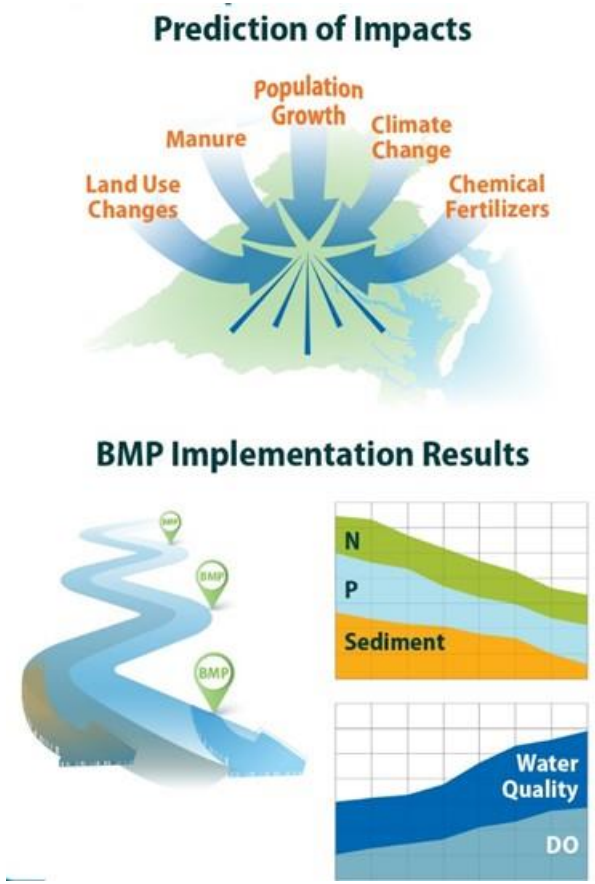
WWTWG Involvement in Phase 7 Watershed Model Development

Wastewater Treatment Workgroup

2/6/2024

Outline

- Bay TMDL Summary
- Background on Watershed Model
- Data ideals
  - Consistency > Accuracy
  - Weather independent values > Actual values
- Topics
  - Boat Discharges
  - WWTP
    - Drinking Water plants
  - CSOs
  - SSOs and Bypass
  - Exfiltration



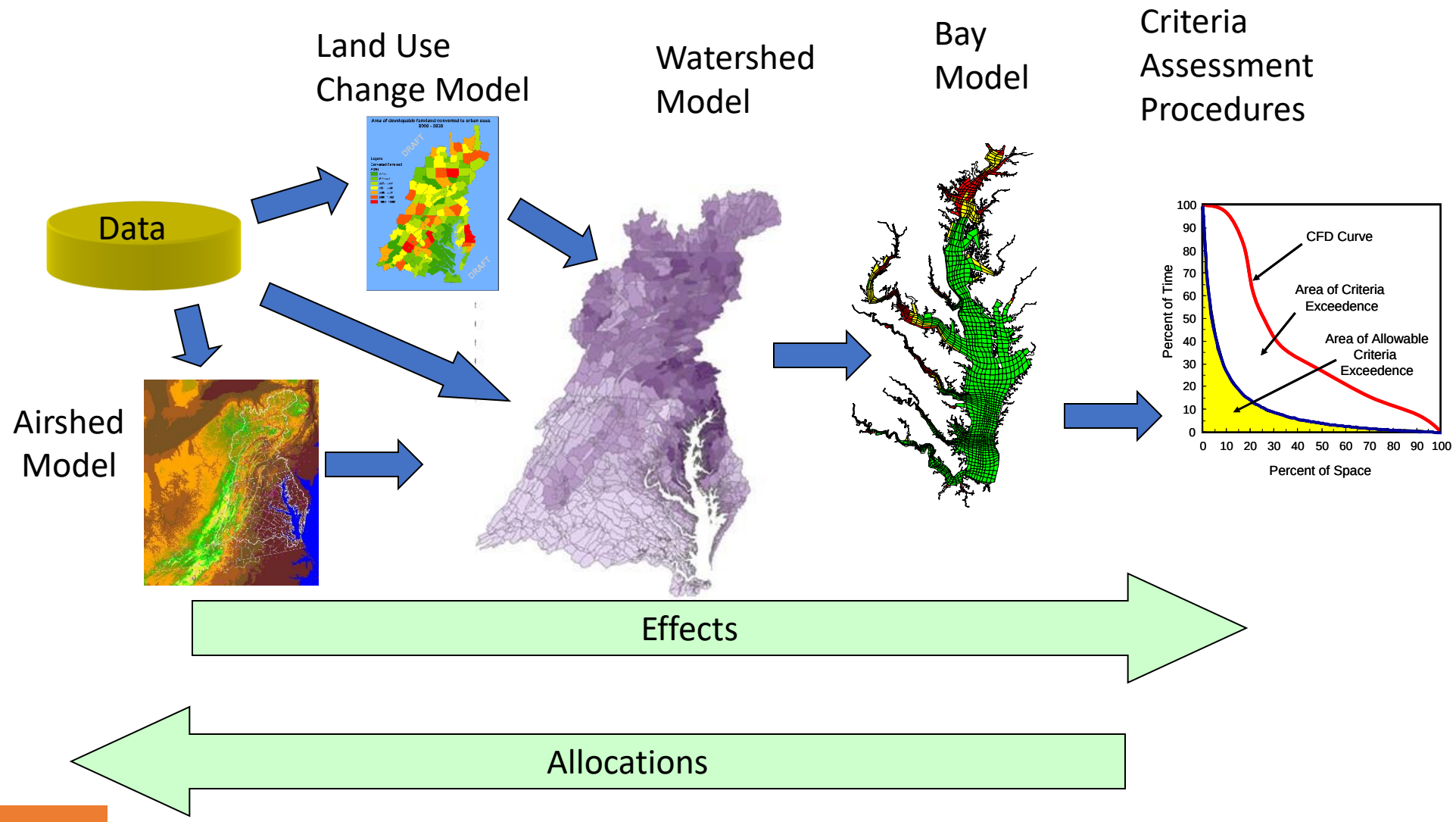
TMDL summary

What management practices…

…. will reduce nitrogen and phosphorus to levels …

…. that will achieve appropriate dissolved oxygen, clarity, and chlorophyll in the Bay?

CBP Decision Support System



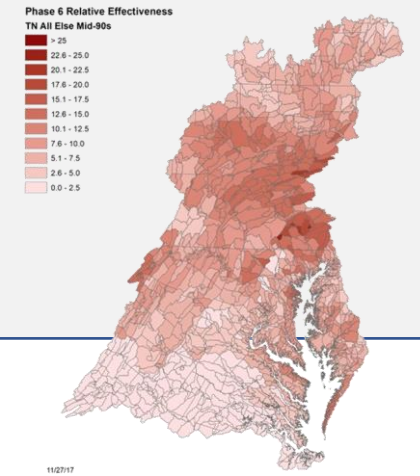
Guidelines for Planning Targets

Everything
Everywhere
Everyone

Effort

No BMPs

Increasing relationship between
Relative Effectiveness and Effort



Effectiveness

Nutrient Targets

Major	State		2018 Planning Targets approved by PSC	
Major	State	StateBasin	Nitrogen	Phosphorus
Potomac	DC	DC Potomac	2.42	0.130
Eastern Shore	DE	DE Eastern Shore	4.55	0.108
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Patuxent	MD	MD Patuxent	3.21	0.301
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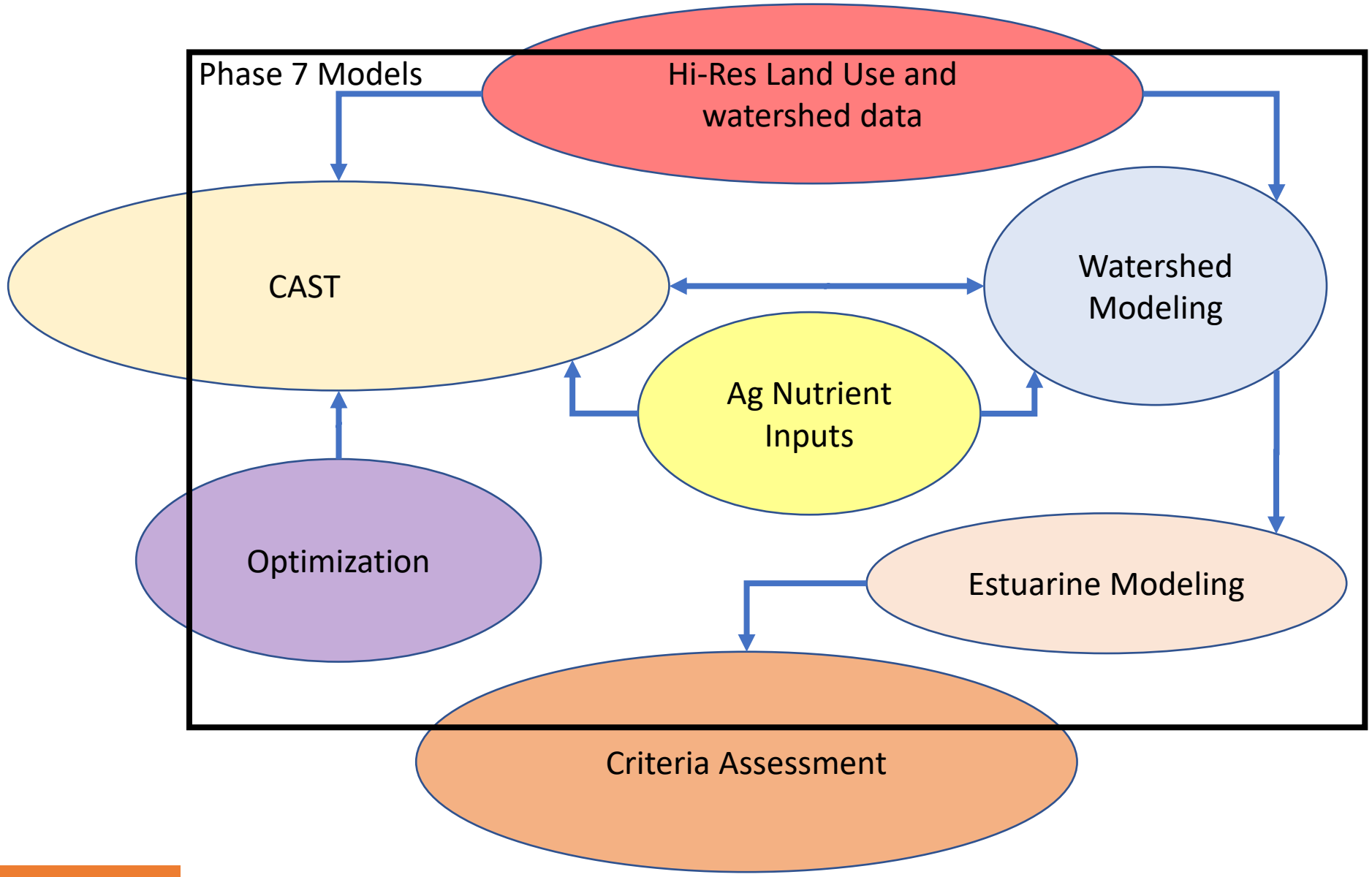
Western Shore	PA	PA Western Shore	0.02	0.001
Eastern Shore	VA	VA Eastern Shore	1.43	0.164
James	VA	VA James	25.92	2.731
Potomac	VA	VA Potomac	16.00	1.892
Rappahannock	VA	VA Rappahannock	6.85	0.849
York	VA	VA York	5.52	0.556
James	WV	WV James	0.04	0.005
Potomac	WV	WV Potomac	8.18	0.427

- Nutrient loads in million lbs/year
- Long-term hydrology
  - When the targets are reached, these are the annual average loads
  - Not the cap for the wettest year or the 90th percentile year
- Will be reevaluated with new models and climate change through 2035 in 2027/2028

Phase 7 Development Tracks



Web page

- Overview
- Seven Projects
  - Descriptions
  - Documents
- Linked from
  - Modeling Workgroup
  - WQGIT
  - Many WQGIT WGs

Phase 7 Model Development | Ch

chesapeakebay.net/what/programs/modeling/phase_7_model_development

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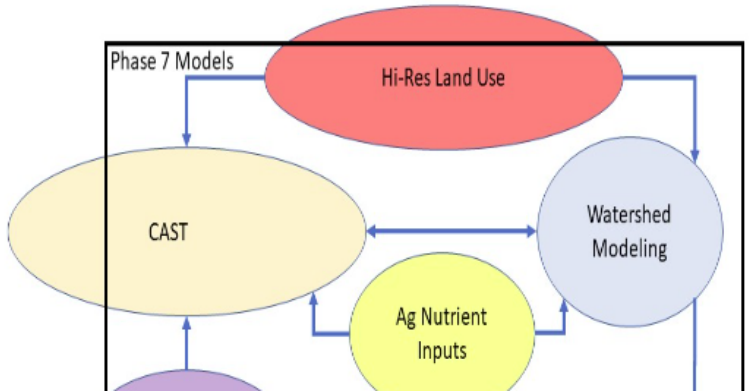
WHAT WE DO > PROGRAMS & PROJECTS > PHASE 7 MODEL DEVELOPMENT

Phase 7 Model Development

The Chesapeake Bay Program is updating its modeling and analysis tools used in the Chesapeake Bay TMDL.

Currently in development, the Phase 7 Modeling Tools will be used by the partnership to inform decisions related to nutrient and sediment reduction goals outlined in the Chesapeake Bay Watershed Agreement. Integral to this updated suite of tools is the ability to project climate change effect through 2035. The model, which will be ready for use by 2027, consists of six interrelated projects:

1. High Resolution Land Use
2. Chesapeake Assessment Scenario Tool (CAST)
3. Optimization
4. Agricultural Inputs
5. Watershed Modeling
6. Estuarine Modeling
7. Criteria Assessment



Modeling

Phase 7 Model Development

Programs & Projects

Modeling
Monitoring
Quality Assurance
Resource Lands Assessment
Chesapeake Bay TMDL
Watershed Implementation Plans
BMP Verification

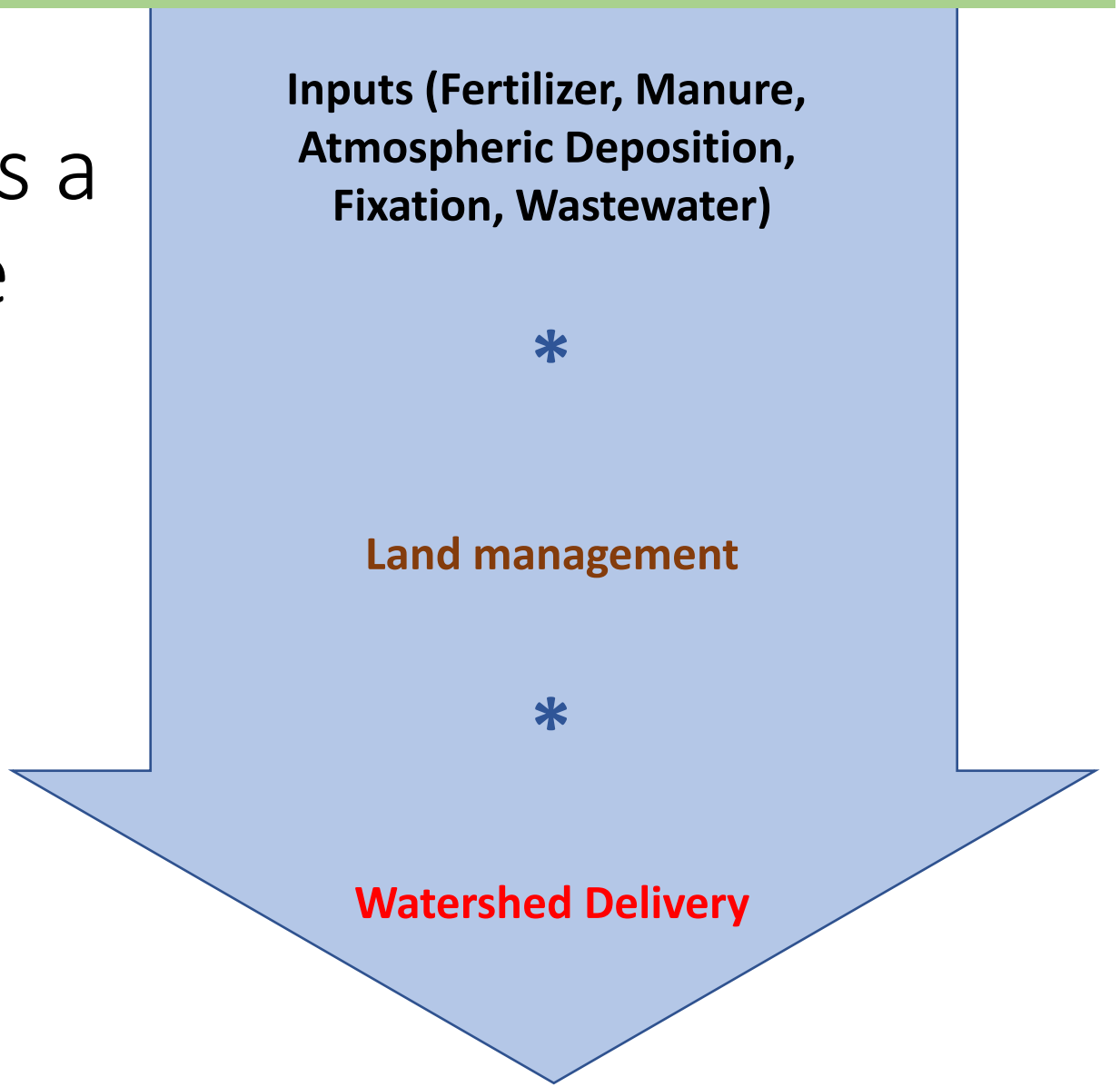
Bay TMDL Summary

Watershed Model Plan – Big Picture

2022	2022	2022	2022	2023	2023	2023	2023	2024	2024	2024	2024	2025	2025	2025	2025	2026	2026	2026	2026
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Work plan			Build	Work plan	Build Models			Work plan	Build Models			Work plan	Build Models			Review Models			
Build Model Structure				Improve Models												Review Models			

CAST Structure

CAST is a simple model



Load by land-river segment and land use

CAST is a simple model

CAST Structure

Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)

*

Land management

*

Watershed Delivery

Load by land-river segment and land use

CAST Structure

Average Load

+

△ Inputs * Sensitivity

*

BMPs

*

Acres

*

Land to Water

*

River Delivery

Load by land-river segment and land use

CAST Structure

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

Septic

*****

Land to Water

*****

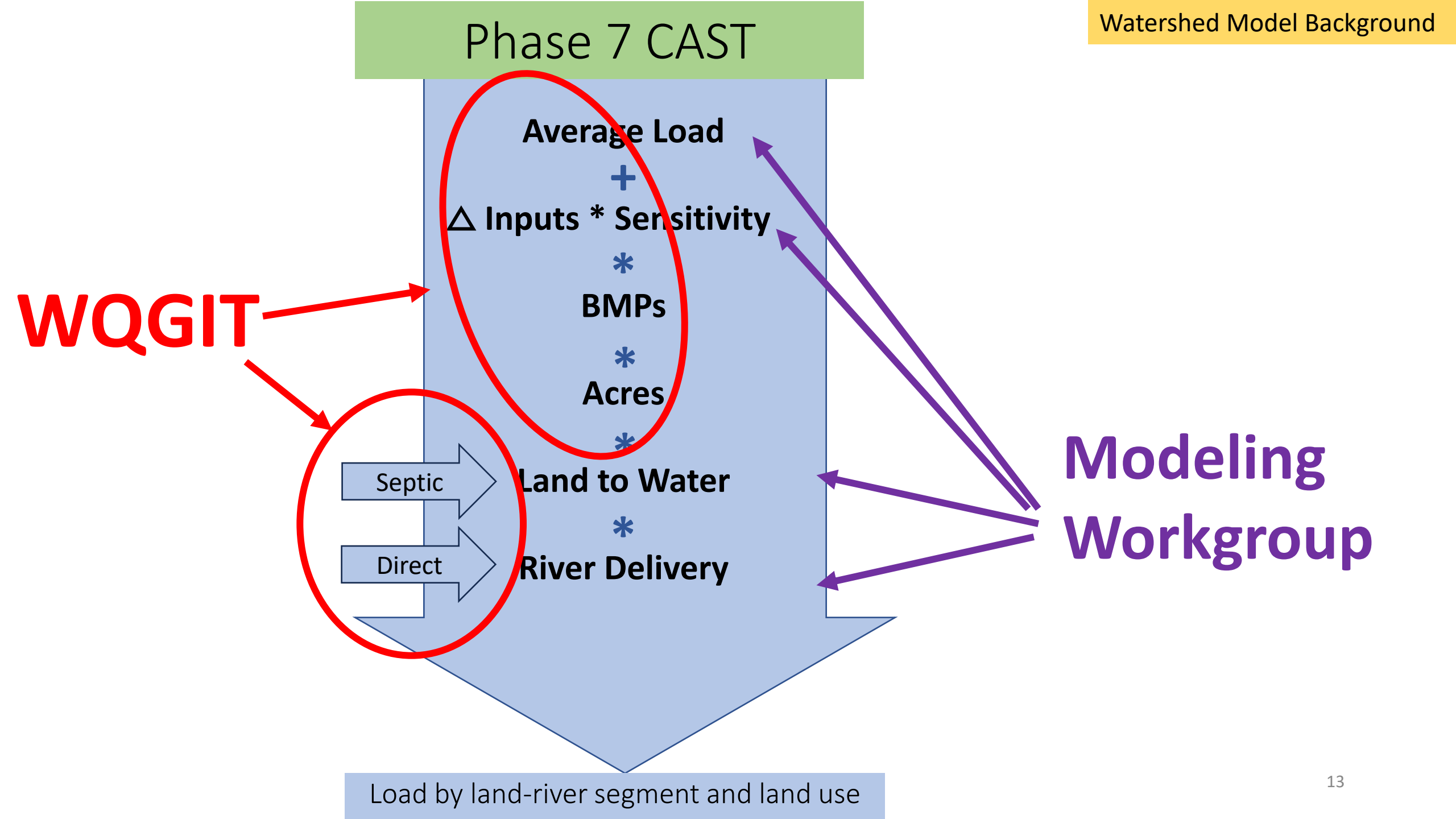
River Delivery

Direct Loads

*****

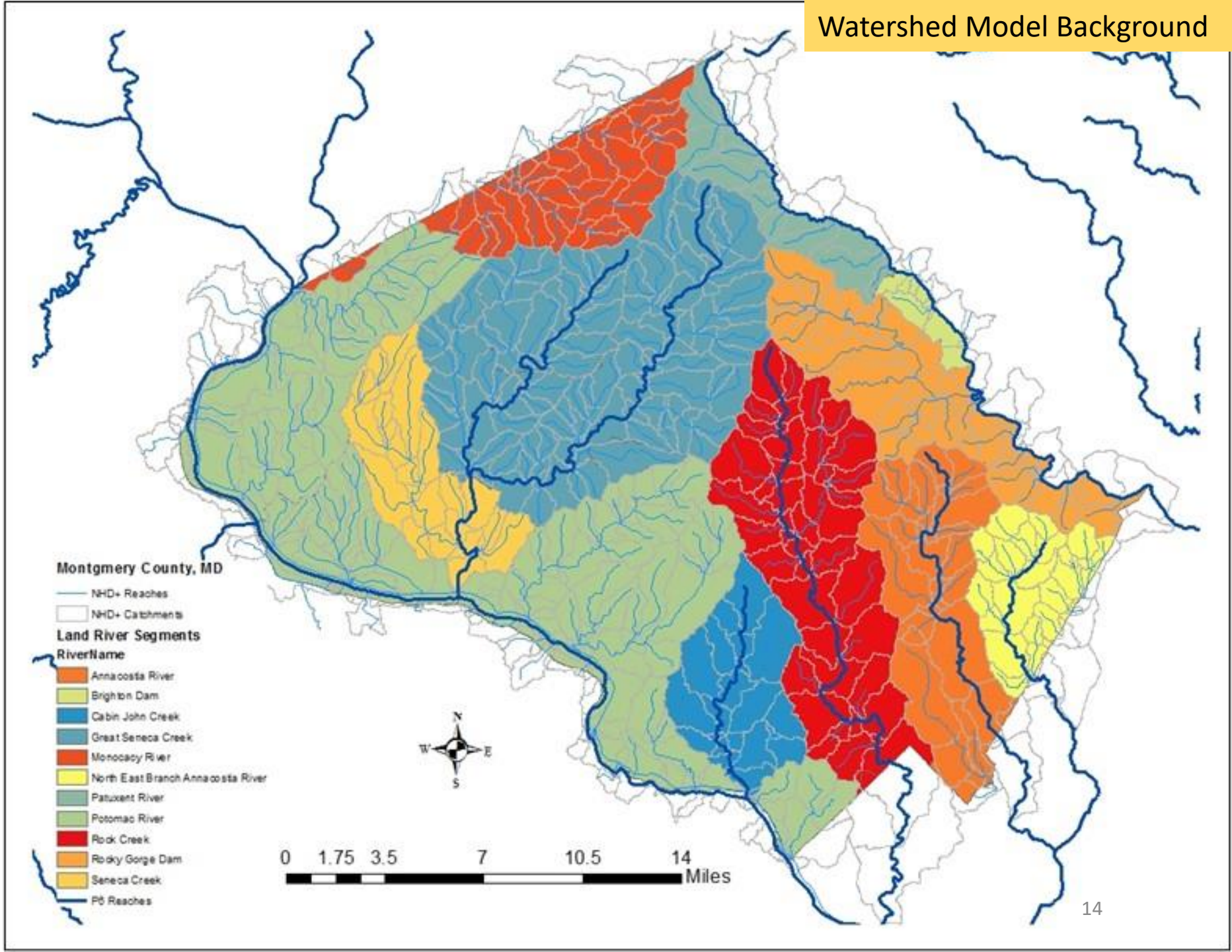
River Delivery

Load by land-river segment and land use


Phase 7 CAST
Average Load
+
Δ Inputs * Sensitivity
*
BMPs
*
Acres
*
Land to Water
*
River Delivery
Septic
Direct
WQGIT
Modeling Workgroup
Load by land-river segment and land use

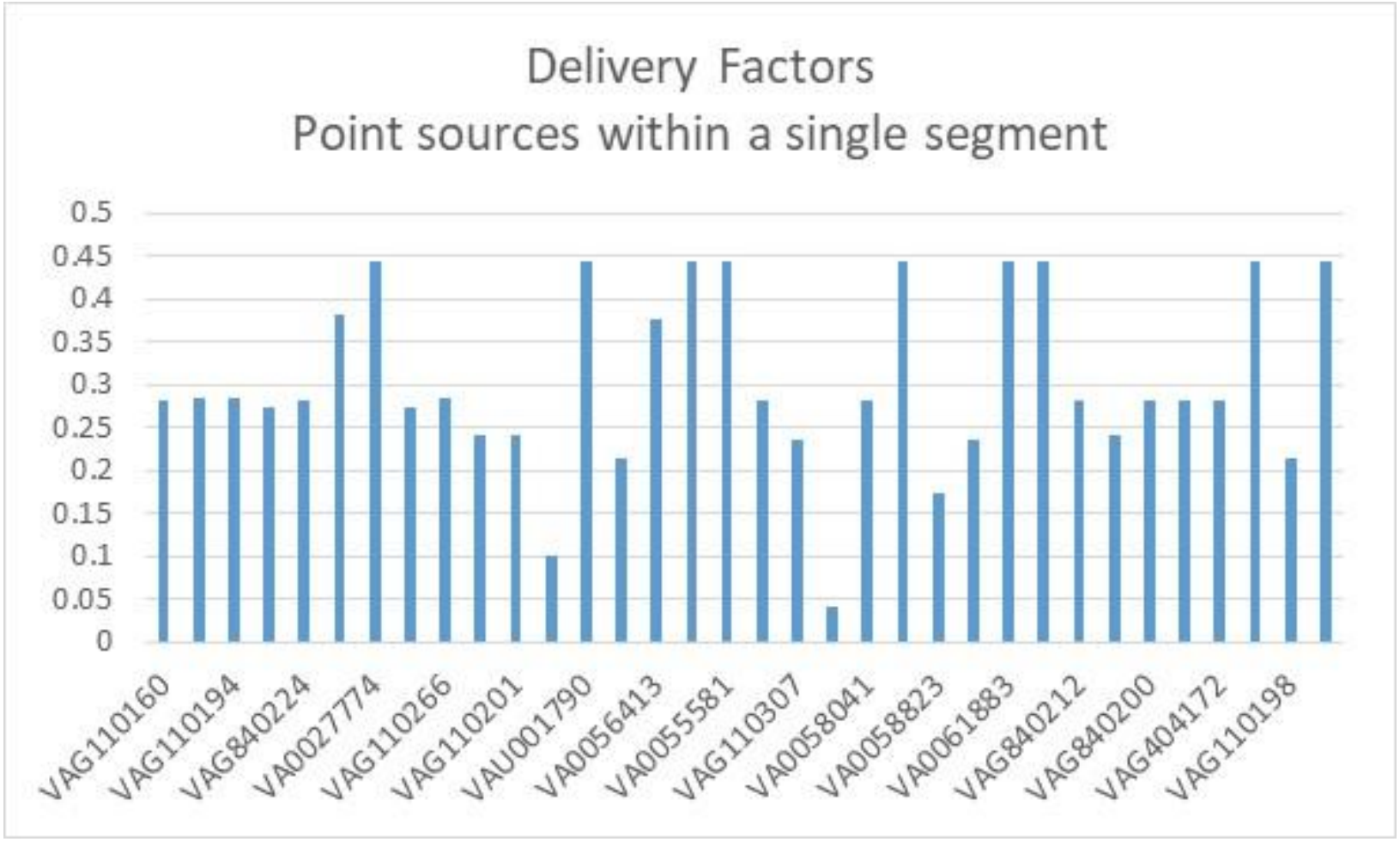
Scale

- Land segment
- Land-river segment
  - nonpoint
- NHD catchment
  - WWTPs



Multiple-Scale in Phase 6

- Delivery Factors for point sources are based on the NHD scale in Phase 6



Phase 7 CAST Structure

Average Load
+
Δ Inputs * Sensitivity
*****
BMPs
*****
Acres
*****
Land to Water
*****
River Delivery

Load by land-river segment and land use

Inform

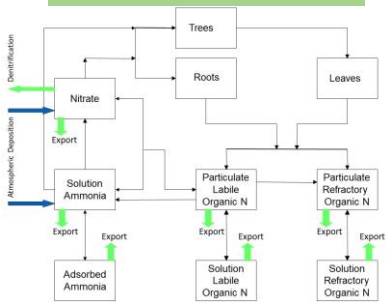
Constrain

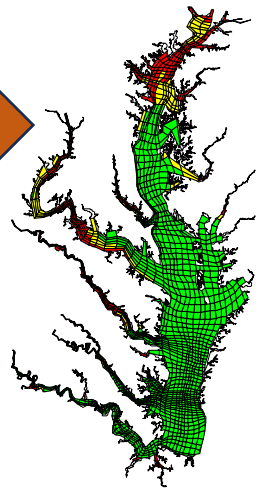
CalCAST

Average Load
+
Δ Inputs * Sensitivity
*****
BMPs
*****
Acres
*****
Land to Water
*****
River Delivery

Load by land-river segment and land use

Temporal downscaling model





CAST model documentation; section 1
https://cast.chesapeakebay.net/Documentation/ModelDocumentation

WIP Indicator

Indicator of implementation

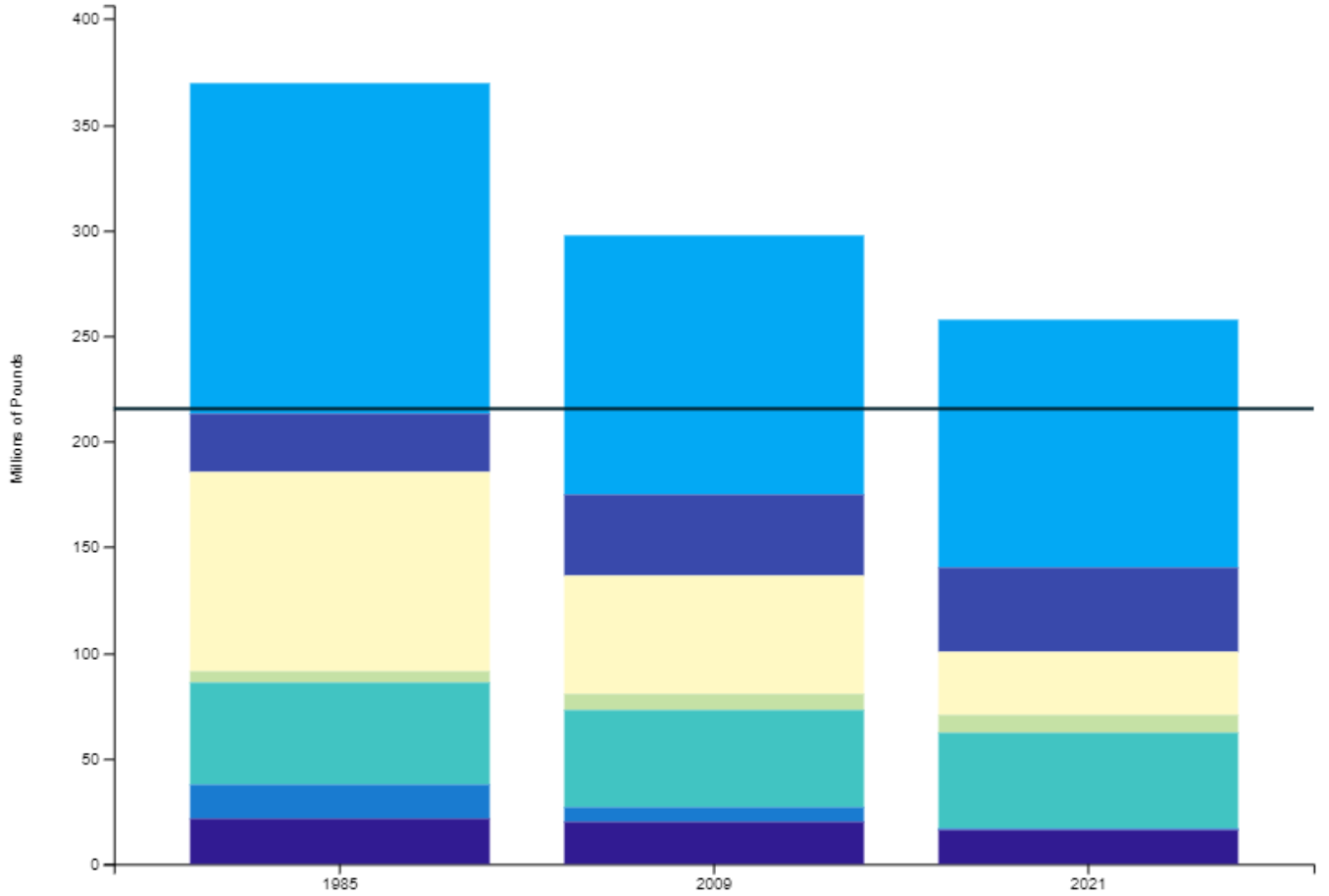
- Agriculture
- Developed
- Wastewater
- Septic
- Natural
- Atmospheric Deposition to Watershed
- Atmospheric Deposition to Tidal Water

Modeled Nitrogen Loads to the Chesapeake Bay (1985-2021)

Loads simulated using CAST19 and jurisdiction-reported data on wastewater discharges. *The natural sector wetlands which are preferable land use types with the lowest loading rates among sources.

VIEW CHART VIEW TABLE

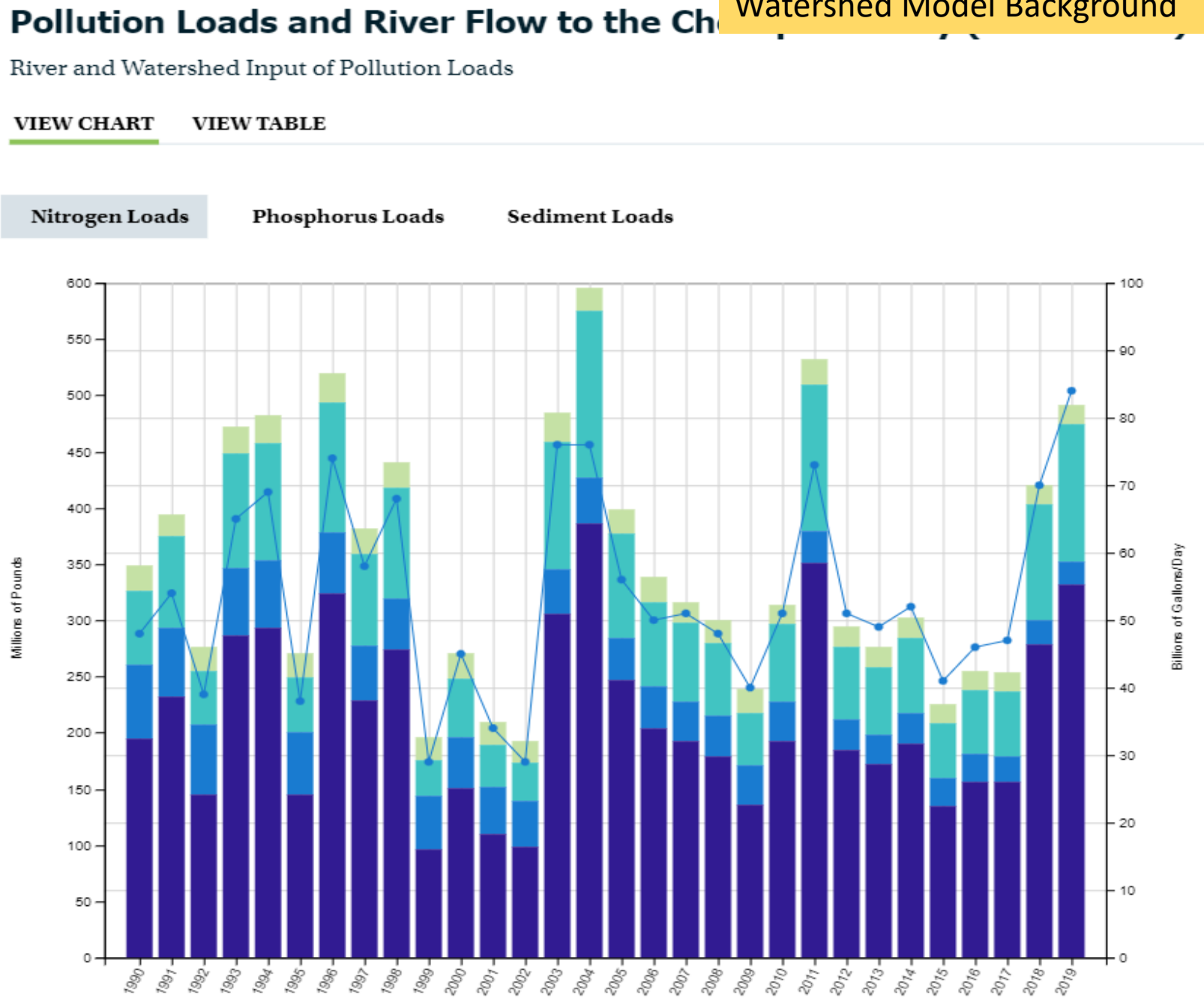
Loads by Source Loads by Jurisdiction



Watershed Model Background

Nontidal Load Indicator

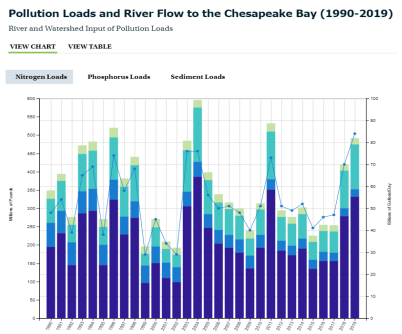
Indicator of what the bay sees



- Atmospheric Deposition to Tidal Waters
- Downstream Nonpoint Sources
- Downstream Wastewater Treatment Plants
- River Input
- River Flow

Watershed Model Background

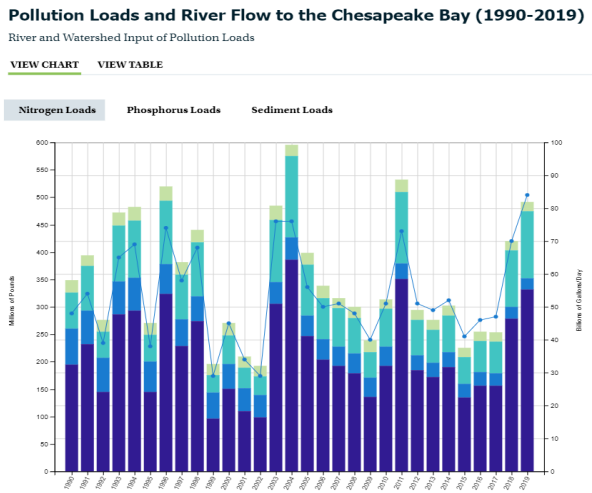
Phase 7 CAST Structure

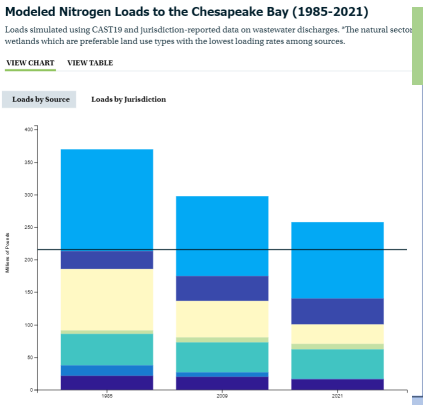


Inform

Average Load
+
Δ Inputs * Sensitivity
*****
BMPs
*****
Acres
*****
Land to Water
*****
River Delivery

Constrain





CalCAST

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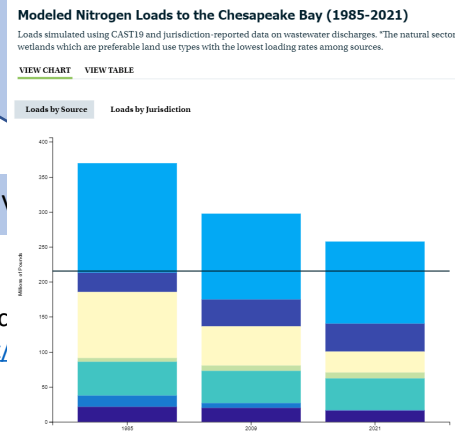
River Delivery

Load by land-river segment and land use



Load by land-ri

CAST model documentation; sec
https://cast.chesapeakebay.net/

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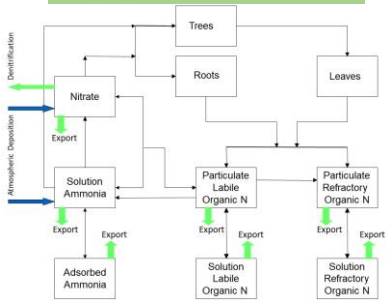
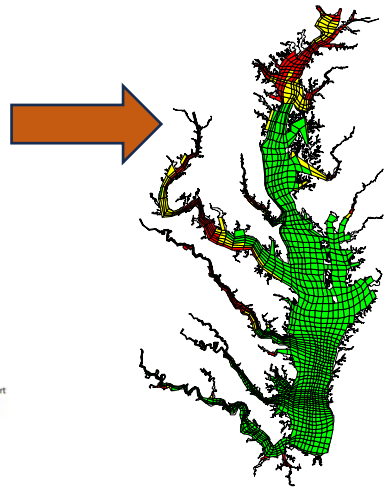


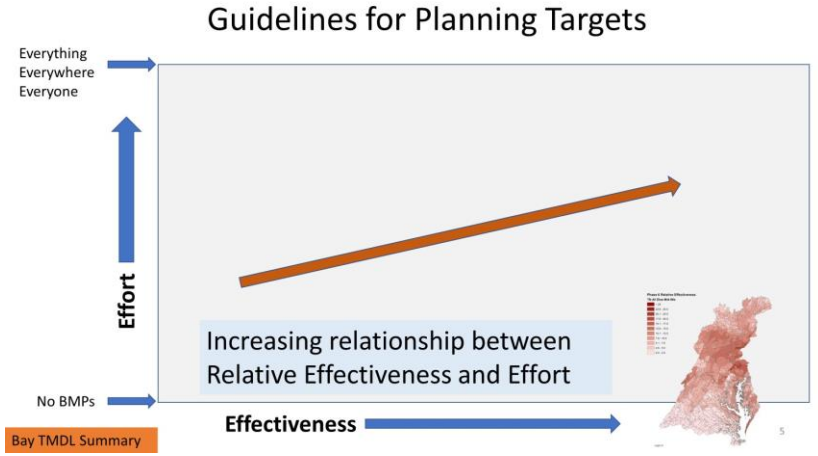


Watershed Model Background

Primary use of the CBP Watershed Model

- Represent anthropogenic changes in load
- Set and track reduction goals

- Ideally:
  - Include all load sources
  - Treat all jurisdictions equally
  - Track actions that change loads
  - Factor out the temporal variability of weather



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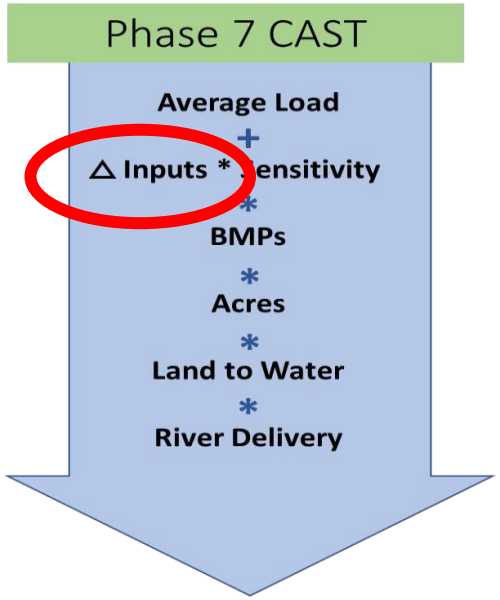
Data Ideals

Consistency > Accuracy



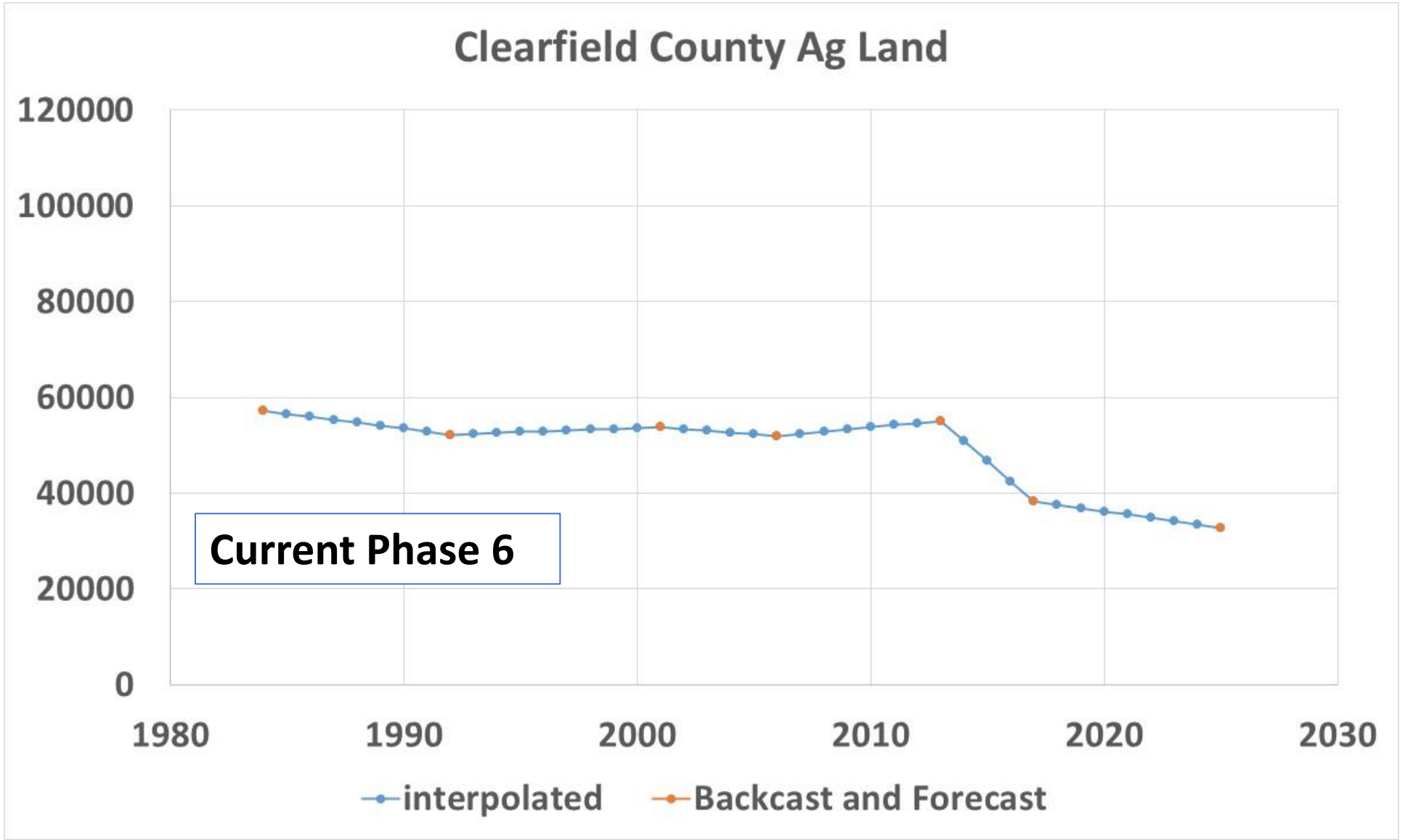
Accuracy of the spatial and temporal trends is more important that the absolute value

Spatial - Model used to allocate responsibility between jurisdictions

Temporal - Model used to track TMDL, based on changes since 1995

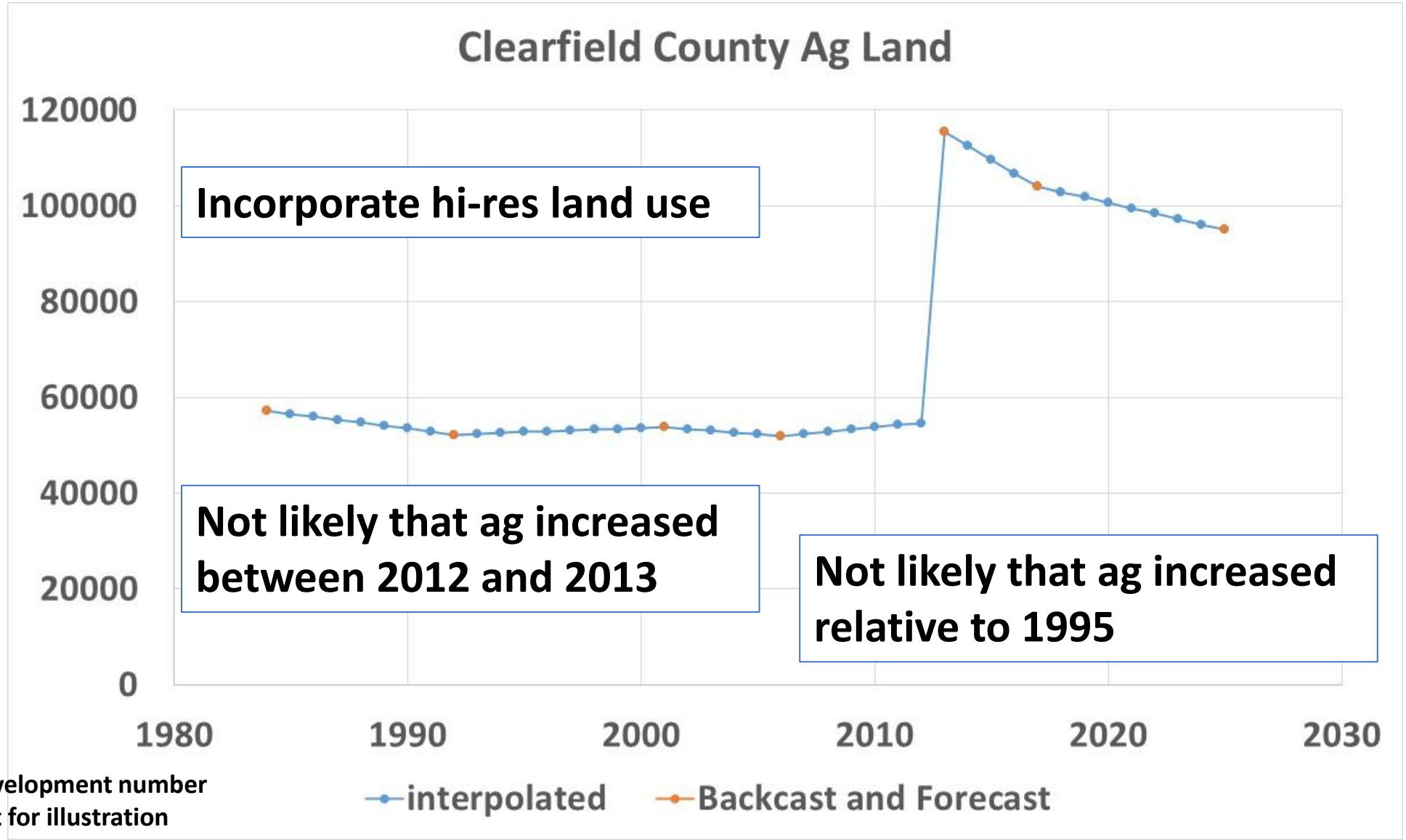
Data Ideals

Consistency example



Data Ideals

Consistency example

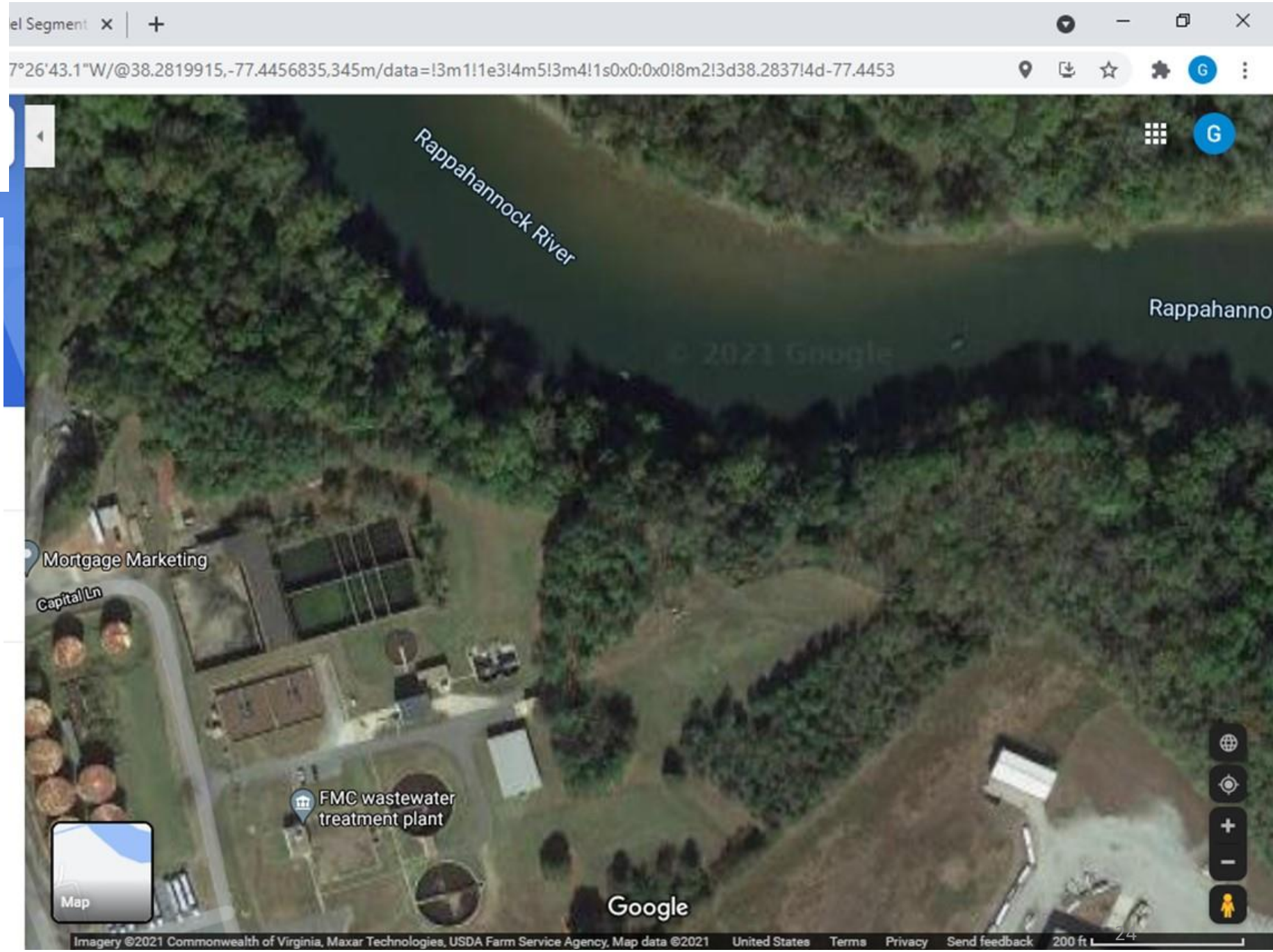


2013 is current development number
ust for illustration

Data Ideals

Example 2: VA point sources

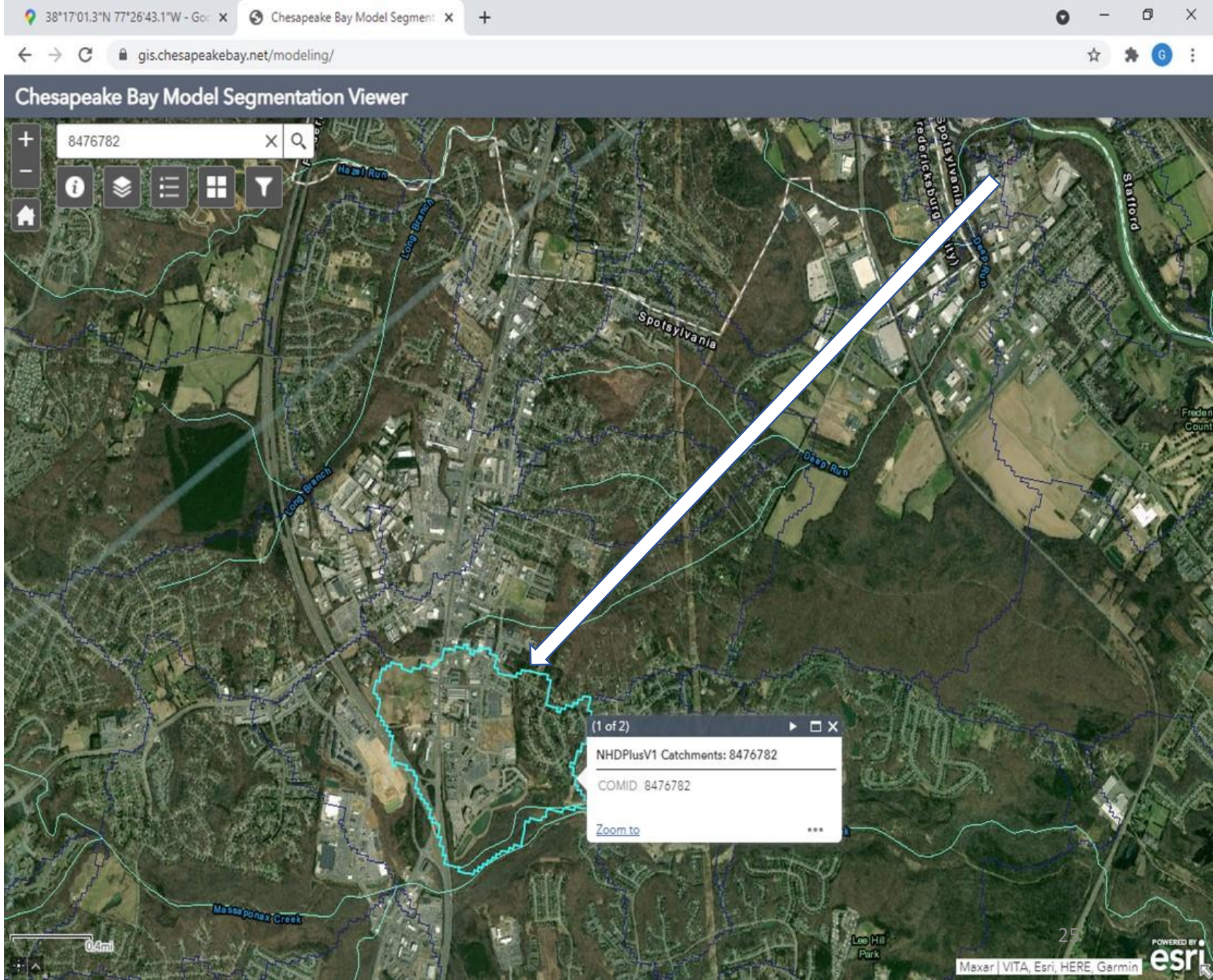
- FMC wastewater treatment plant clearly discharges to tidal Rappahannock



Example 2: VA point sources

- Lat/Long from database places outfall in business park which flows though multiple reservoirs

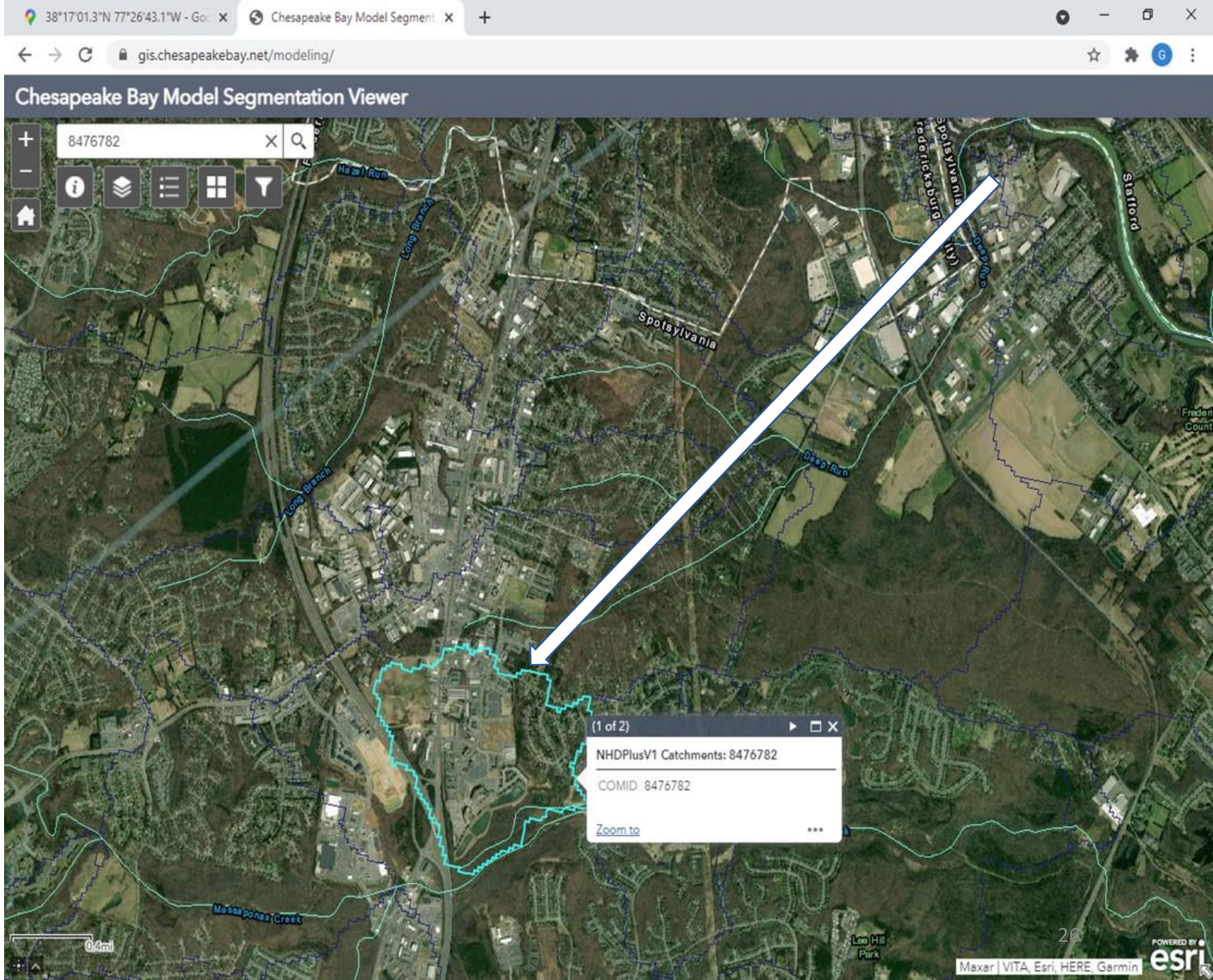
- 24% TN and 56% TP is removed in the model



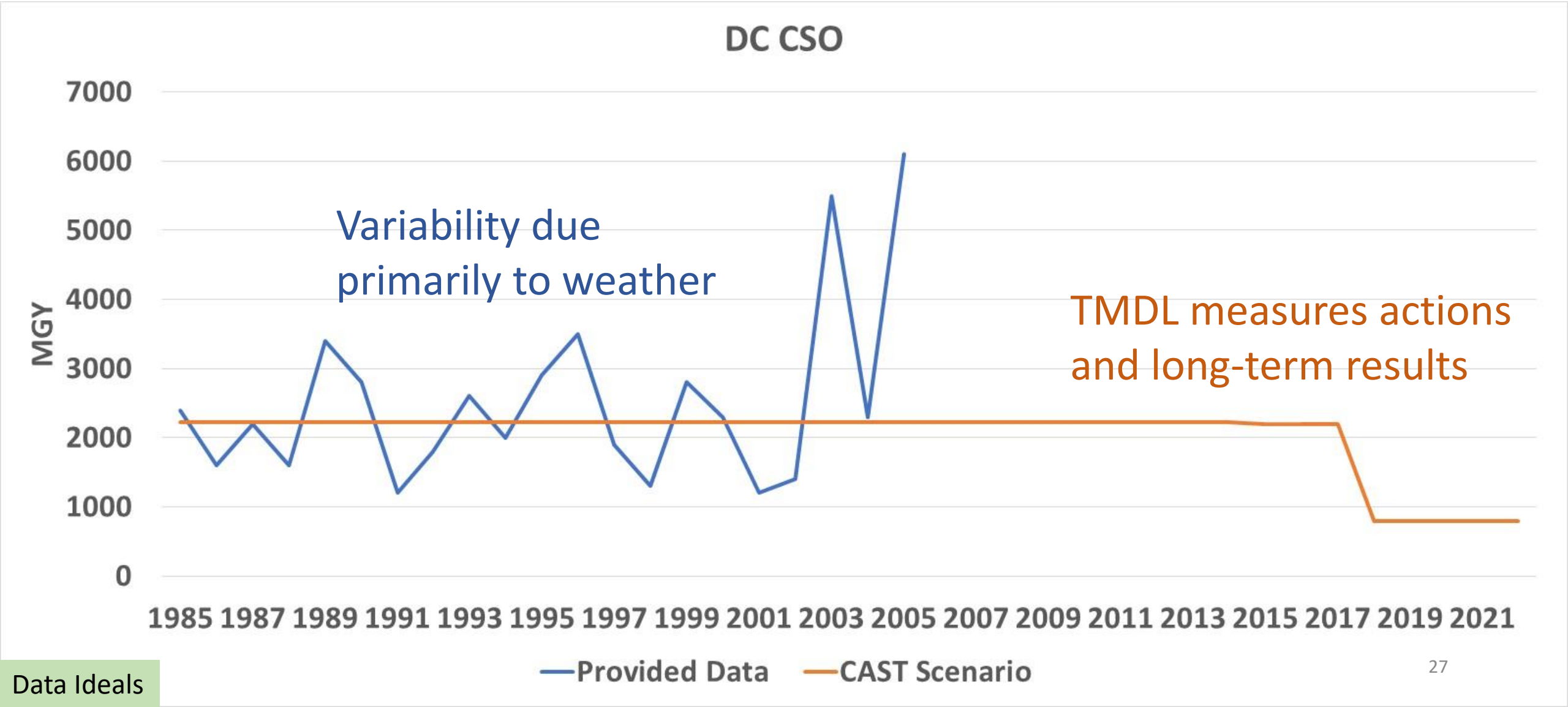
Example 2: VA point sources

- ‘Better data’ for loads could argue that loads are 19,000 lbs TN and 1600 lbs TP higher

- But
  - Inaccurate trend
  - Unfair to VA

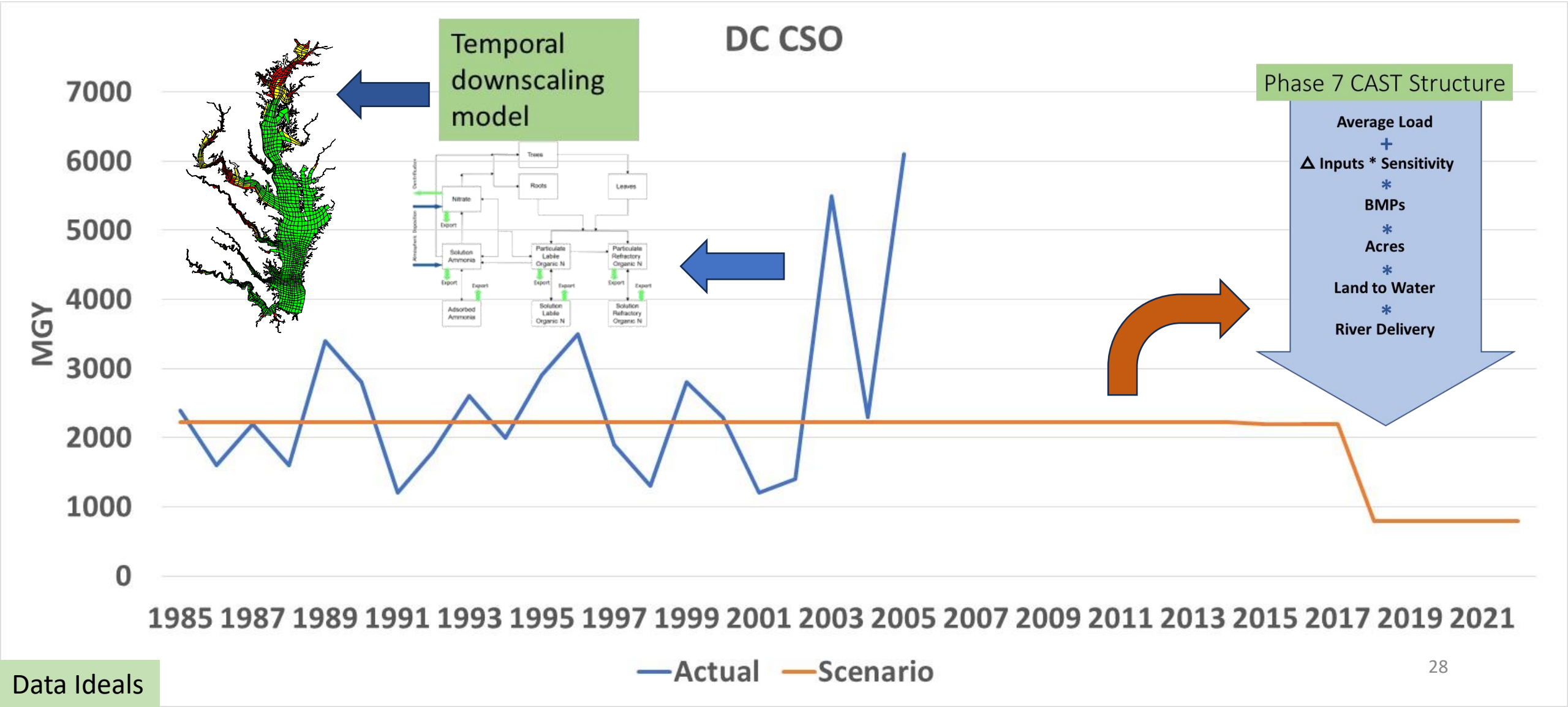


Weather independence > Actual Values



Data Ideals

Weather independence + Actual Values



Data Ideals

WWTWG Topics

- CSOs
- Boat Discharges
- WWTP double-check
  - Drinking Water plants
- SSOs and Bypass
- Exfiltration

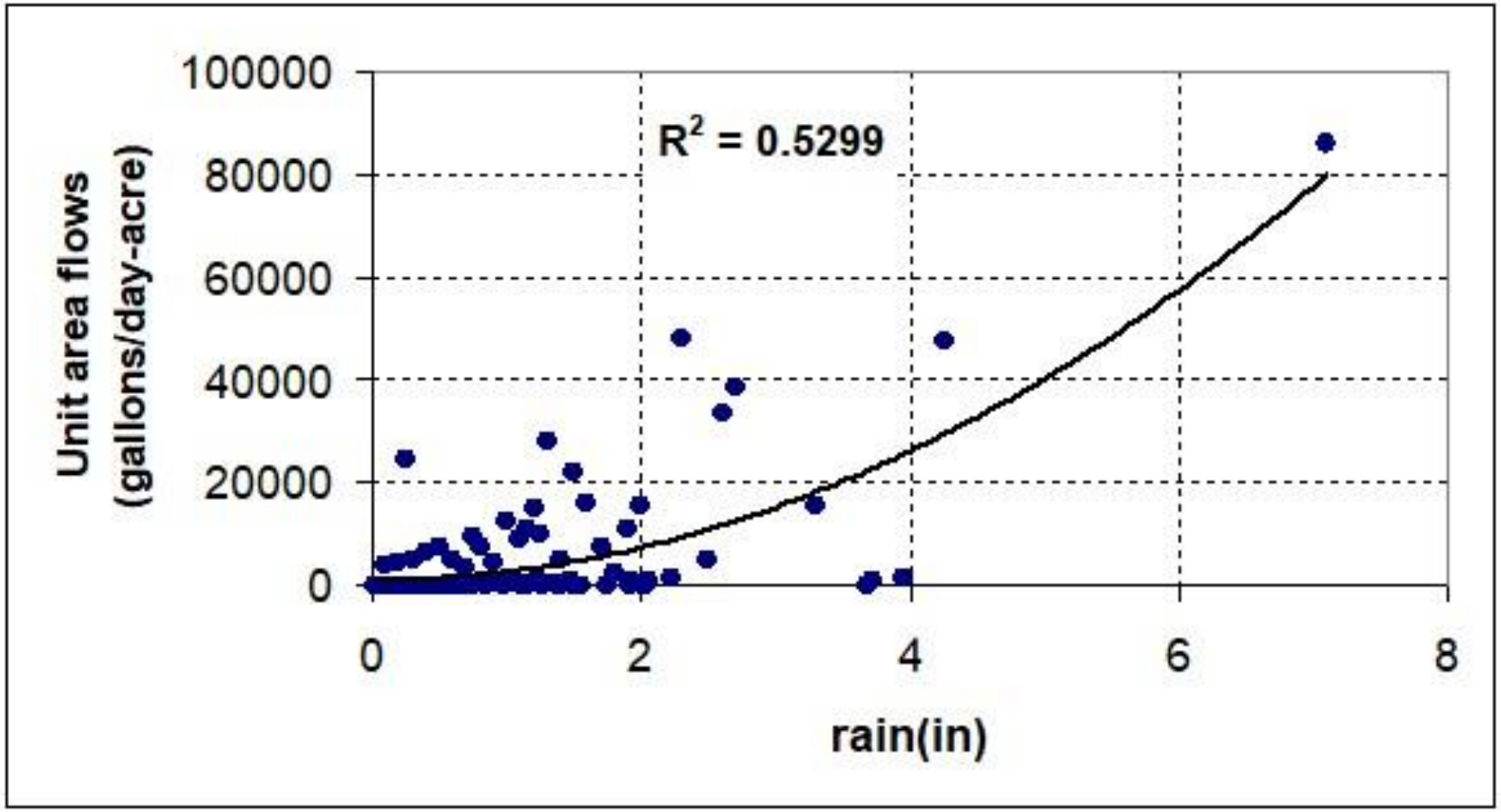
- Covered briefly today – each will have detailed discussion

CSOs – directly modeled systems

- Site-specific models for four cities
  - DC
  - Alexandria
  - Richmond
  - Lynchburg
- Models produced by the cities themselves
- Last investigated for 2010 Phase 5 model

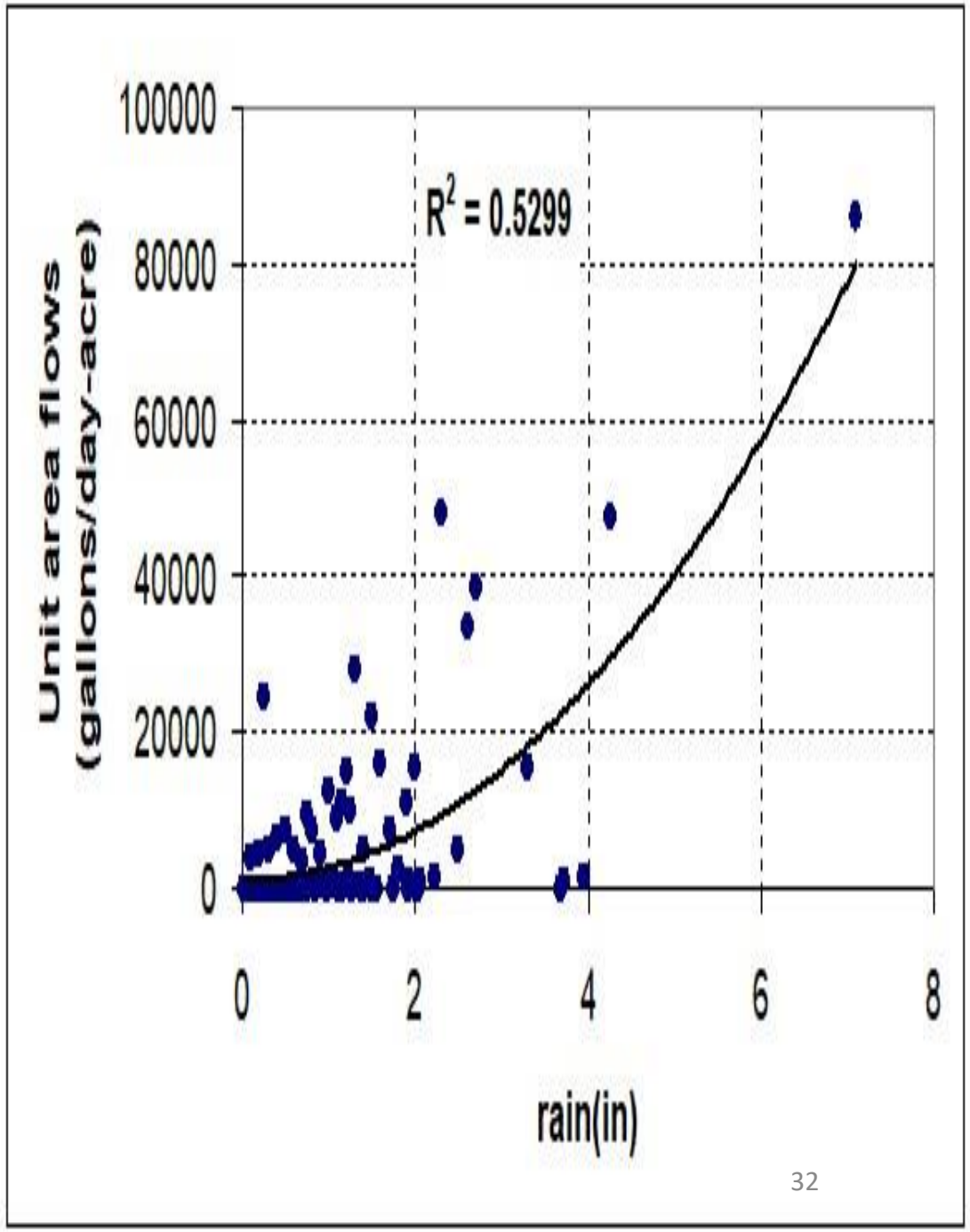
CSOs – remaining 60 CS systems

- Single model for remaining 60 sites:



CSOs – remaining 60

- Issues previously identified:
  - Predicts CSO for 0.01 inch of rain
  - Low predictive ability
- Potential new analysis:
  - More data now available
  - More sophisticated model may be useful
    - Take into account other factors



CSOs – long term control plans

- Disconnection
  - CSO eliminated
  - Combined Sewer land converted to MS4
- Increased capacity
  - Jurisdictions provide expected long-term reduction in CSO load

Boat Discharges

July 2018 pump-out BMP panel report

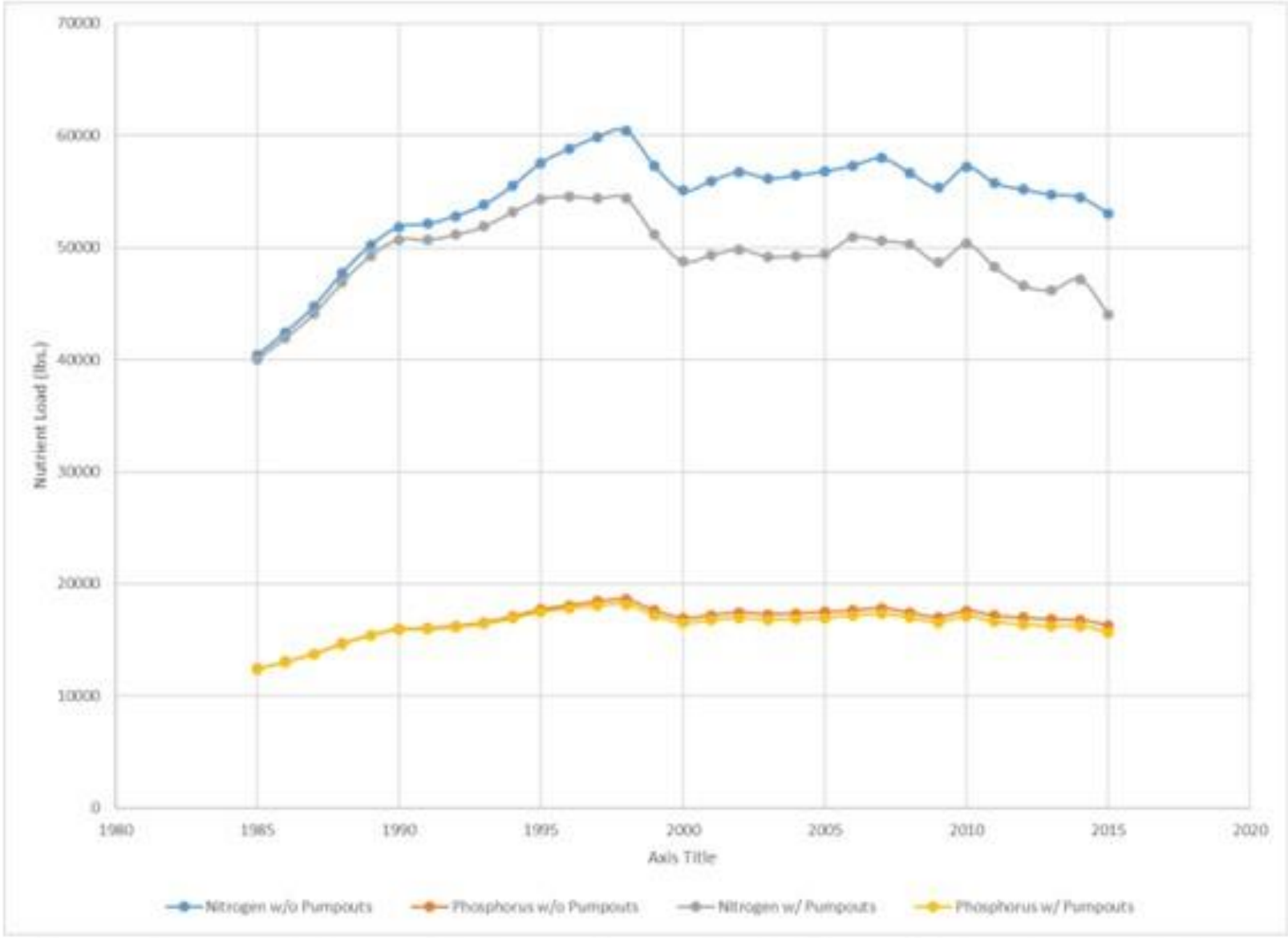


Figure 4. Estimated Nutrient Load Taking into Account Nutrient Removal by Boat Pumpout Facilities, Virginia 1985-2015

Boat Discharges

July 2018 pump-out BMP panel report

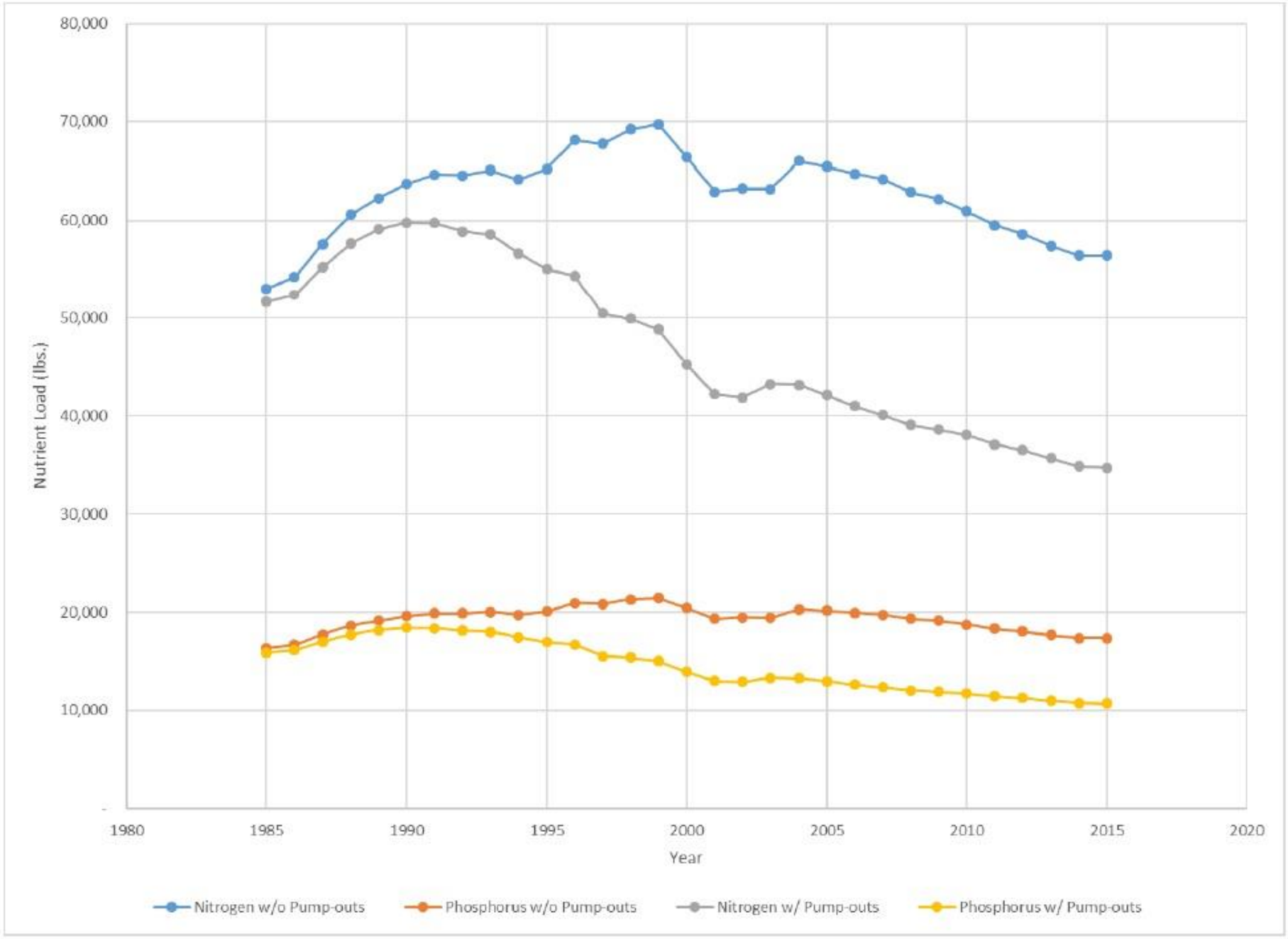


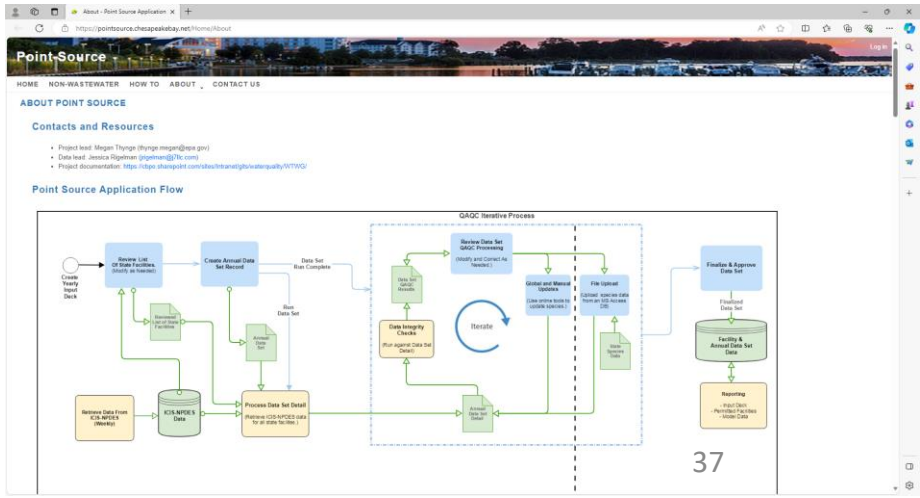
Figure 2. Estimated Nutrient Load Taking into Account Nutrient Removal by Boat Pumpout Facilities, Maryland 1985-2015

Boat Discharges

- Data available by county
- Draft technical appendix to BMP report from Watershed Technical WG
- Went to the WQGIT in 8/2018
  - Decision/Action: The proposed boat pump-out practice was ***not approved*** for interim BMP status at this time. The WWTWG will address the comments received and will refine the boat pump out practice recommendations to include commercial type I and II manure sanitation devices.
- Discussed at a WWTWG meeting
  - wwtwg_meeting_minutes_09_04_18_draft_1.pdf (d18lev1ok5leia.cloudfront.net)
- CBP Retirements, CBPO staff turnover…

WWTP

- Established process:
  - CBPO queries ISIS
  - Jurisdictions revise through point source portal
- Phase 7
  - Jurisdictions encouraged to revise locations particularly
  - VA and CBPO have made some location changes
  - Location changes stored for implementation in P7



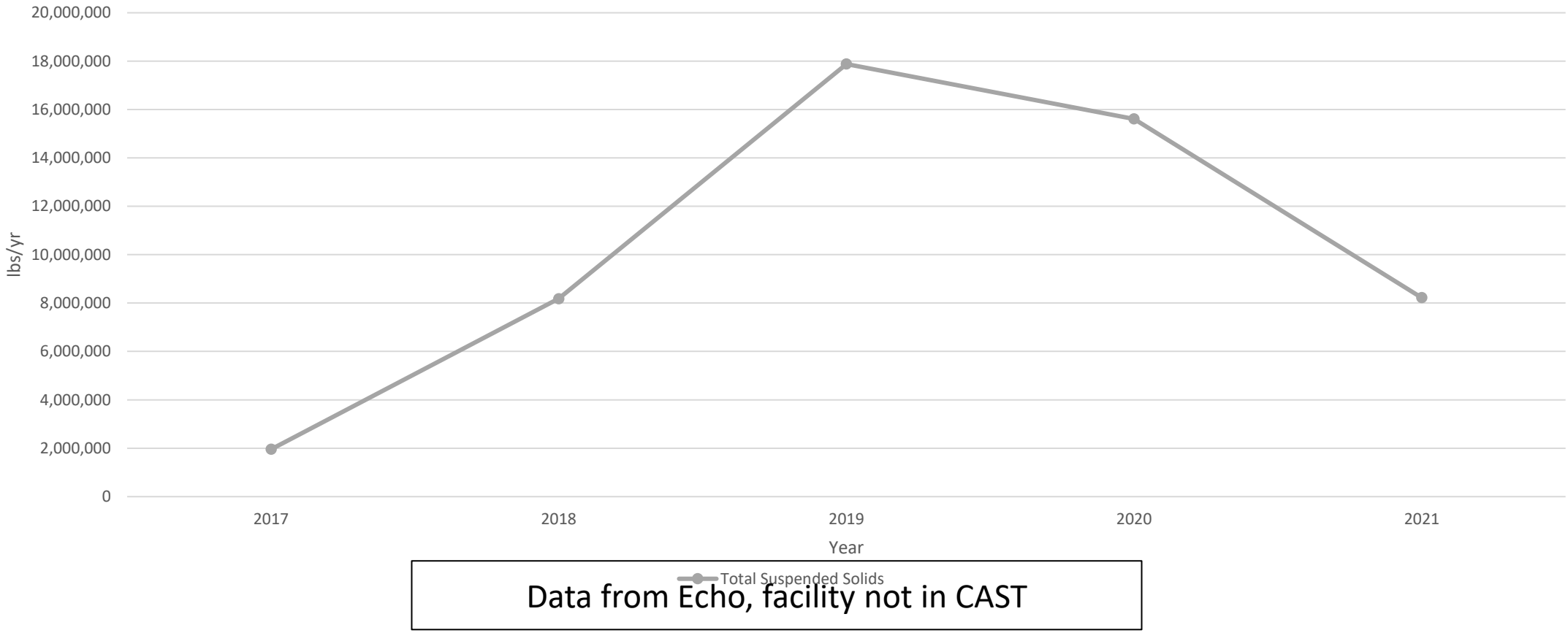
- Megan Thyne; Jessica Rigelman

https://pointsource.chesapeakebay.net/Home/About

Drinking Water plants

- Phase 5: Dalecarlia near DC
  - Historic 126,000 lbs of TN; 27,000 lbs of TP; 18,000,000 TSS
  - By 2010 Reduced to 630 TN and 136 TP by 2010; 90,000 TSS
- Phase 6: dependent on reporting – not included

Potomac water filtration plant sediment loads over time



Data from Echo, facility not in CAST

Slide from Helen Golimowski

Comparison of ECHO and CAST

- ECHO
- city of Lynchburg Abert water filtration plant
  - Tss: 2,236 lb/yr
- Columbia water company
  - Tss: 824 lb/yr
- Lorton water treatment plant
  - TSS: 39,986 lb/yr

- CAST
- City of Lynchburg Abert water filtration plant
  - Tss: 2,430 lb/yr
- Columbia water company
  - Tss: 1,434 lb/yr
- Lorton water treatment plant
  - TSS: 185,475 lb/yr

- difference
- City of Lynchburg Abert water filtration plant
  - TSS: -194 lb/yr
- Columbia water company
  - Tss: -610 lb/yr
- Lorton water treatment plant
  - Tss: -145,489 lb/yr

Why is ECHO different than CAST?

Slide from Helen Golimowski

Drinking Water

- Are all jurisdictions including water filtration in annual reporting?
- Why is ECHO different from CAST?

SSOs and Bypass - From the Phase 6 documentation

- Members of the CBP's Wastewater Treatment Workgroup were reticent to include SSOs in the model since they are considered illegal discharges.
- Data availability is also a significant issue.
- Only Blue Plains bypass outfall has reported data for Phase 6.

Reconsider SSOs in Phase 7

- Greatly refined spatial scale in estuarine models
- Specific request from Patapsco/Back modelers

Reconsider SSO in Phase 7

- More data sources now available
  - online resources from VA, MD, and NY
- Could credit actions if SSOs reduced

Outline

- Bay TMDL Summary
- Background on Watershed Model
- Data ideals
  - Consistency > Accuracy
  - Weather independence > Actual values
- Topics
  - Boat Discharges
  - WWTP double-check
    - Drinking Water plants
  - CSOs
  - SSOs and Bypass
  - **Exfiltration**