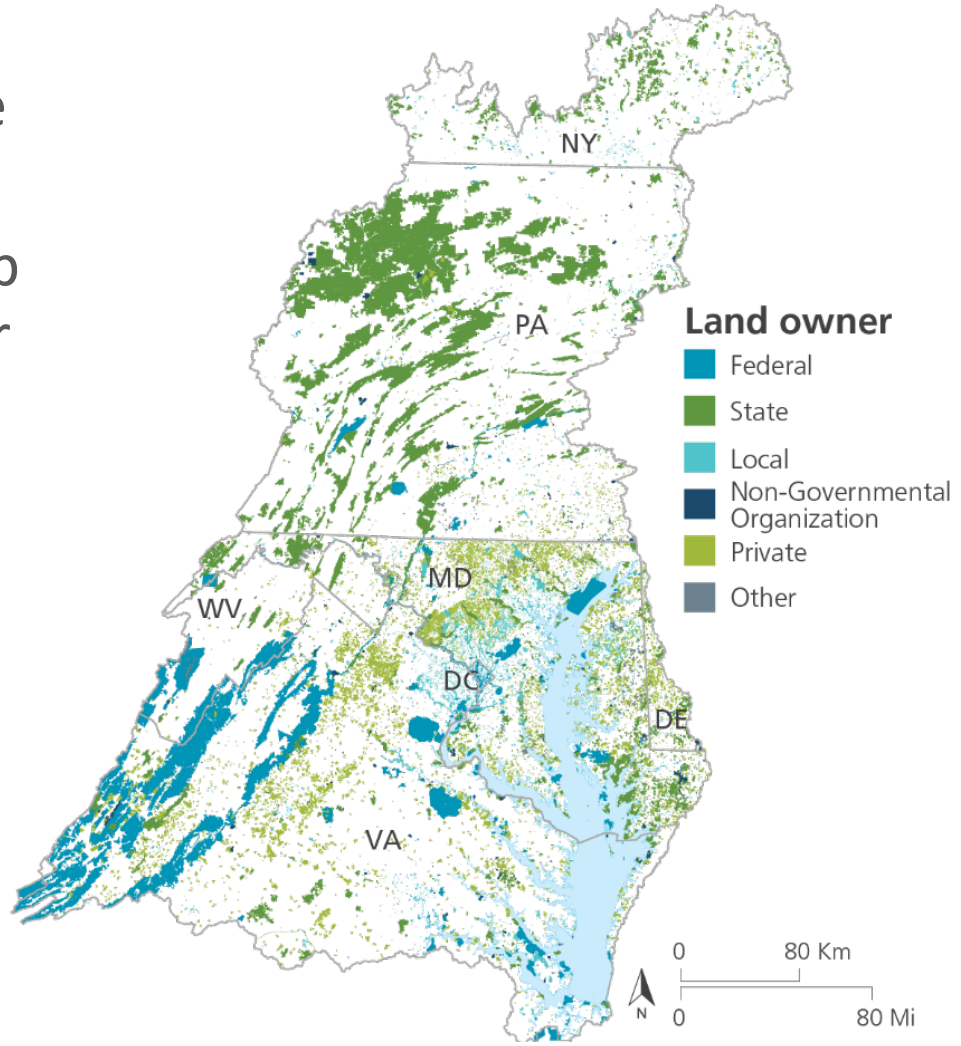
- Data from the Wildlife & Sport Fish Restoration Program
- Data is yearly and only on the state wide level
  - No regional or local data
  - Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and DC
  - No hunting licenses are sold in DC, so only fishing license data was used
- This indicator can only be calculated at the watershed level
- Methods were replicated from those used in the Mississippi River Watershed Report Card

Hunting and Fishing Licenses – Data & Scoring

- Included data for each state from 2009-2019.
- Found the maximum and minimum values from “Total Fishing/hunting Licenses, Tags, Permits & Stamps” and the total sales range.
- Subtracted each years total sales by the lowest sales and divided it by the range gives the % range and score for each year.
- Total fishing licenses of the past 3 years (2017-2019) were averaged to calculate the final grade for each state.

Protected (conserved) lands indicator – Background

- Protected lands data came from Chesapeake Progress (CBP)
- In the 2017 report card we included this map of the protected lands by type of land owner
- Data was last updated in 2018
- Contacts: Renee Thompson and Nora Jackson (CBP)



Protected Lands Indicator – Data

- Protected lands raster provided by Chesapeake Progress (CBP)
- In ArcGIS, raster was split by reporting regions (extract by mask)
- This data was exported to excel
- The pixel numbers were converted to acreage by using (count x 25)/4046.86.
- Methods were recommended by Renee Thompson (USGS- CBP)