Simulation of Conowingo Infill

Modeling Workgroup Quarterly Meeting

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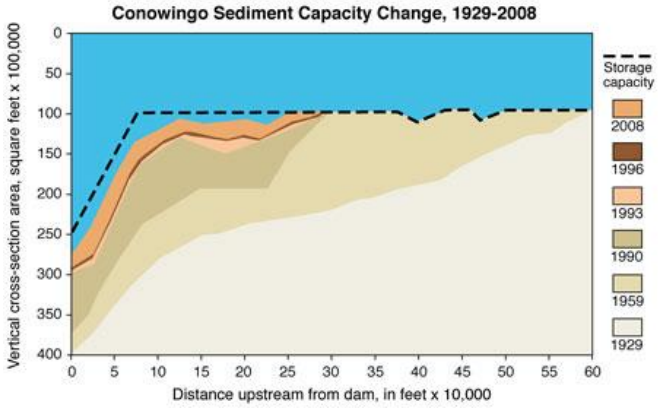
Presentation Outline

- Brief review
- Incorporation into HSPF
- Stationary model
- Simulation using Phase 6 Model
- A scenario

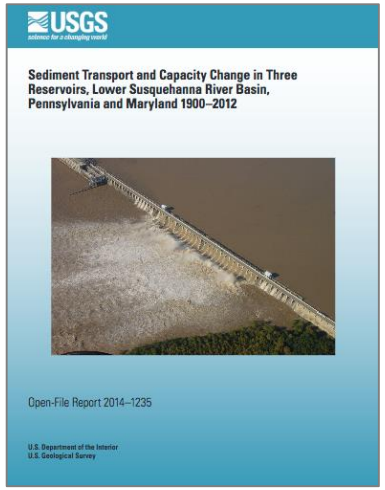
Brief Review of Conowingo Infill

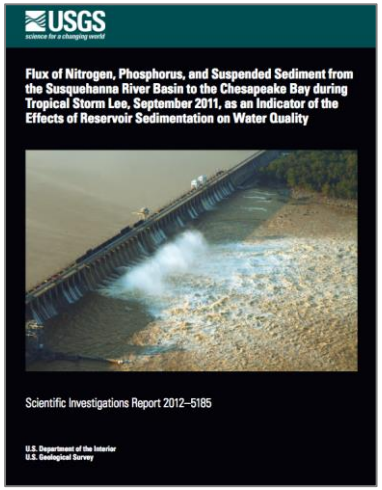
- Conowingo is nearing dynamic equilibrium, which has reduced its ability to trap sediment and nutrients.

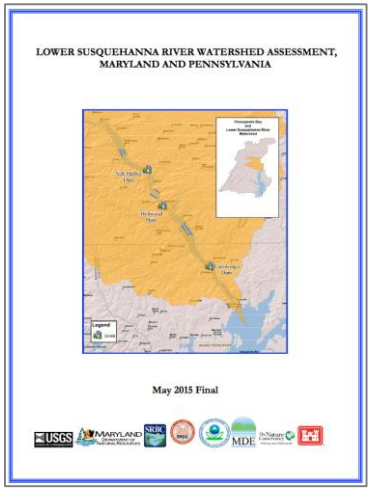


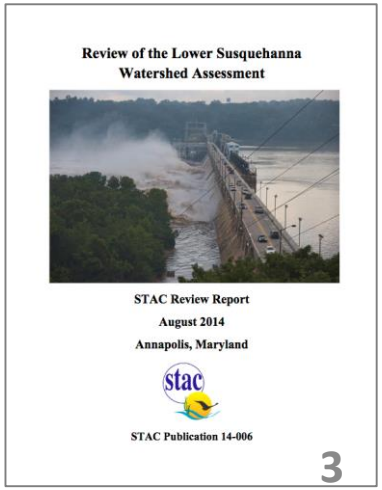
Source: Graph, Michael Langland, U.S. Geological Survey

- Several research articles have documented it, and they provide an analysis of changes in transport, which are incorporated in this analysis.







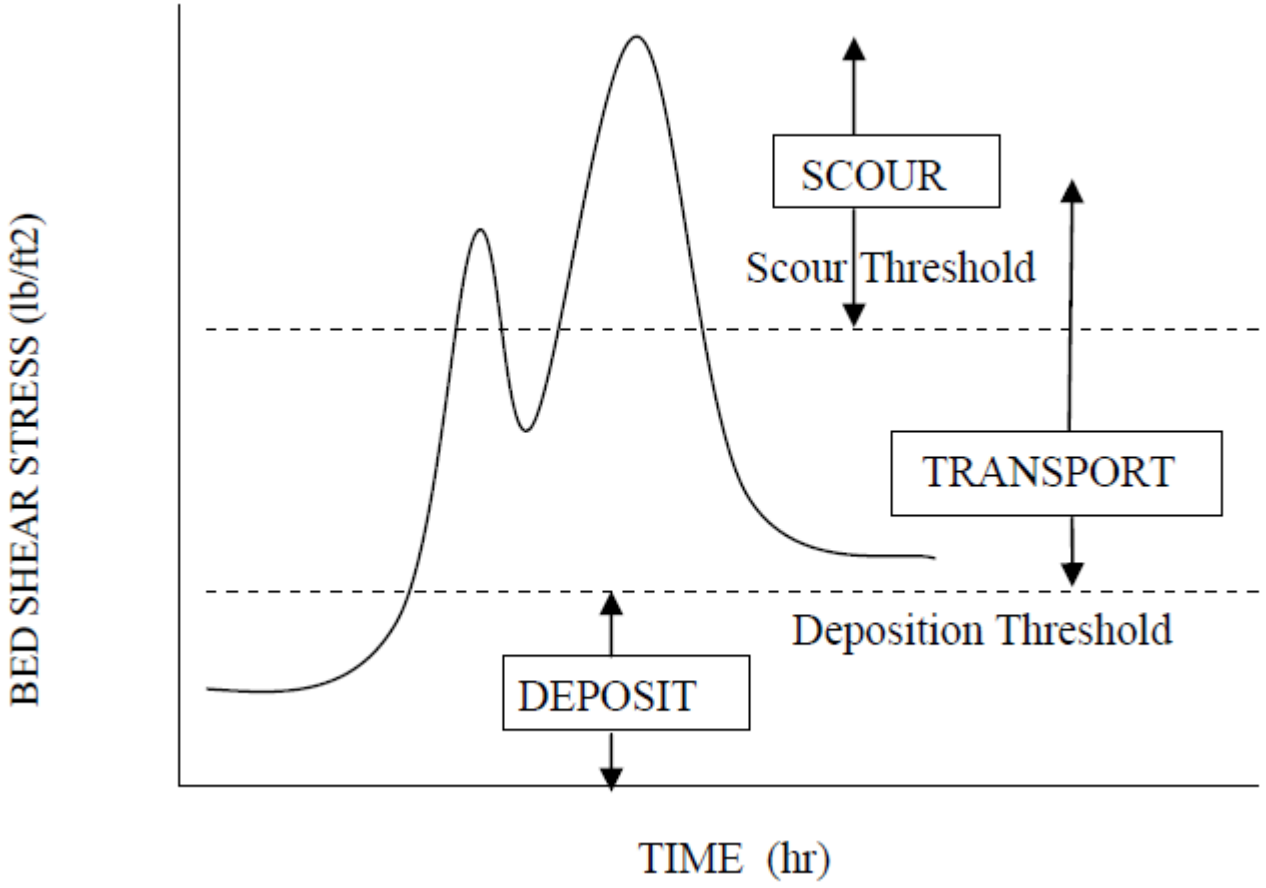


STAC Guidance on Conowingo Infill

Paraphrasing…

- Conowingo models should be evaluated based on the ability to "hindcast" data from observations and statistical analyses
- Address the full range of flows
- Address bioavailability of sediment nutrients

HSPF SEDTRN simulation



Erodibility

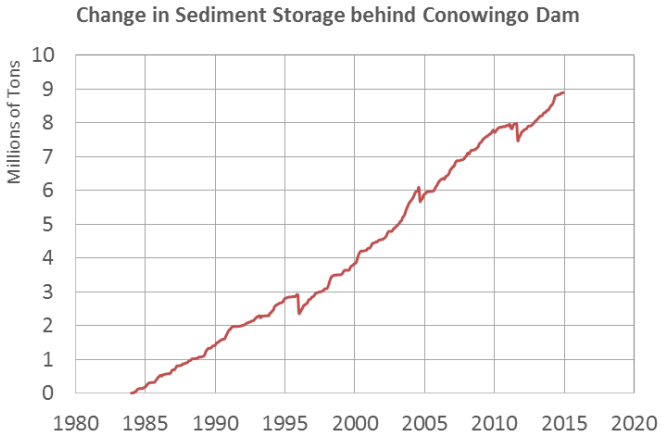
Scour critical shear stress

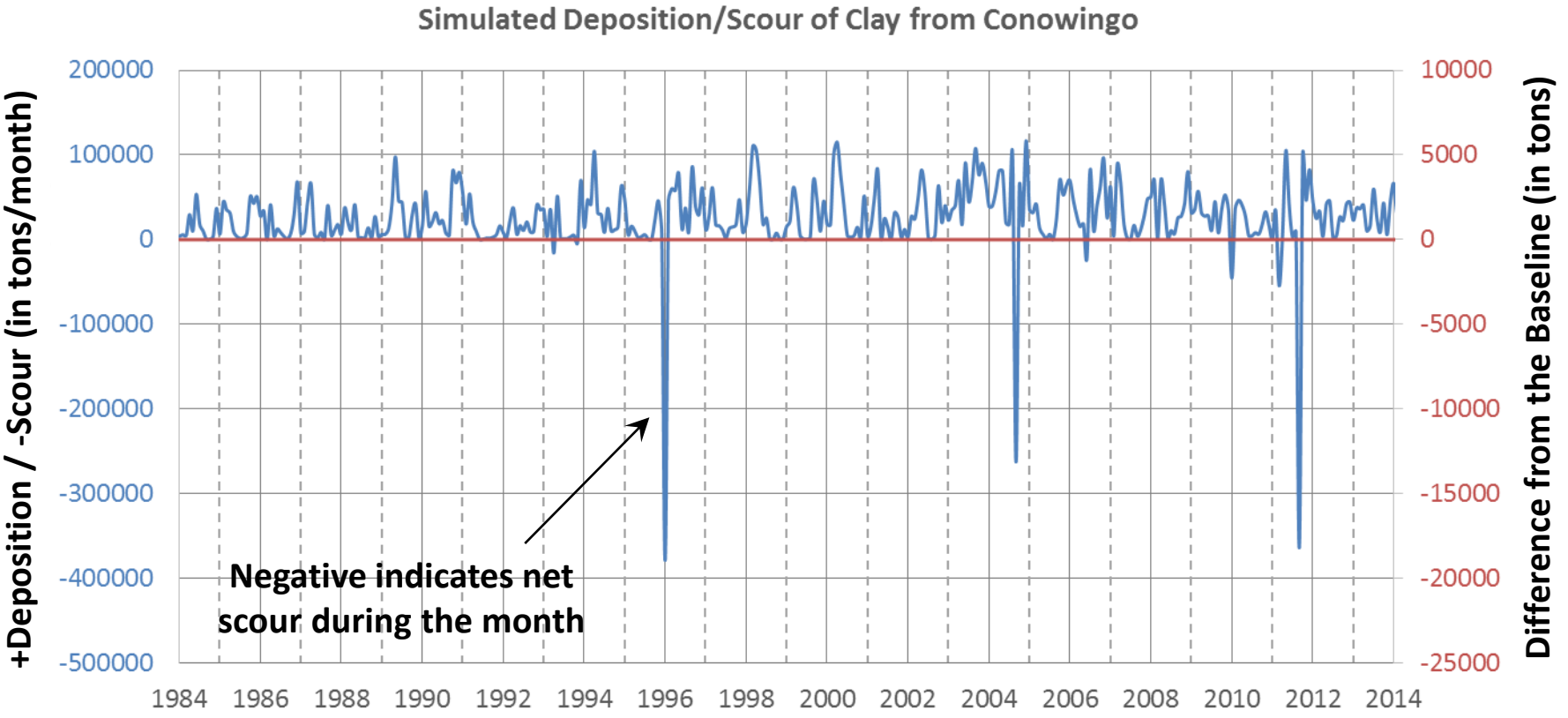
Settling Velocity

Deposition critical Shear Stress

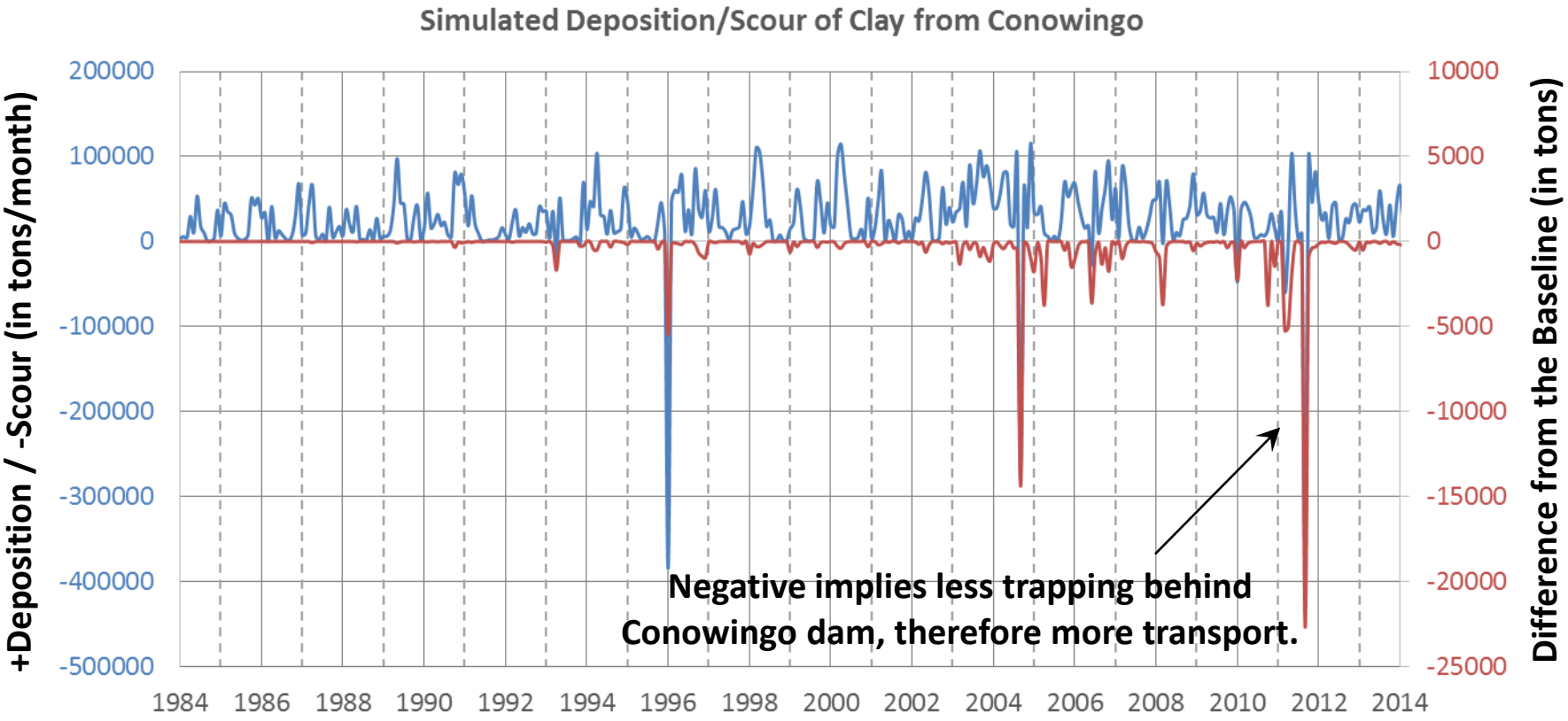
***Tau$_{CD}$, Tau$_{CS}$, Erodibility*, and *Settling Velocity* are all changeable through time.**

Baseline Calibration





Variable Critical Shear Stress for Clay Deposition Prototype



Lines of evidence for incorporating Conowingo Infill in Phase 6

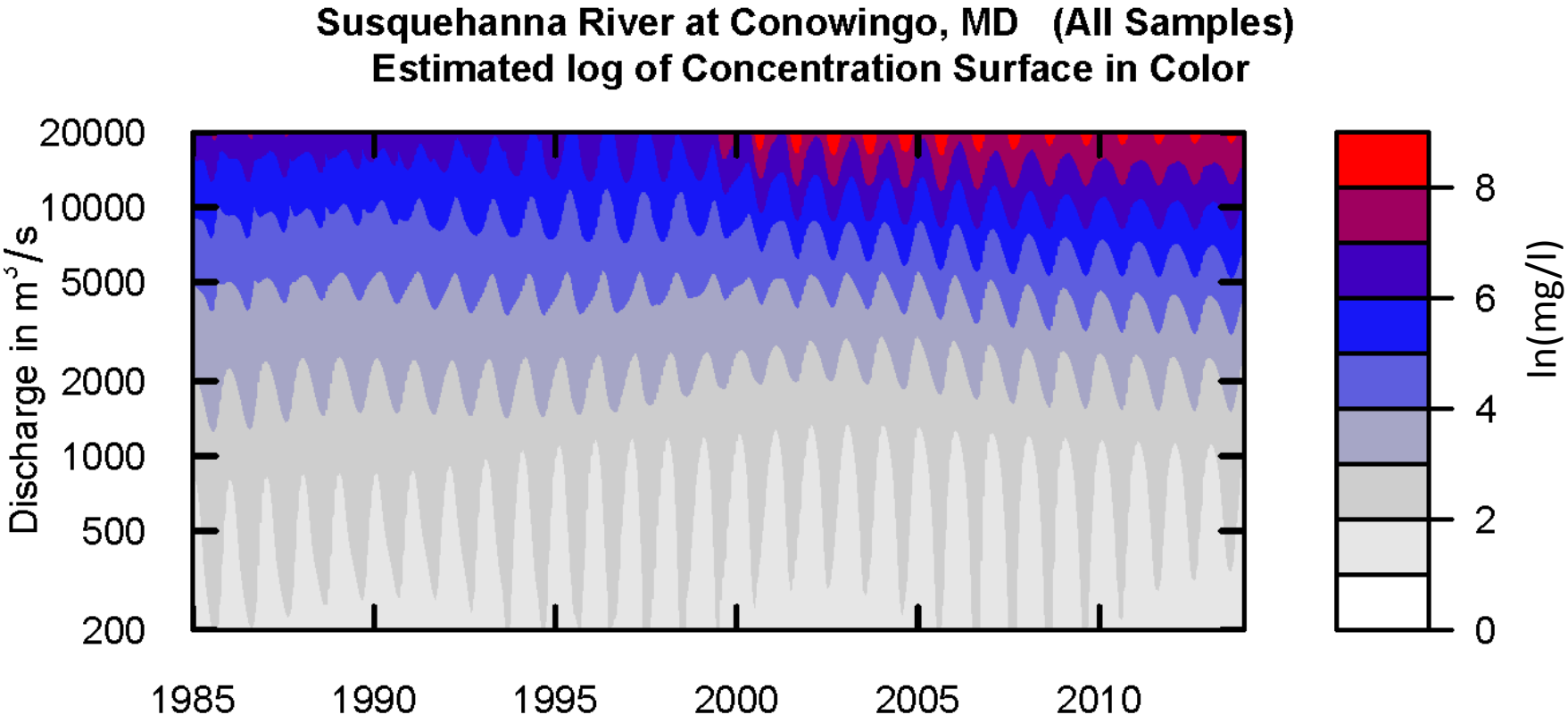
- Zhang, Hirsch, and Ball (2016) can be used for a WRTDS based analysis of changes in sediment and nutrient transport with Conowingo infill.

- Conowingo Pool Mass Balance Model (CPMBM) and Sediment Flux Model (SFM) can potentially provide information on changes in transport mechanism (settling vs. scour) for sand/silt/clay.

- Hirsch and Langland analyses can be used for validation.

WRTDS

- WRTDS uses time, discharge, and seasonality as regression variables for estimating concentration.

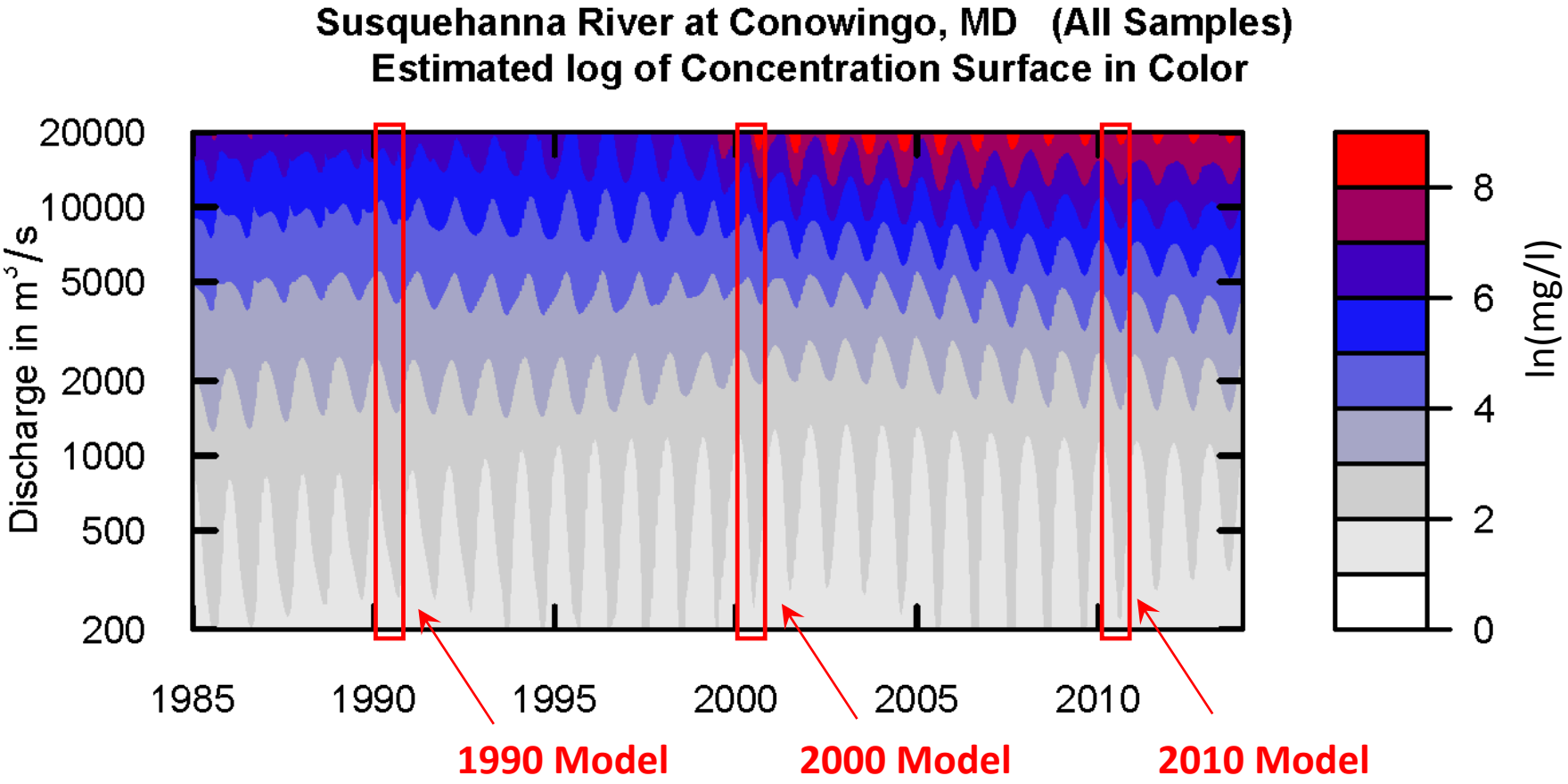


Hirsch

Stationary Model of Conowingo: an analysis using WRTDS

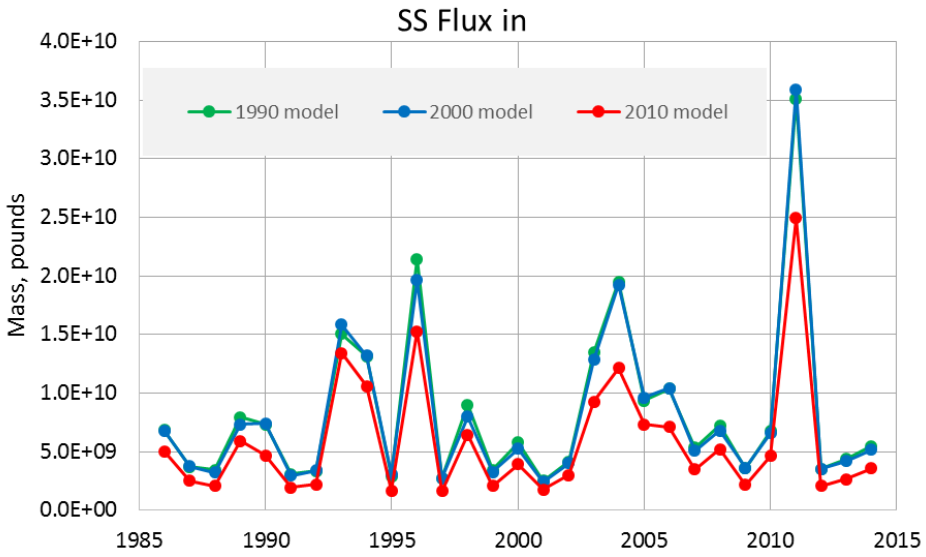
Qian Zhang

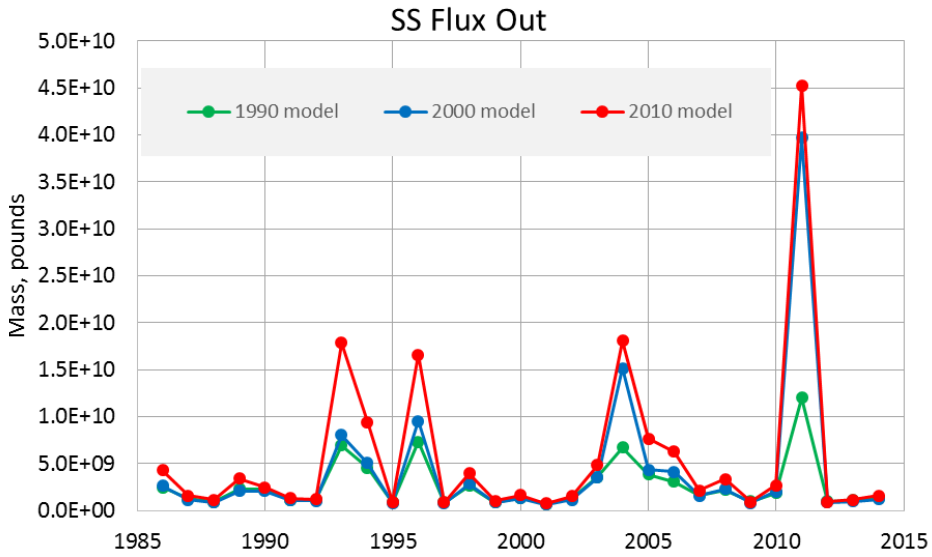
- Stationary WRTDS concentration surfaces were developed:



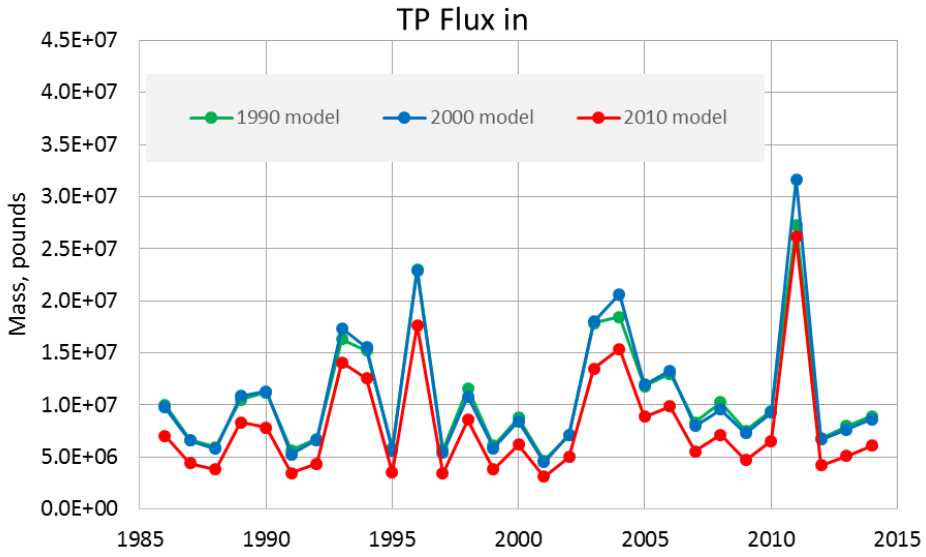
Zhang, Hirsch, and Ball ES&T 2016

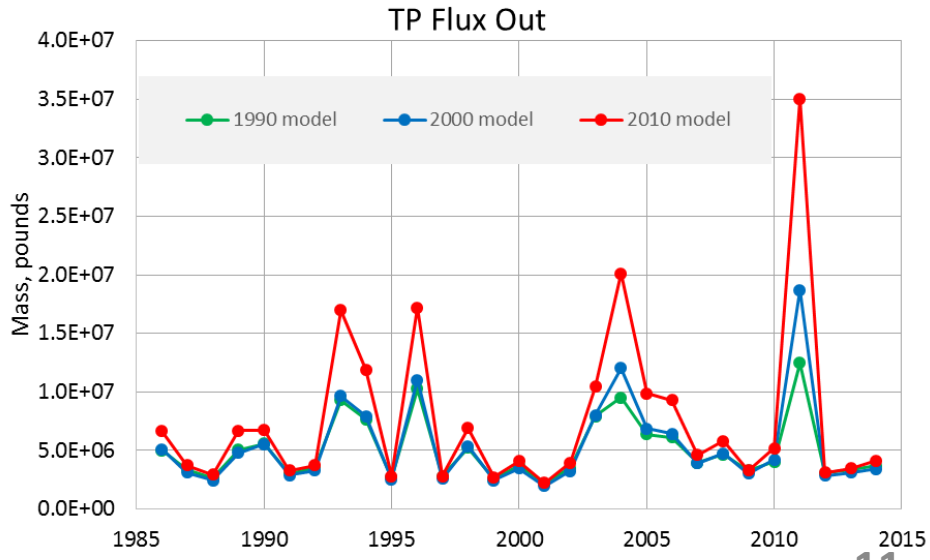
Sediment



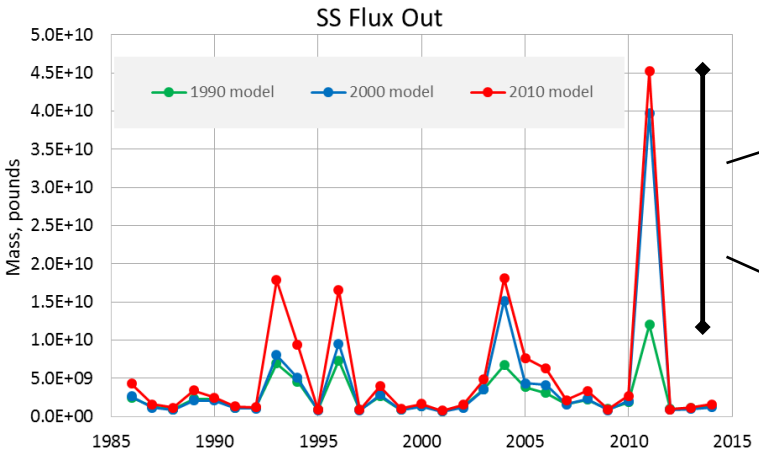


Phosphorus

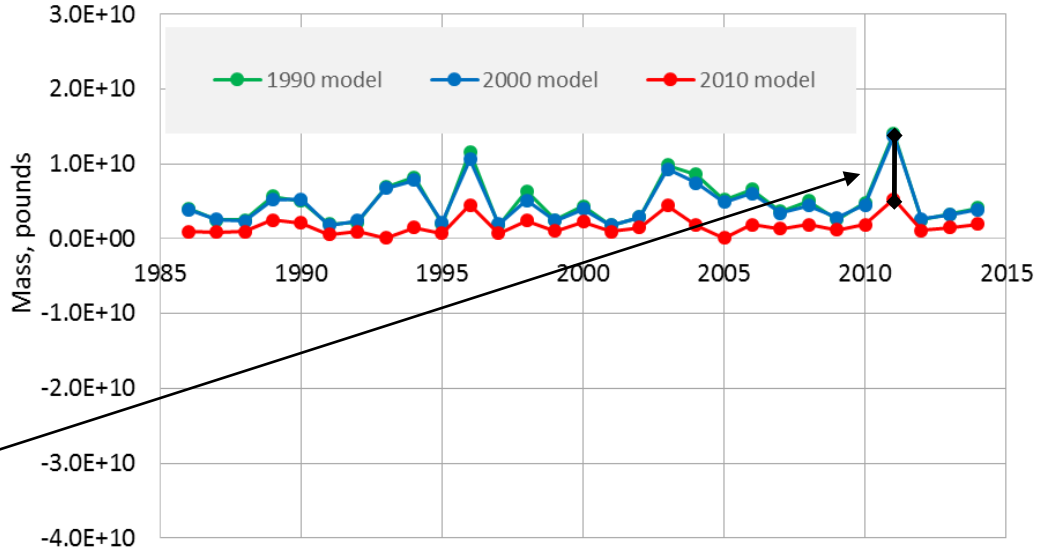




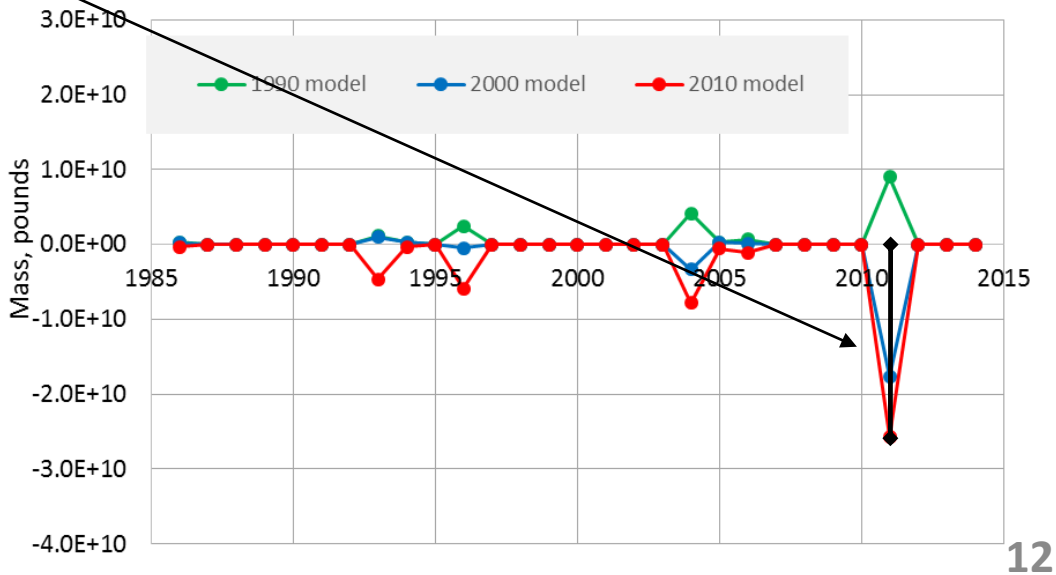
Sediment



Behavior of reservoir under 10,000 cms (353k cfs)

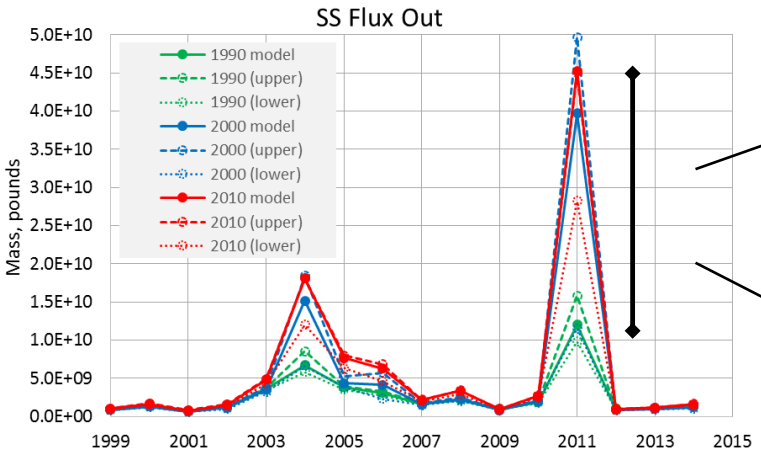


Behavior of reservoir above 10,000 cms (353k cfs)



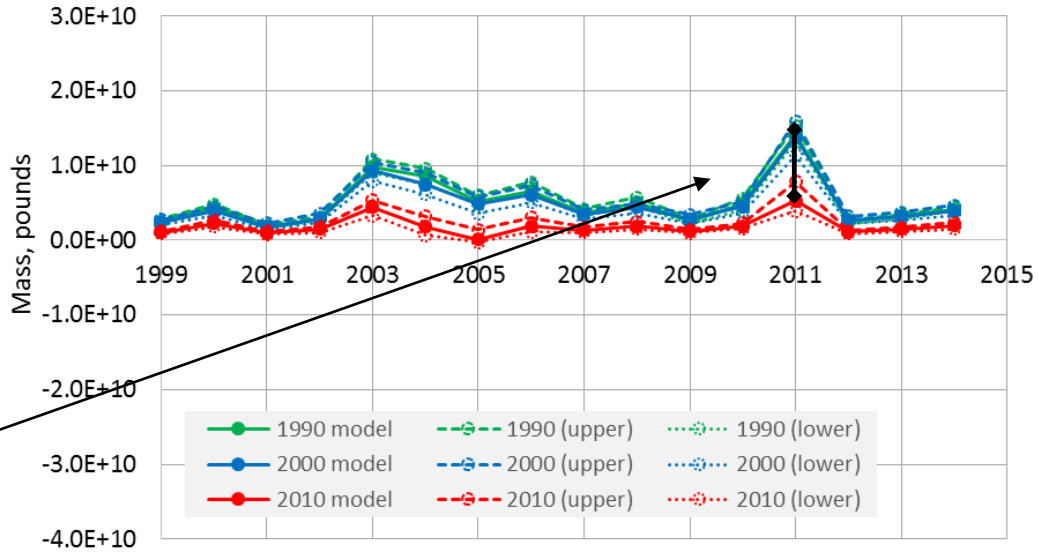
The stationary models provide a quantitative estimate of changes in scour and deposition.

Sediment (uncertainty)

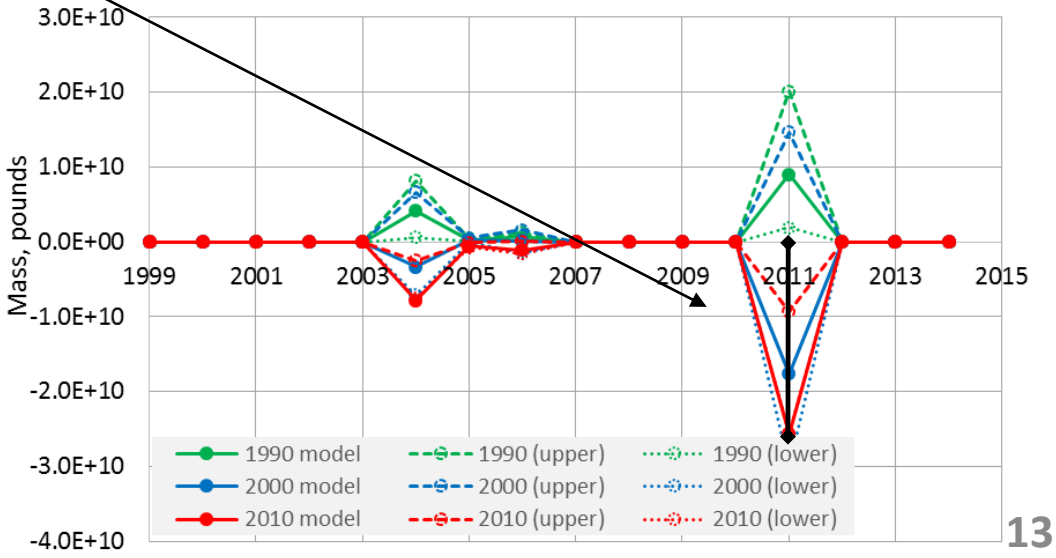


These uncertainty bounds are considered in the model calibration.

Behavior of reservoir under 10000 cms (353k cfs)

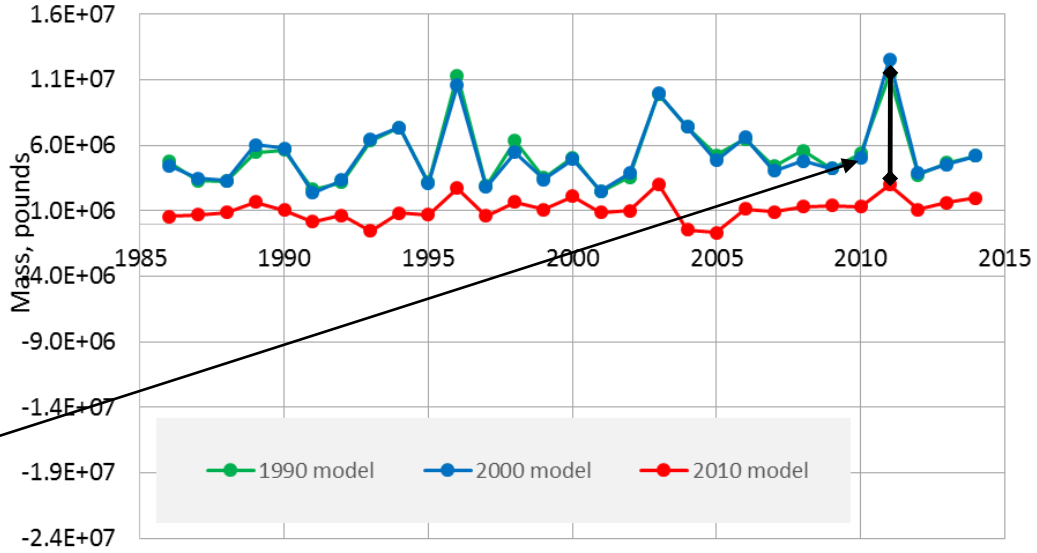


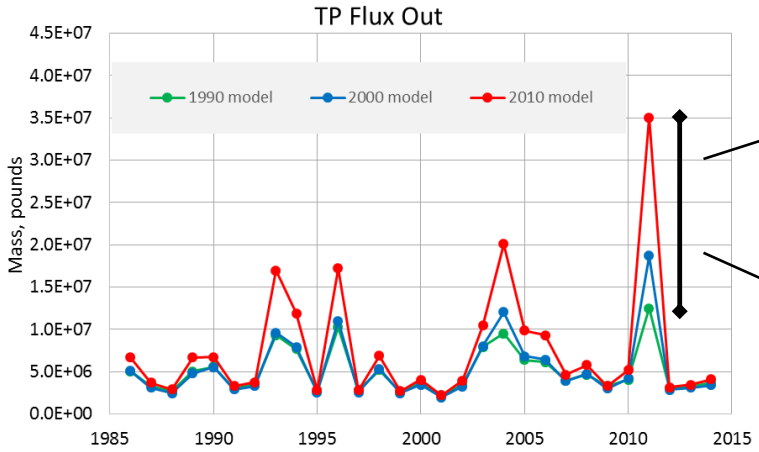
Behavior of reservoir above 10000 cms (353k cfs)



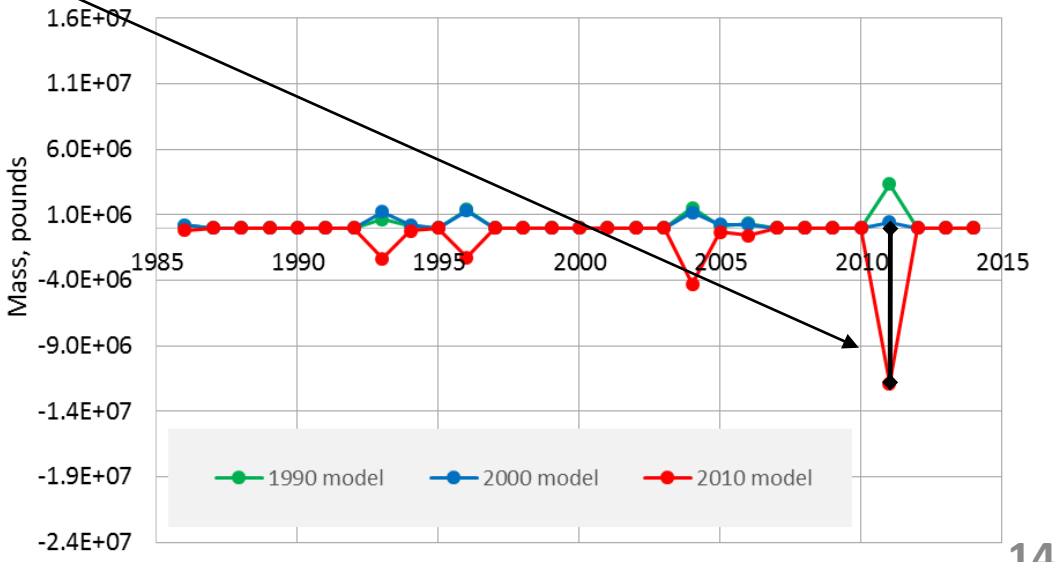
Phosphorus

Behavior of reservoir under 10000 cms (353k cfs)



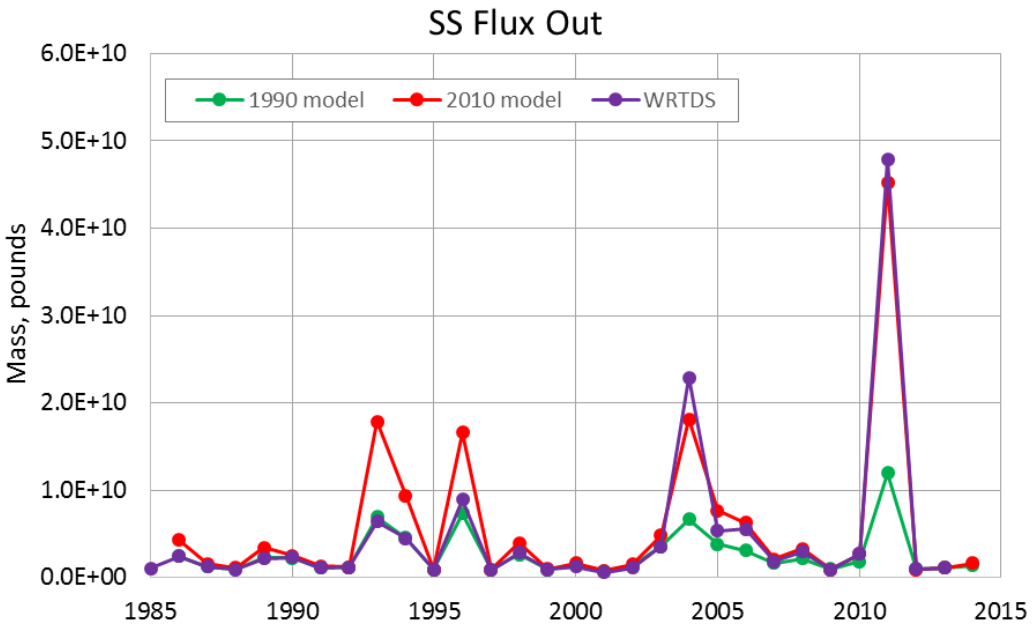


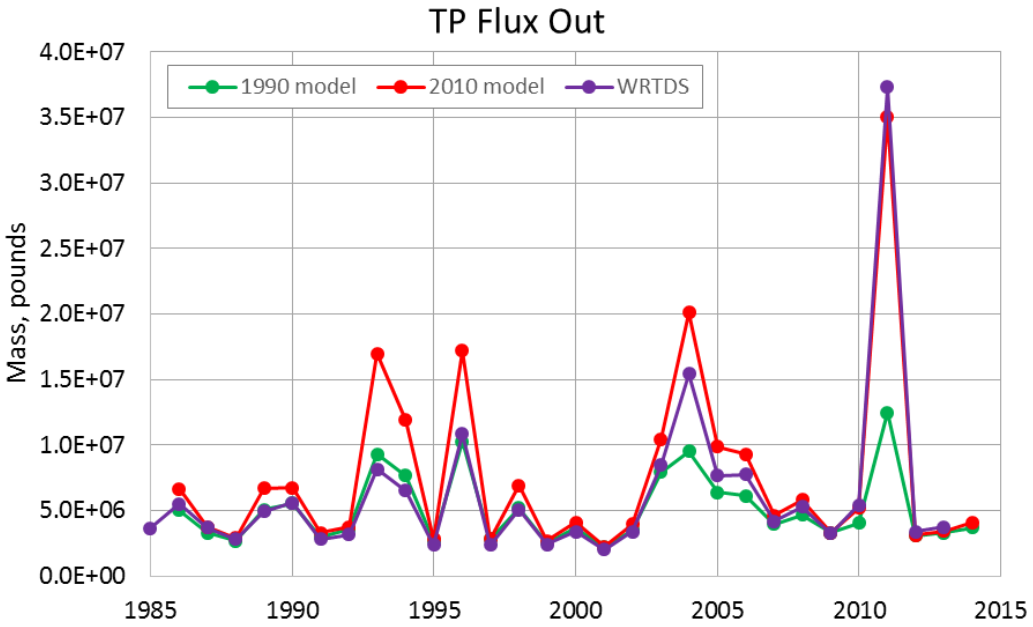
TP Scour



The stationary models provide a quantitative estimate of changes in phosphorus transport with scour and deposition.

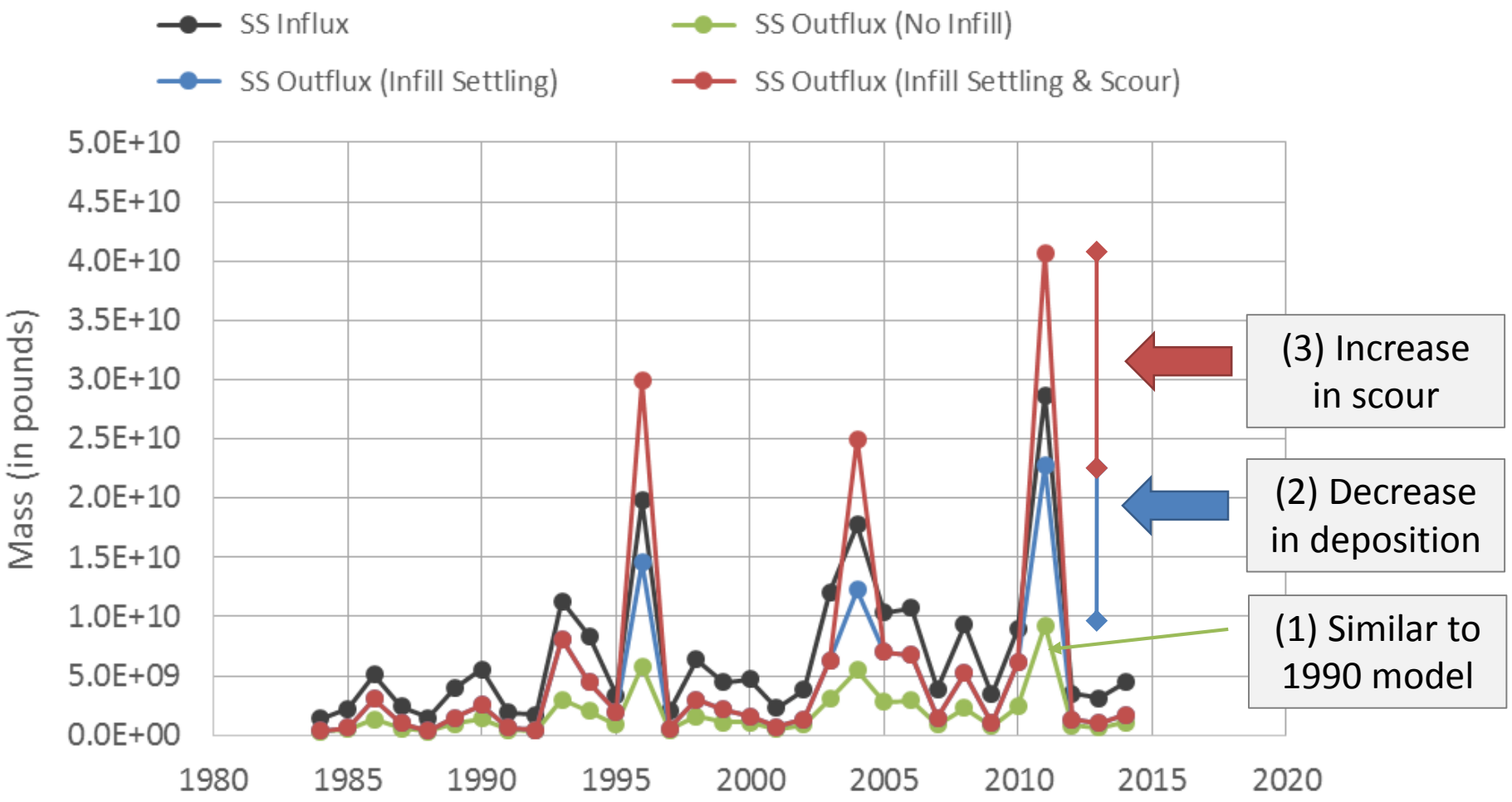
- The goal is to estimate how model parameters should change with infill.
  - A transition from 1990 to 2010 model.
- Calibrated parameters would change with time or storage (bathymetry).
- Once parameters are known, scenarios can be run using fixed parameters that represent infill condition.





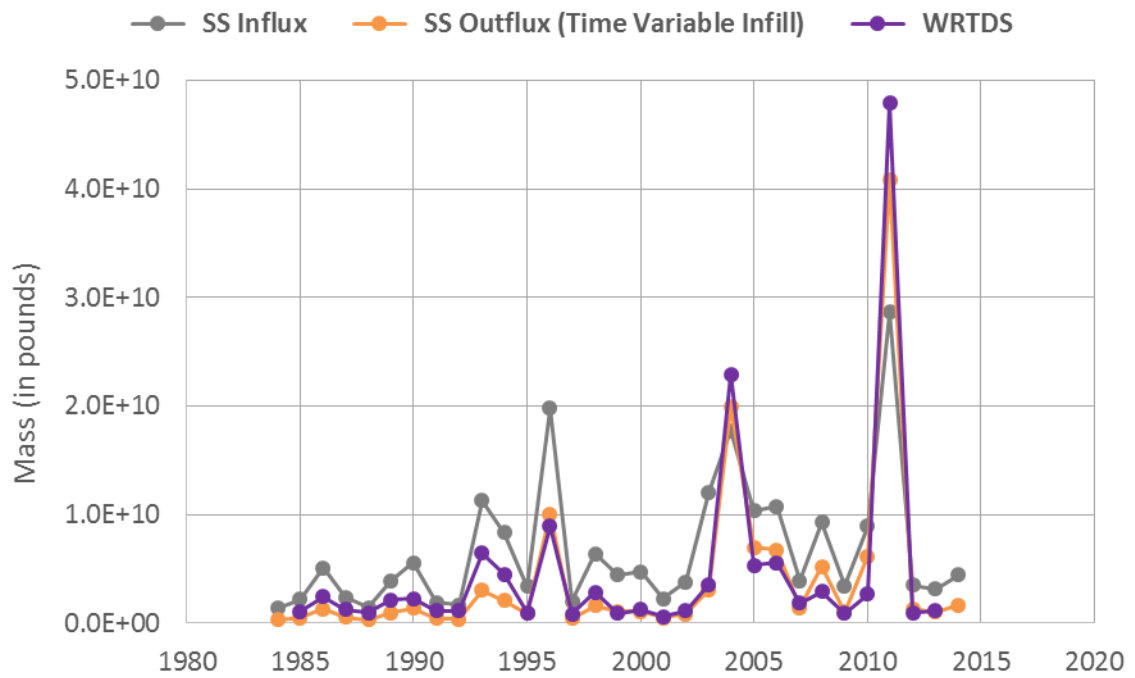
Three step calibration strategy:

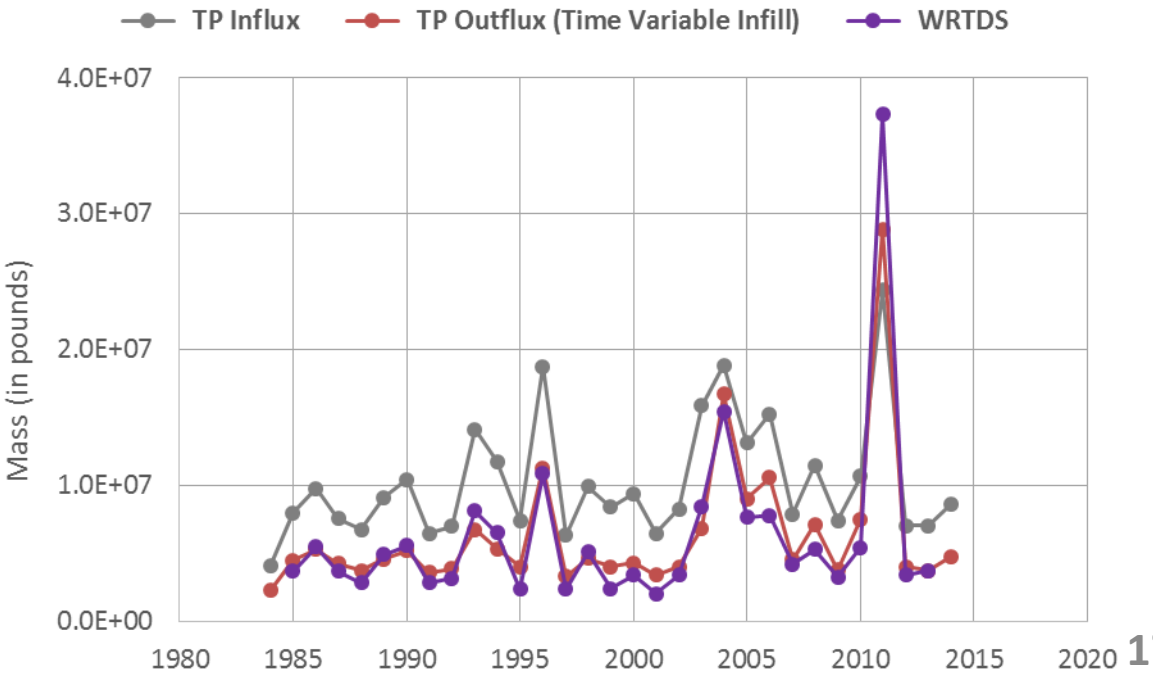
1. Estimate no-infill model parameters
2. Estimate changes in deposition parameters
3. Estimate changes in scour parameters



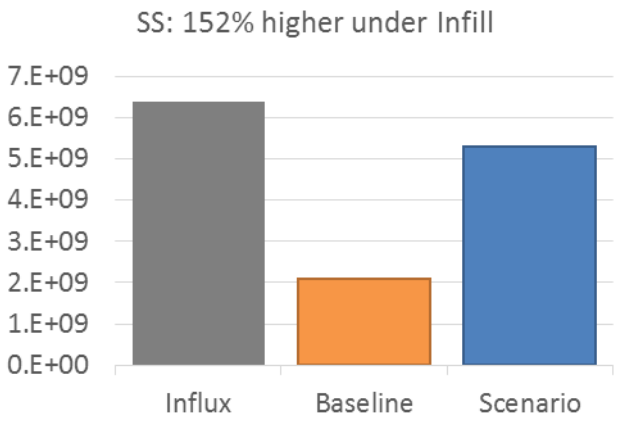
- Refined Beta 3 calibration of sediment and phosphorus.

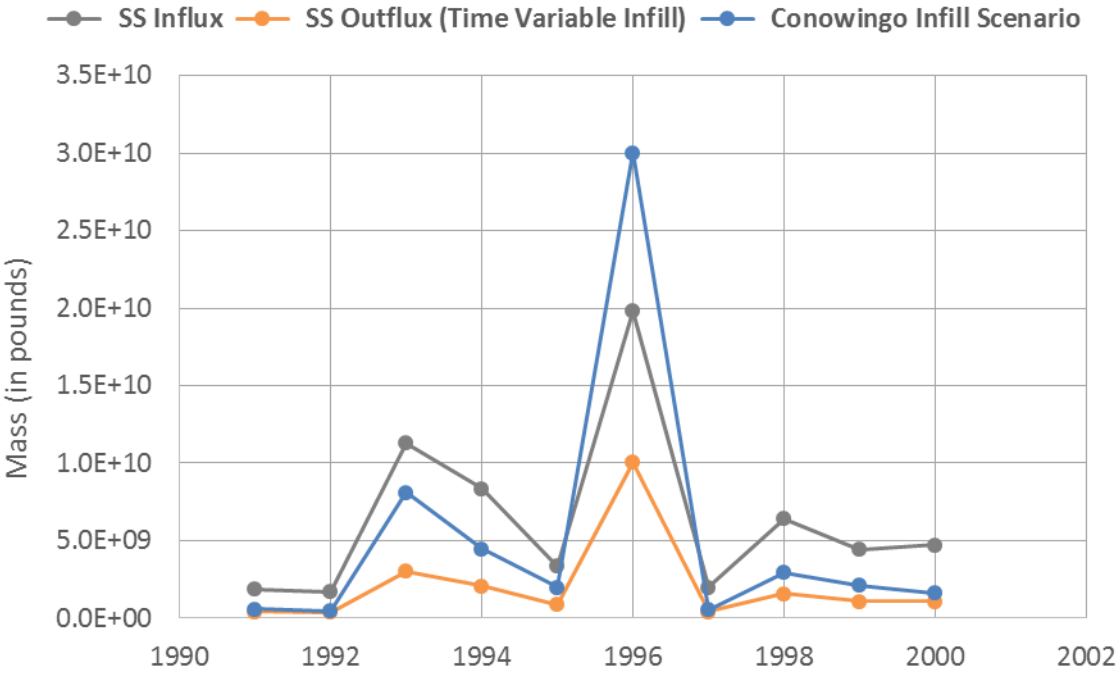
- Here both scour and deposition parameters change with time.

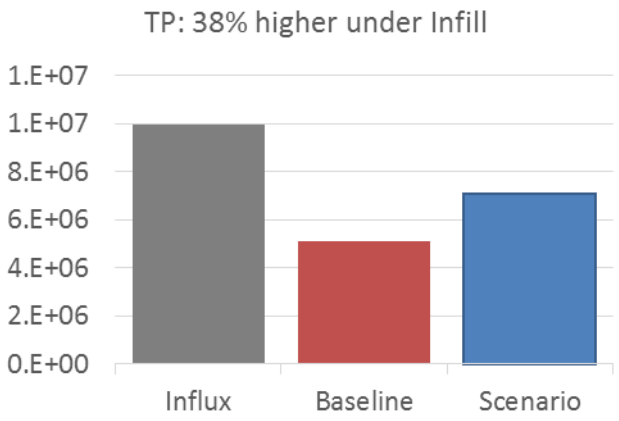


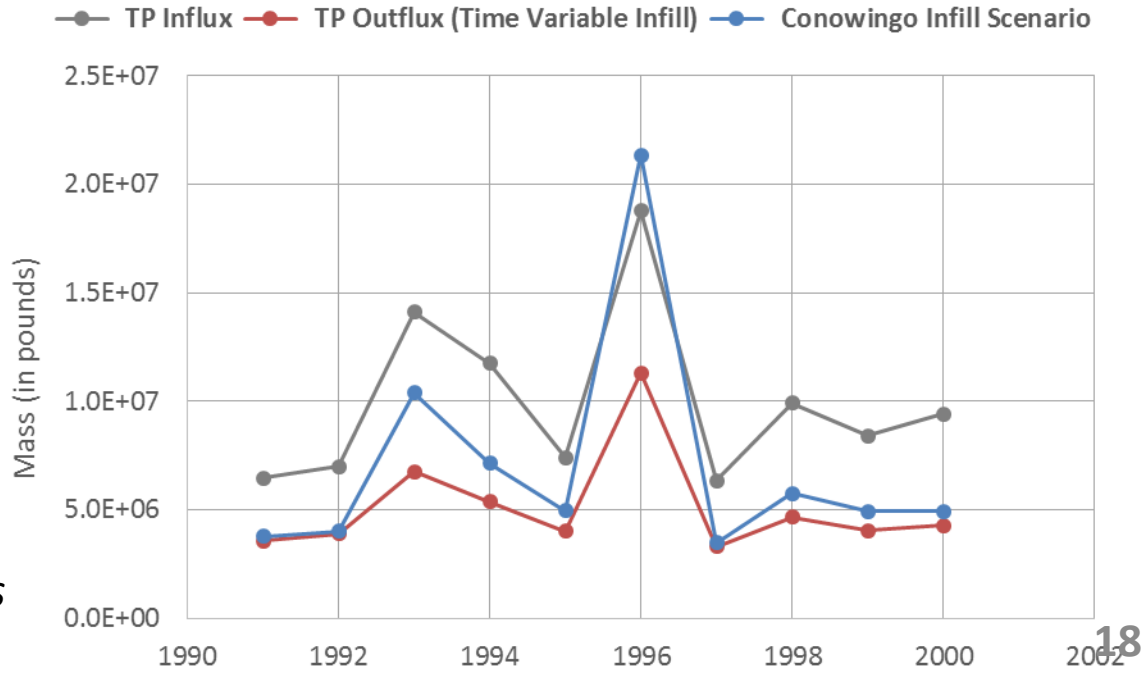


Conowingo Infill Scenario









less net deposition over the 10 years period as compared to baseline

Next Steps…

- WRTDS is one piece of evidence
- CPMBM/SFM will provide additional dataset to refine calibration
- Langland 2015 provides addition sediment data for corroboration