Chesapeake Bay "Effective Basins"

Info available for understanding geographic differences in the watershed

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Chesapeake Bay Commission
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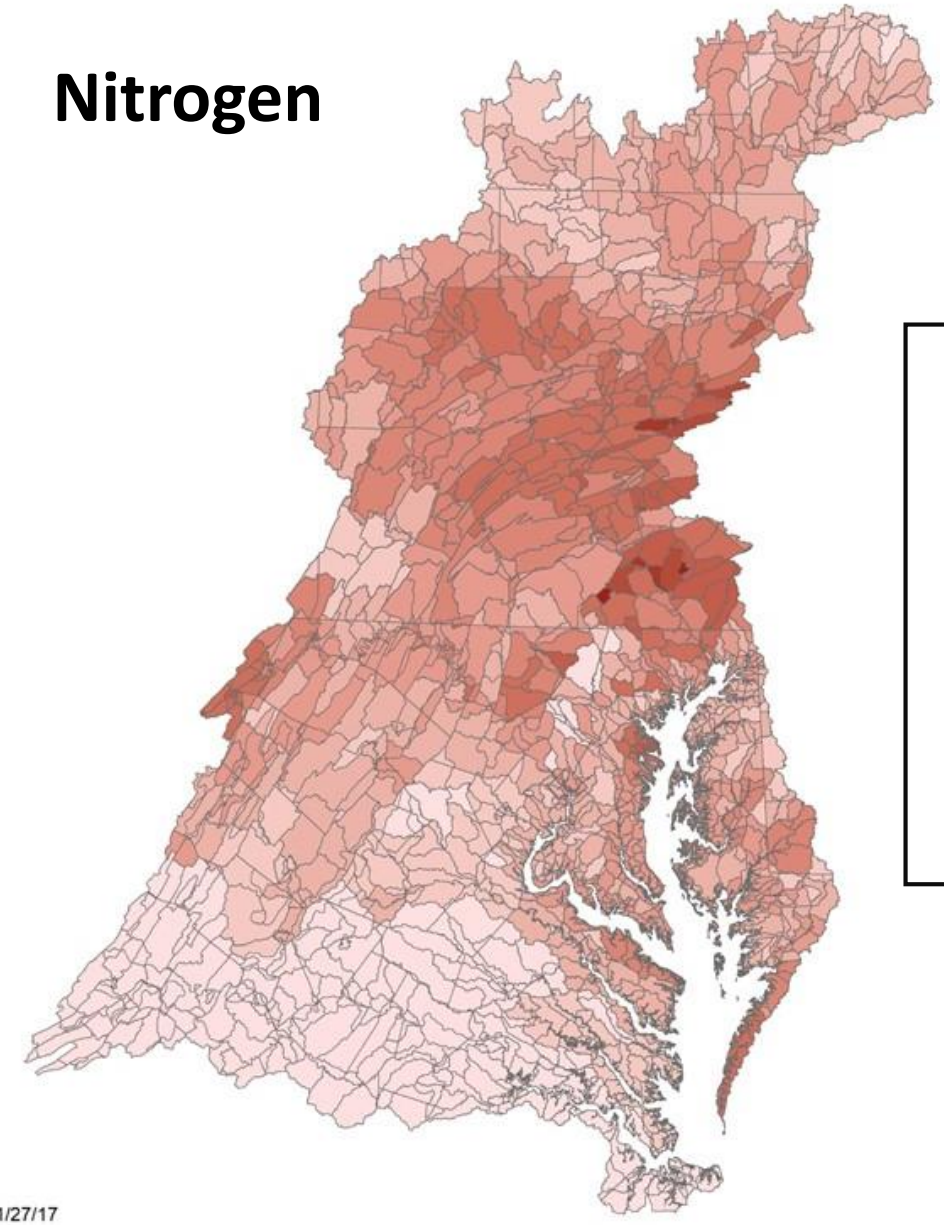
Why target restoration efforts?

- Not all areas of the Chesapeake Bay watershed contribute equally to water quality in the Bay
- Targeting activities to the most effective areas can provide the biggest returns
- Today we're focusing on targeting for the Bay's water quality – pollution control measures also help improve local waters

Estimating the effect of nutrient reductions

Nitrogen



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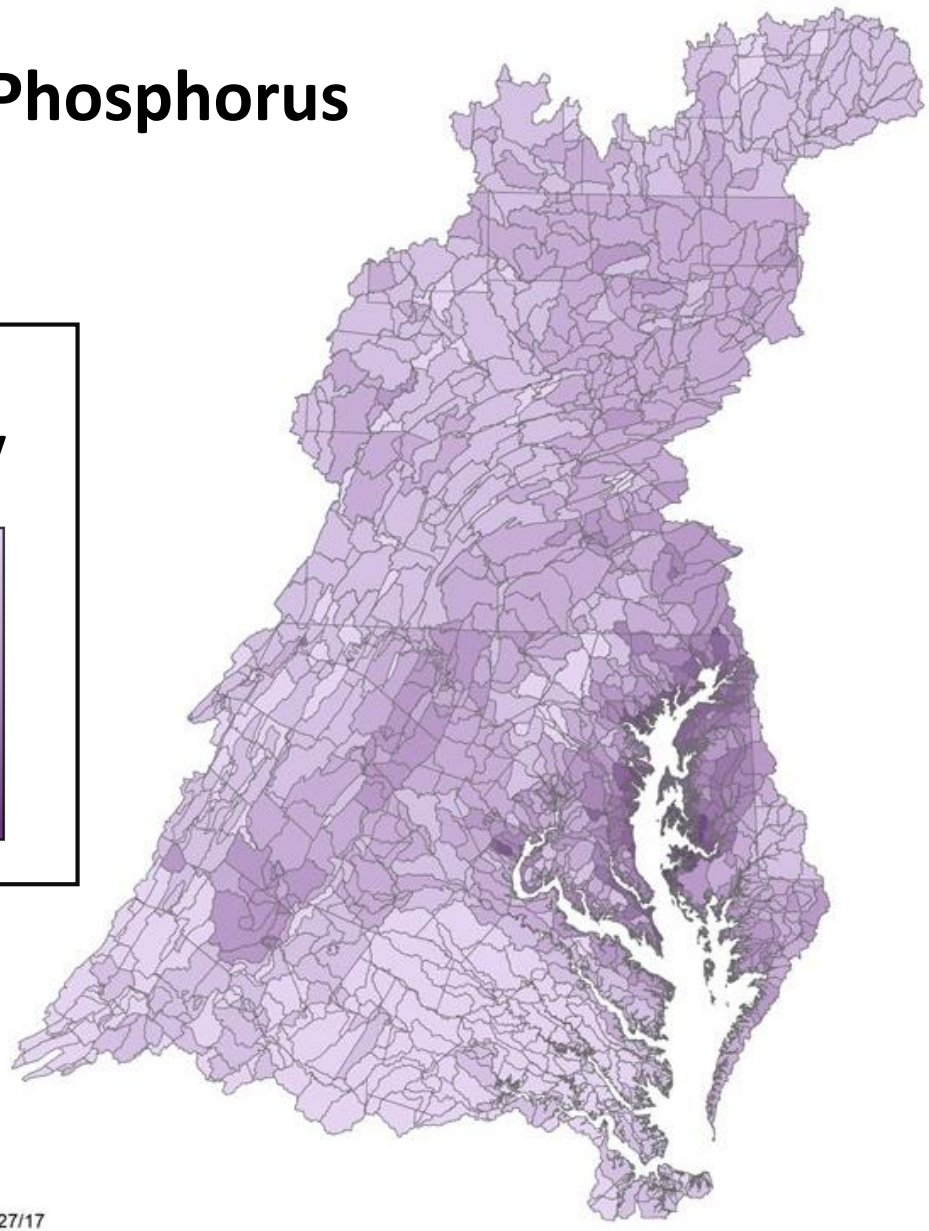
Impact on water quality in the Bay

Less

More

Phosphorus



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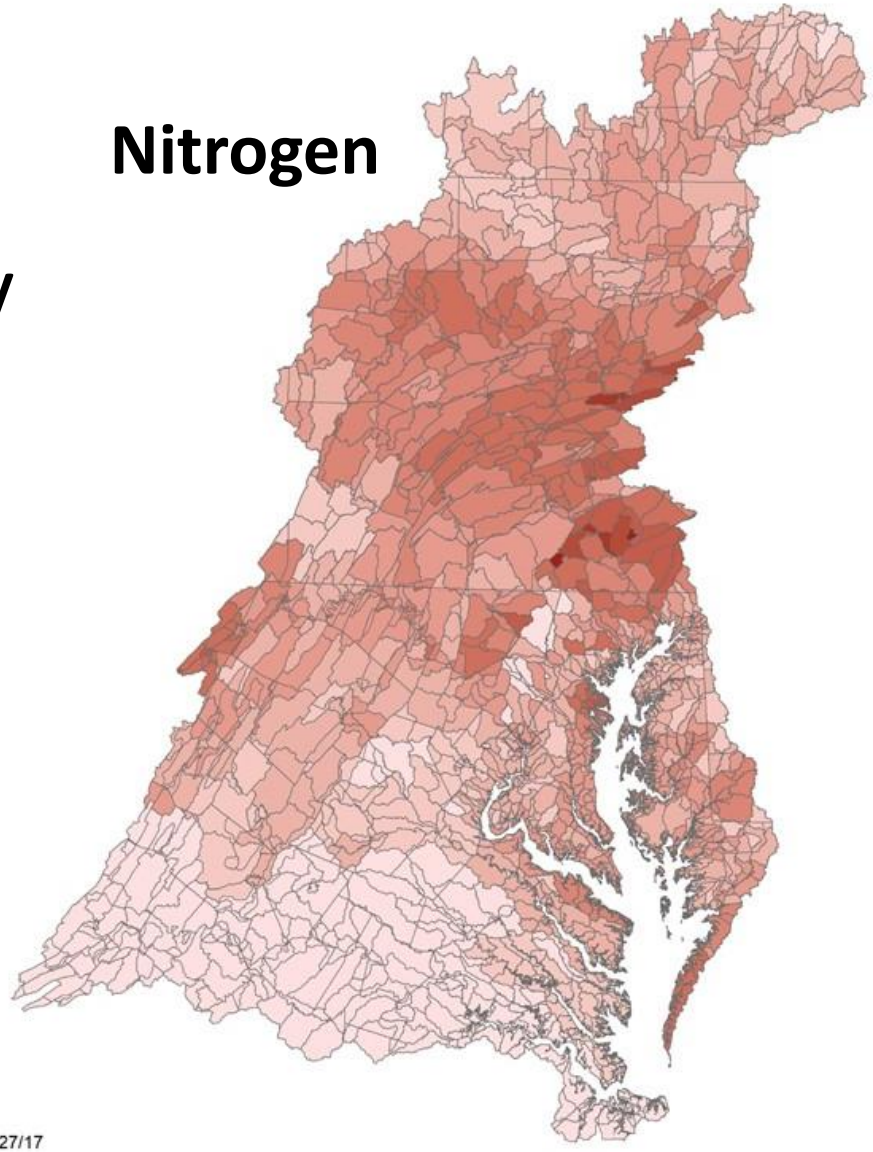
Estimating the effect of nutrient reductions: relative effectiveness

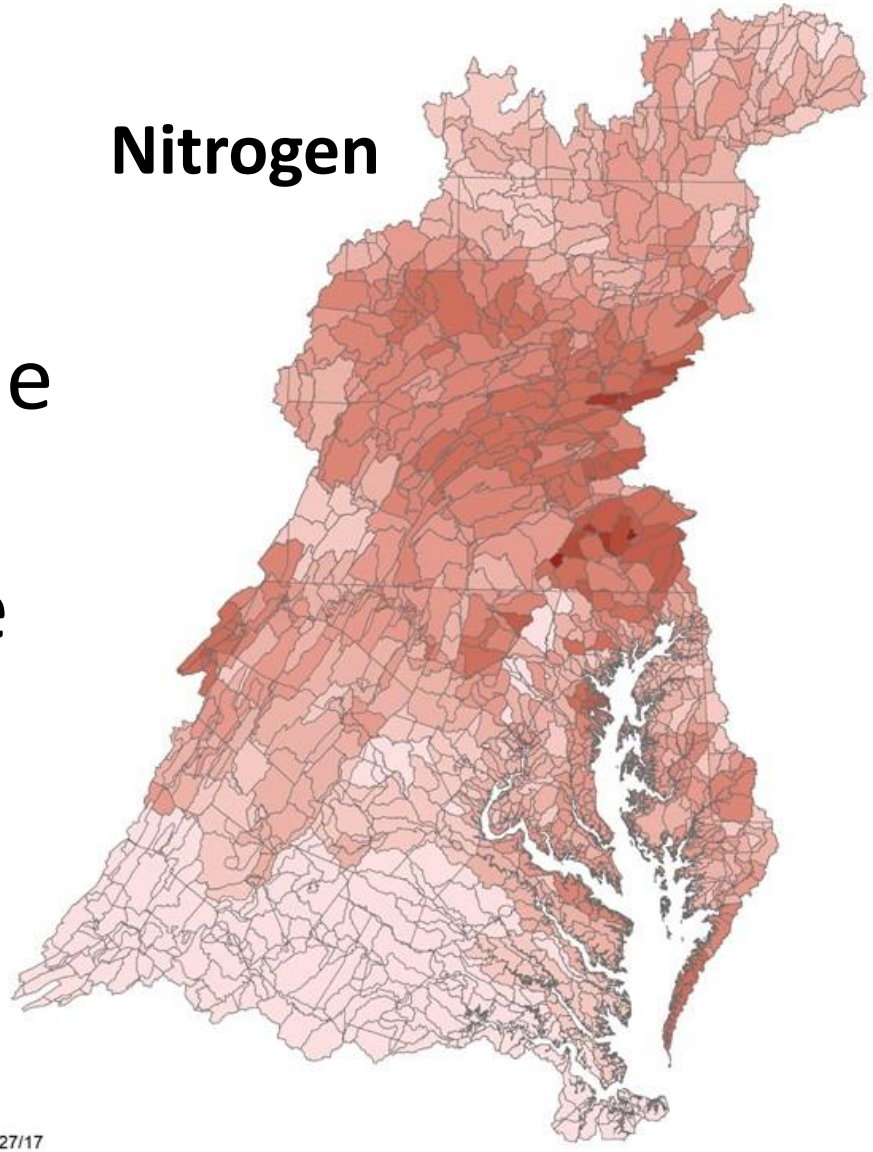
These maps represent the change in dissolved oxygen that occurs in the Bay per pound of nutrient changed locally in the watershed

E.g. increase in dissolved oxygen per lb reduced locally



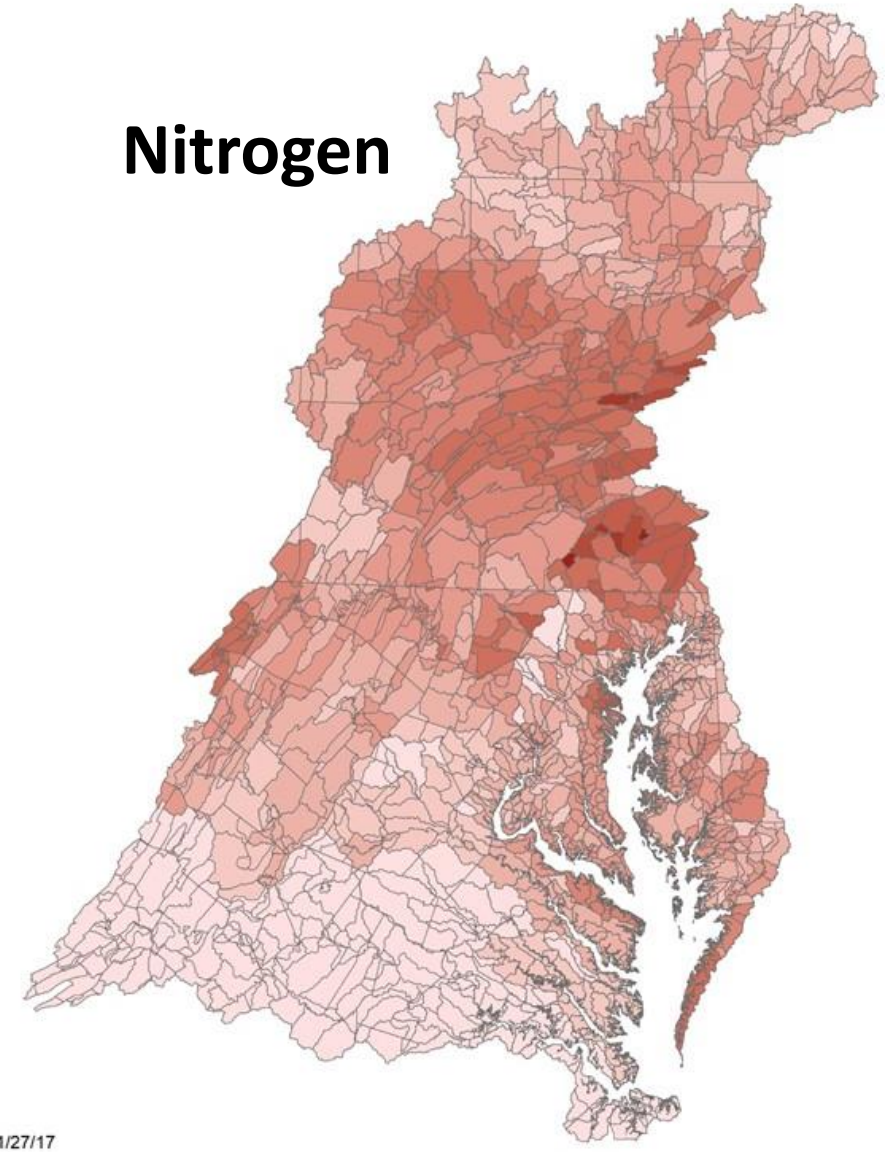
Estimating the effect of nutrient reductions: relative effectiveness

The same practice/control applied in one location in the watershed may not impact dissolved oxygen as much as the same control applied in another place



Estimating the effect of nutrient reductions: relative effectiveness

- Concept behind these maps is not new
- Methodology was developed by CBP Partnership and applied as part of original TMDL allocations in 2009
- Maps were updated with Phase 6 modeling suite for Partnership-approved Phase III planning targets in 2018



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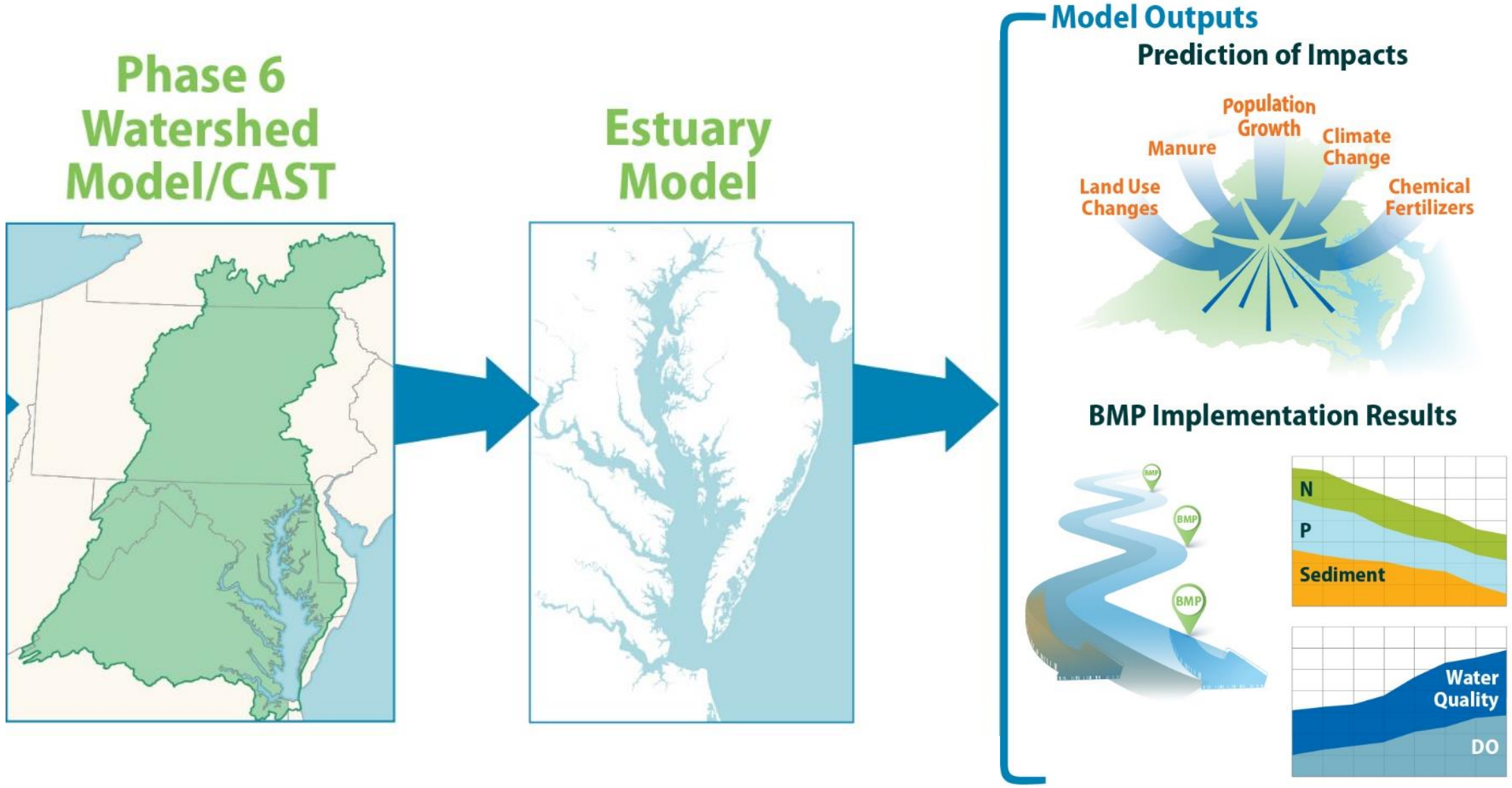

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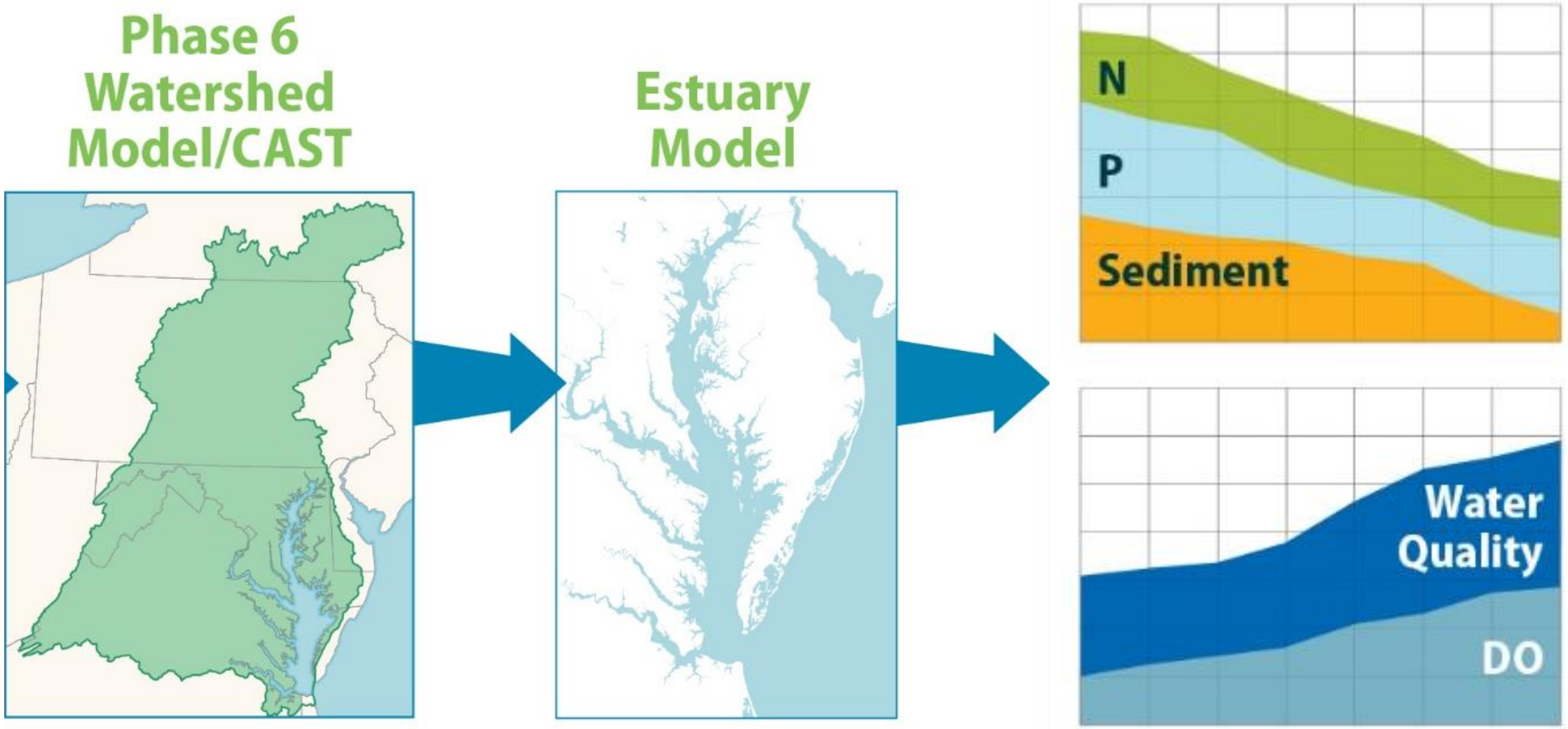
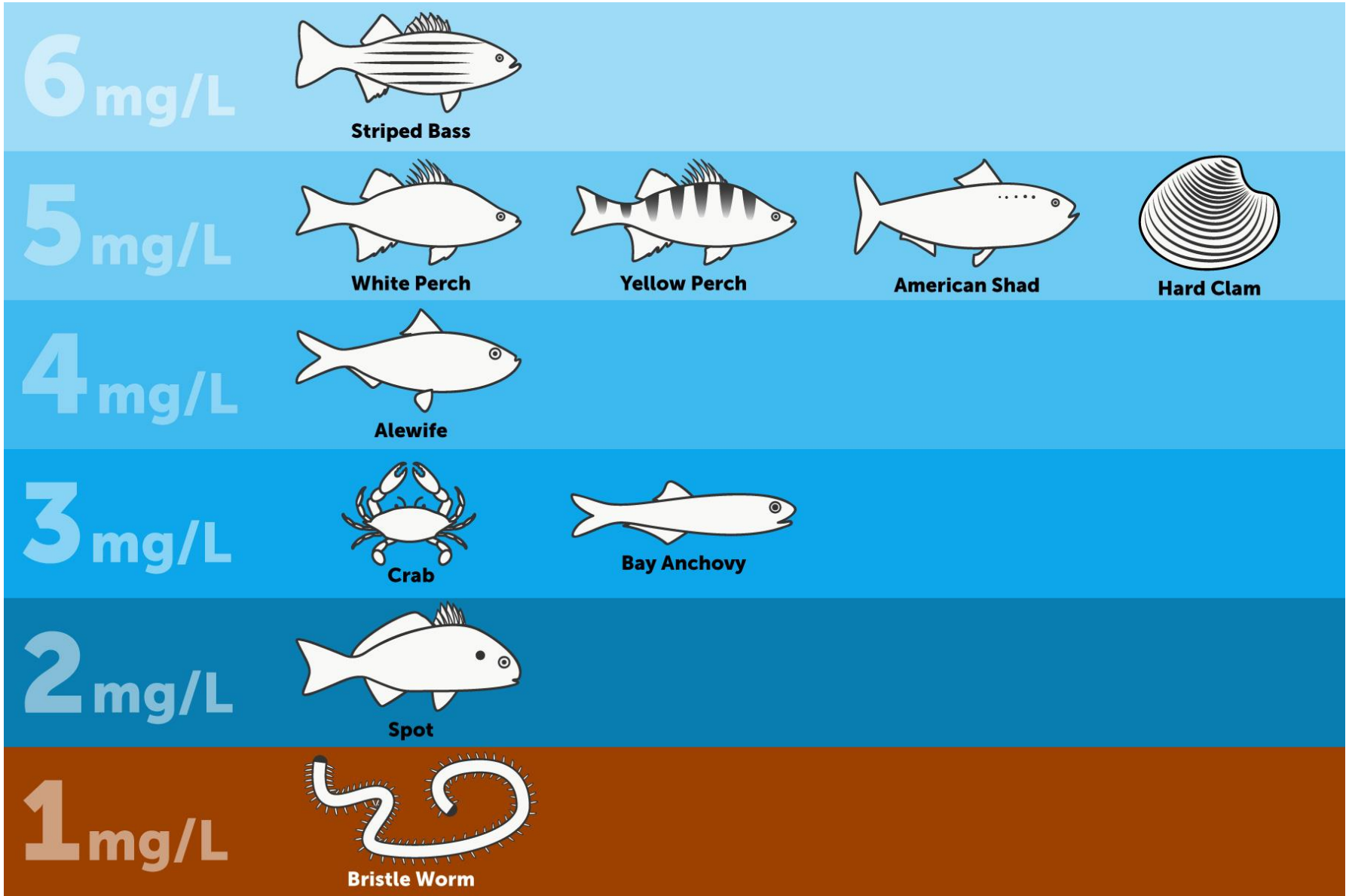
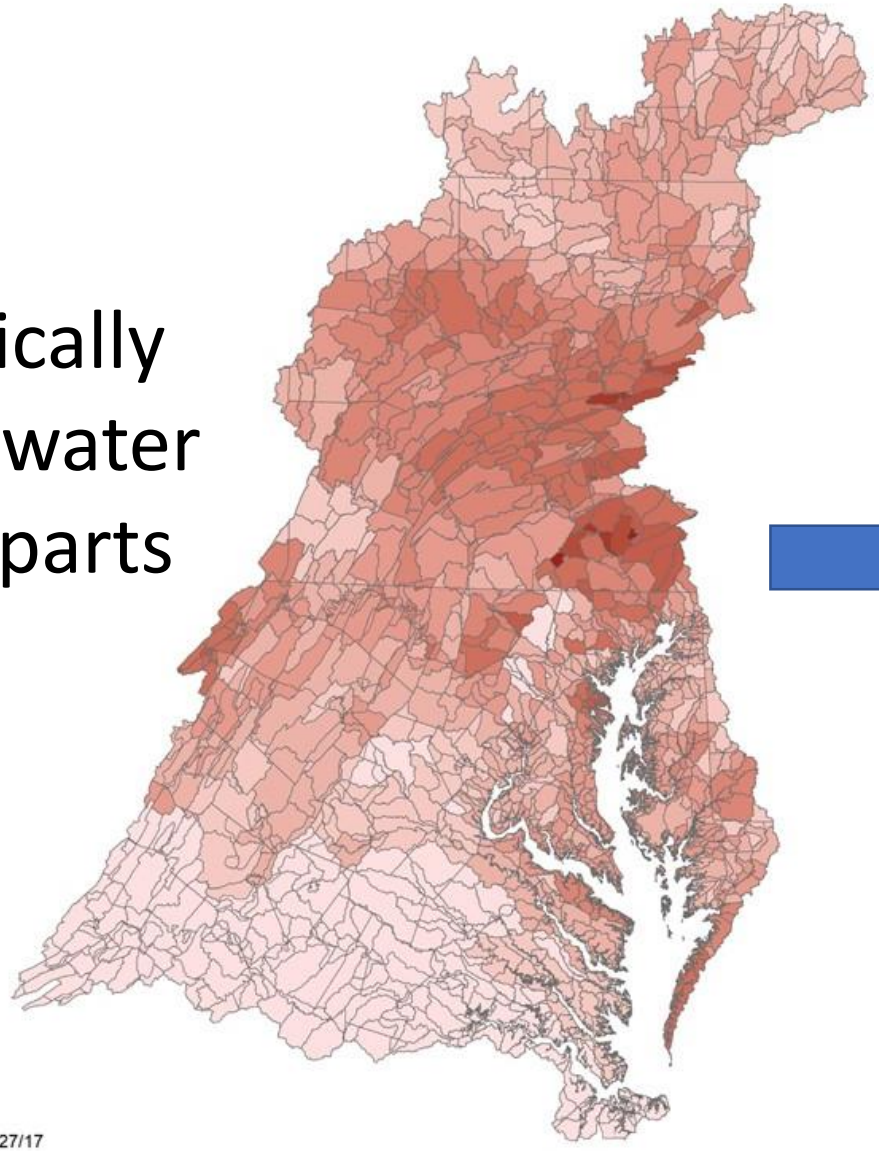


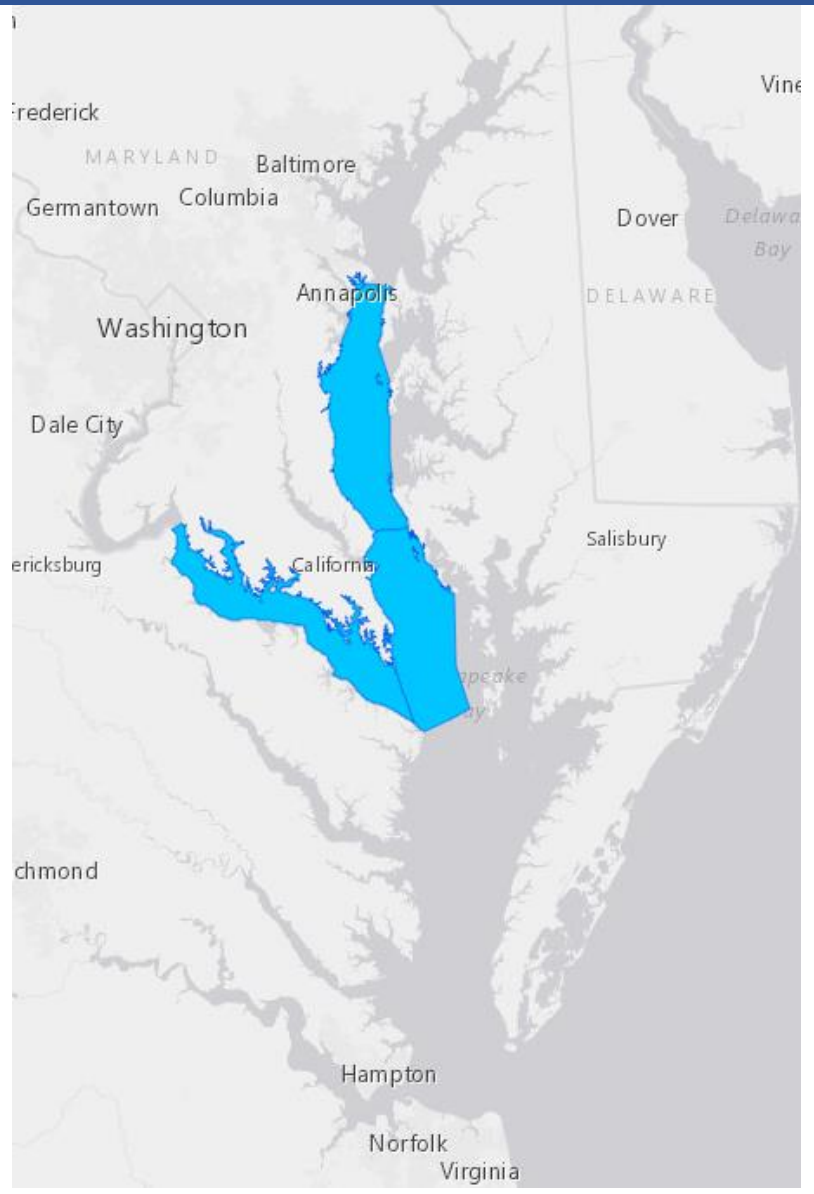
These maps represent the increase in **dissolved oxygen** that occurs in the Bay per pound of nutrient reduced in the watershed



These maps represent the increase in dissolved oxygen that occurs in **the Bay** per pound of nutrient reduced in the watershed

These maps specifically relate to the deep water and deep channel parts of the Bay

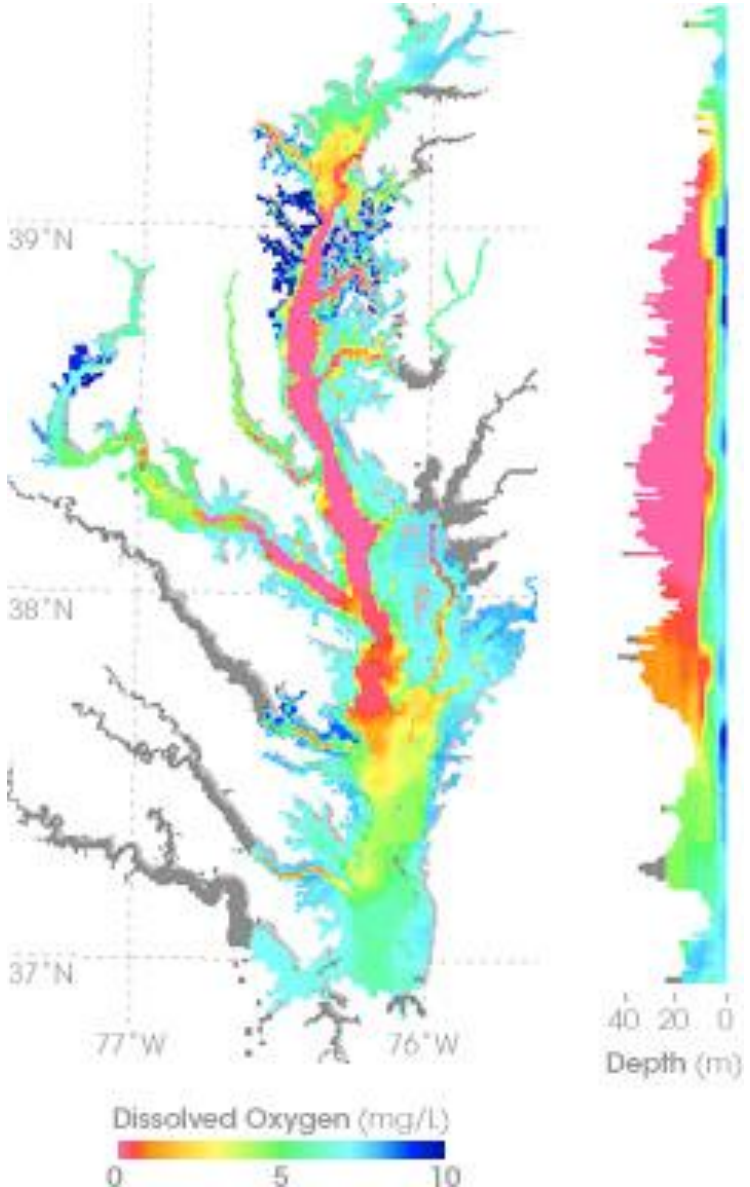




These maps represent the increase in dissolved oxygen that occurs in **the Bay** per pound of nutrient reduced in the watershed

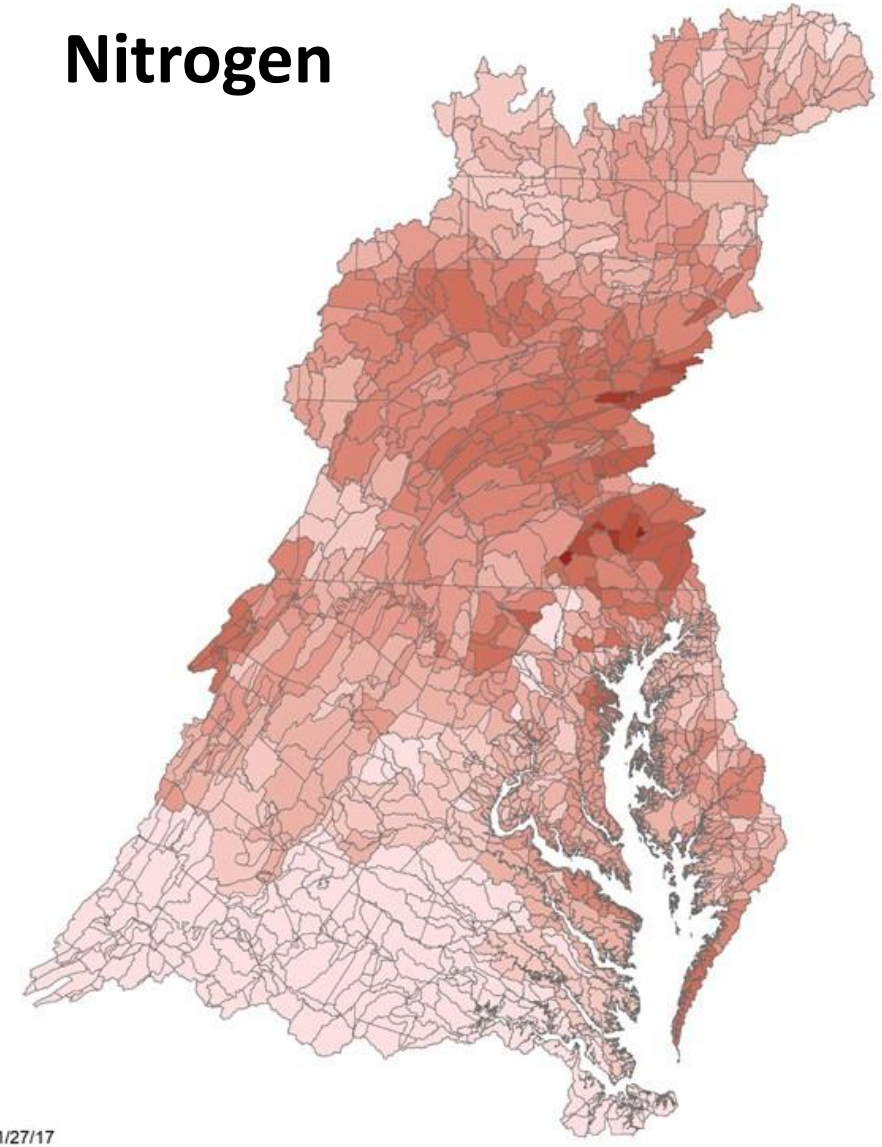
These parts of the Bay are affected by nutrients from all parts of Bay watershed and all sources

These parts of the Bay are considered to be most difficult areas to achieve water quality standards



These maps represent the increase in dissolved oxygen that occurs in the Bay per pound of nutrient reduced in the watershed

Nitrogen



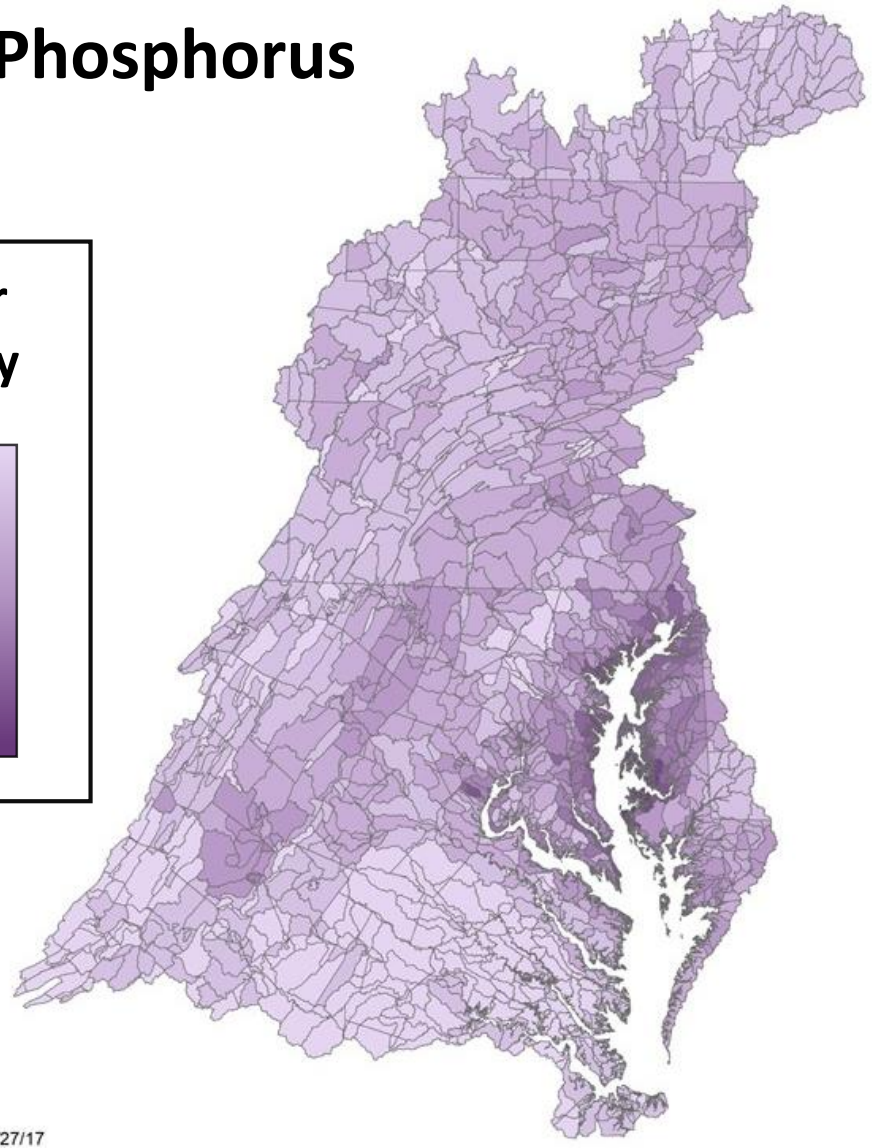
11/27/17

Impact on water quality in the Bay

Less

More

Phosphorus



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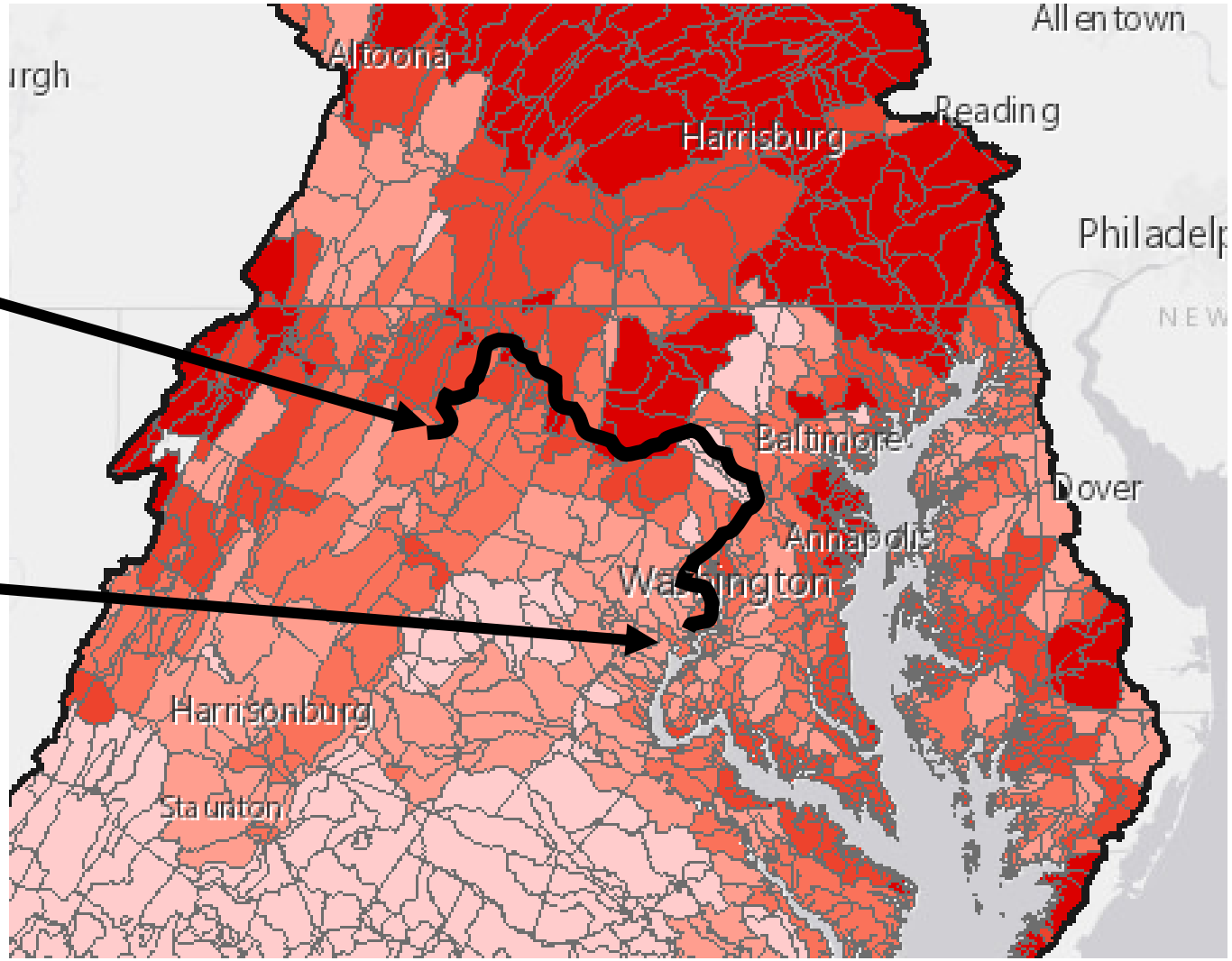
Key factors: transport through the watershed

E.g. Nitrogen watershed delivery factors

How much of the nutrients produced in this area

makes it to the tidal waters

= watershed delivery



Key factors: transport through the watershed

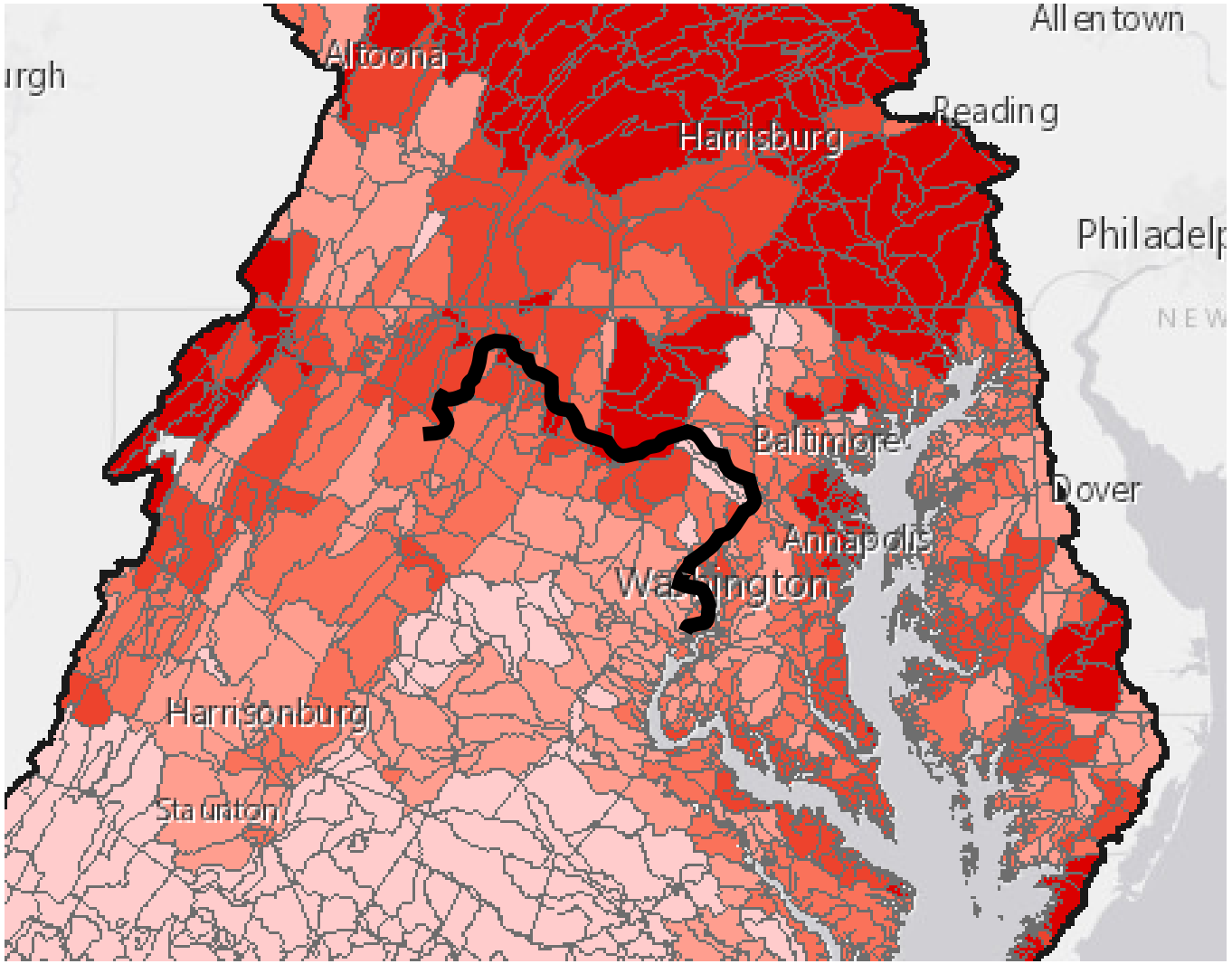
Dependent on:

Watershed characteristics

Travel time

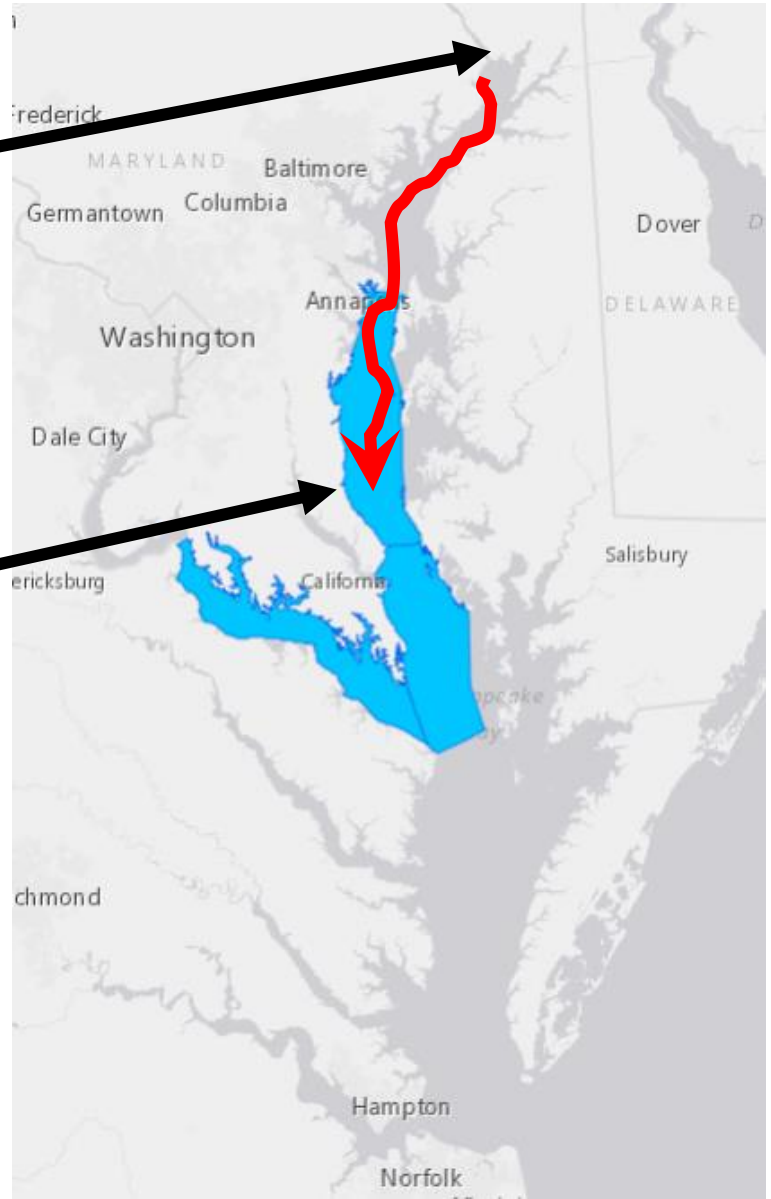
Impoundments/dams

E.g. Nitrogen watershed delivery factors



Key factors: transport through the estuary

How much do nutrients entering the Bay from this river



= estuarine delivery

impact dissolved oxygen in the deep parts of the Bay here

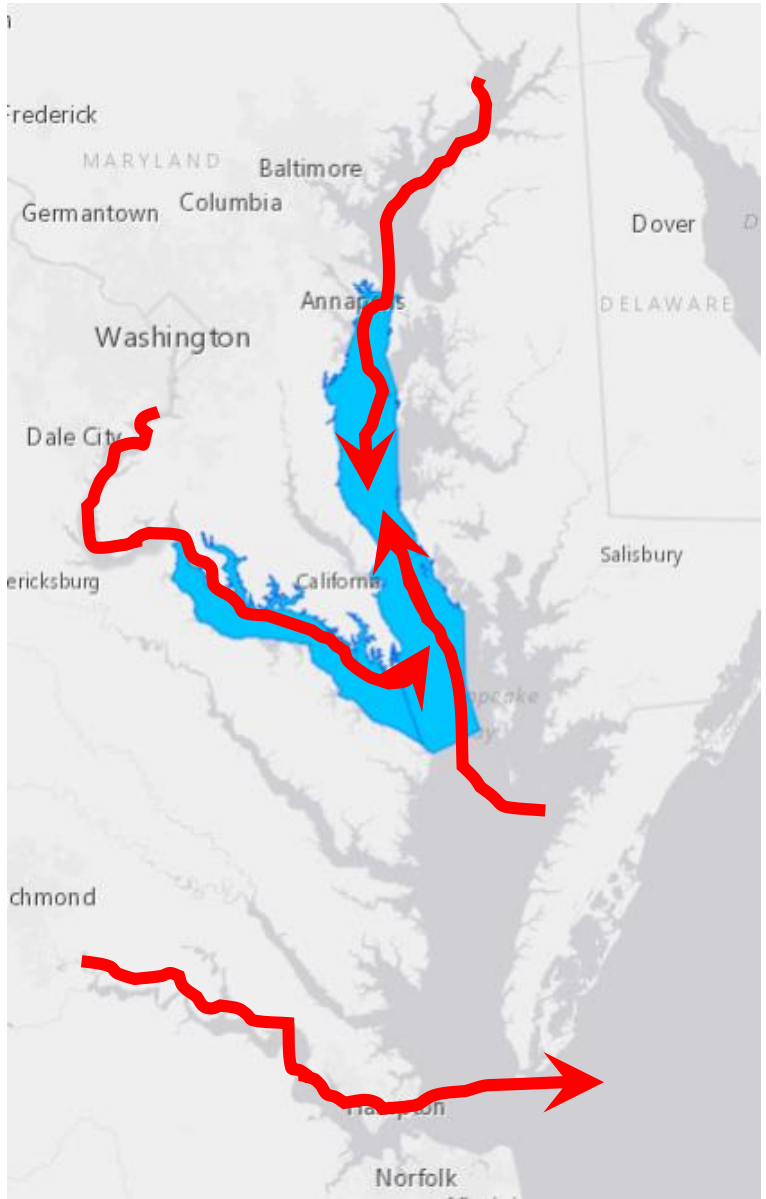
Key factors: transport through the estuary

Dependent on:

Bay's circulation (counter-clockwise)

Travel time in tidal tributary

Proximity to mainstem vs. mouth

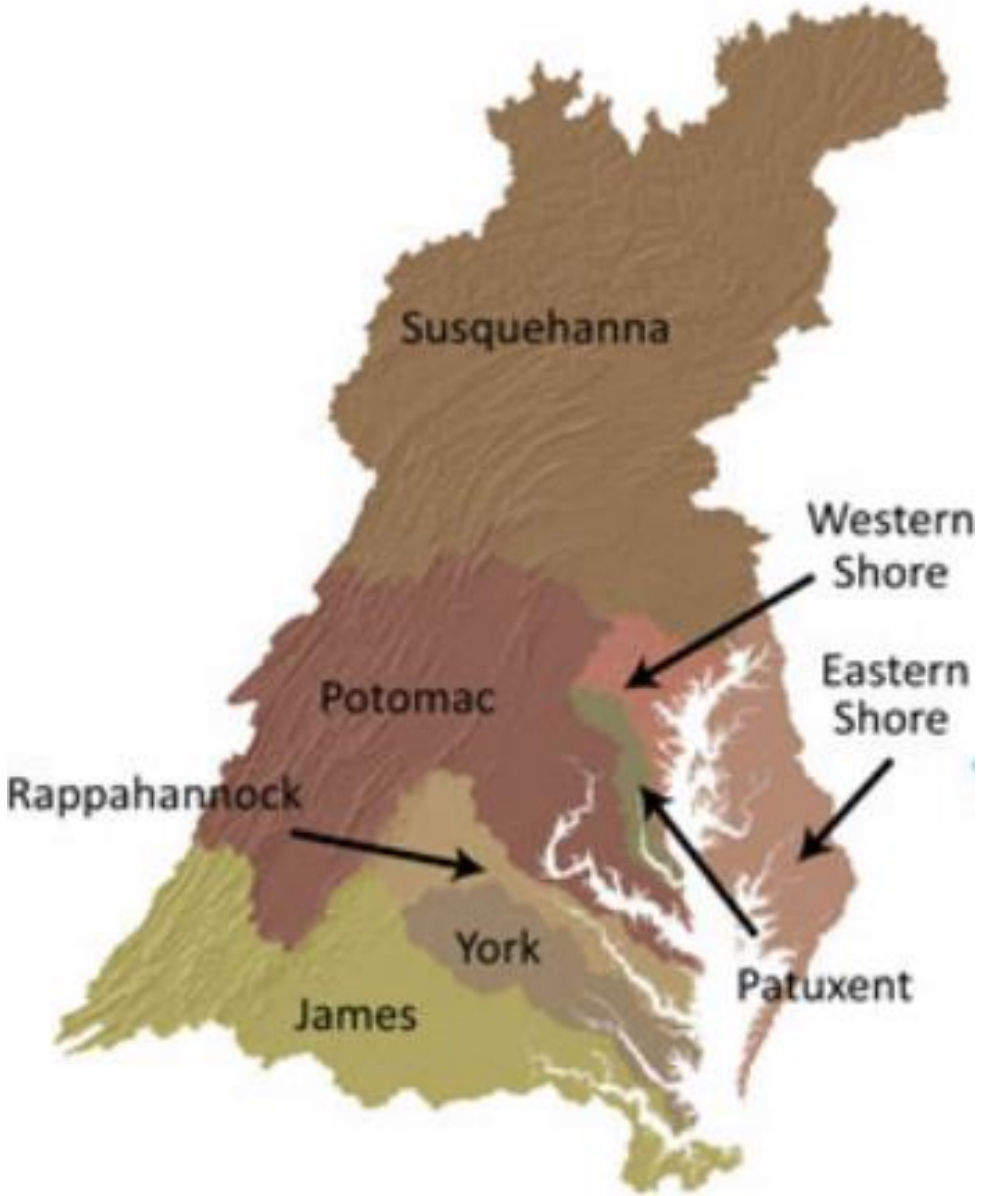


How do we put it all together? 1) Estuarine delivery

Use estuarine model

Change amount of nutrient entering Bay from one river basin at a time in model (e.g. add 1 million lbs nitrogen to Bay from Potomac)

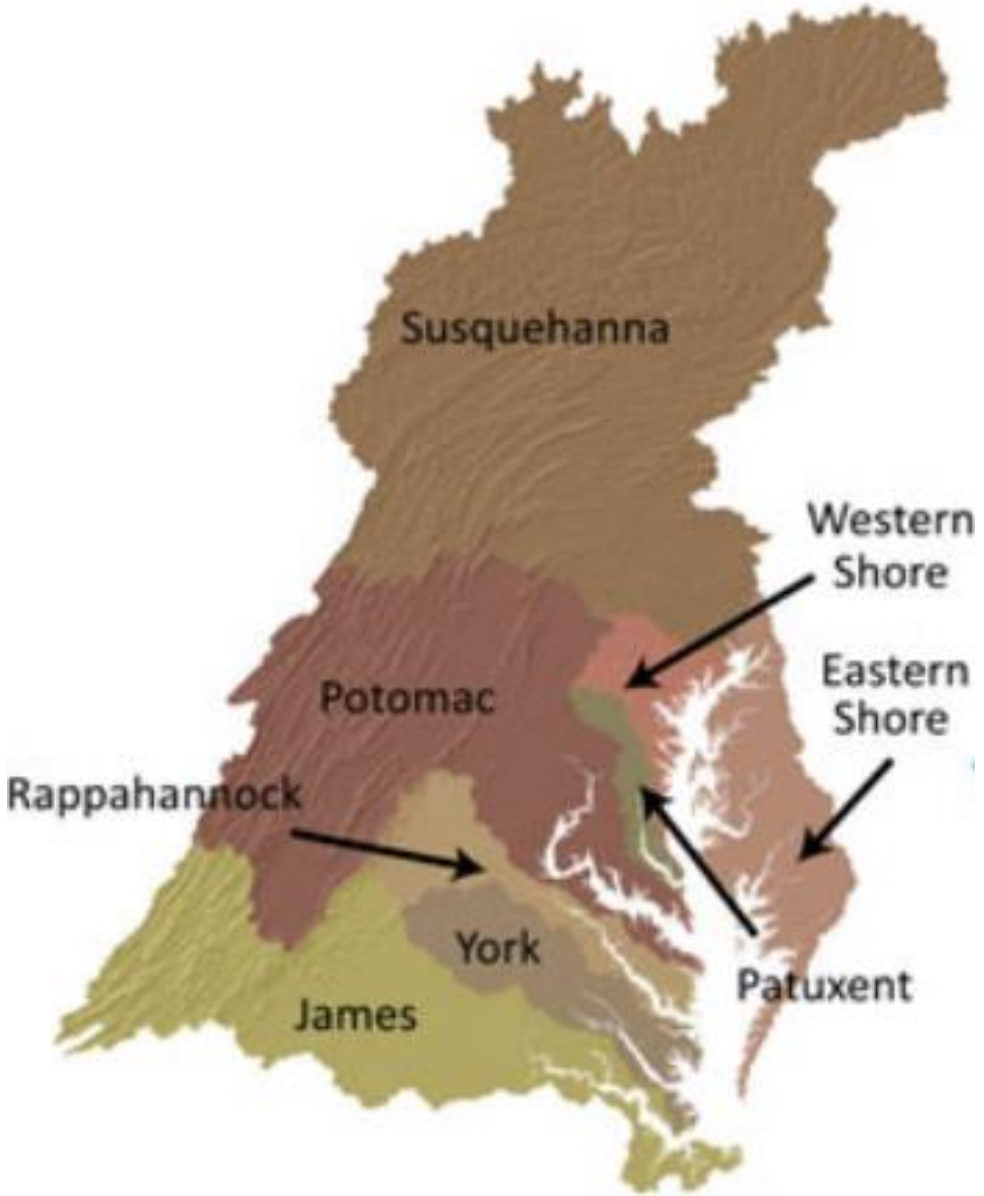
Look at resulting change in dissolved oxygen in Bay



How do we put it all together?

Result: change in dissolved oxygen per change in pound of nutrients entering Bay from that river basin (e.g. 0.01 mg/L increase in dissolved oxygen per million lbs nitrogen decreased from Potomac river basin)

Accounts for **estuarine delivery**



How do we put it all together? 2) Watershed delivery

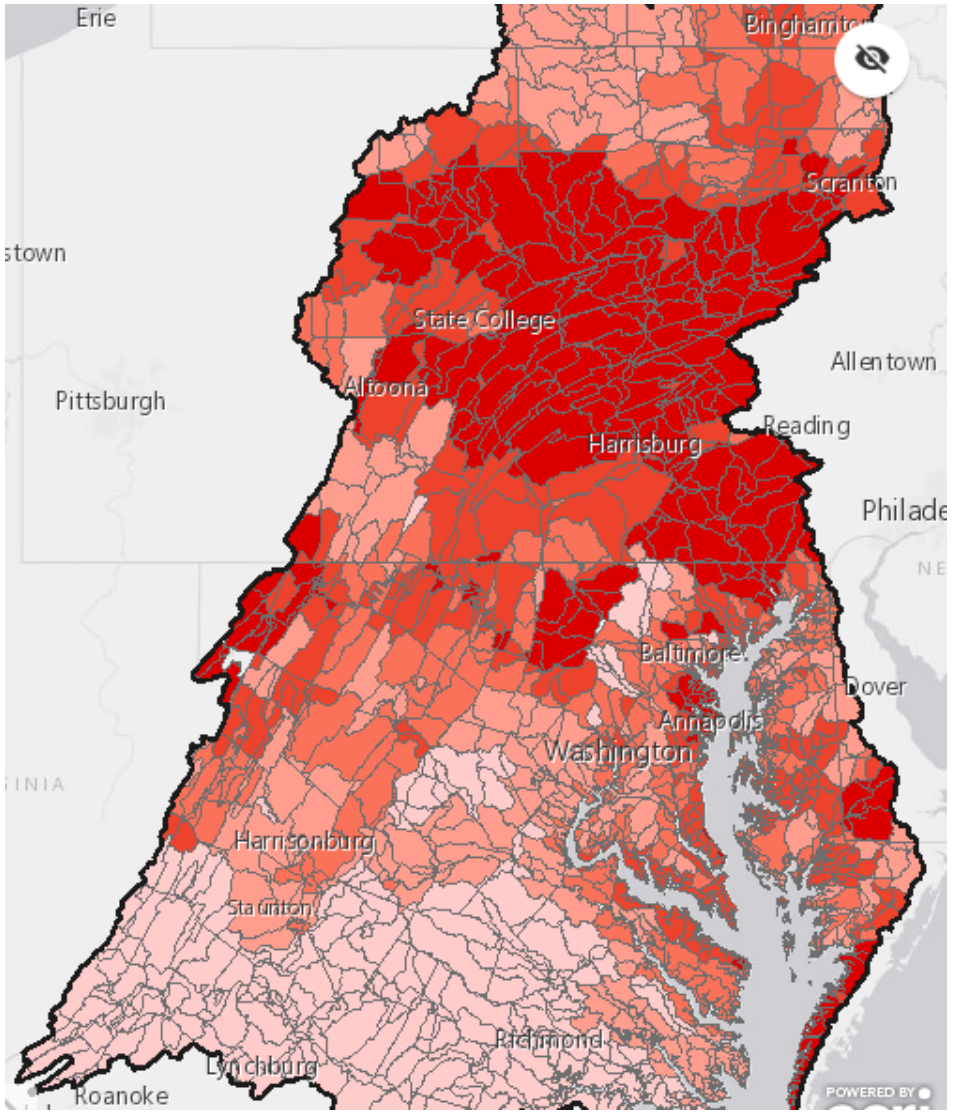
Use watershed model

Extract watershed delivery factors for each land-river segment

Results is lbs of nutrient delivered to Bay per lb produced in that segment

Accounts for **watershed delivery**

E.g. Nitrogen watershed delivery factors

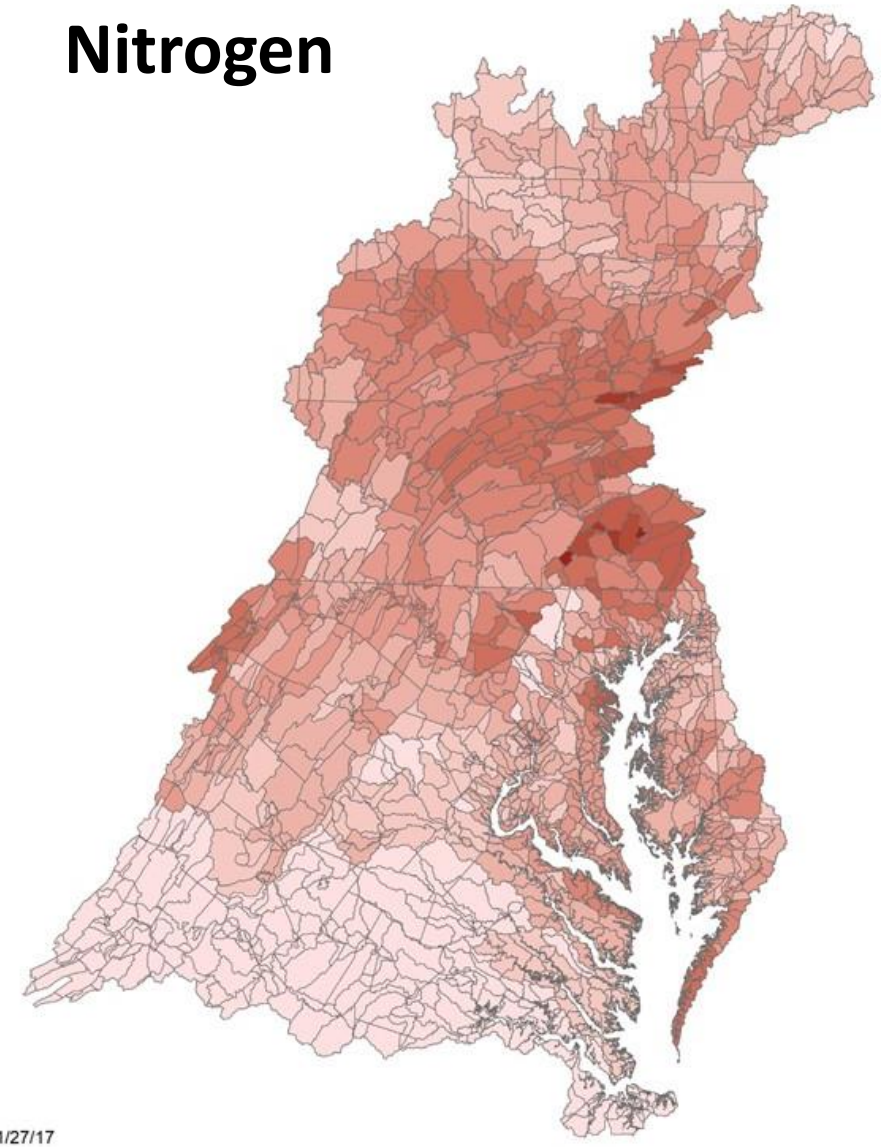


How do we put it all together?

Multiply estuarine and watershed factors

Result: change in dissolved oxygen in Bay per change in nutrients lbs in local watershed

Nitrogen



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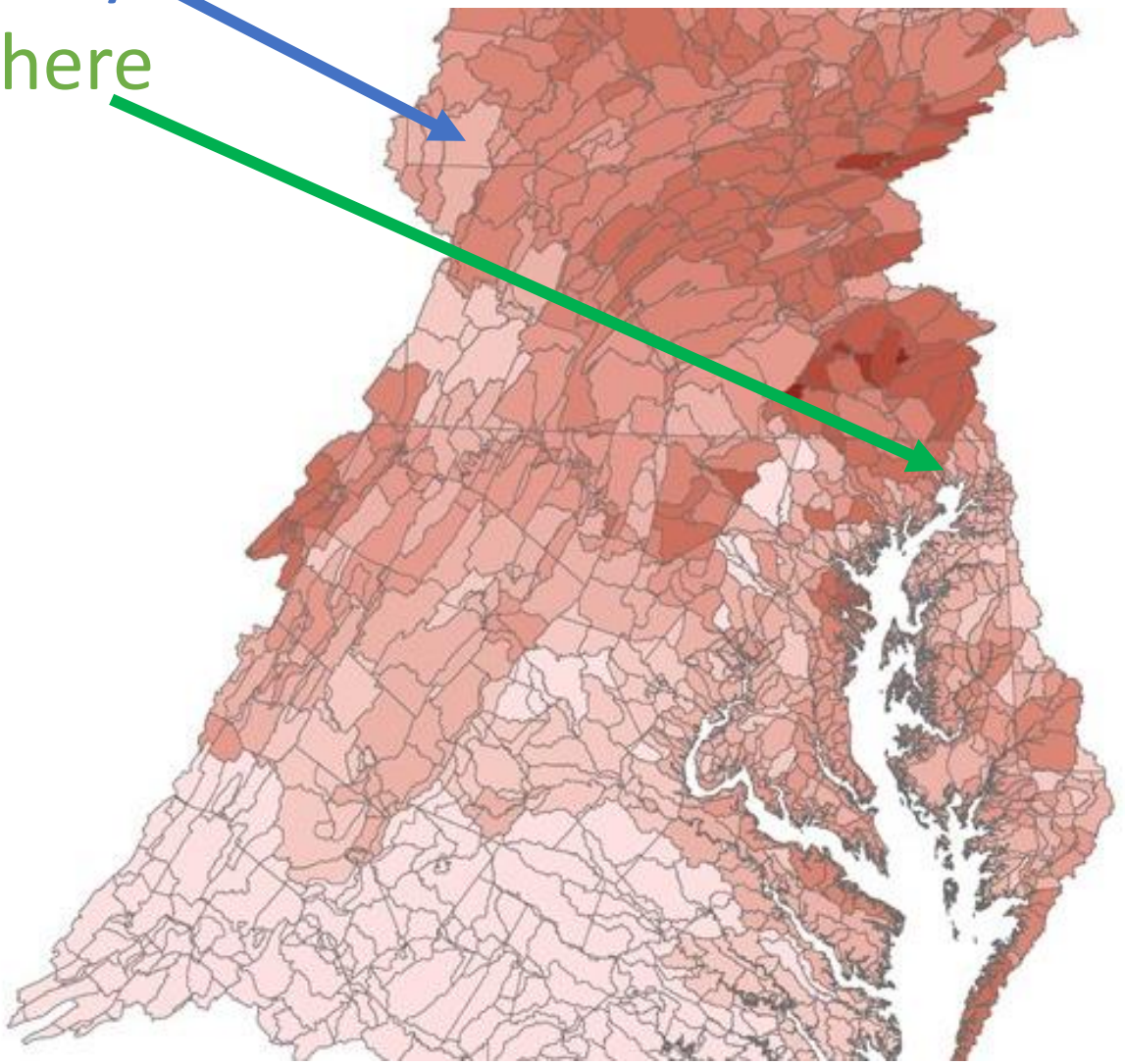
How do we put it all together?

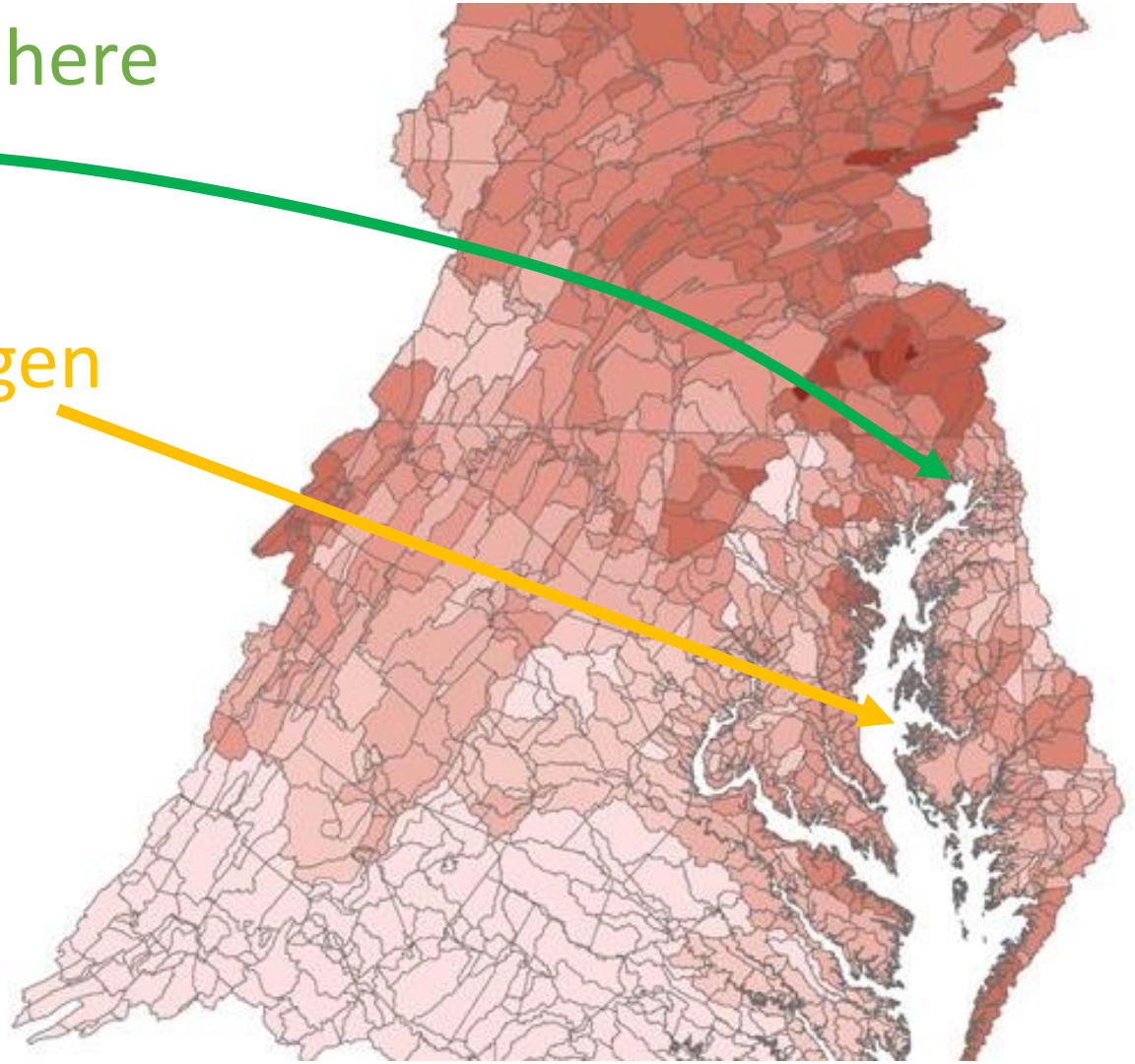
If we know how much of what is locally produced here actually makes it to here



How do we put it all together?

If we know how much of what is locally produced here actually makes it to here

And we know how much changing what makes it to here changes oxygen here



How do we put it all together?

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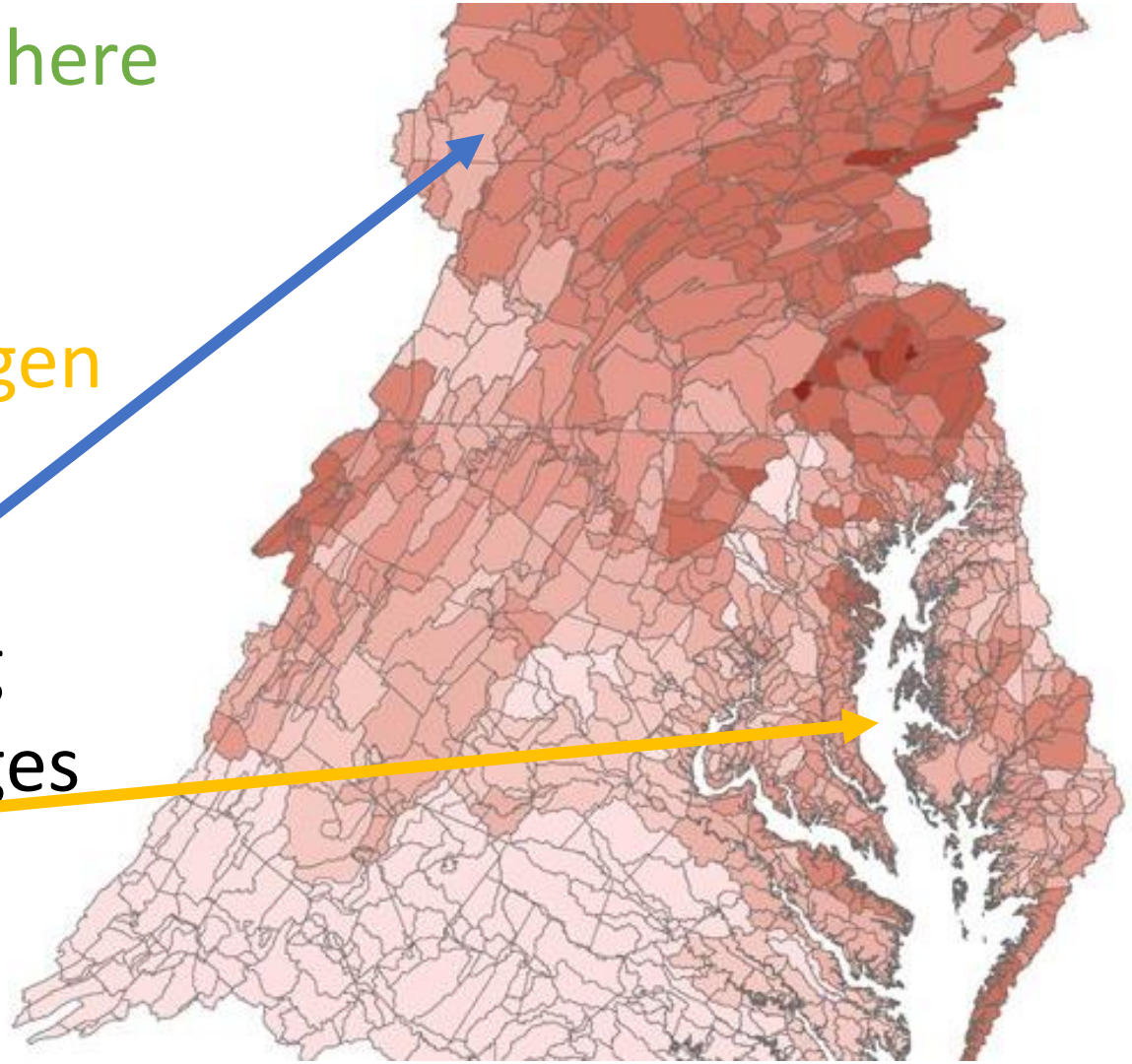
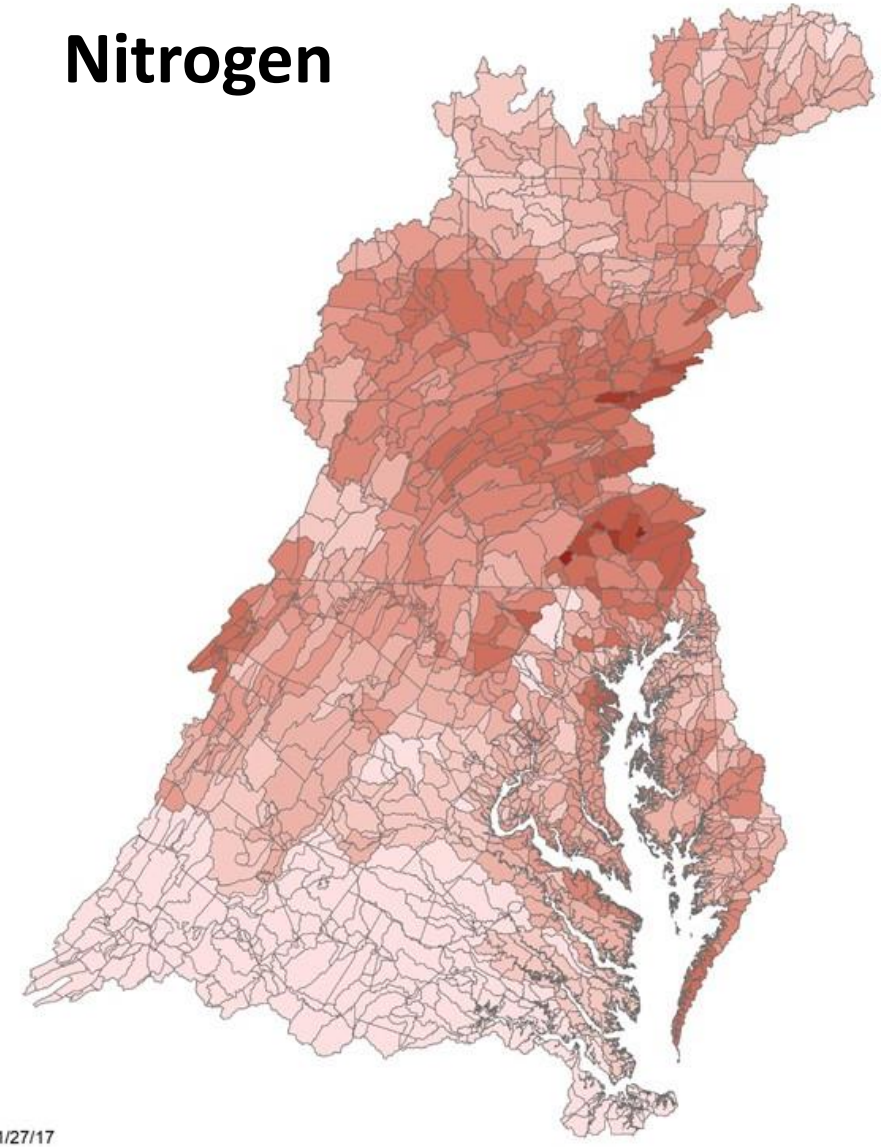
And we know how much changing what makes it to here changes oxygen here

Then we know how much changing what's locally produced here changes oxygen here



Estimating the effect of nutrient reductions: relative effectiveness

Nitrogen



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Impact on water quality in the Bay

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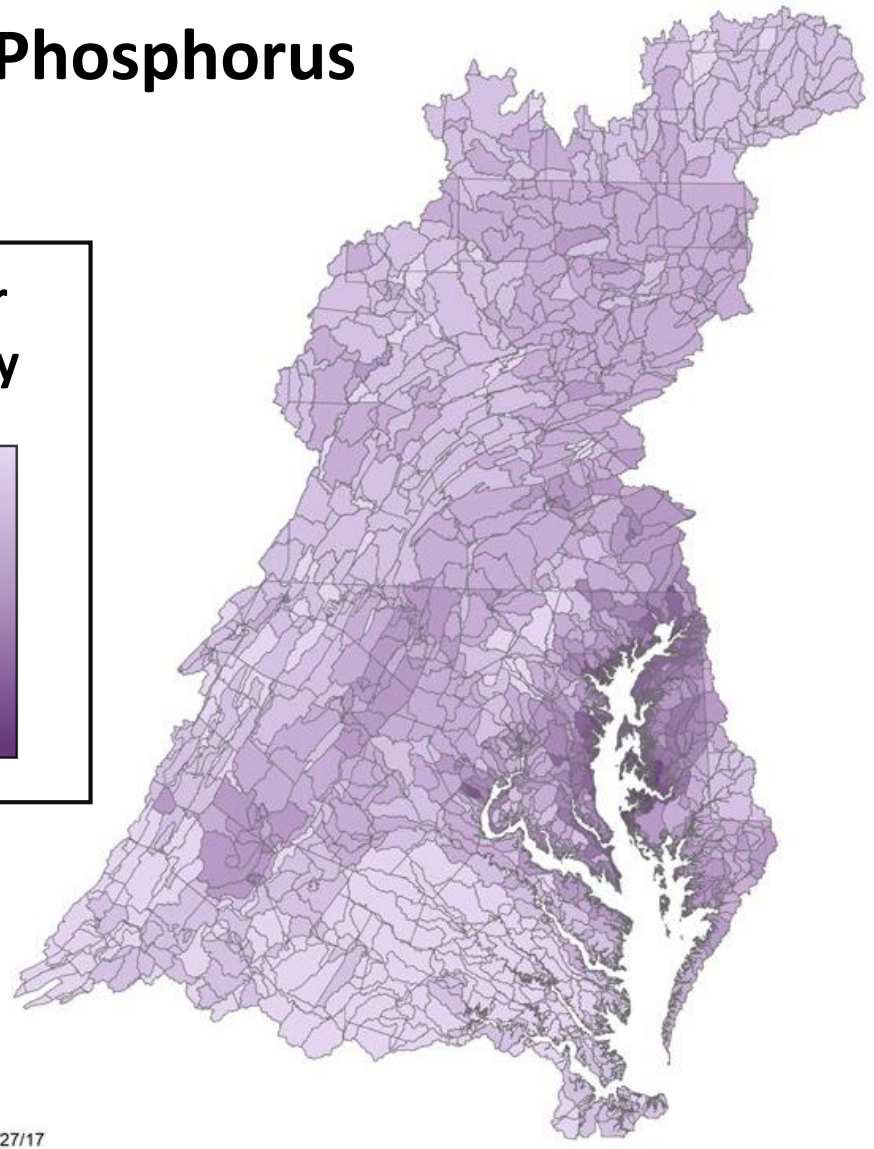

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Why do the maps look the way they do?

Remember our key factors:

Transport through the watershed

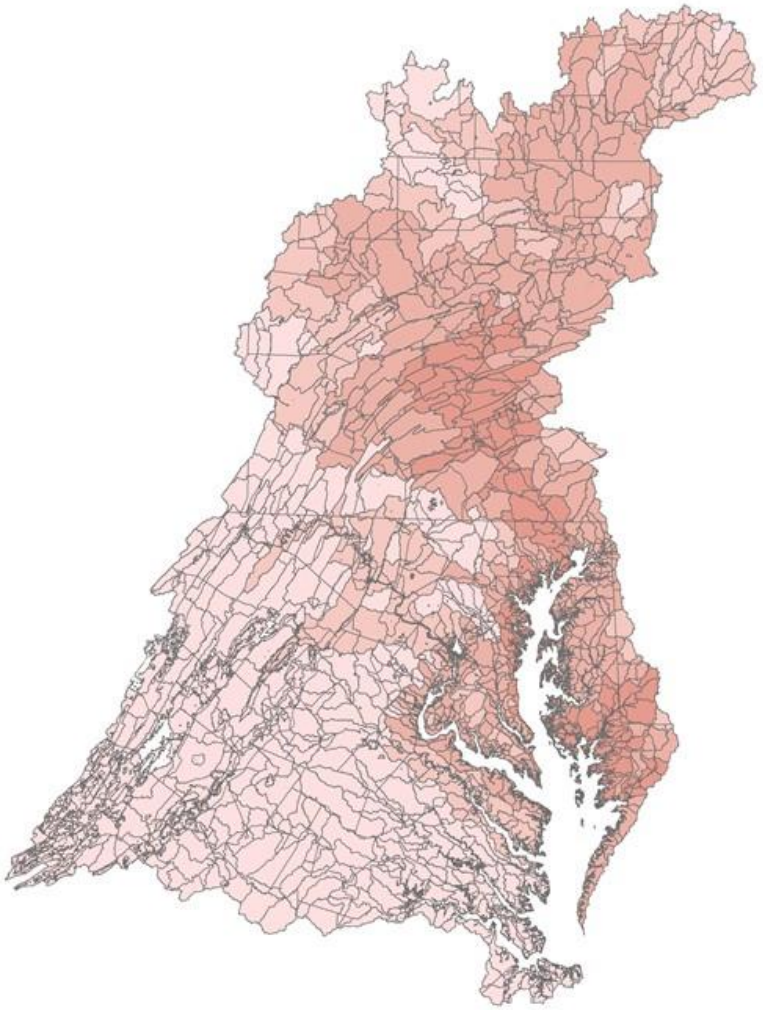
- Greater attenuation with greater travel distance or in certain types of streams/rivers
- Watershed characteristics

Transport through the estuary

- Northern river basins do not have tidal tributaries
- Loads from northern river basins have longer residence time in estuary
- Eastern shore influential due to counterclockwise circulation

How have these maps changed?

Phase 5 Nitrogen



Impact on water quality in the Bay

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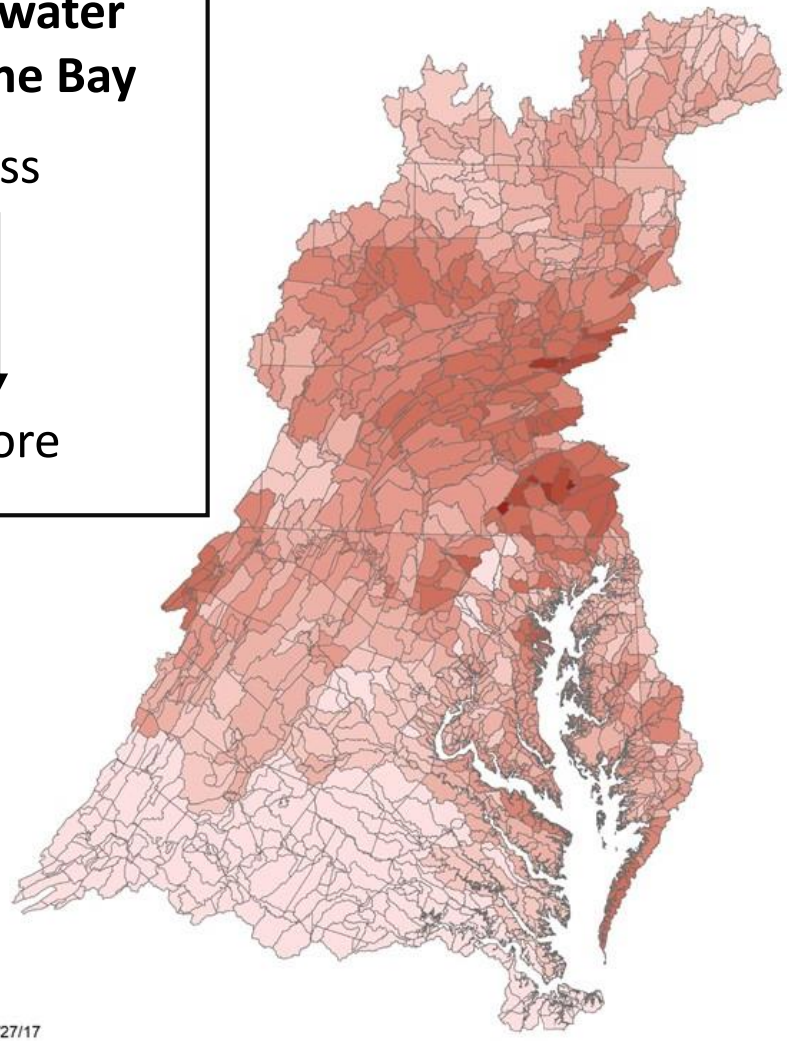
More

Phase 6 Nitrogen



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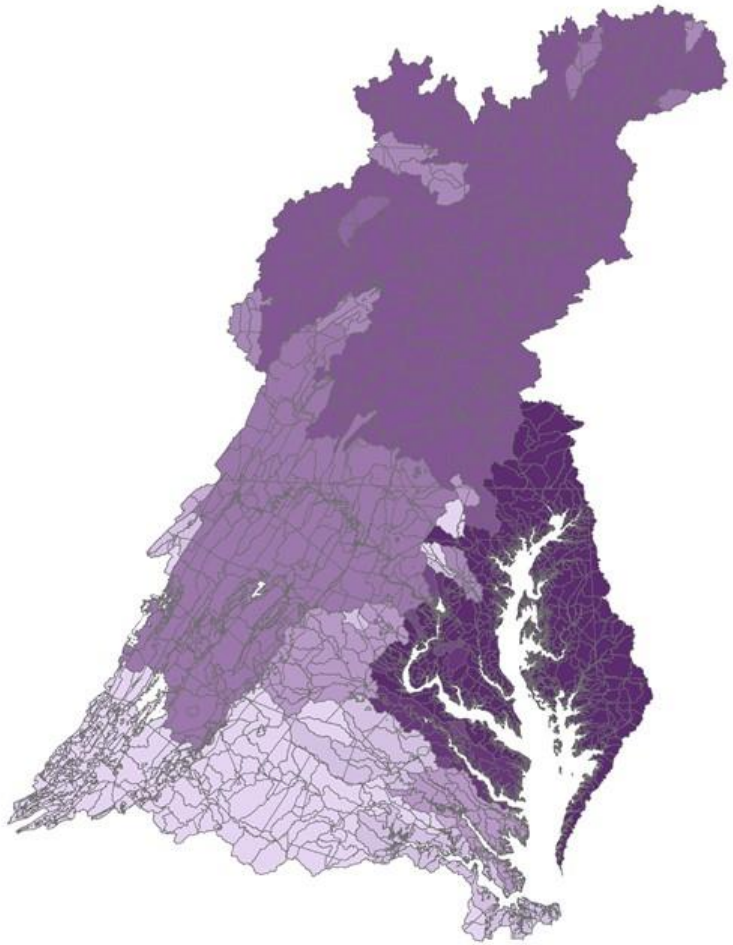
How have these maps changed?

Phase 5 Phosphorus



Impact on water quality in the Bay

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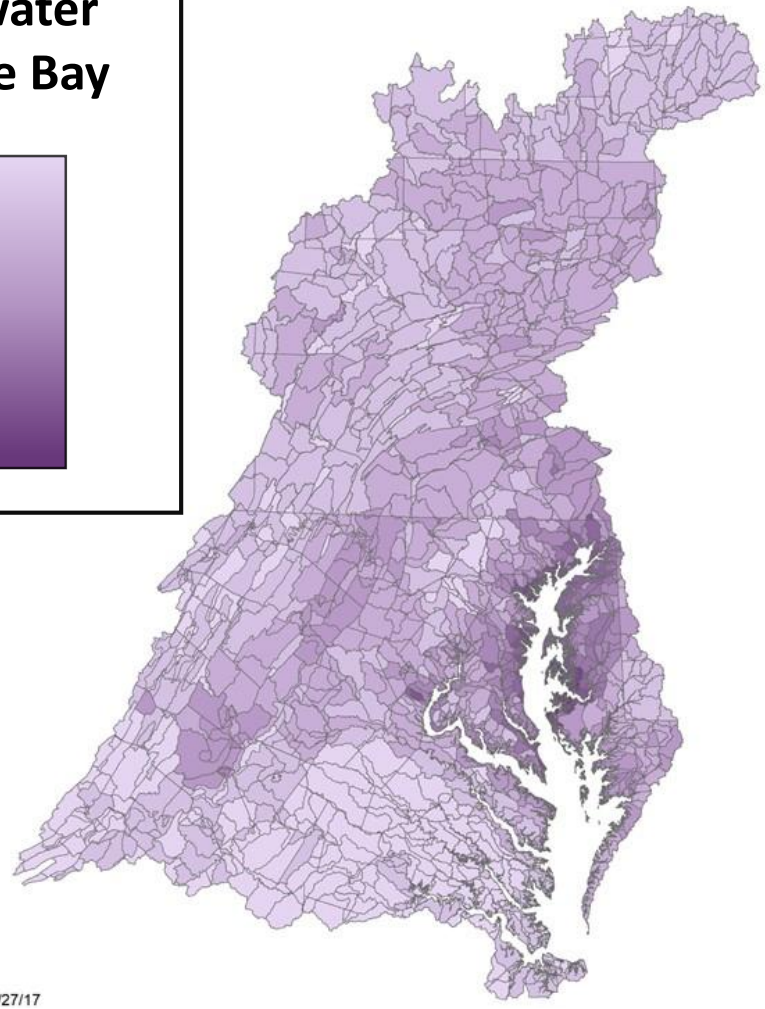
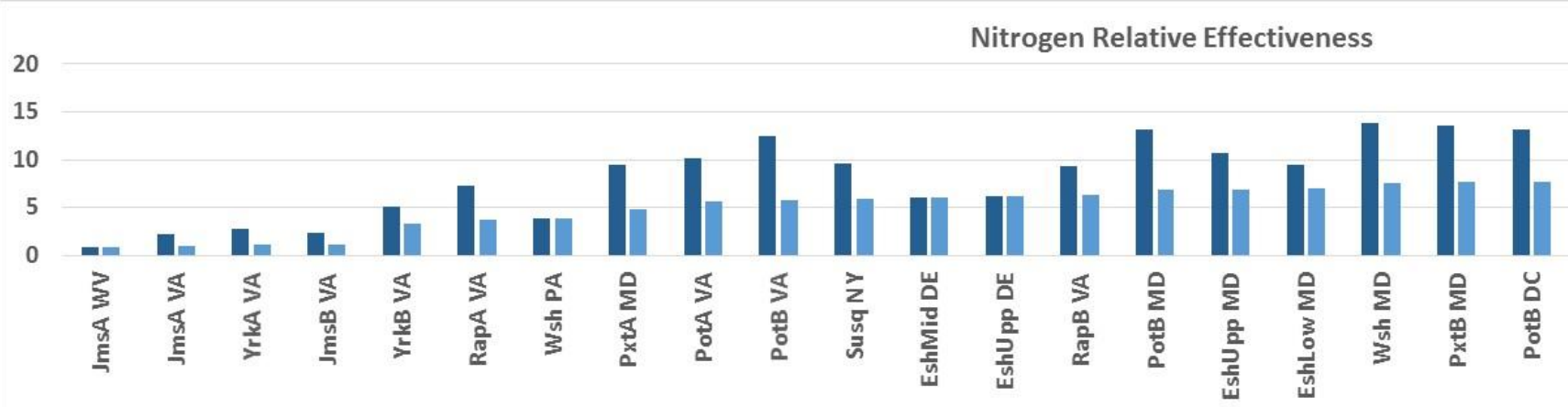
More

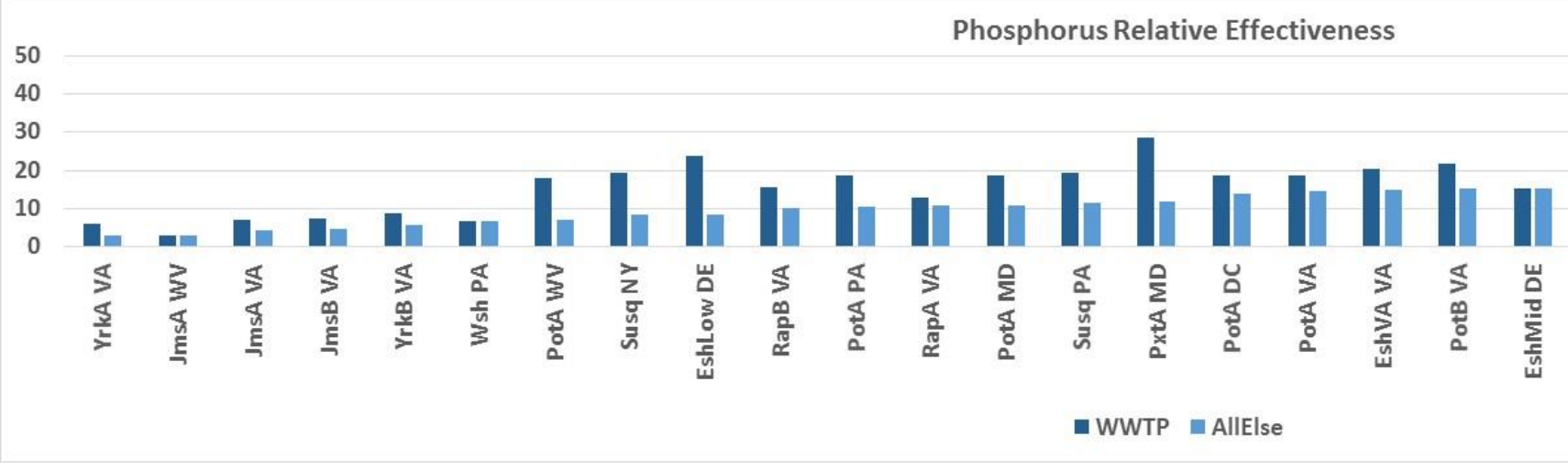
Phase 6 Phosphorus

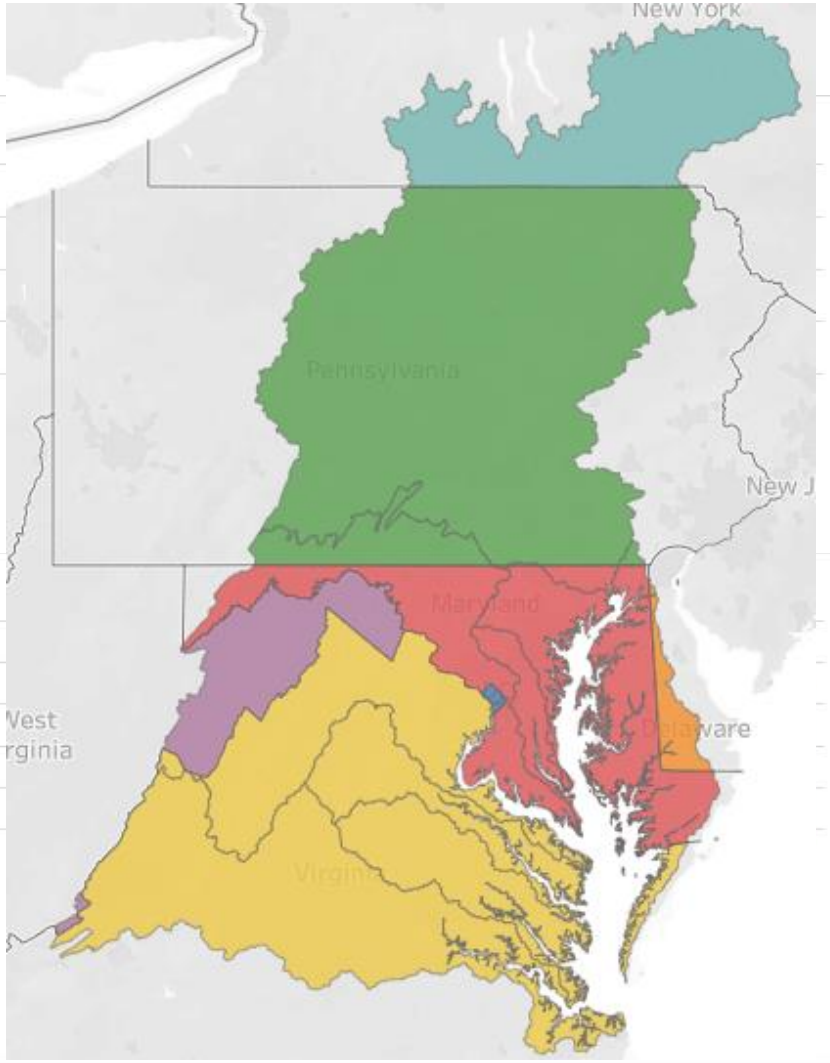


What do we currently use them for?

Used to generate the Phase III Watershed Implementation Plan planning targets – “more impact, do more”







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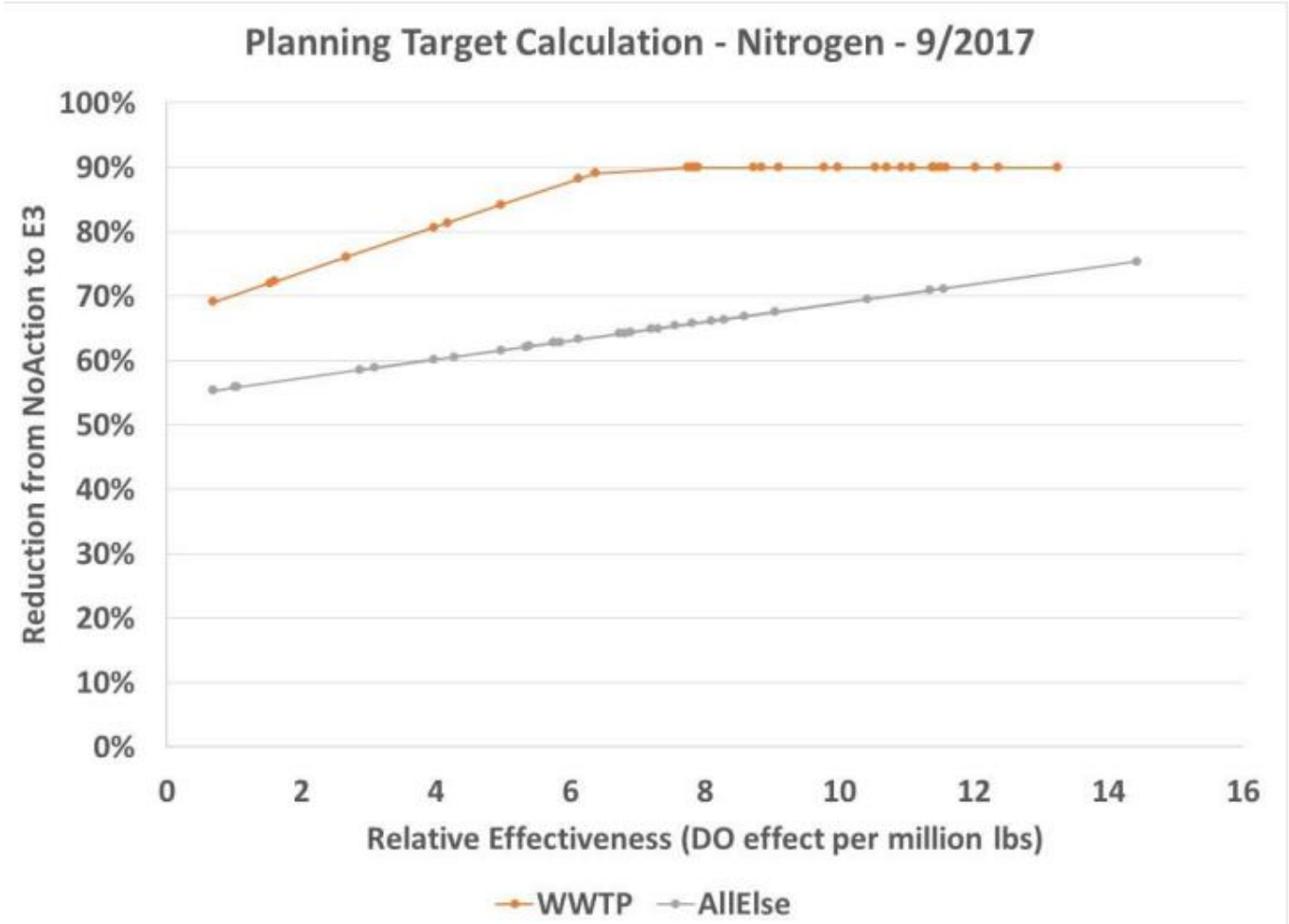

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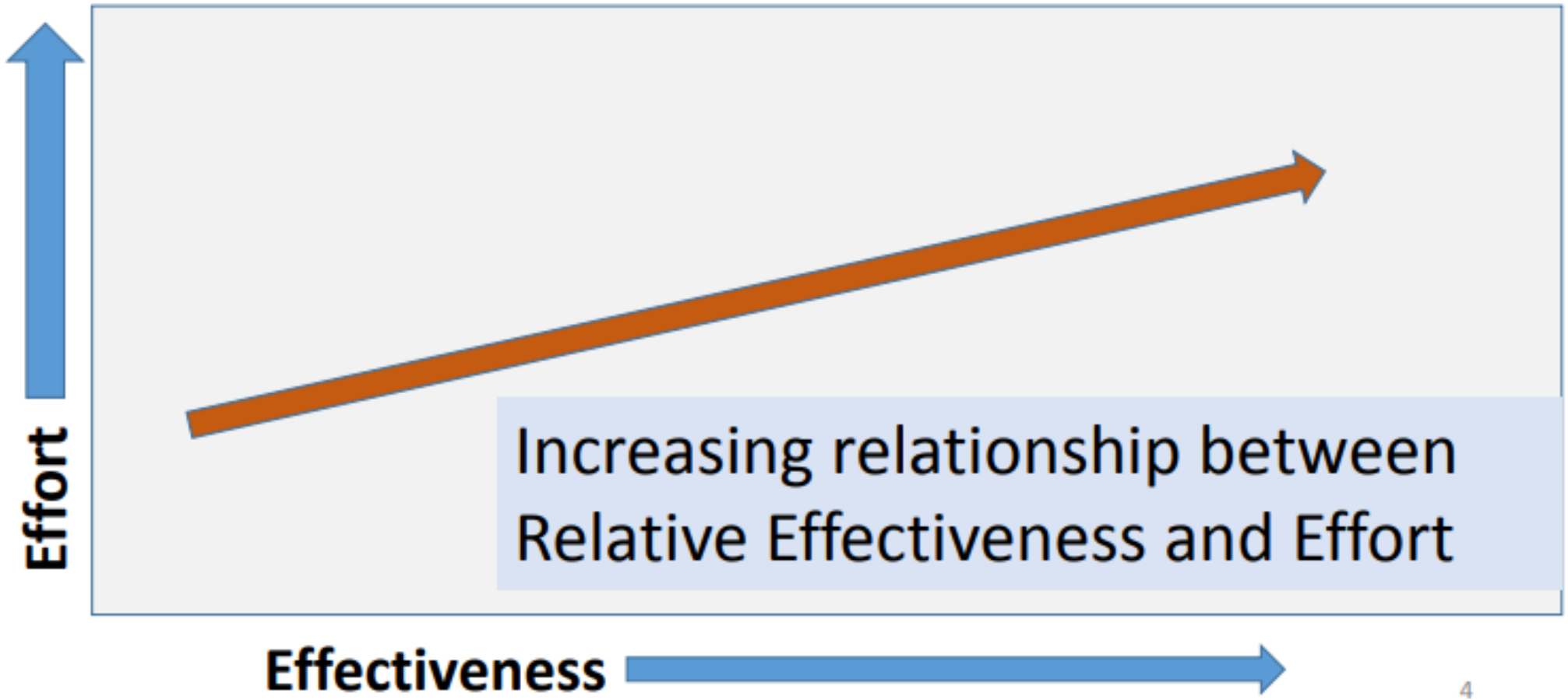
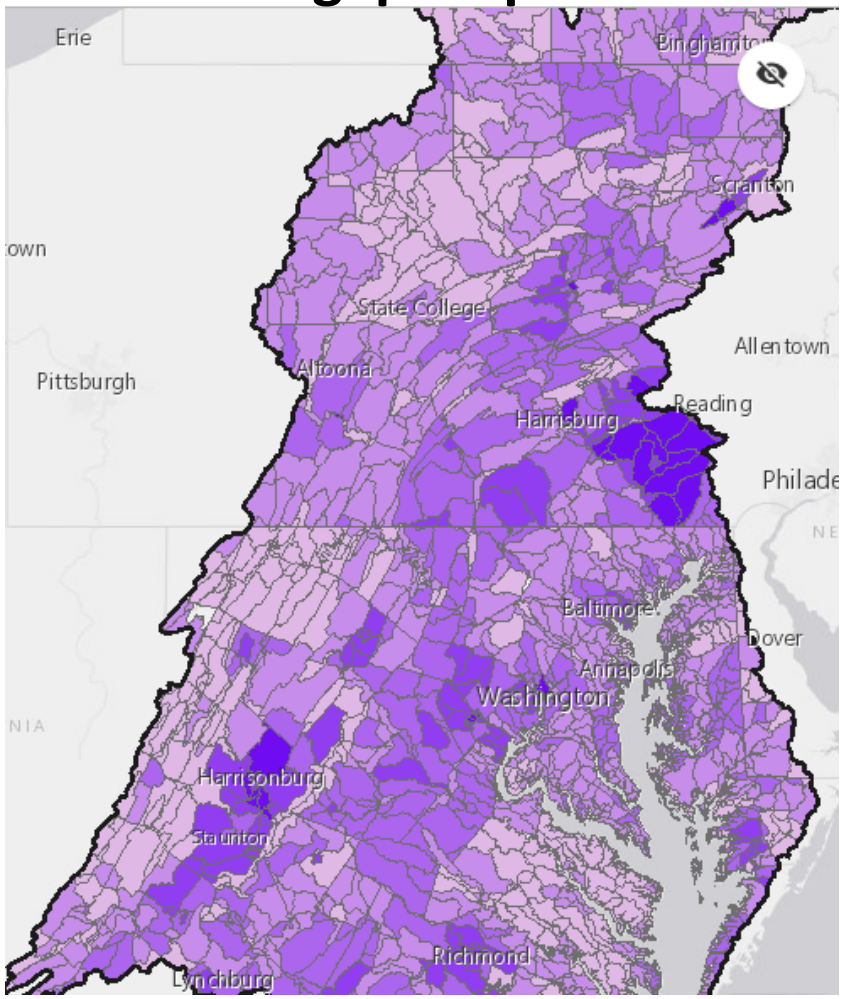


What other ways can we target?

Can utilize relative effectiveness maps along with other data:

Highest loading areas

E.g. phosphorus loads



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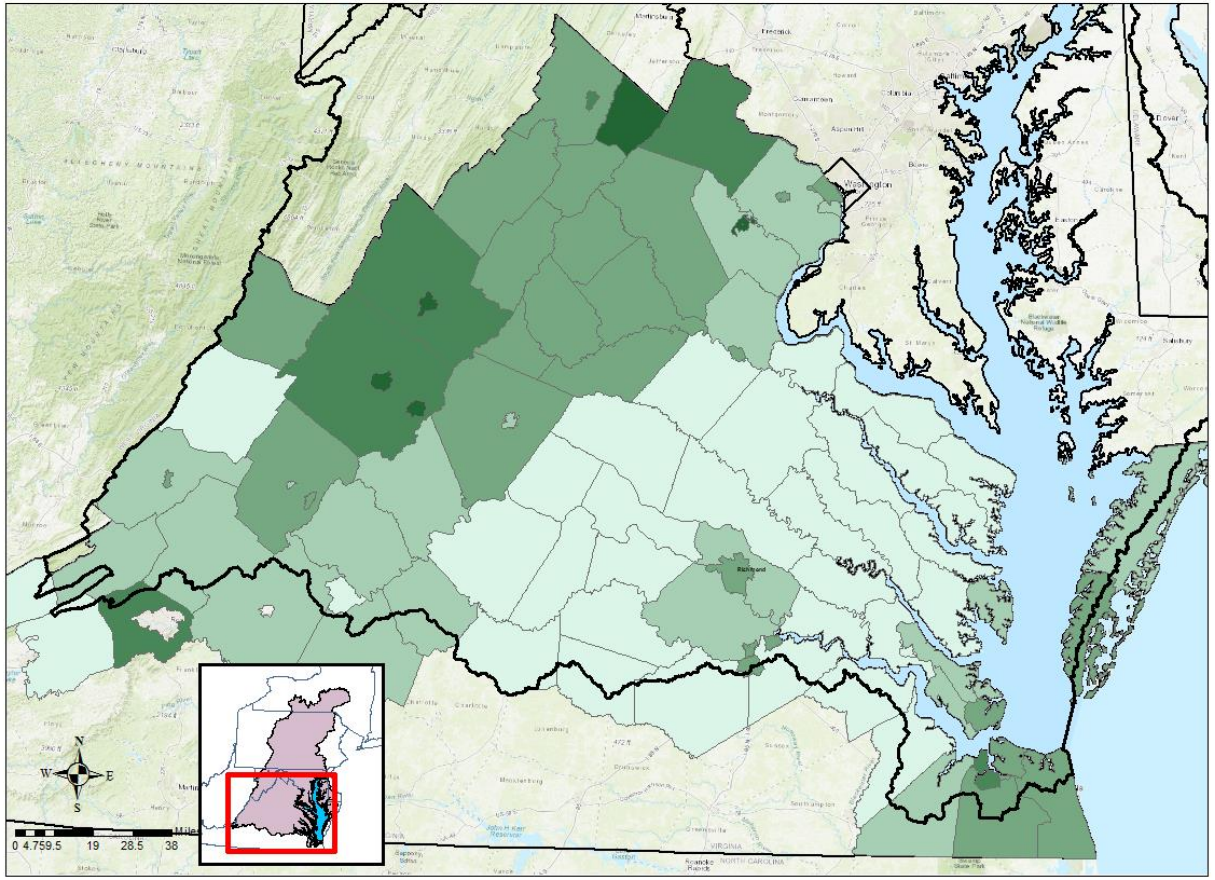
Can utilize relative effectiveness maps along with other data:

E.g. riparian buffer opportunities

Highest loading areas

BMP opportunity areas



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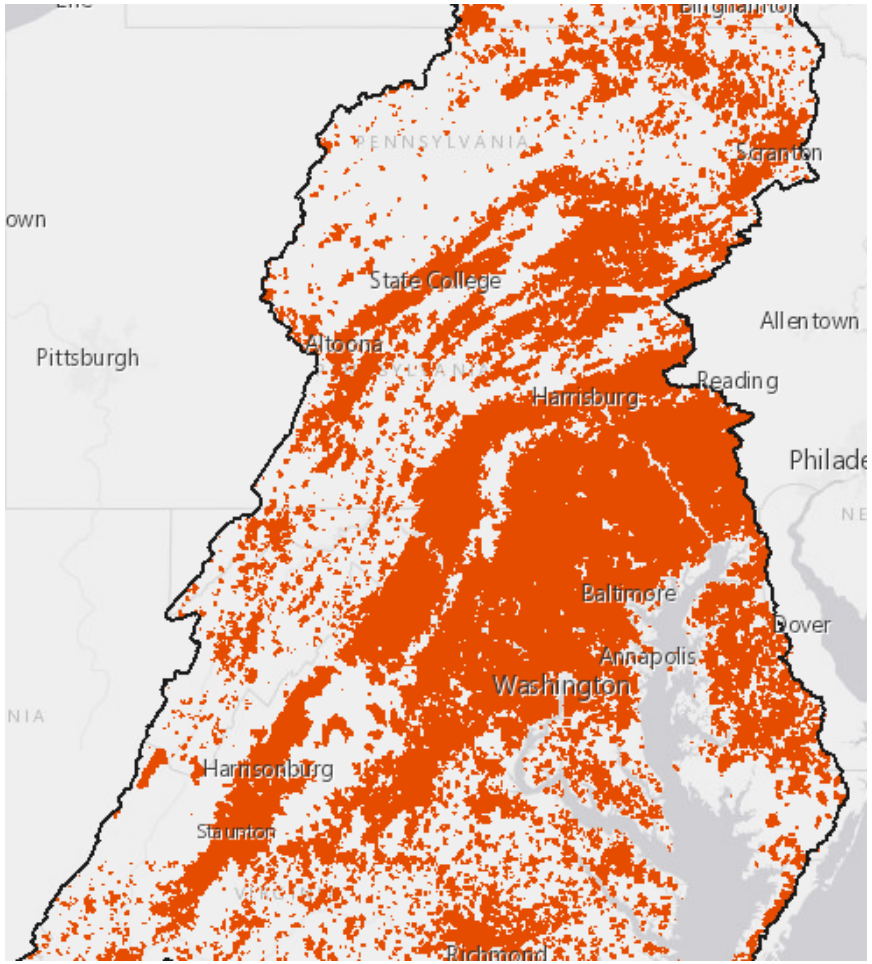
Highest loading areas

BMP opportunity areas

Other goals and priorities

E.g. high-risk fish habitat



Thank you!

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410-267-5797