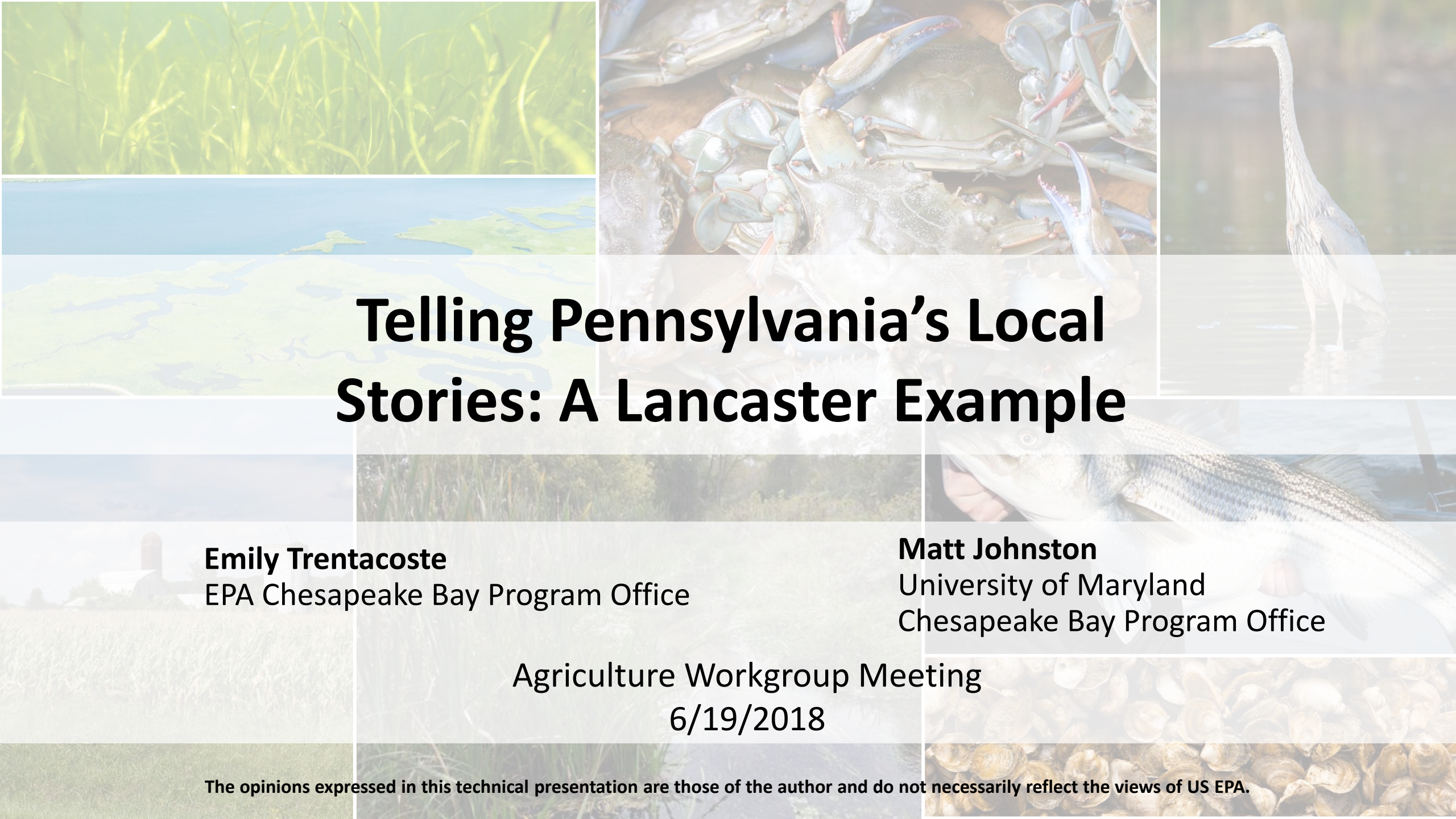


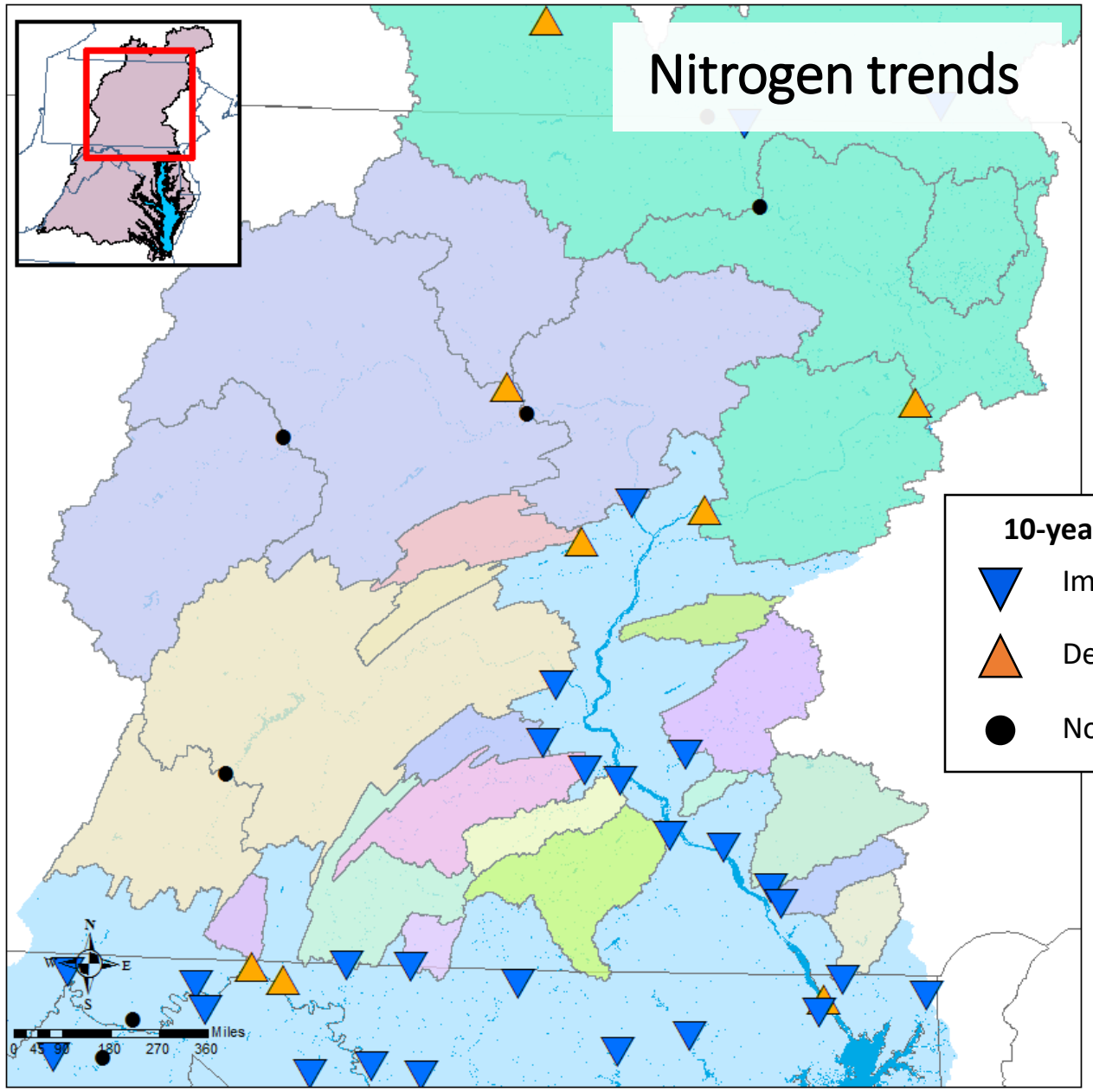
Telling Pennsylvania's Local Stories: A Lancaster Example

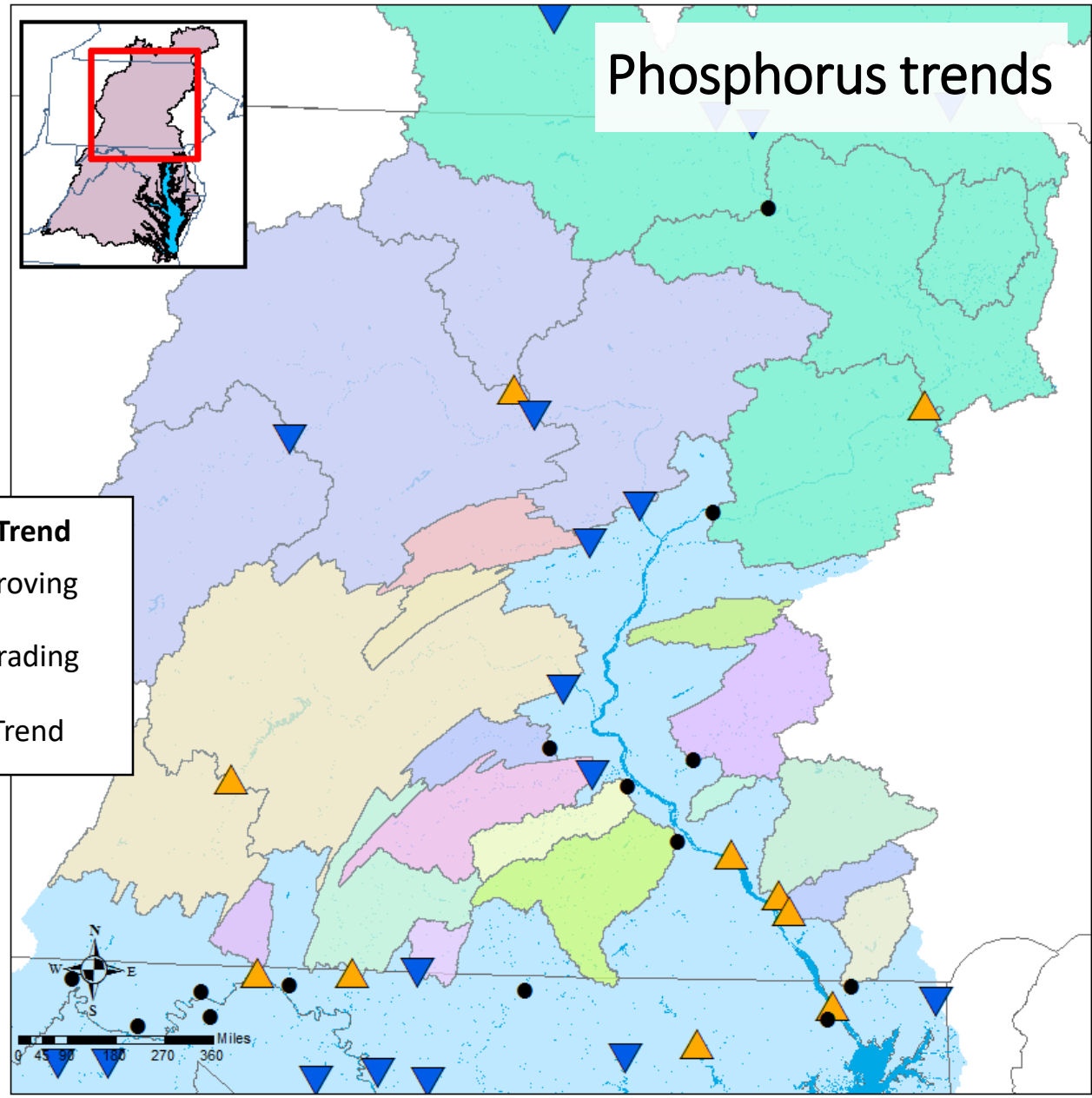
Emily Trentacoste
EPA Chesapeake Bay Program Office

Matt Johnston
University of Maryland
Chesapeake Bay Program Office

Agriculture Workgroup Meeting
6/19/2018

Water quality trends vary geographically and patterns are changing

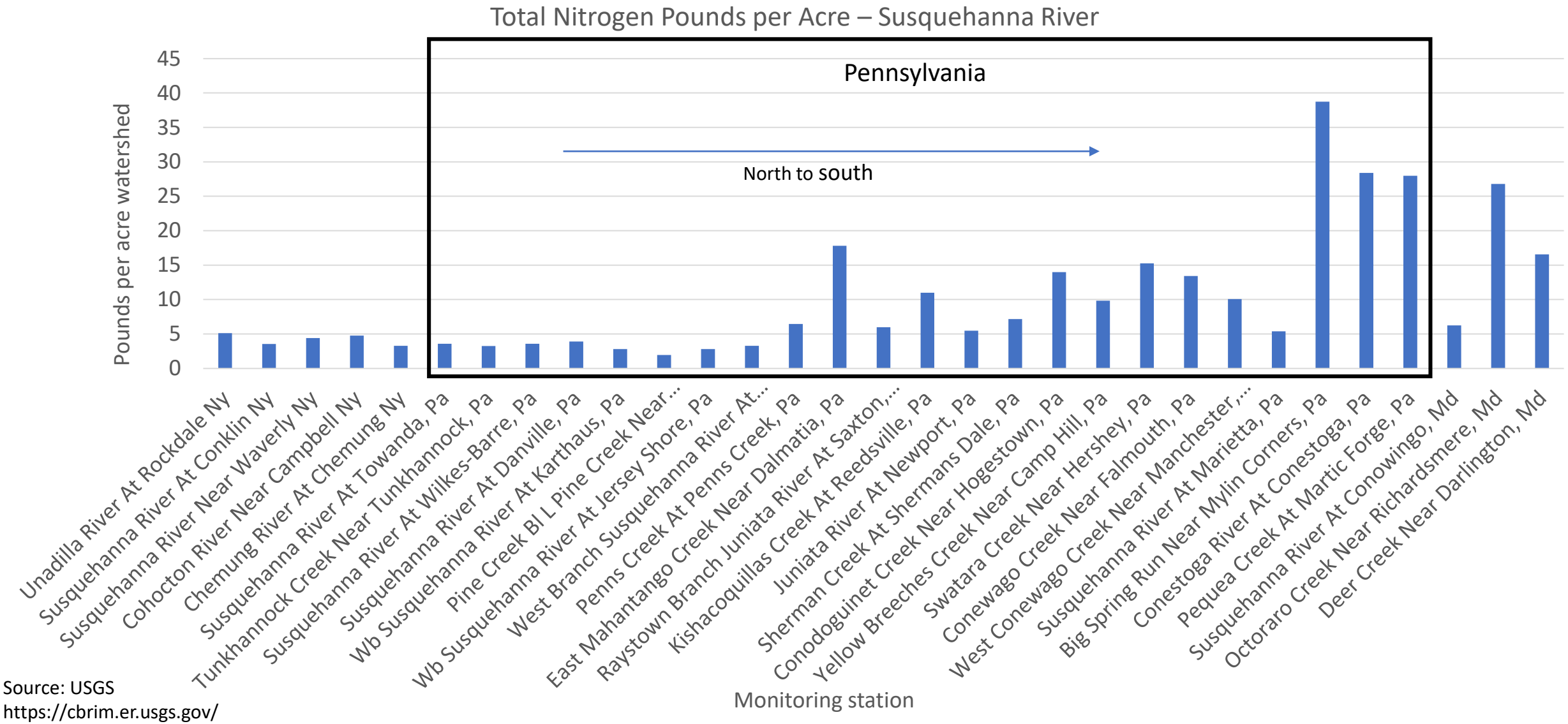




USGS. https://cbrim.er.usgs.gov

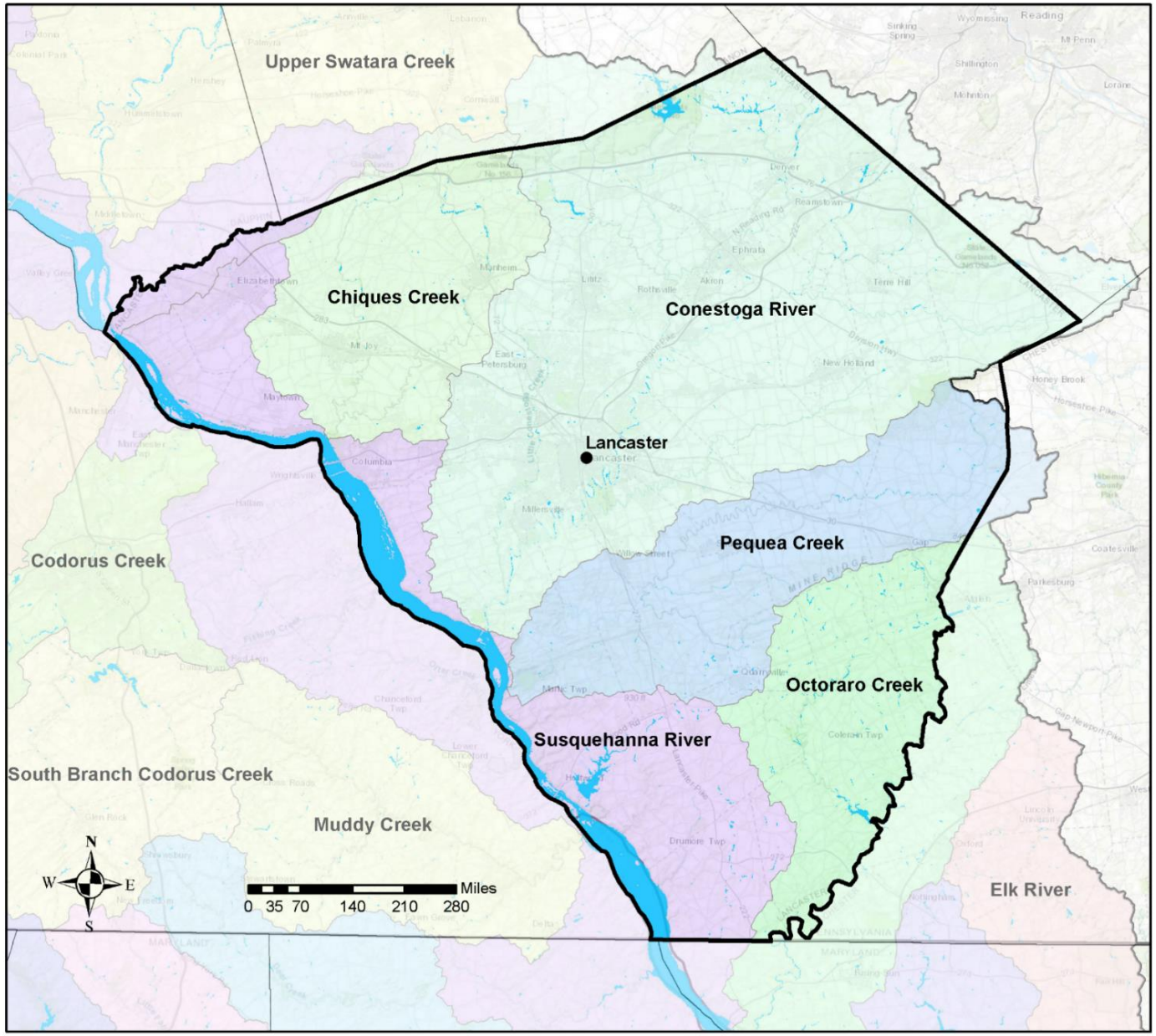
Water quality trends vary geographically and patterns are changing

Monitoring shows that some Pennsylvania watersheds, especially in the Lower Susquehanna, generate some of the highest amounts of nitrogen, phosphorus and sediment in the Chesapeake Bay watershed.



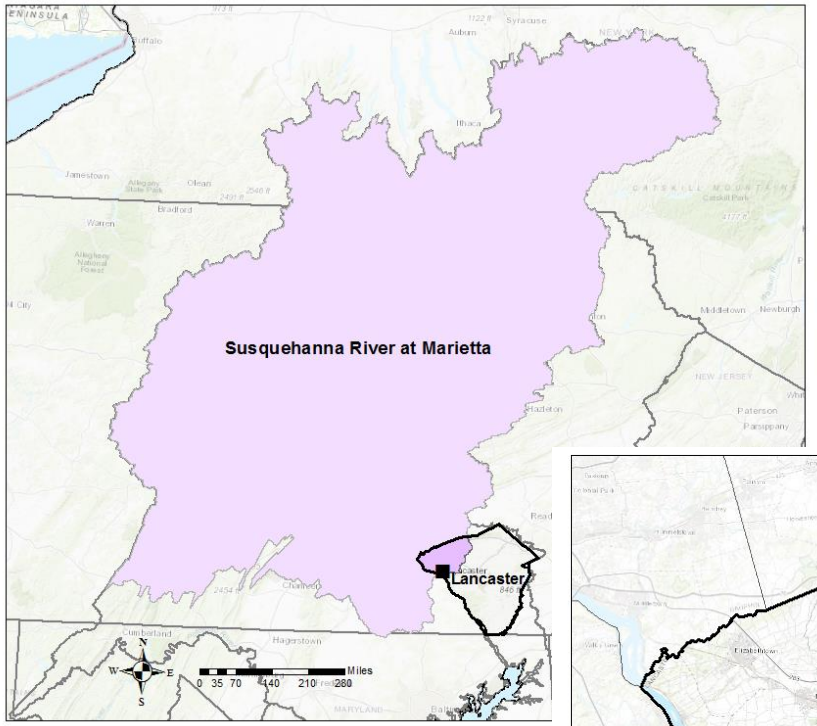
Source: USGS
https://cbrim.er.usgs.gov/

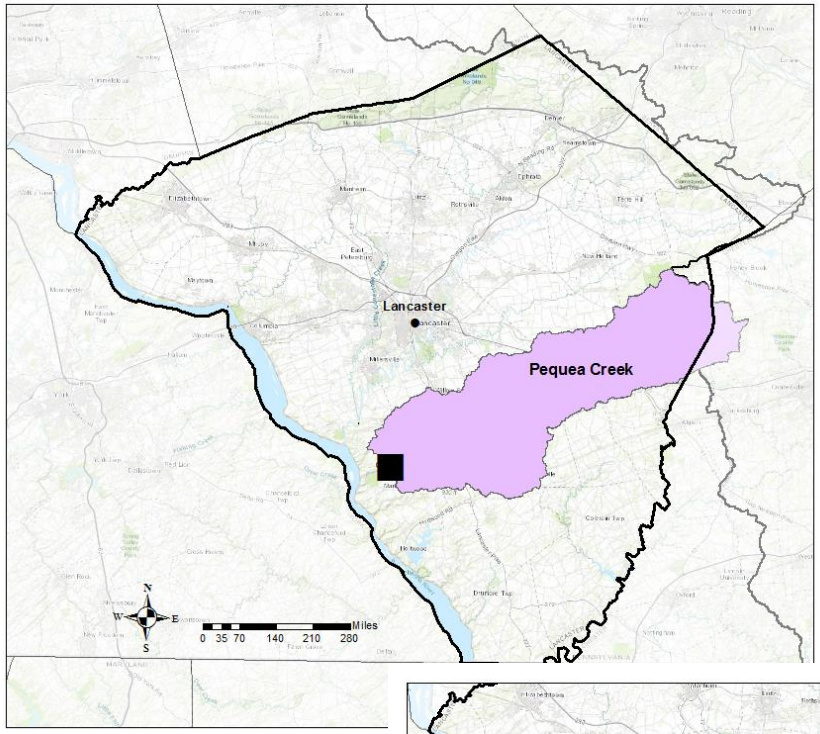
Water quality trends vary geographically and patterns are changing

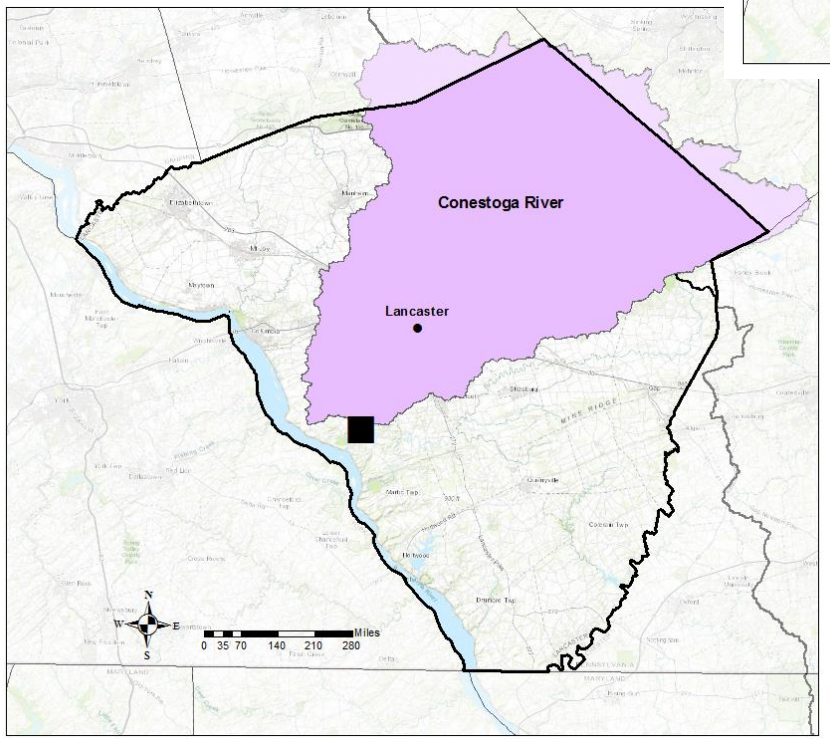


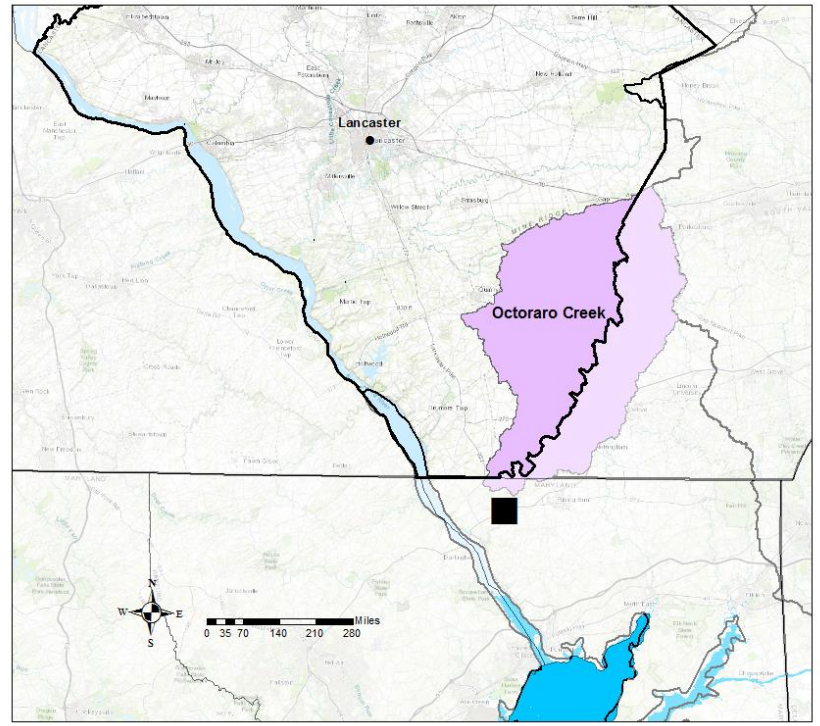
USGS. https://cbrim.er.usgs.gov

Example: Water quality in Lancaster County watersheds

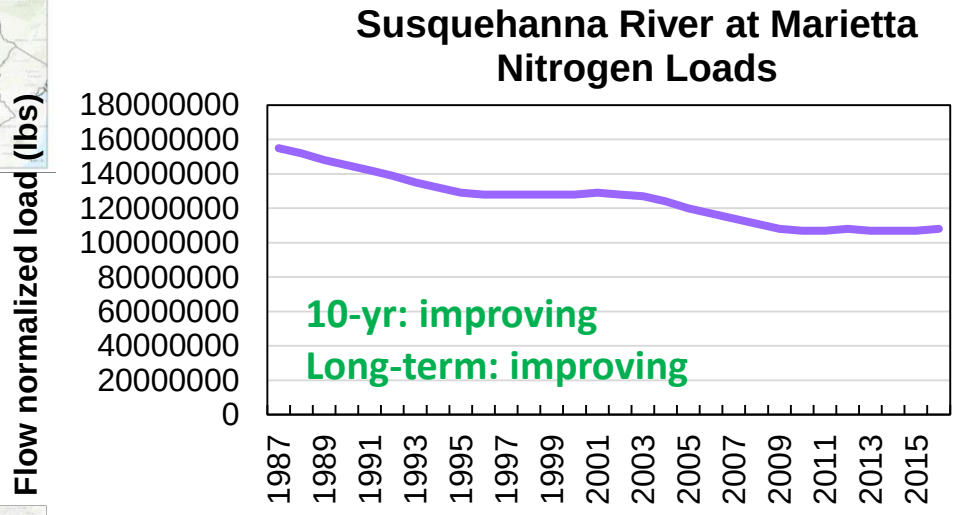


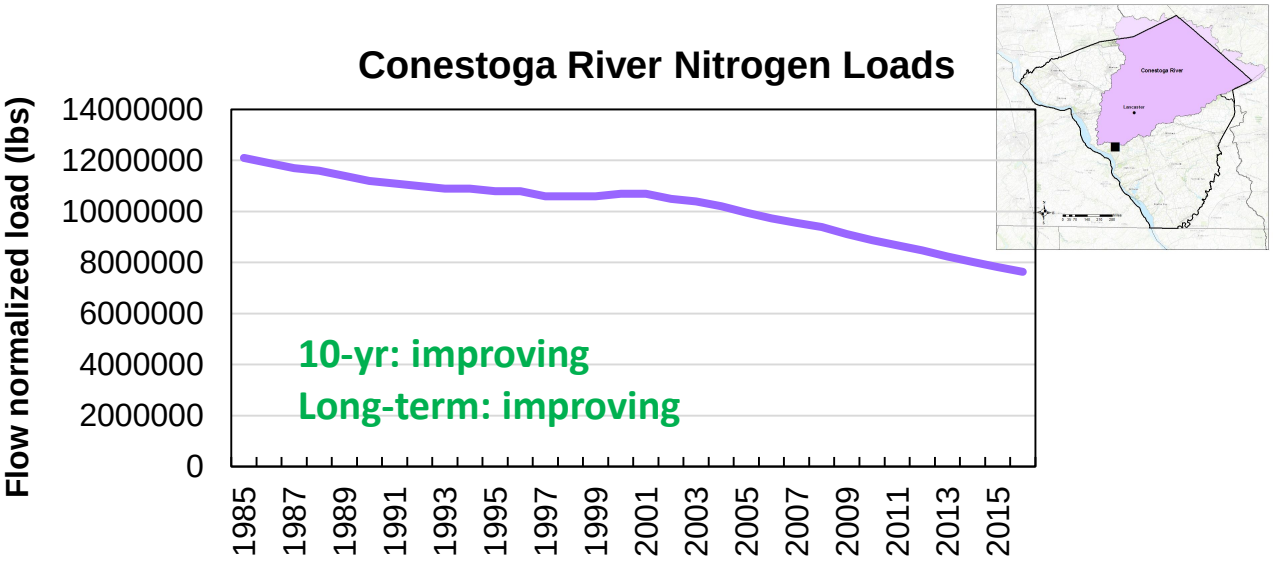


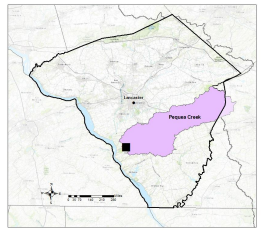


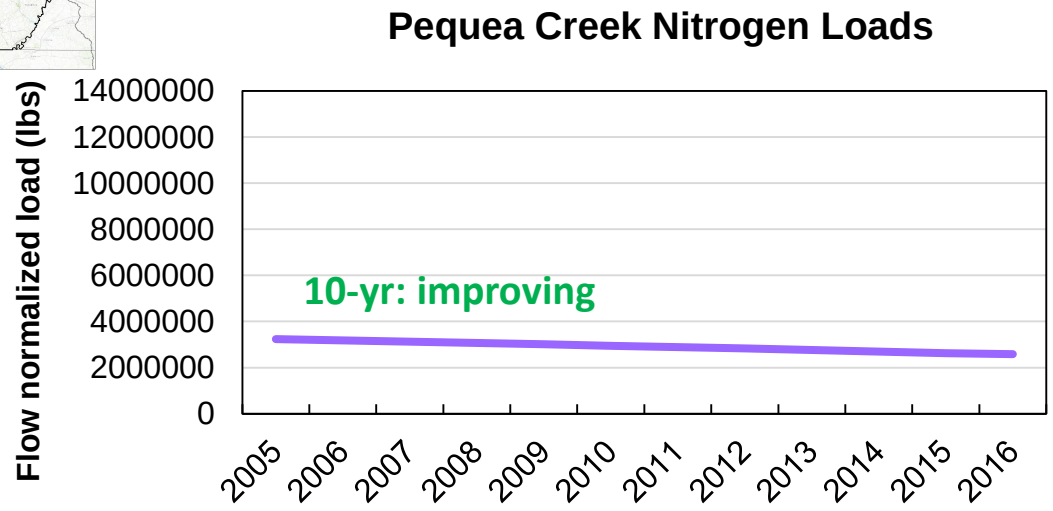


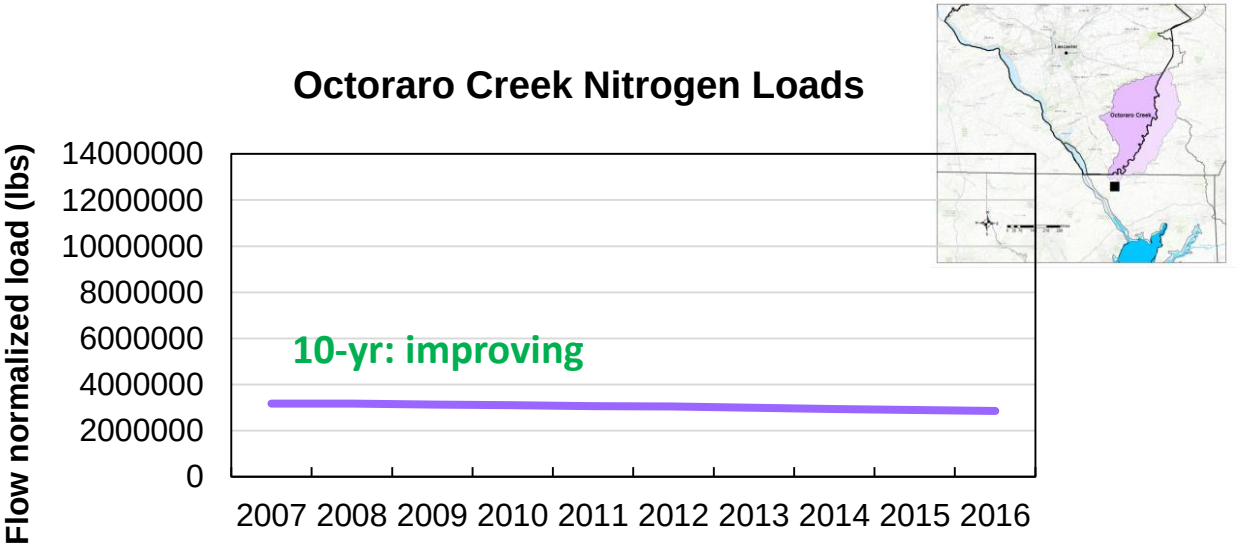
Example: Water quality in Lancaster County watersheds: nitrogen





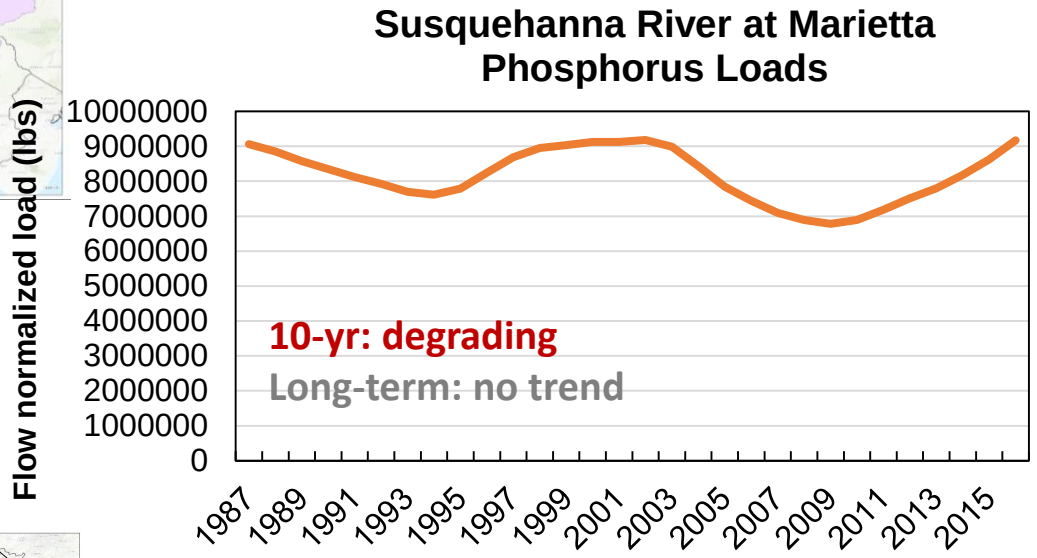


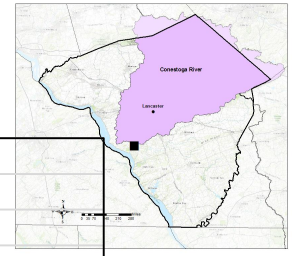


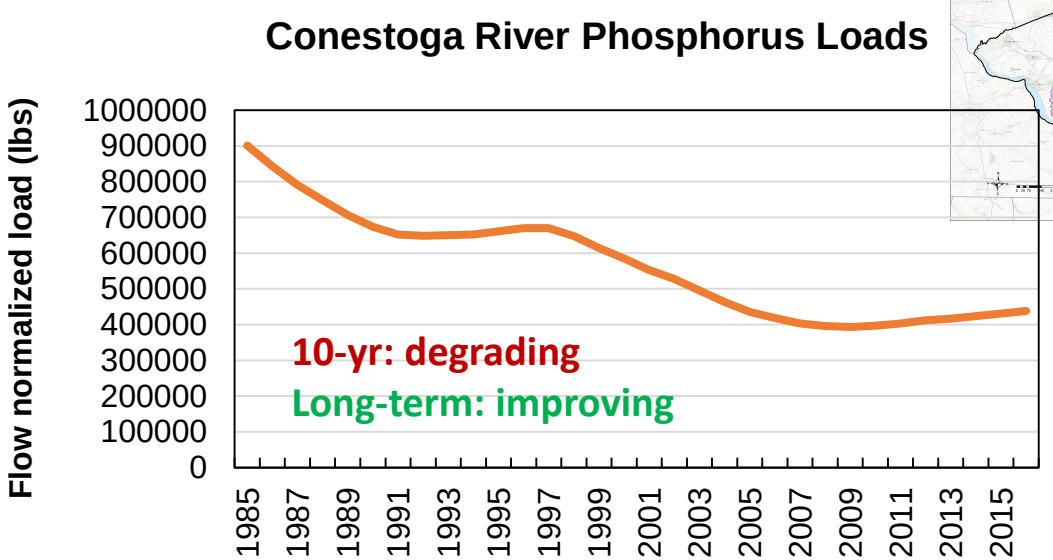


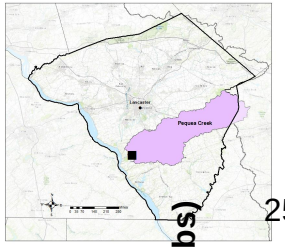
USGS. https://cbrim.er.usgs.gov

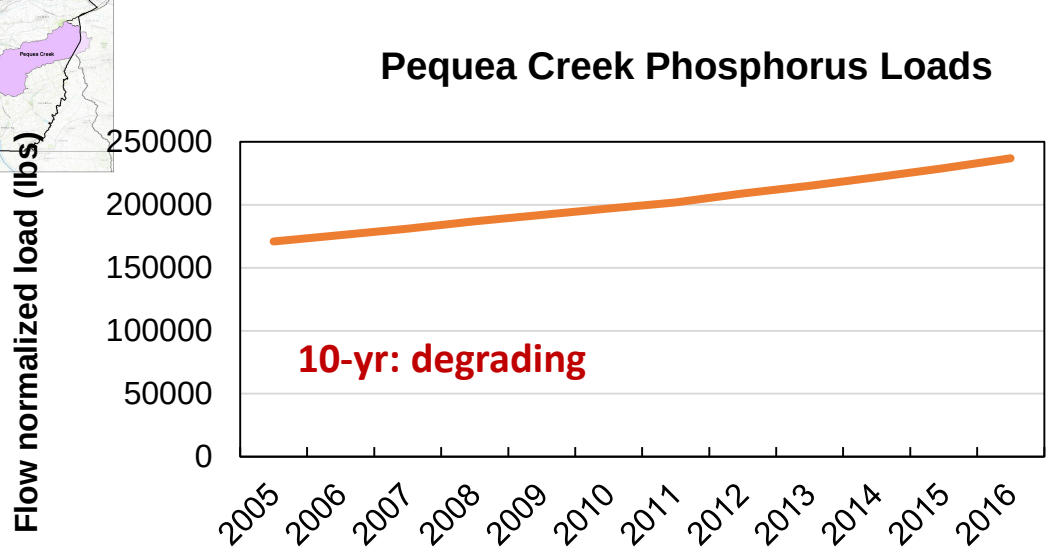
Example: Water quality in Lancaster County watersheds: phosphorus

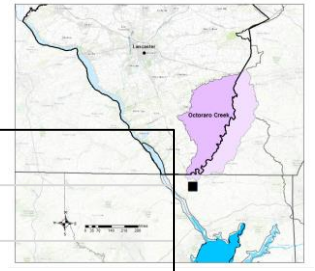


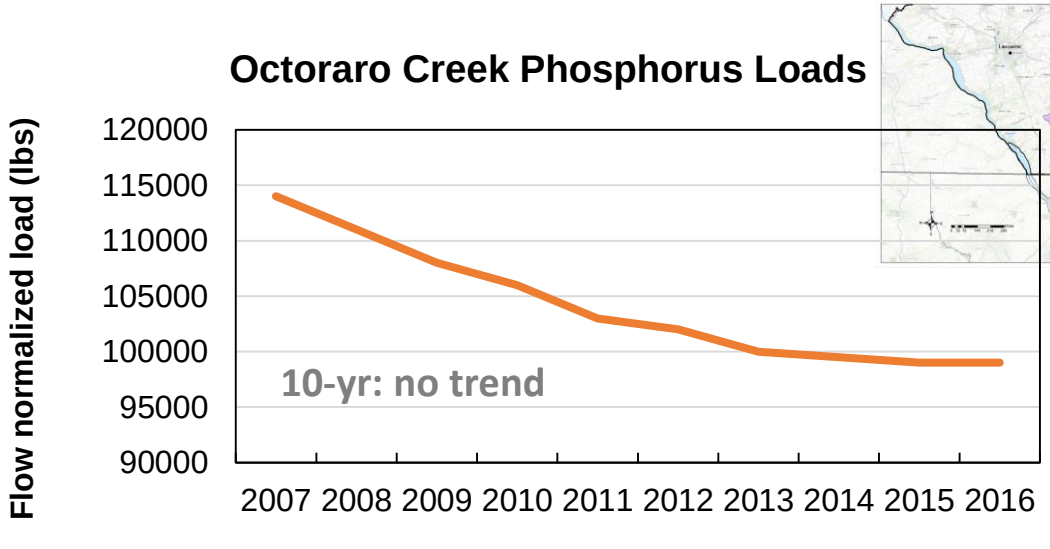






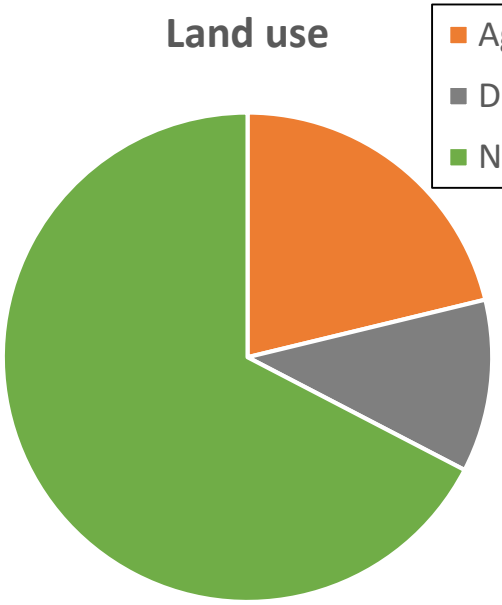




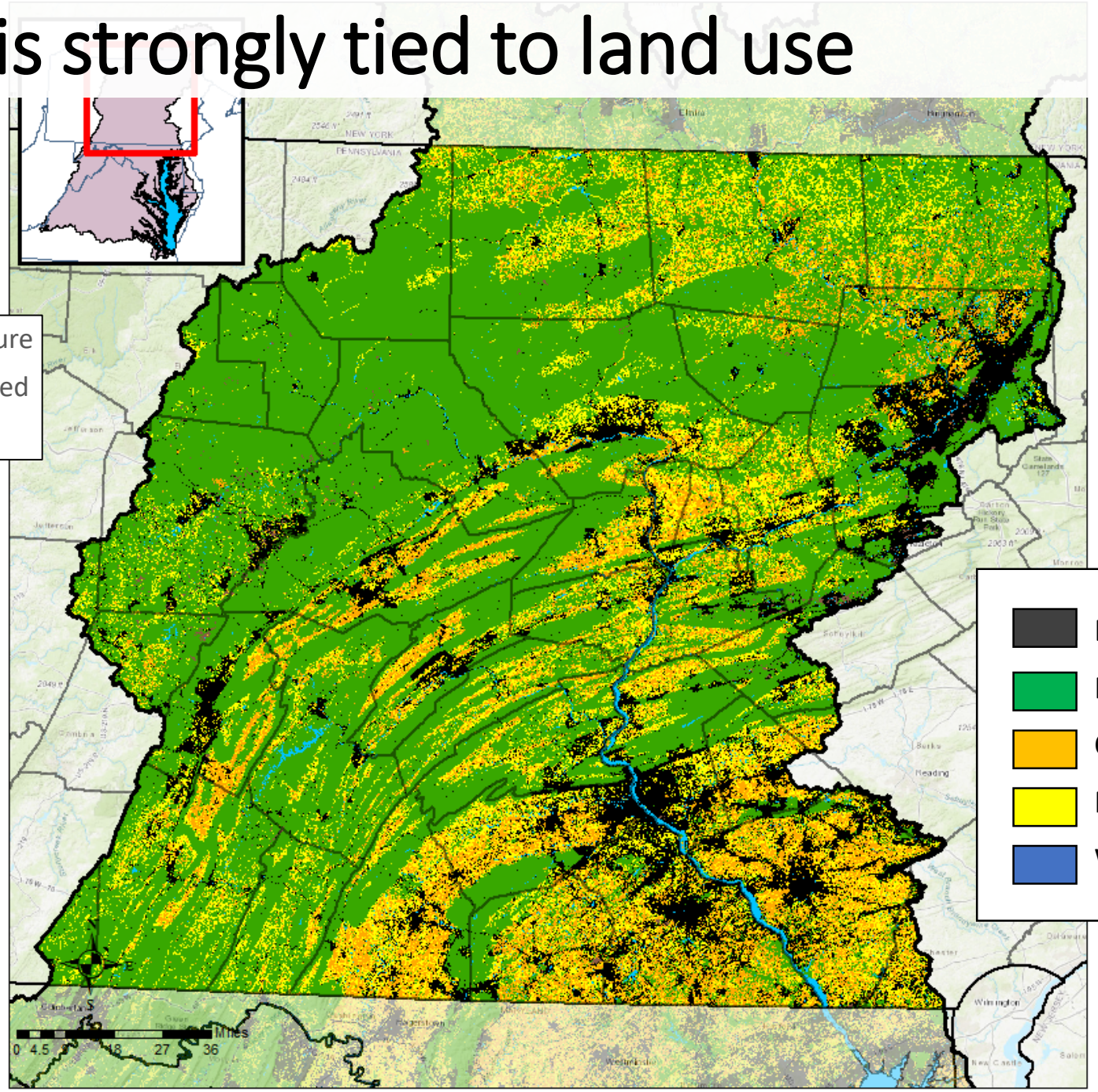


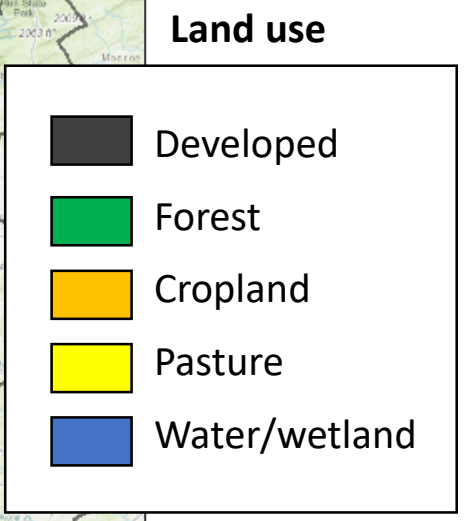
USGS. https://cbrim.er.usgs.gov

Water quality is strongly tied to land use



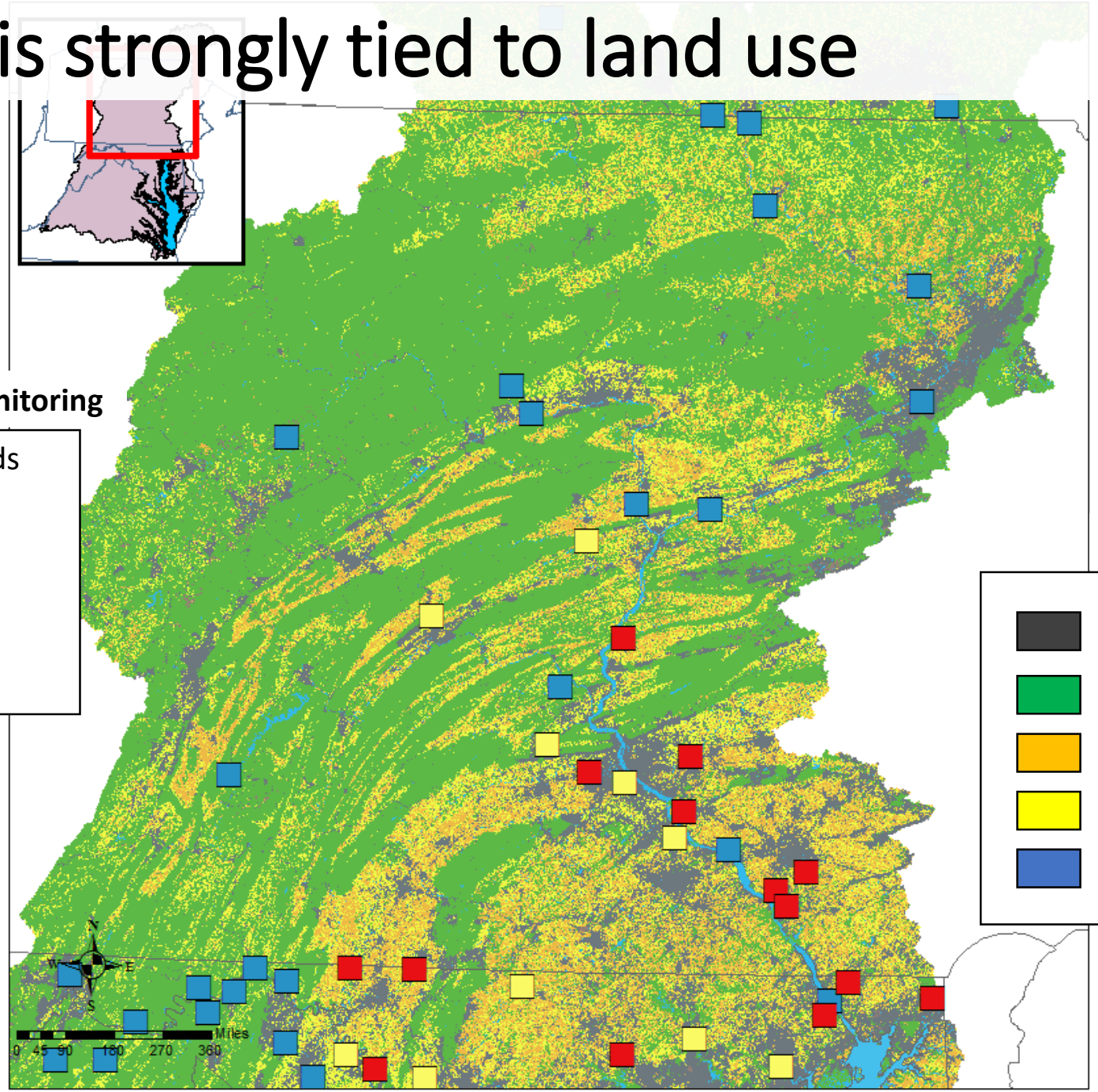
Chesapeake Bay Program Phase 6 Watershed Model. 2016 Progress V9. http://cast.chesapeakebay.net





Land-use map from USGS. Falcone, 2015.

Water quality is strongly tied to land use



Loads from USGS. https://cbrim.er.usgs.gov

Chesapeake Bay Program Phase 6 Watershed Model. 2016 Progress V9. http://cast.chesapeakebay.net

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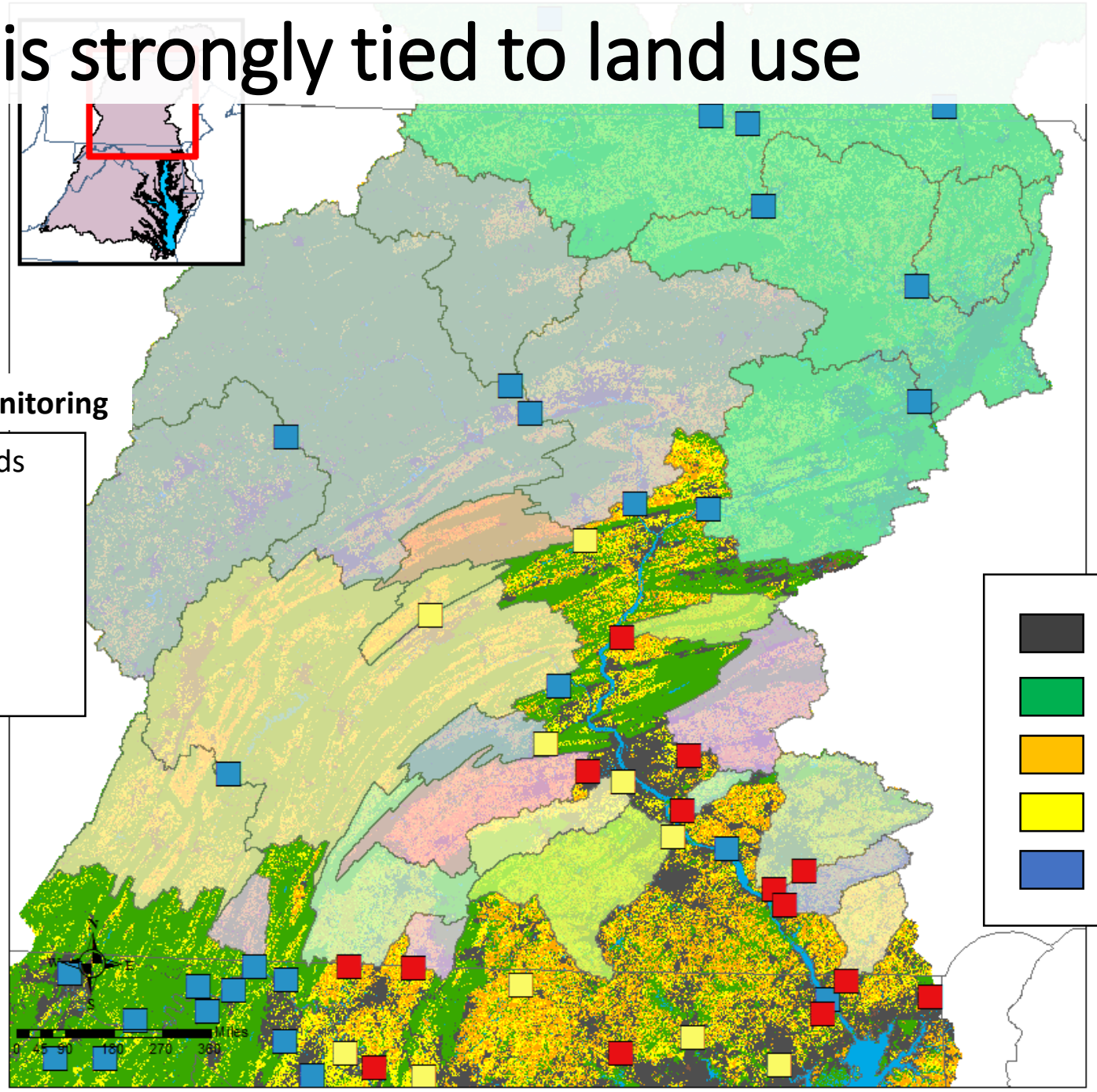


Loads from USGS. https://cbrim.er.usgs.gov

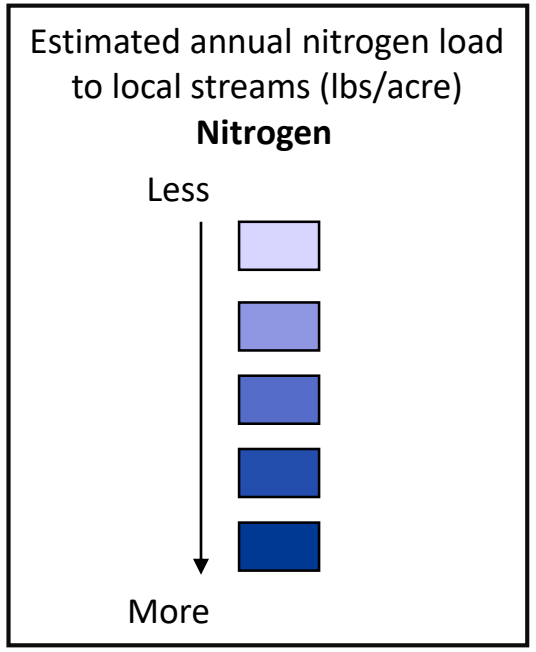
Chesapeake Bay Program Phase 6 Watershed Model. 2016 Progress V9. http://cast.chesapeakebay.net

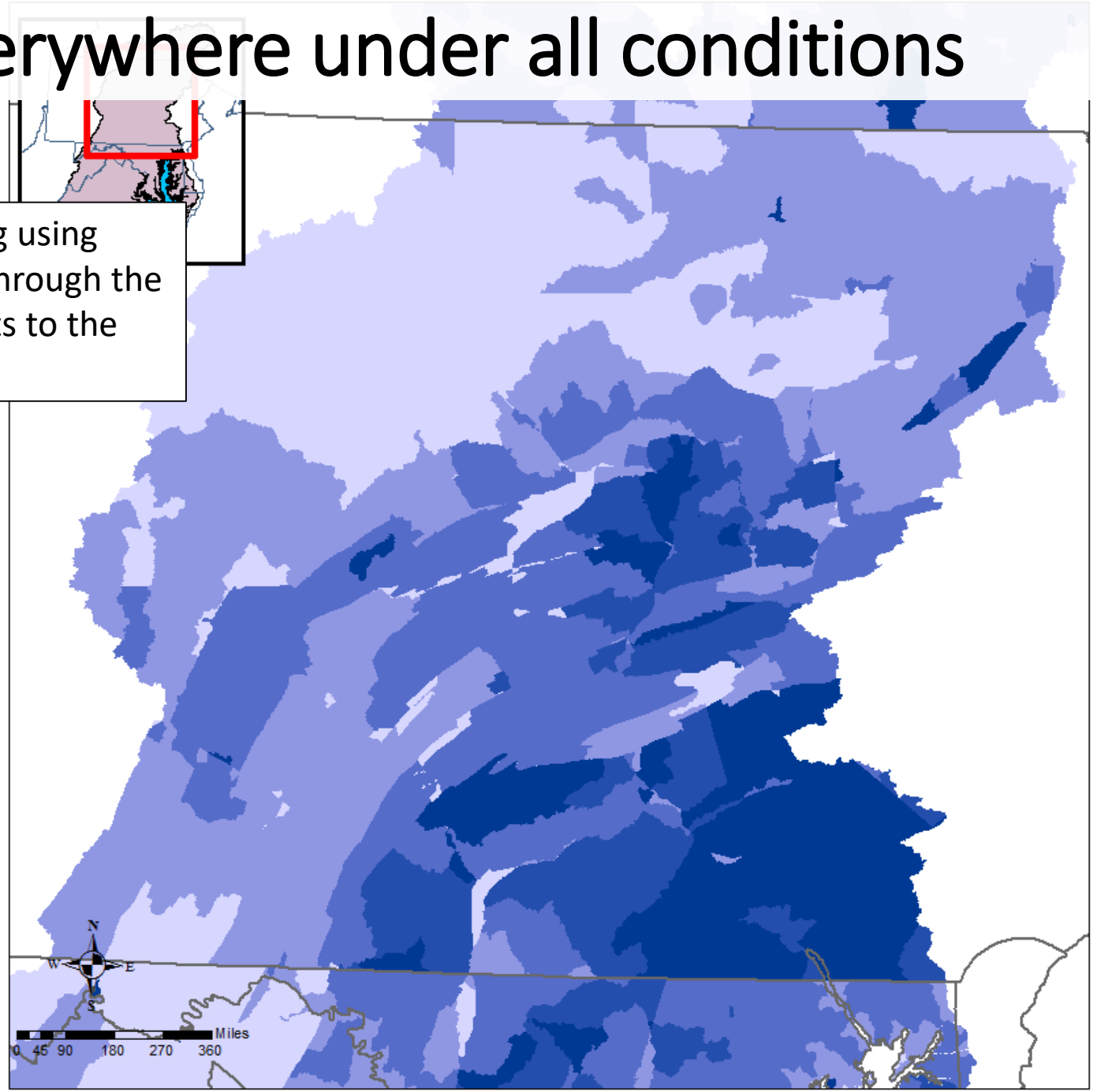
Land-use map from USGS. Falcone, 2015.

We can’t monitor everywhere under all conditions

Models are built off water quality monitoring using research that explains how nutrients move through the watershed, and incorporating reported inputs to the watershed

Bay Program Watershed Model





Chesapeake Bay Program Phase 6 Watershed Model.
2016 Progress V9. http://cast.chesapeakebay.net

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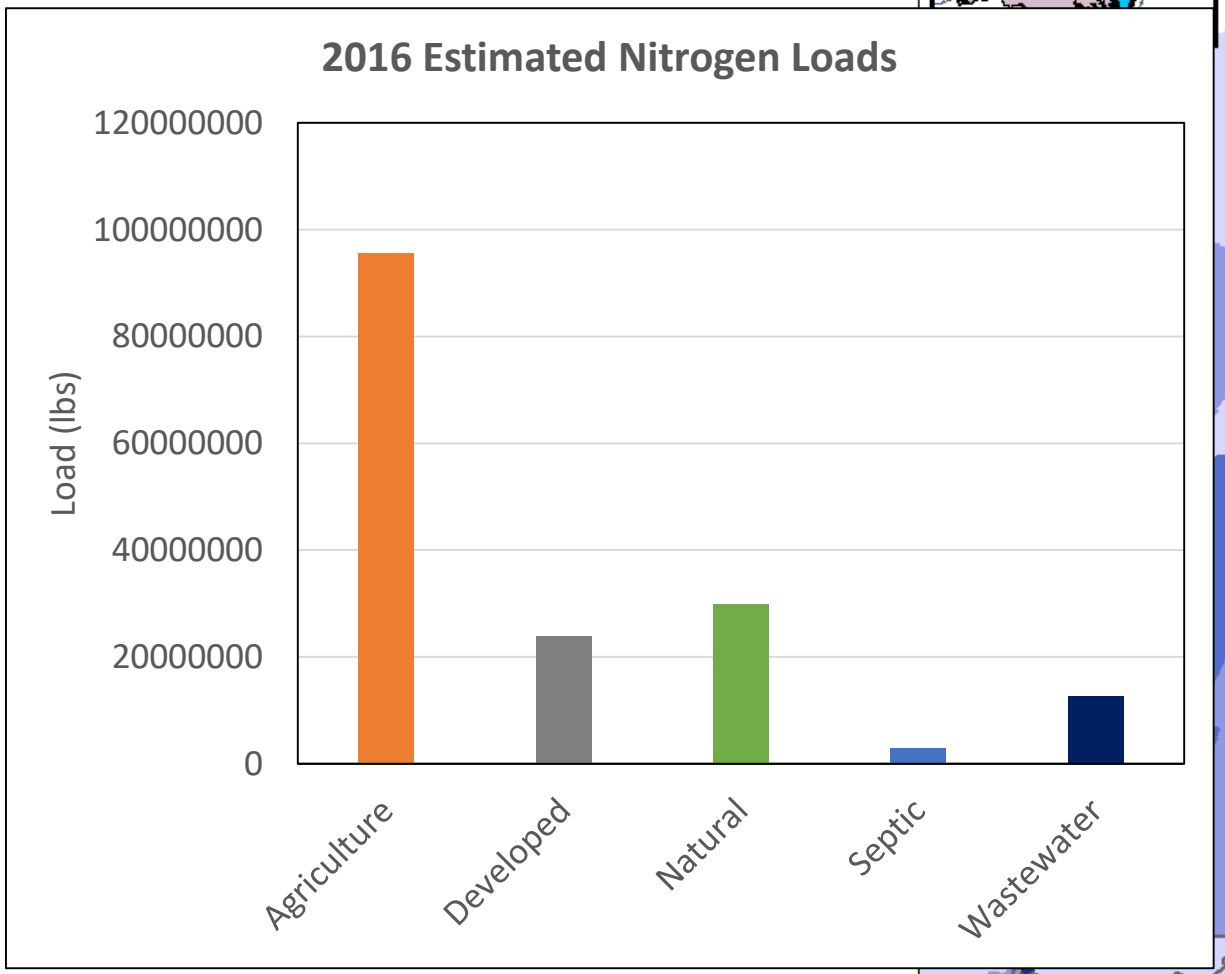
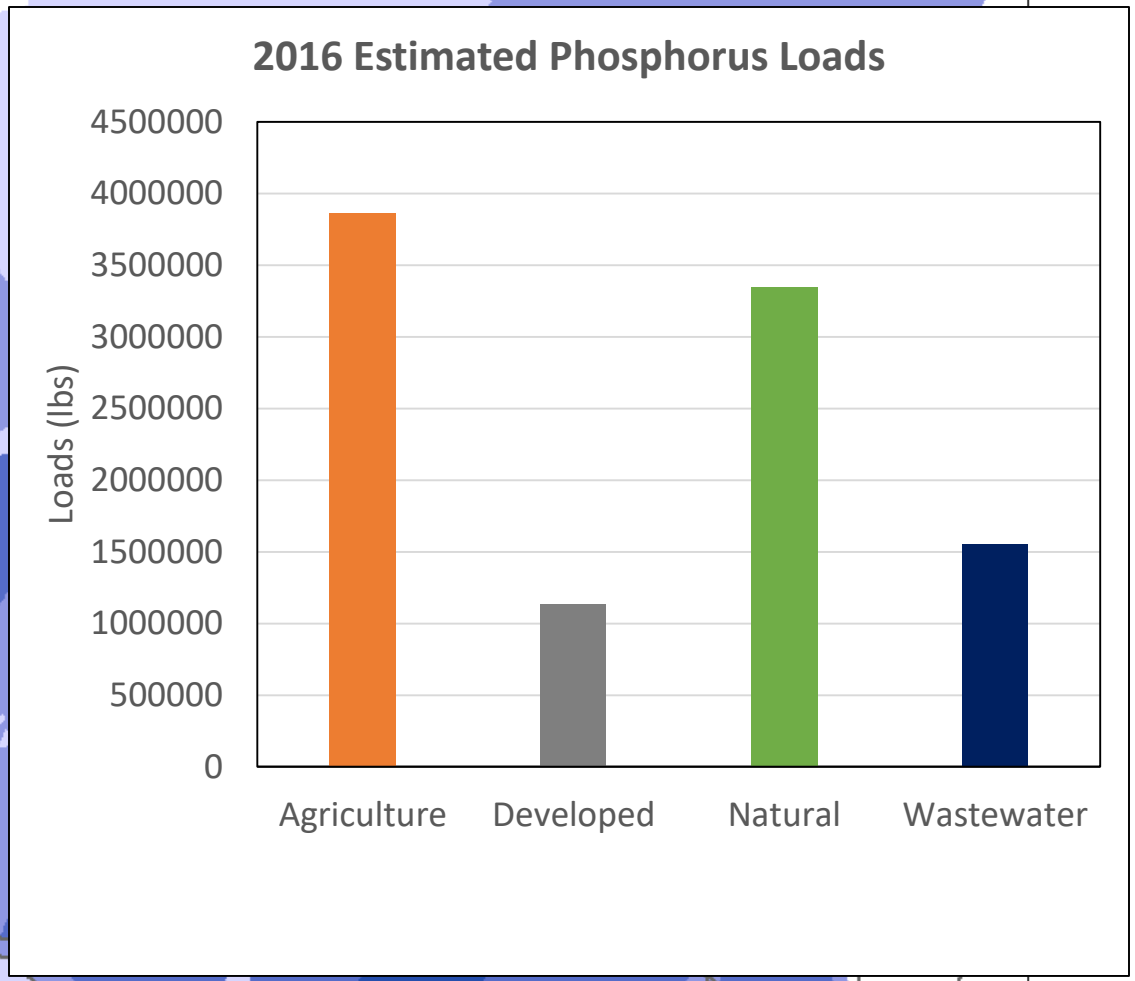
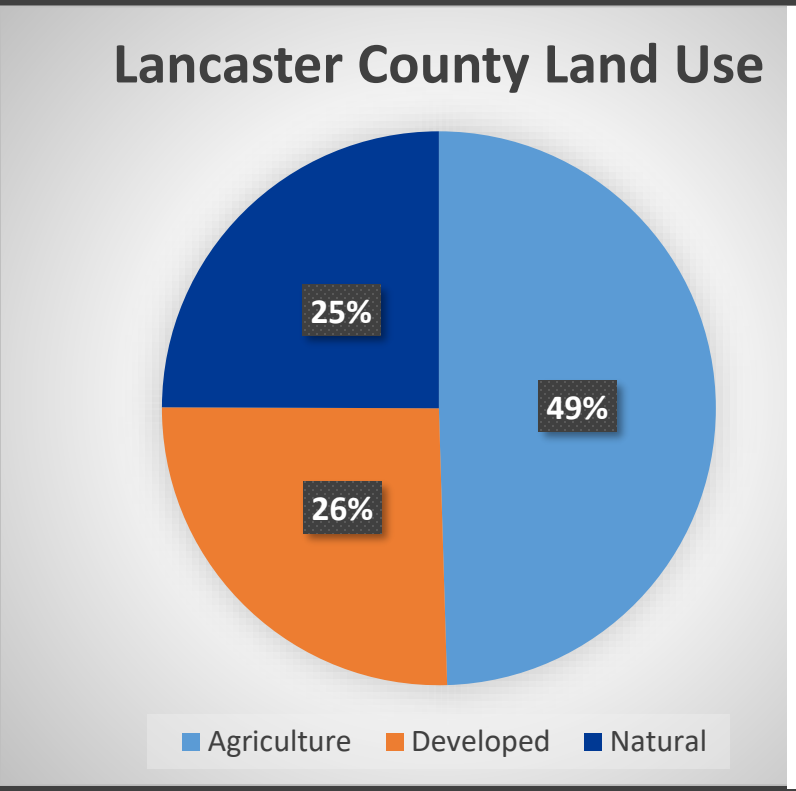
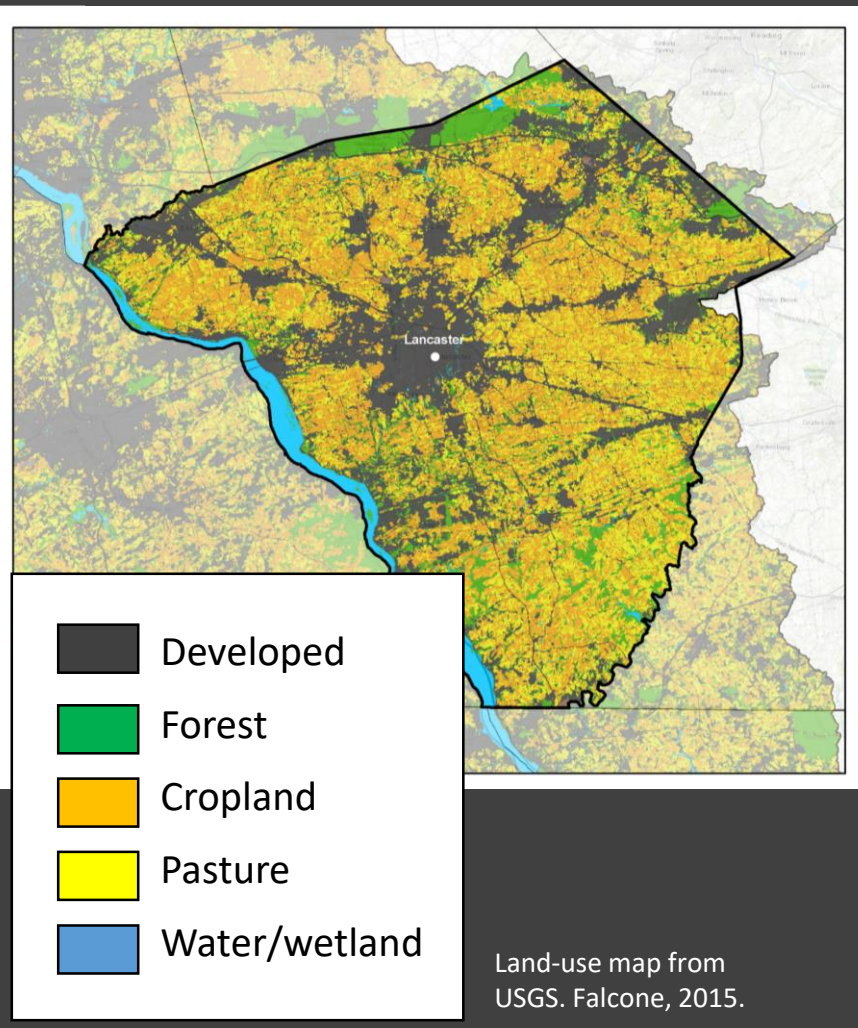


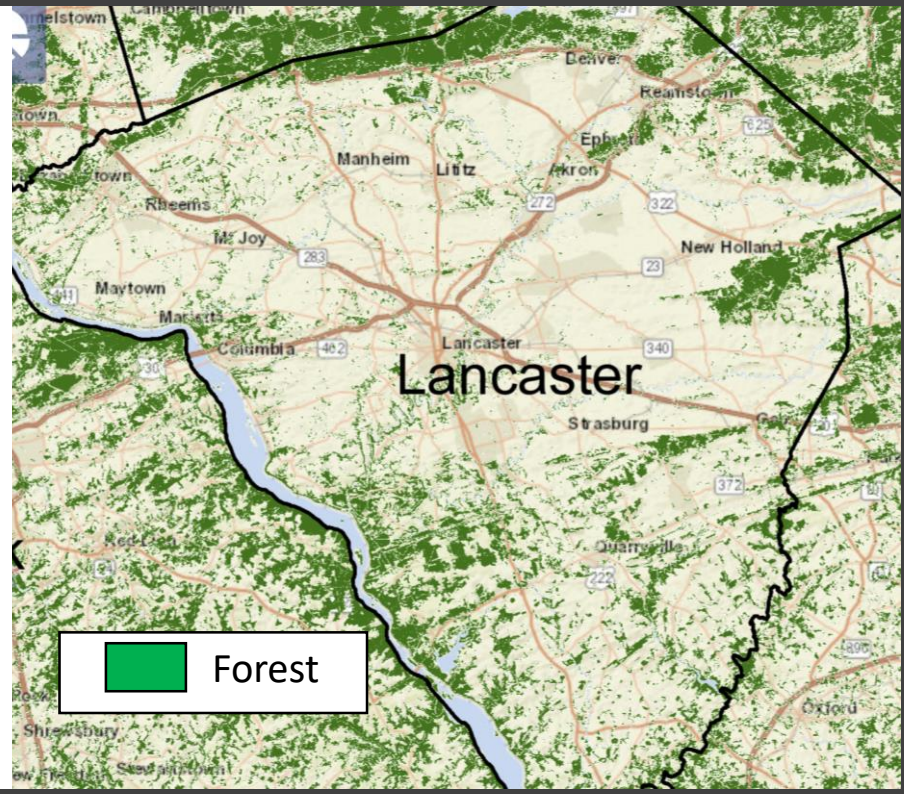


Chesapeake Bay Program Phase 6 Watershed Model. 2016 Progress V9. http://cast.chesapeakebay.net

Lancaster County has much less forested land than most other Pennsylvania counties





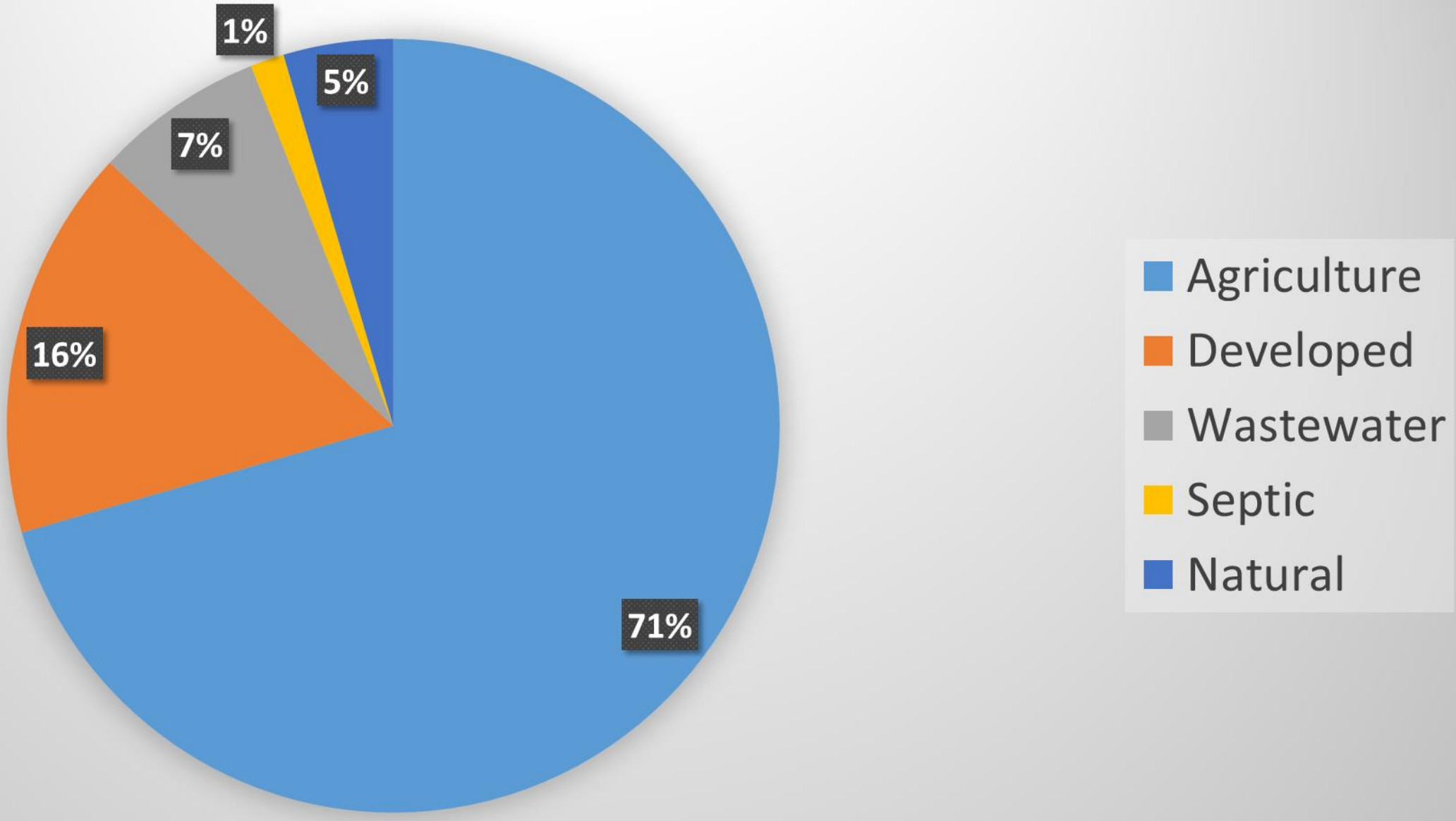


Phase 6 land use coverage available at https://chesapeake.usgs.gov/phase6/map/

Land-use map from USGS. Falcone, 2015.

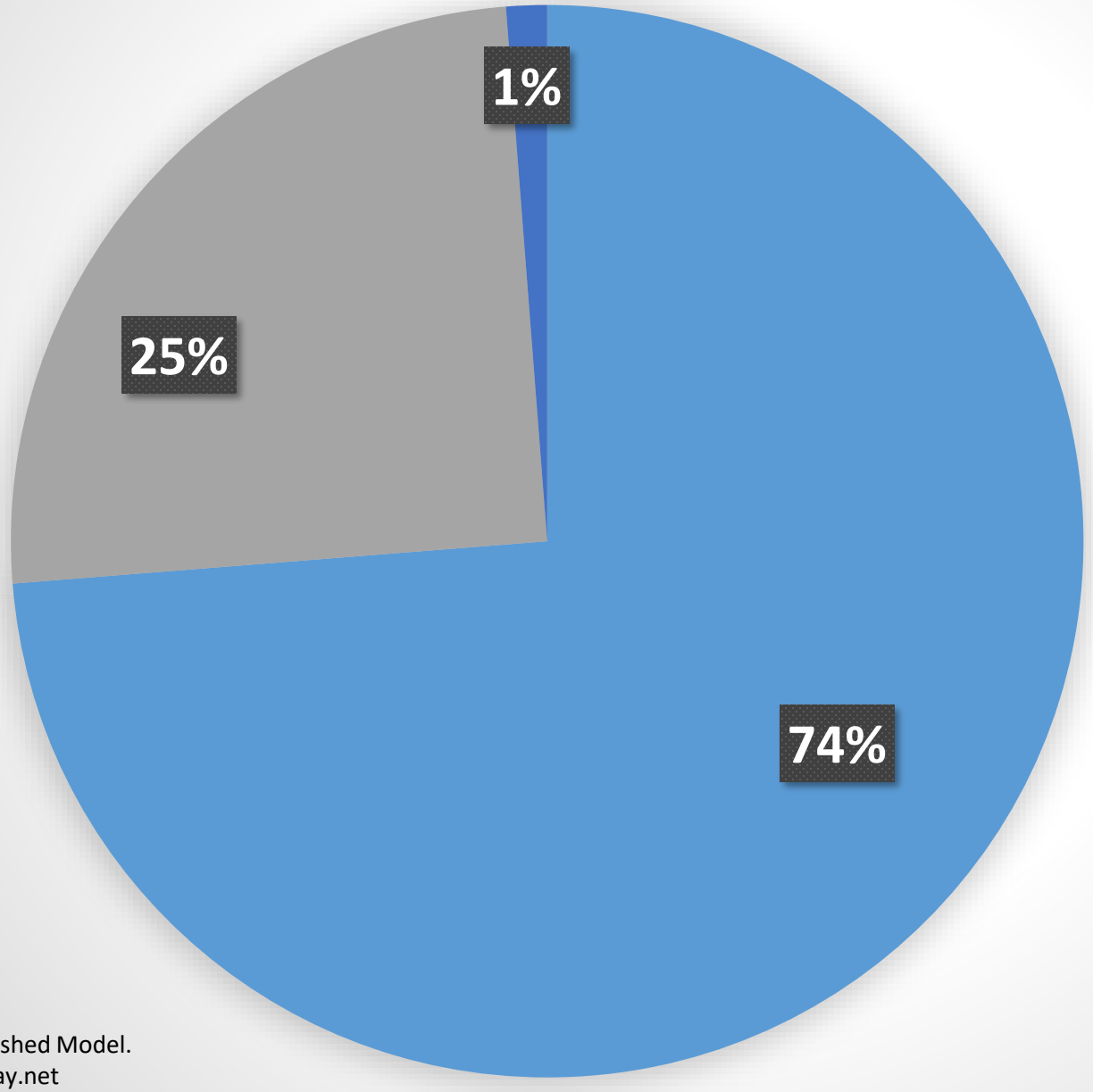
Google Earth

Lancaster, PA 2016 Nitrogen Delivery to Streams by Sector



Chesapeake Bay Program Phase 6 Watershed Model.
2016 Progress. http://cast.chesapeakebay.net

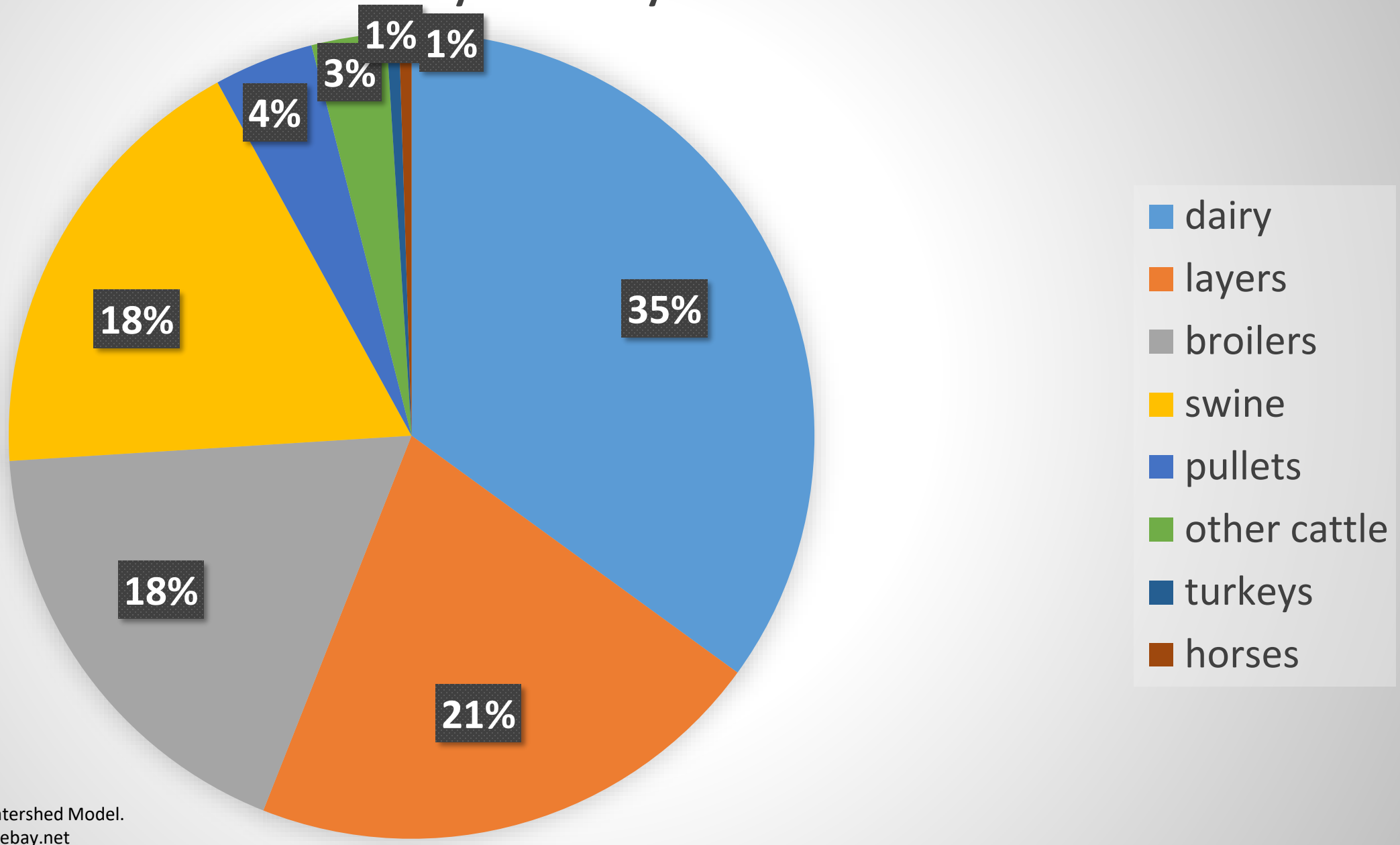
Estimated Share of Nitrogen Applied to Agricultural Land in Lancaster County in 2016 by Main Source



CBPO estimates that application of manure alone almost exceeded crop need in 2016.

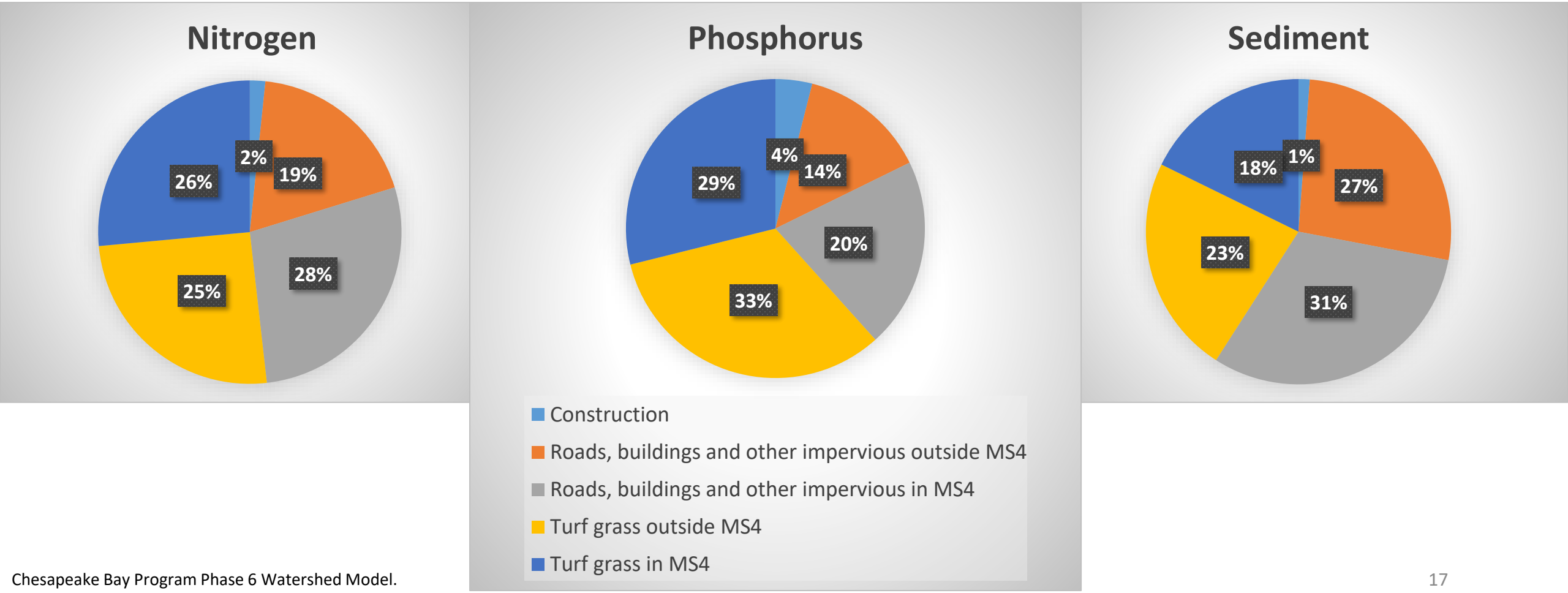
Chesapeake Bay Program Phase 6 Watershed Model. 2016 Progress. http://cast.chesapeakebay.net

Estimated Share of Manure Nitrogen Applied to Agricultural Land in Lancaster County in 2016 by Animal Source



Chesapeake Bay Program Phase 6 Watershed Model.
2016 Progress. http://cast.chesapeakebay.net

Lancaster County Nitrogen delivered to streams from developed/stormwater sector



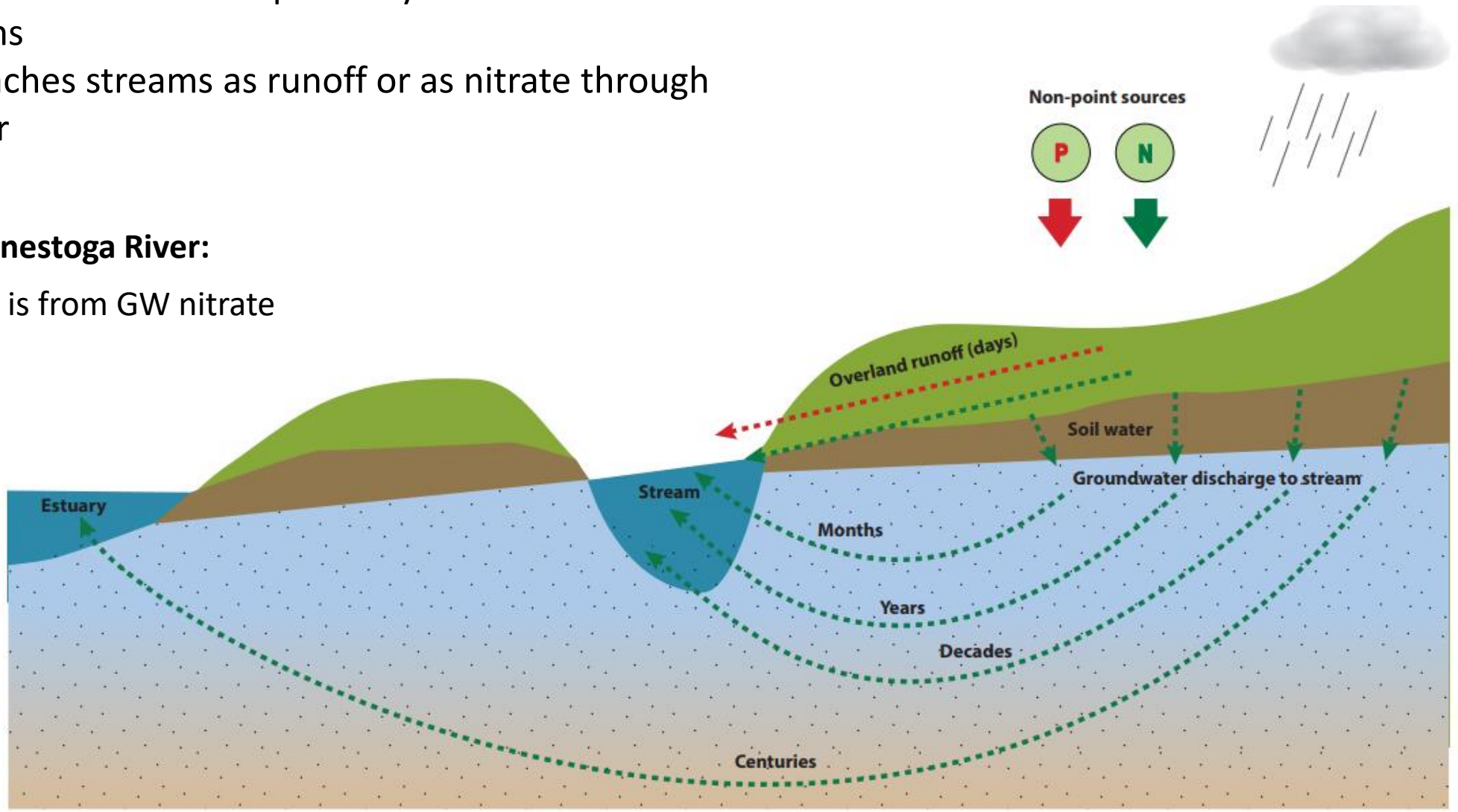
Chesapeake Bay Program Phase 6 Watershed Model. 2016 Progress. http://cast.chesapeakebay.net

The transport of nutrients matters for planning implementation

- Phosphorus reaches streams primarily from overland runoff during storms
- Nitrogen reaches streams as runoff or as nitrate through groundwater

Conestoga River:

64% of nitrogen is from GW nitrate

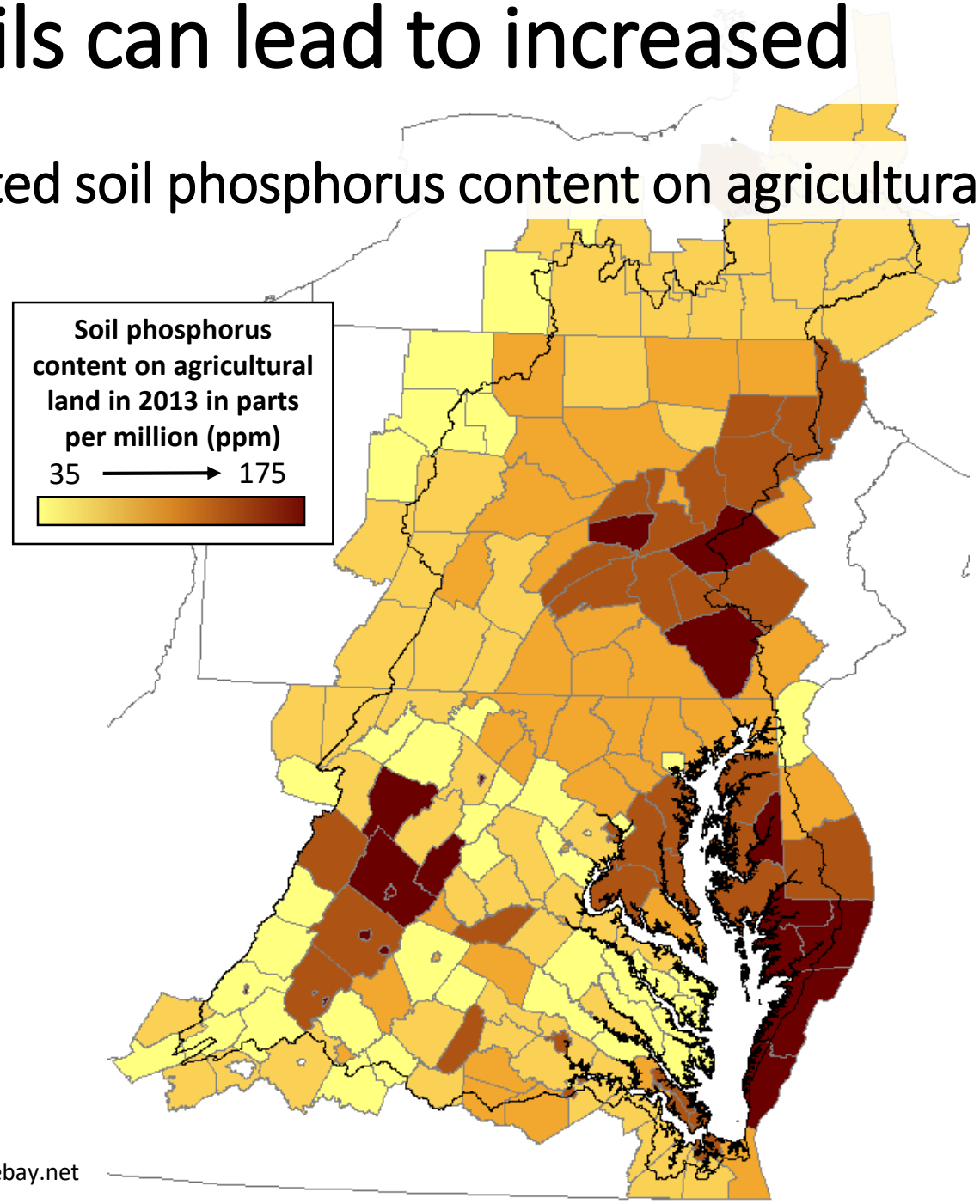


Ator, S.W. & Denver, J.M., 2015.
Bachman, L.J., et al., 1998.
Diagram from Lyerly, A.L. et al., 2014.

Buildup of phosphorus in soils can lead to increased phosphorus runoff

- Application of phosphorus above what plants can uptake can result in phosphorus build in soils
- As soils become more saturated with phosphorus, new phosphorus is more apt to run off, and can result in an increase in dissolved phosphorus
- Sediment erosion from these areas can also deliver high amounts of sediment-bound phosphorus

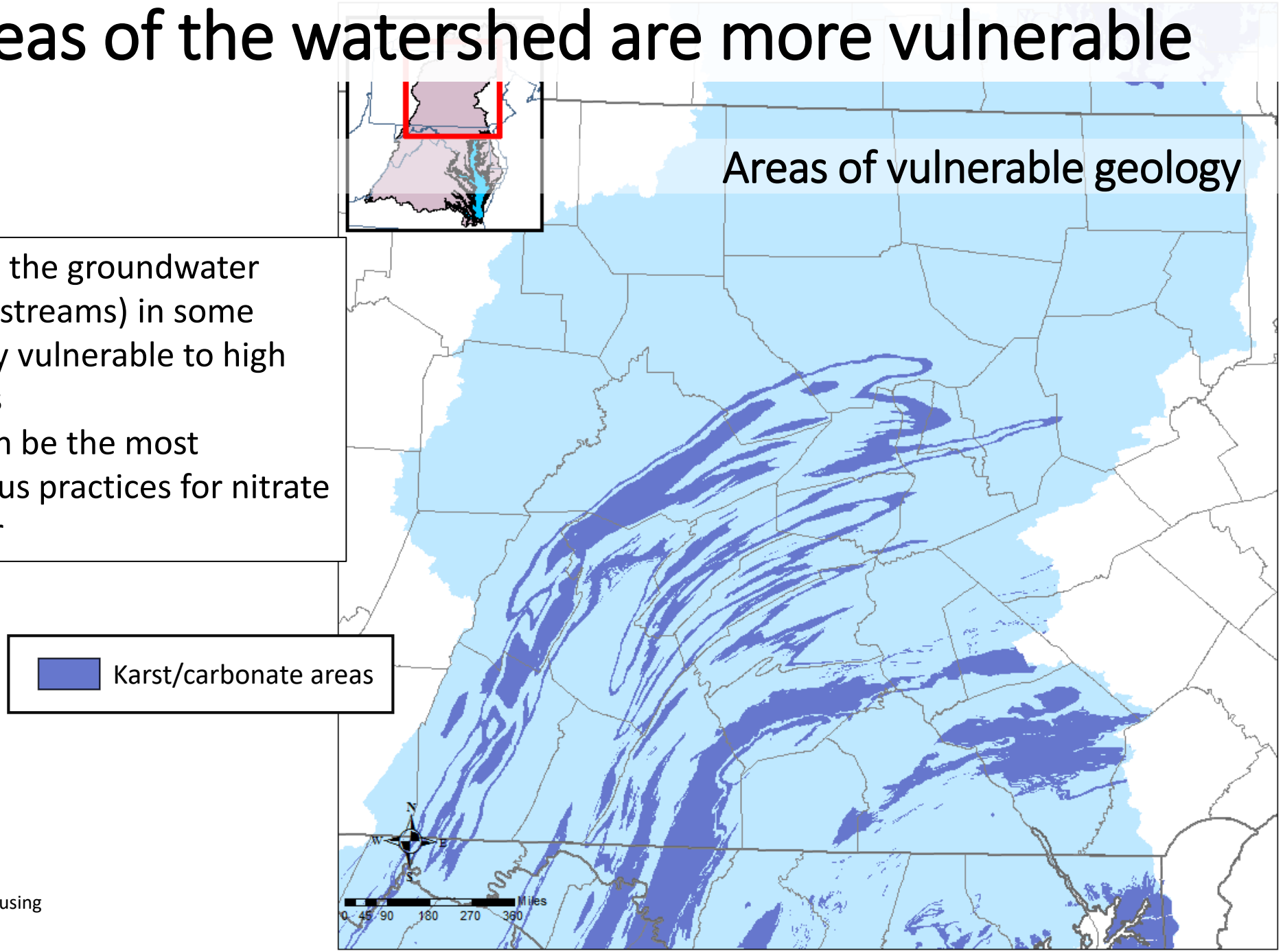
Estimated soil phosphorus content on agricultural land



Phase 6 Watershed Model. http://cast.chesapeakebay.net

Certain areas of the watershed are more vulnerable

- Geology makes the groundwater (and therefore streams) in some areas especially vulnerable to high nitrogen inputs
- These areas can be the most effective to focus practices for nitrate in groundwater



Modified from Jimmy Webber, USGS, using
Brakebill, JW 2000, Ator, S. et al. 2005

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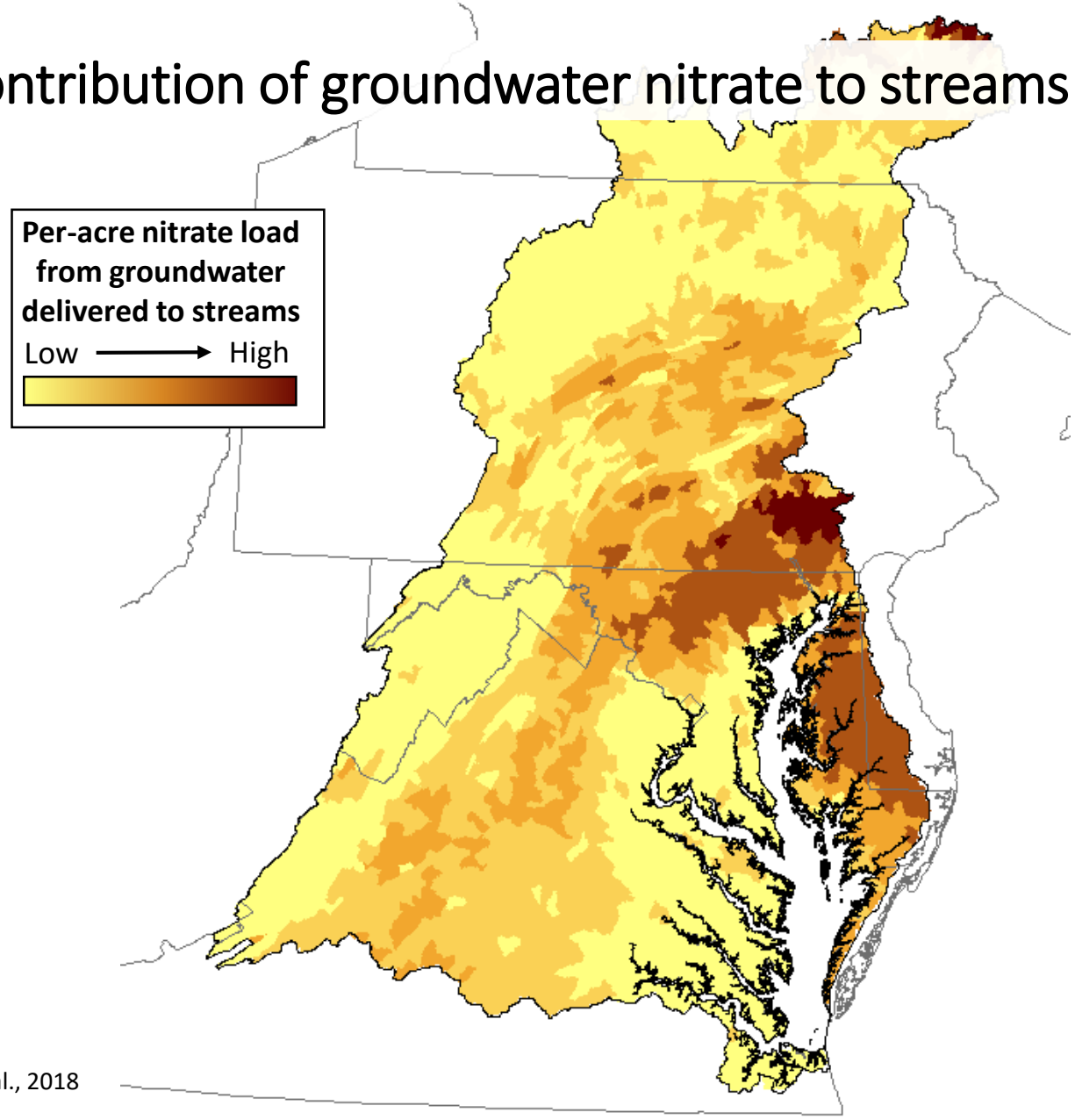

USGS. Terziotti, et al., 2018

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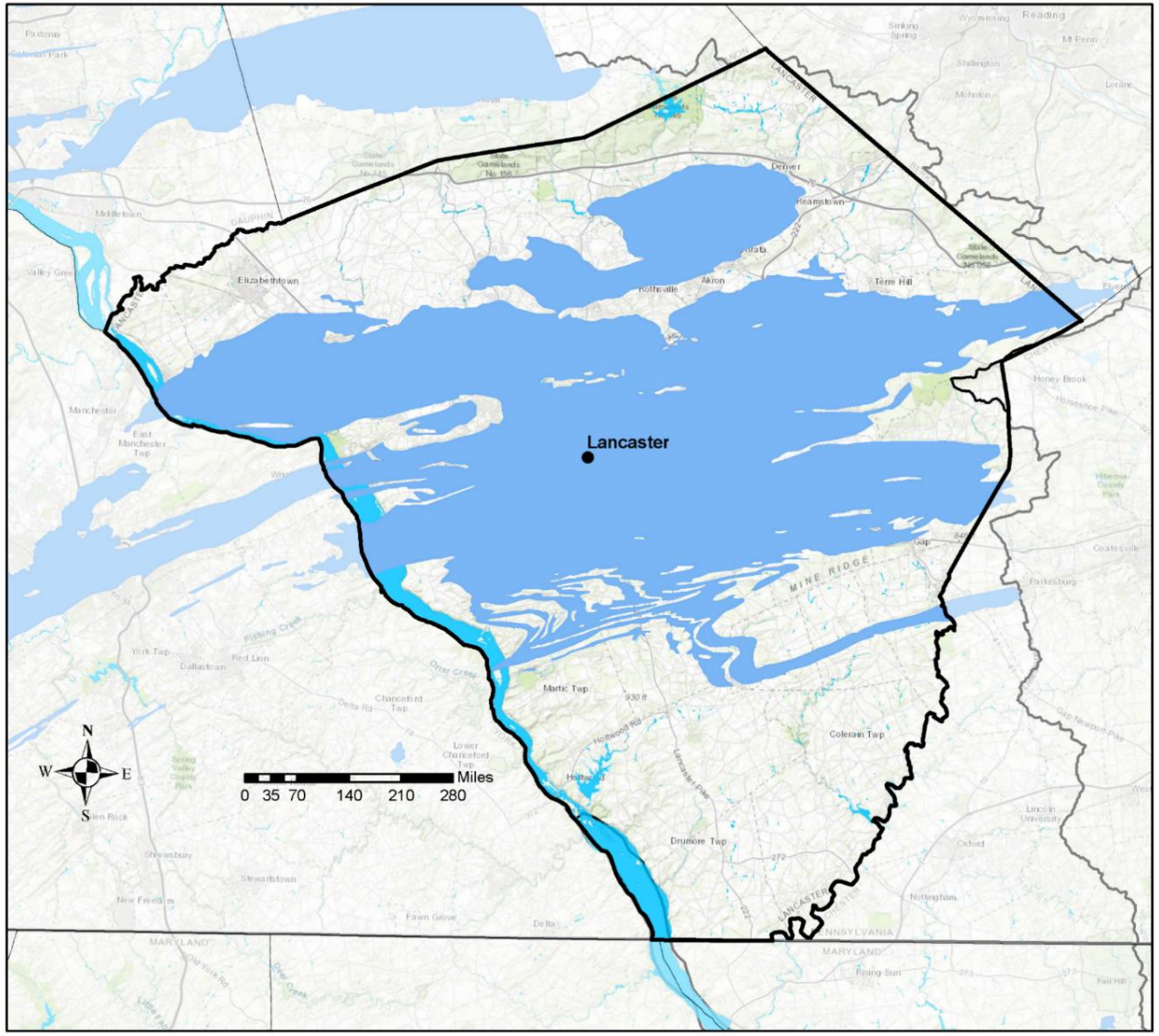
Karst/carbonate areas

Areas of vulnerable geology



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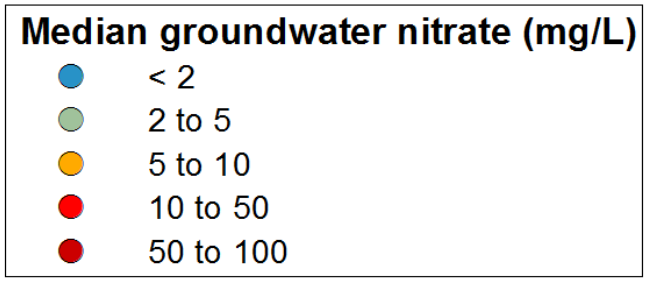
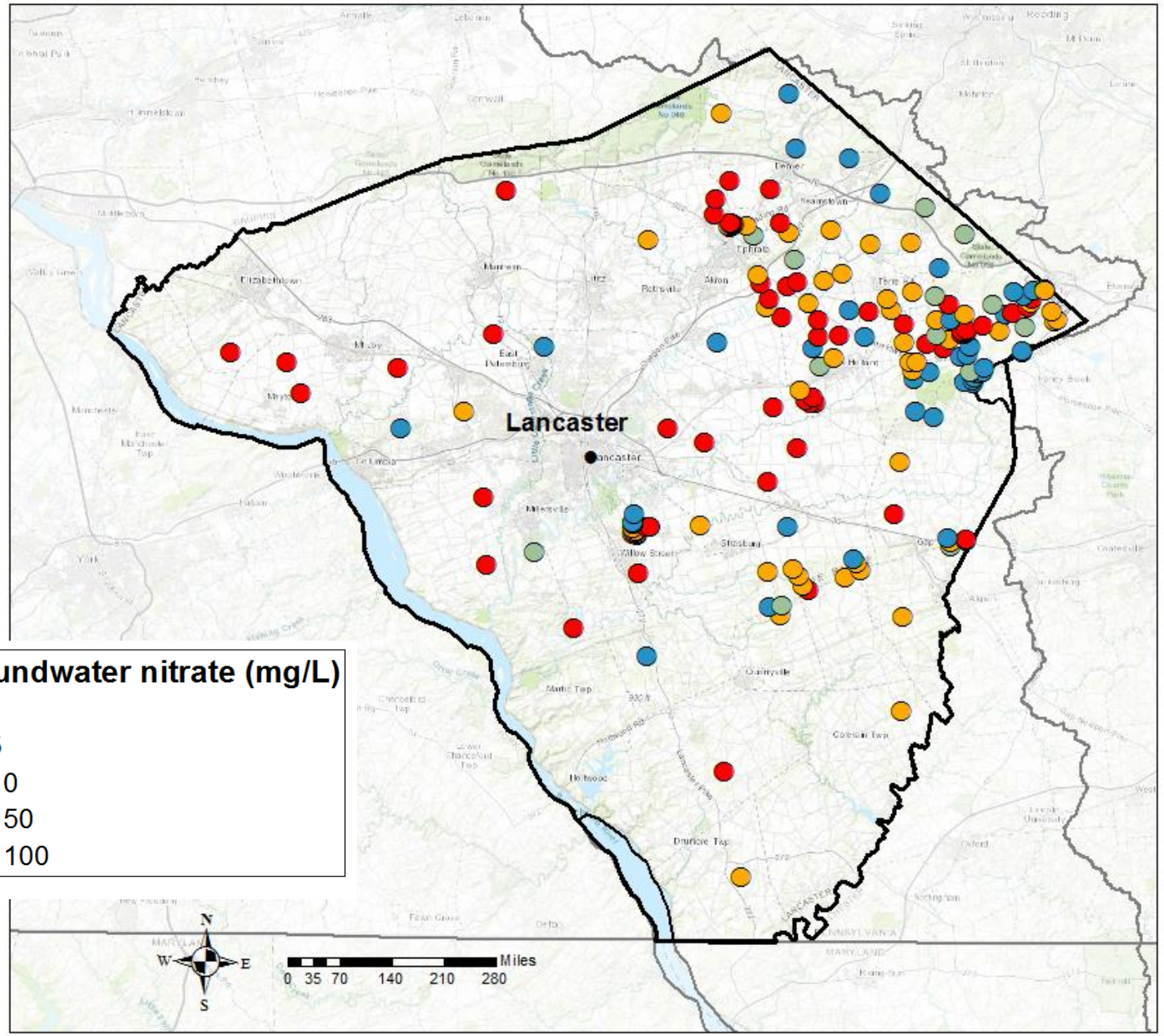
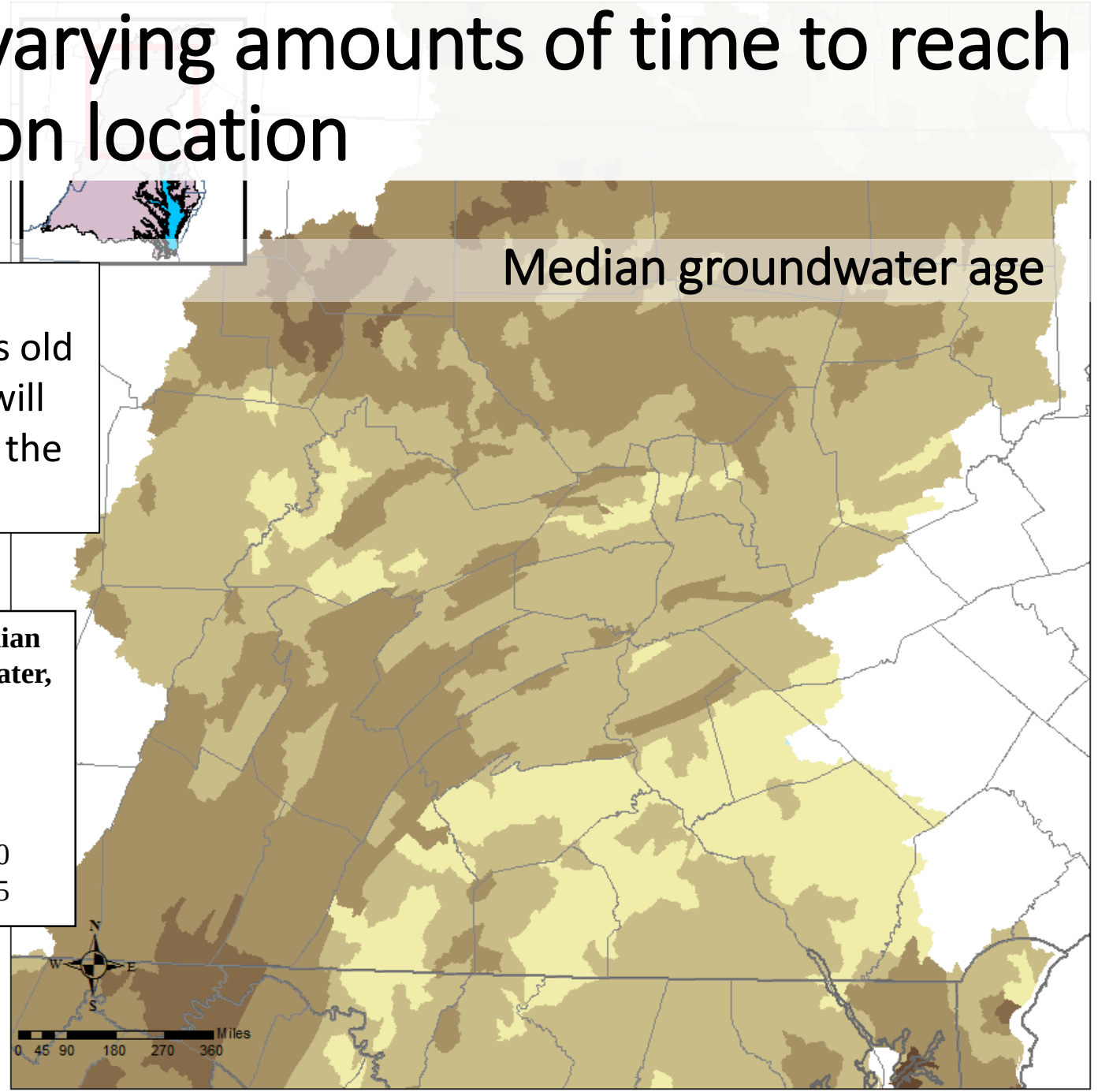




Data from USGS PA Water Science Center

Groundwater takes varying amounts of time to reach streams depending on location

- Nitrate in groundwater represents a range of ages from recent to decades old
- Benefits from management actions will manifest immediately as well as into the future



Phase 6 WSM groundwater age estimates. DRAFT from Gopal Bhatt, Chesapeake Bay Program.

Remaining opportunities in Lancaster County for agricultural practices

Chesapeake Bay Program Phase 6 Watershed Model. 2016 Progress. http://cast.chesapeakebay.net

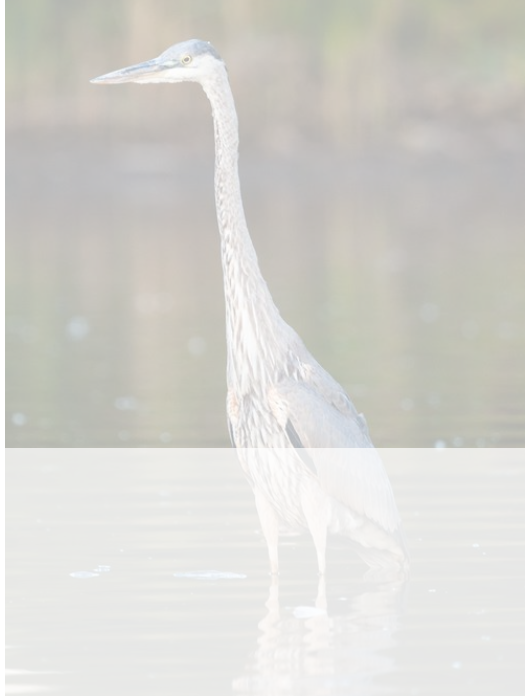
Practice	Current Percent Implementation	Acres Remaining	Nitrogen $/lbs reduced/yr	Phosphorus $/lbs reduced/yr	Sediment $/lbs reduced/yr
Conservation Tillage	44%	112,976	0	0	0
Soil & Water Conservation Plans	16%	260,409	0.82	15.36	0.01
Forest Buffers	1%	24,000	1.45	81.17	0.11
Barnyard Runoff Control	76%	386	1.71	38.81	0.28
Basic Nutrient Management for N	21%	241,286	3.7	-	-
Cover Crop	32%	138,385	6.28	-	-
Prescribed Grazing	7%	41,532	9.4	48.57	27.72

Remaining opportunities in Lancaster County for stormwater practices on developed/urban land

Practice	Current Reported Implementation	Acres Remaining
Erosion & Sediment Control	100%	0
Stormwater Management	5.3%	150,739

Chesapeake Bay Program Phase 6 Watershed Model.
2016 Progress. http://cast.chesapeakebay.net






Questions?

410-267-5797

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EPA Chesapeake Bay Program Office

Matt Johnston
University of Maryland
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The opinions expressed in this technical presentation are those of the author and do not necessarily reflect the views of US EPA.