Representation of the Conowingo Reservoir in the Phase 6 Watershed Model

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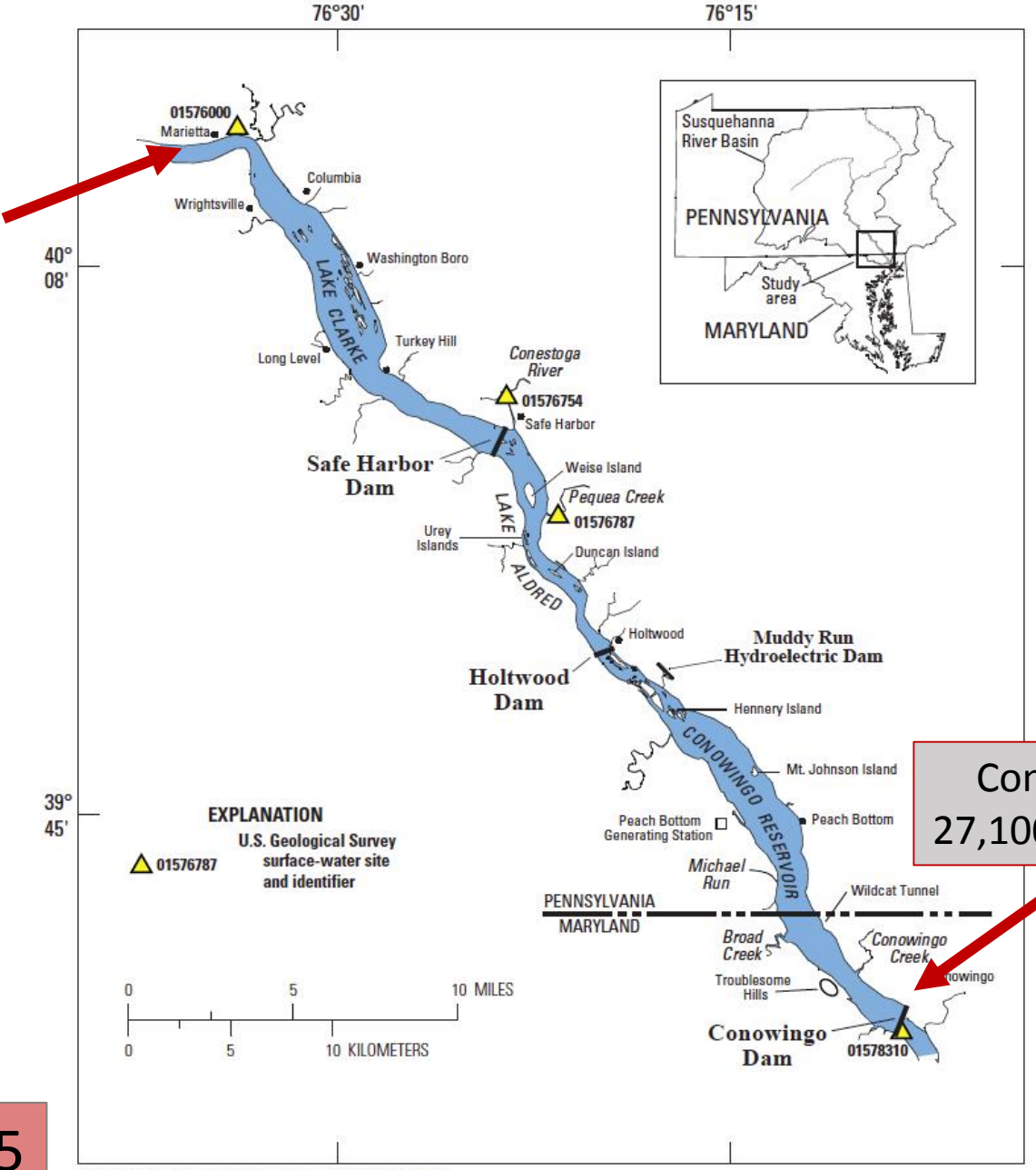
Modeling Workgroup

11/3/2015

The Reservoir System in the Lower Susquehanna River Basin

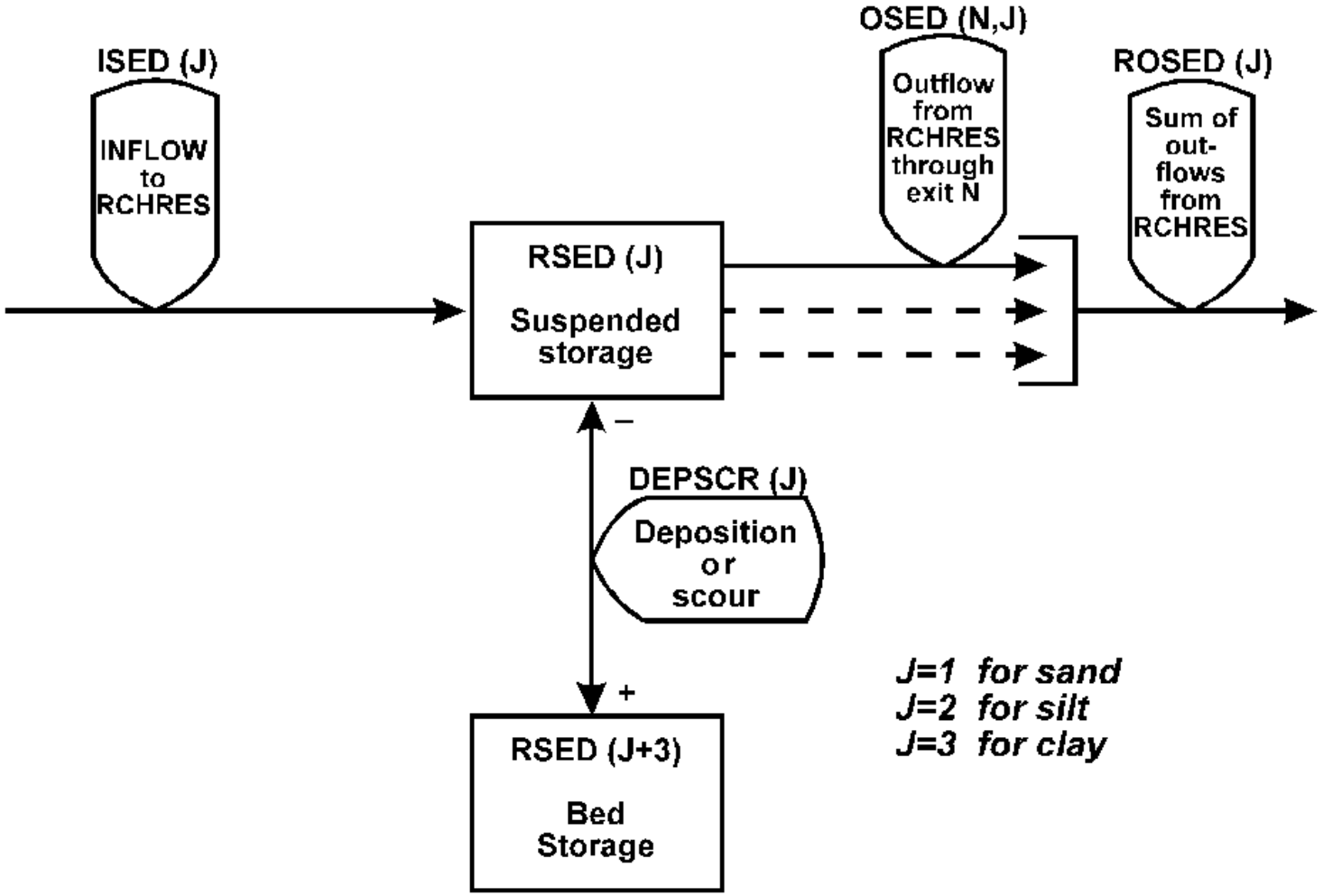
Marietta
25,990 sq. miles



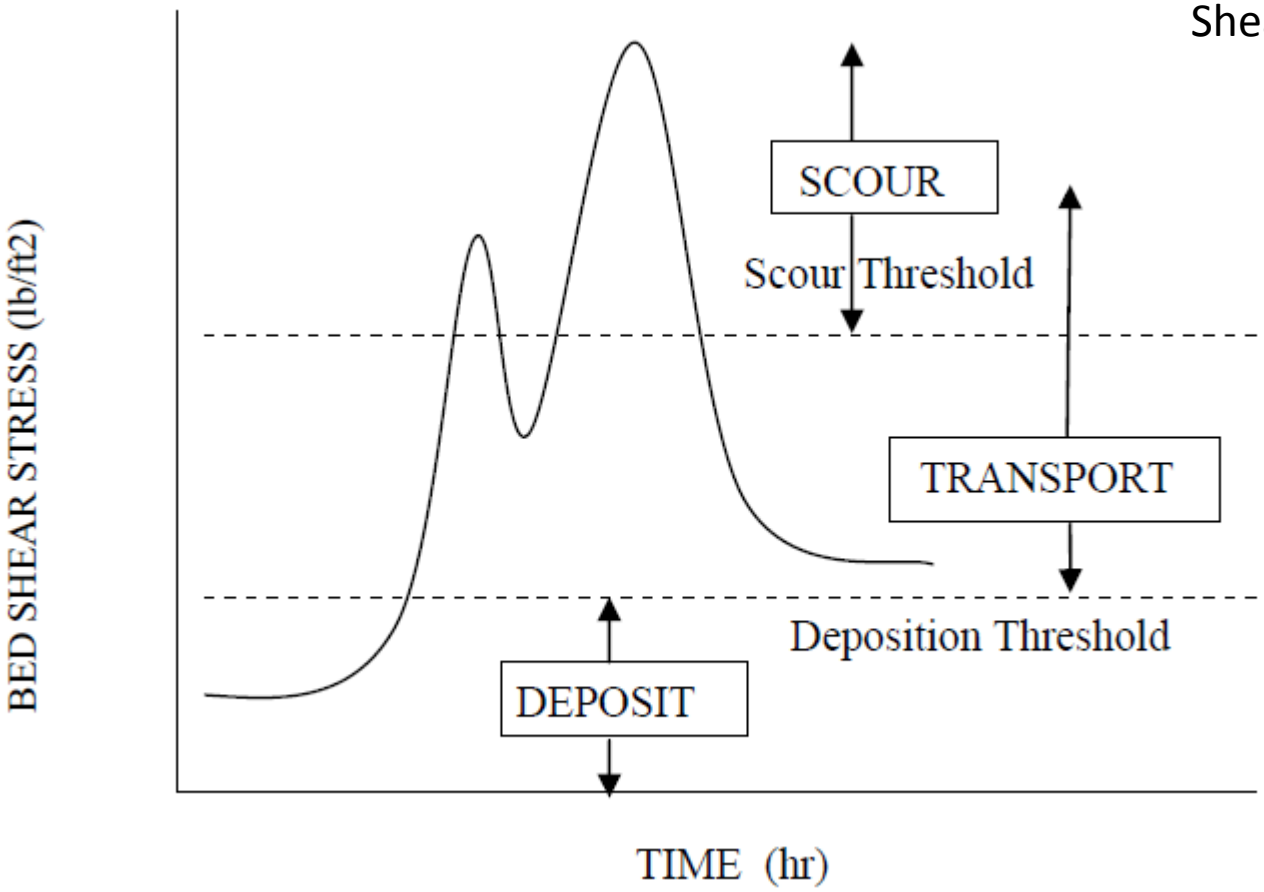
Conowingo
27,100 sq. miles

Langland, MJ, 2015

HSPF SEDTRN simulation



HSPF SEDTRN simulation



Shear Stress

Erodibility

$(Tau/Tau_{cs}-1) * M$

Settling Velocity

$(1-Tau/Tau_{cd}) * W/d$

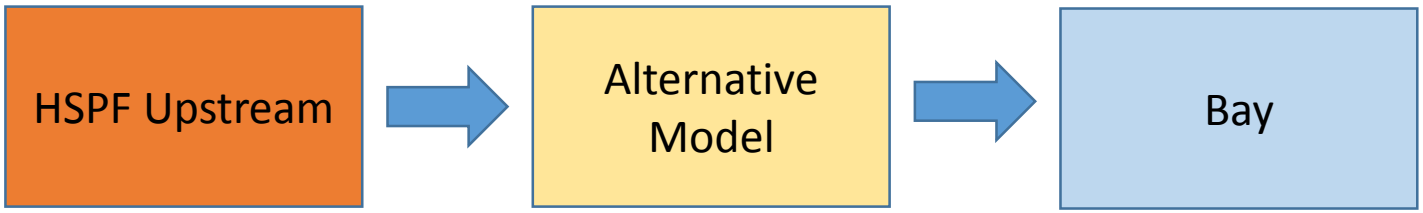
Actual equation expressed as exponential for concentration change

Depth

Tau_{cs} , Tau_{cs} , Erodibility, and Settling Velocity are all changeable through time

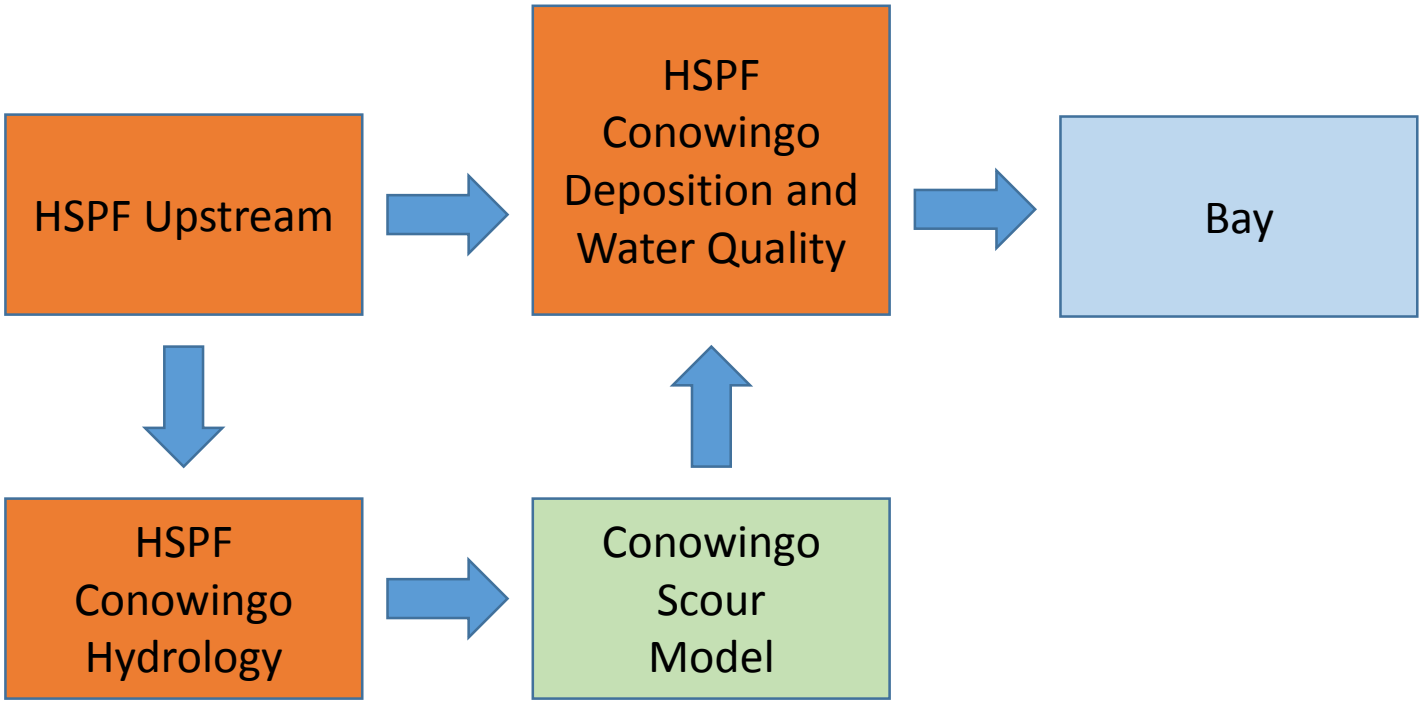
Phase 6 Prototypes

Alternative to HSPF Scour



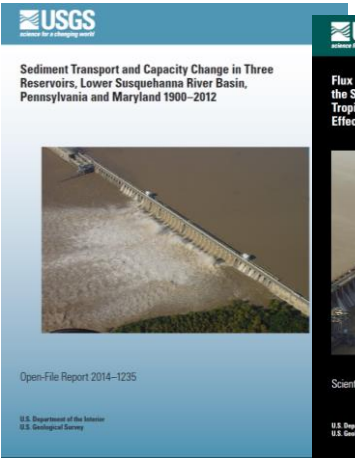
Jim Fitzpatrick 11:25

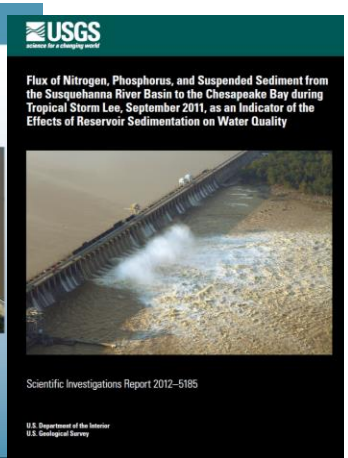
Alternative to HSPF Scour

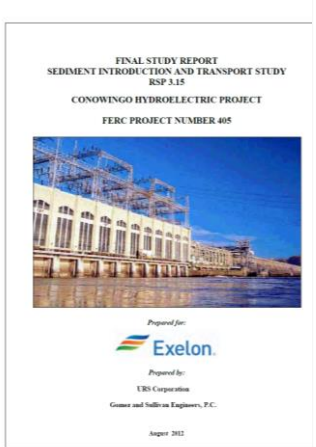


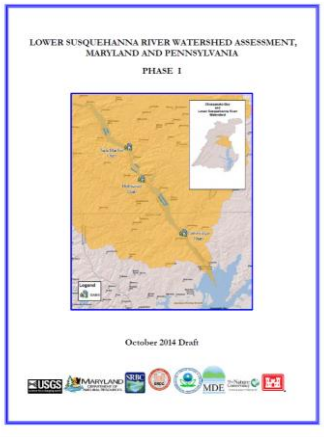
Lots of new information

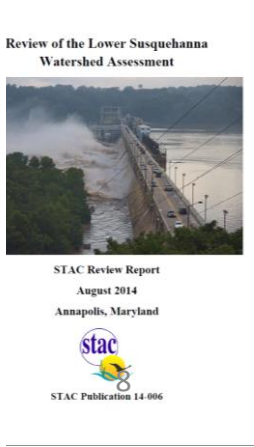
- Langland 2015
- Hirsch 2012
- Zhang 2013, 2015
- Gomez and Sullivan 2012
- LSRWA 2014
- STAC review of LSRWA 2014
- … more to come – right after this talk!











STAC Conowingo Workshop Goals (paraphrased)

- Based on observations and physical understanding, what is the best approach to modeling the Conowingo processes, considering the 2017 MPA timeframe?
- Formulate a plan for future study.
- *Likely Presenters:* Qian Zhang, Bob Hirsch, Bill Ball, Gregory Morris, Mike Langland, Larry Sanford, Carl Friedrichs, Bruce Michael, Gomez and Sullivan, Jeremy Testa, Cindy Palinkas, Jeff Cornwell, Gopal Bhatt, Gary Shenk, Steve Scott, Peter Wilcock

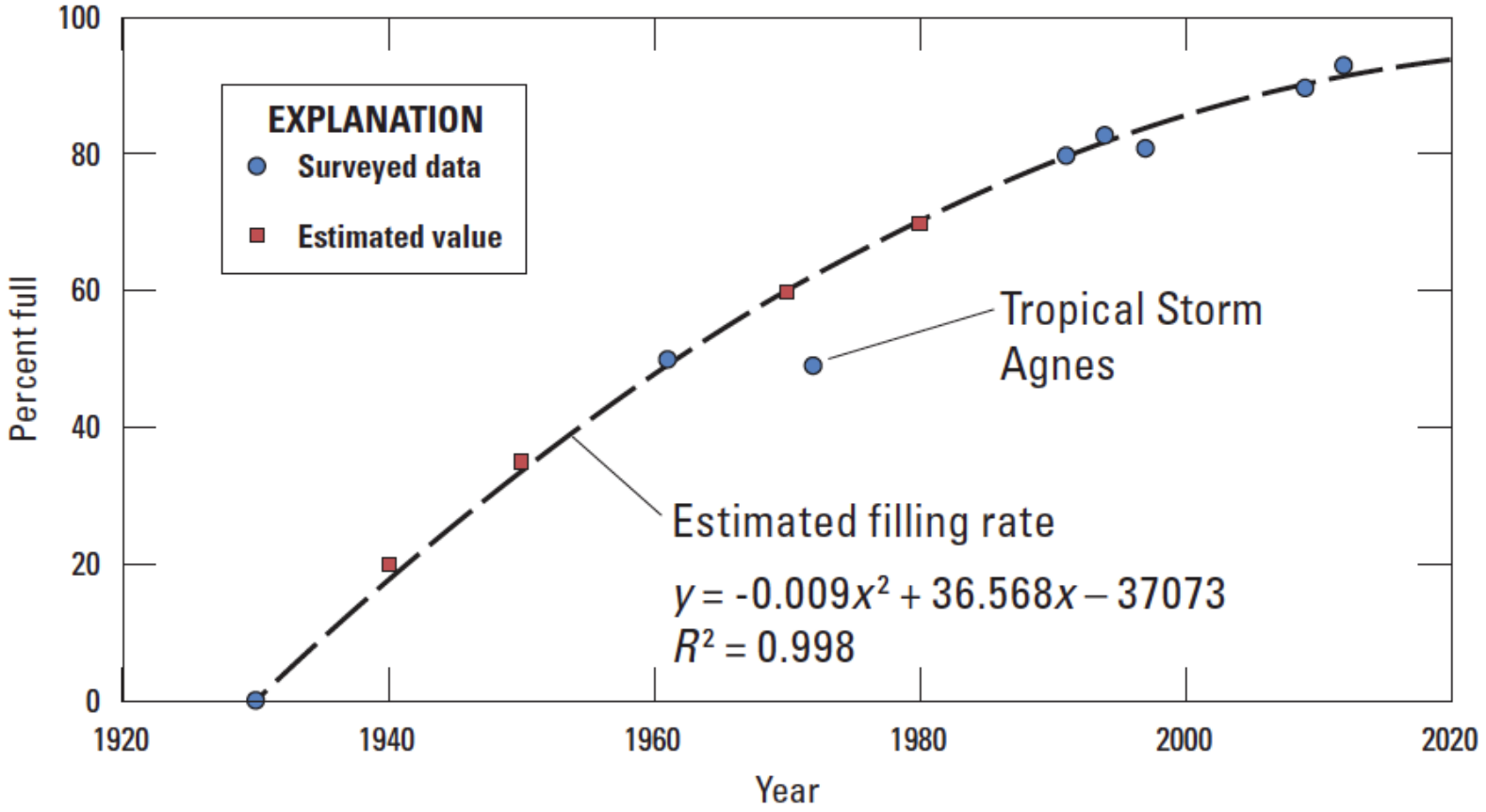


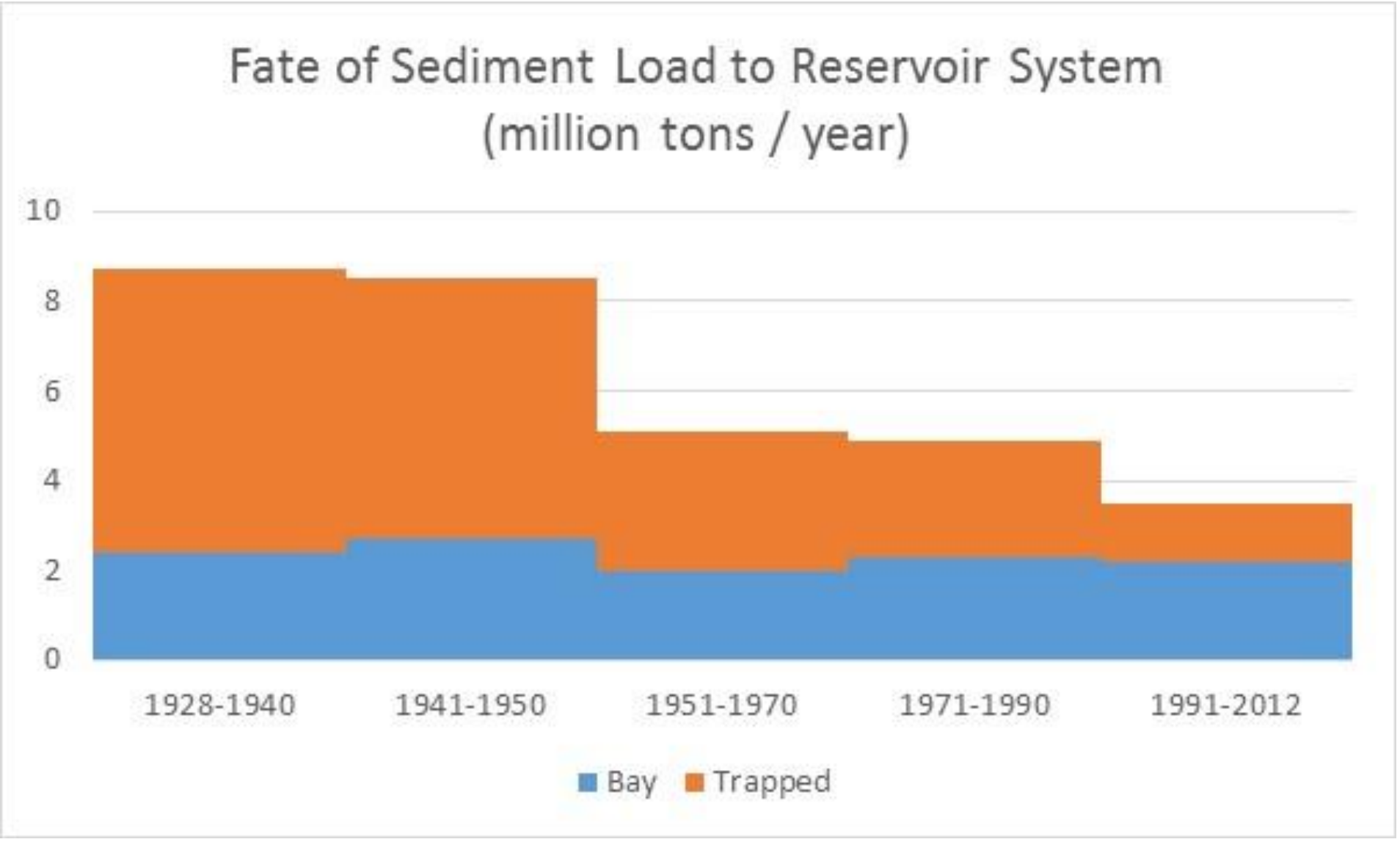
Figure 9. Trend in sediment storage capacity change (percent full) in the Conowingo Reservoir; Lower Susquehanna River Basin, Pennsylvania and Maryland, since construction, 1929–2012. Values are estimated from a combination of methods and assume a gradual reduction in long-term trapping efficiency from 75 to 55 percent.

Langland, 2015

Filling up

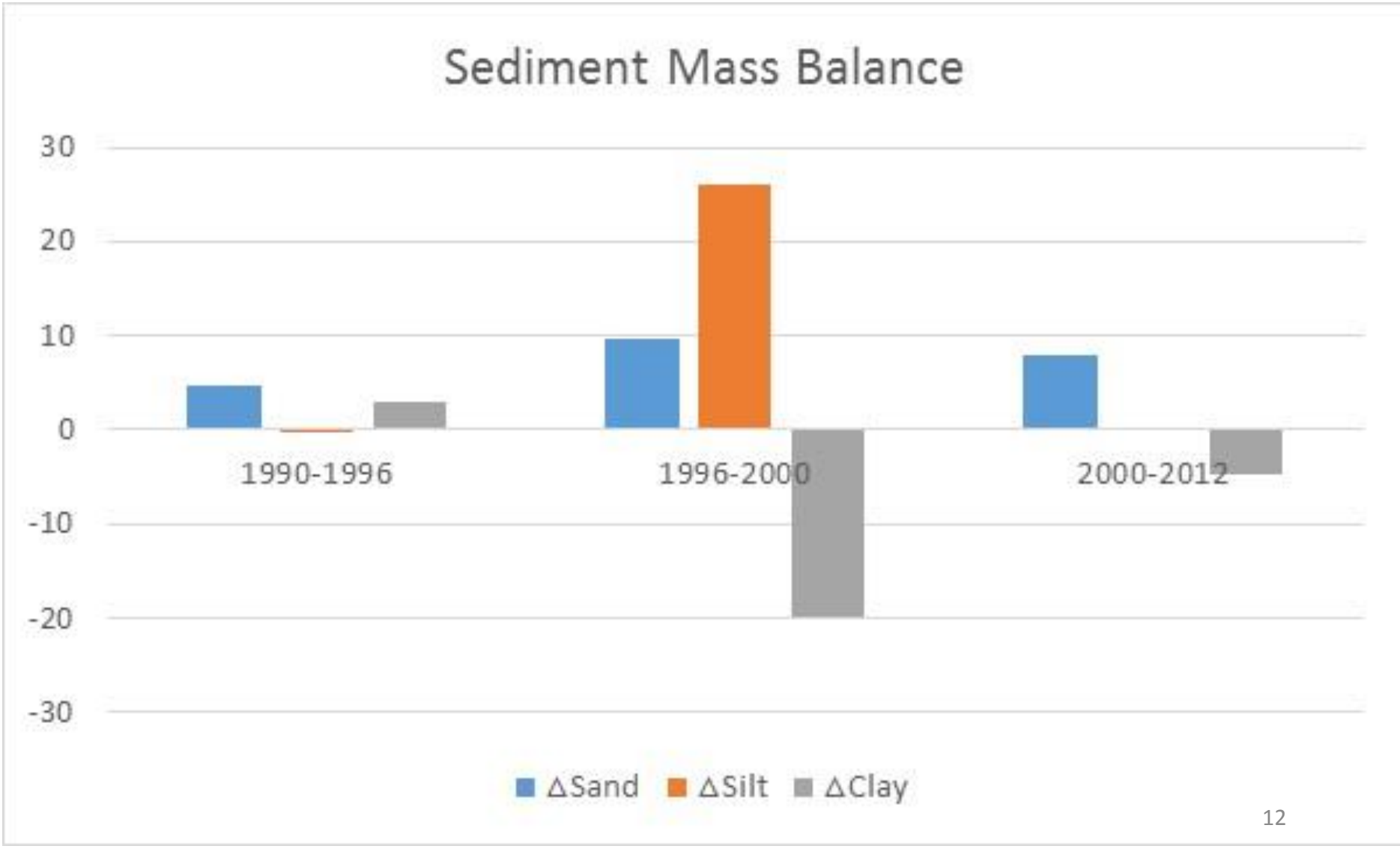
Sediment load to the reservoir system has decreased considerably over the long term, but the load to the bay has remained constant

After Langland 2015

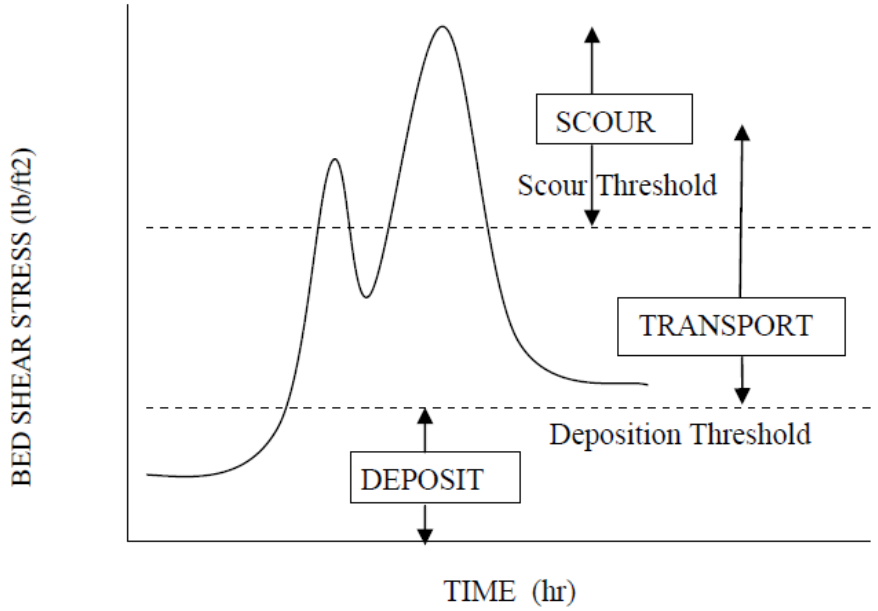


Lower Reservoir Sorting

- Bhatt analysis of Langland 2015



Thresholds



- 200,000 – 250,000 cfs
  - Clays and Silts start to move (Schuleen and Higgins, 1953) and (Steve Scott 2014, quoted in Langland 2015)
- 400,000 cfs
  - Large-scale bed movement (Hainly, et al 1995)
  - Threshold for scour that leaves reservoir system (Langland 2015)
- 600,000 cfs
  - Sand and Gravel (Schuleen and Higgins, 1953)
- 75,000 cfs
  - Deposition is decreasing over time (LSRWA 2014 and Hirsch 2012)

Langland (2015) provides an estimate of Sediment Scour based on:

1. Streamflow and loads
2. Bathymetry

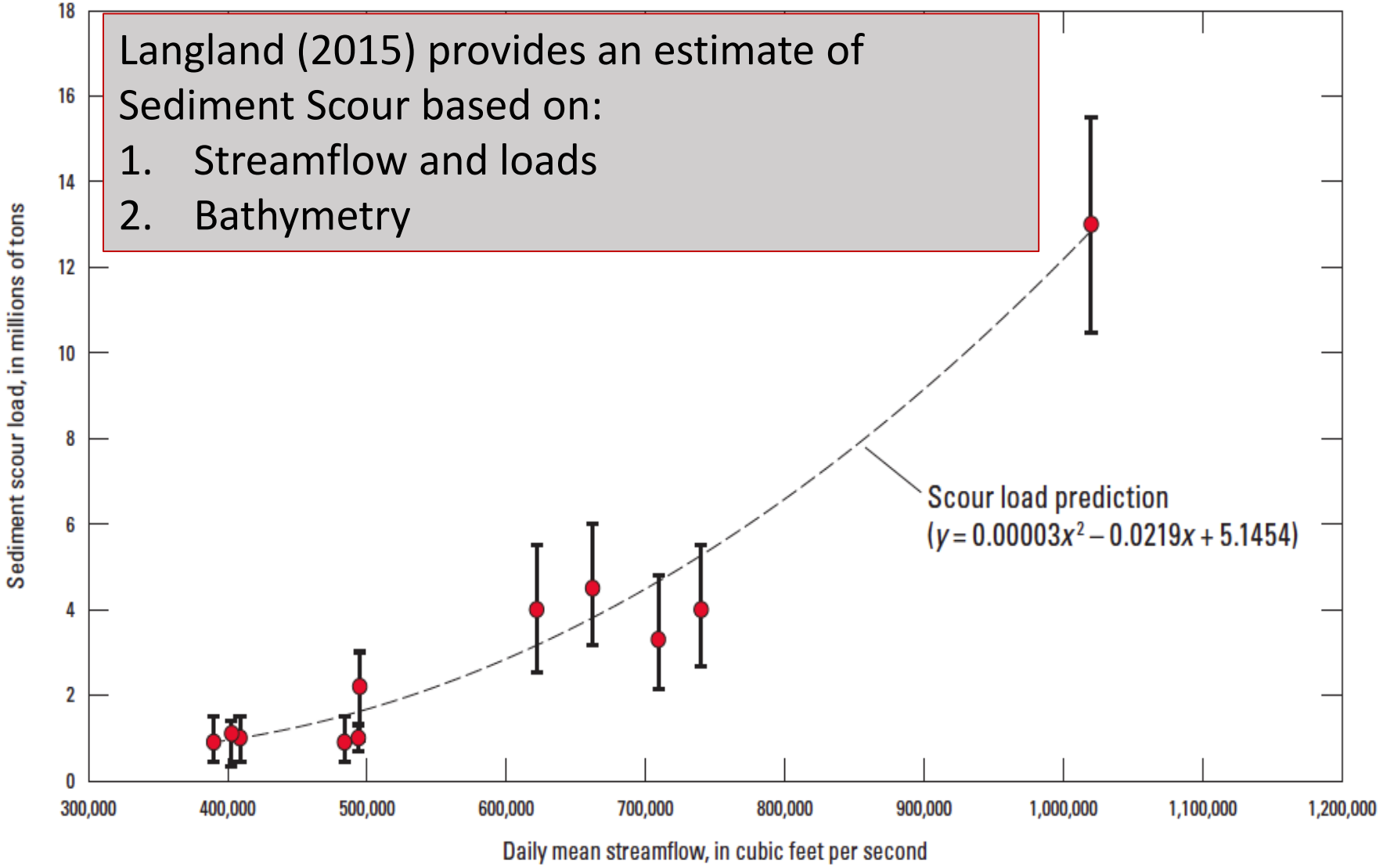


Figure 8. Daily mean streamflow in relation to sediment scour load and U.S. Geological Survey scour equation used to predict scour using streamflows generally exceeding 400,000 cubic feet per second in the Lower Susquehanna River reservoir system.

Langland, 2015

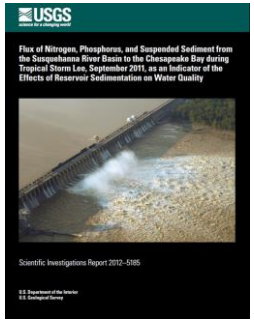
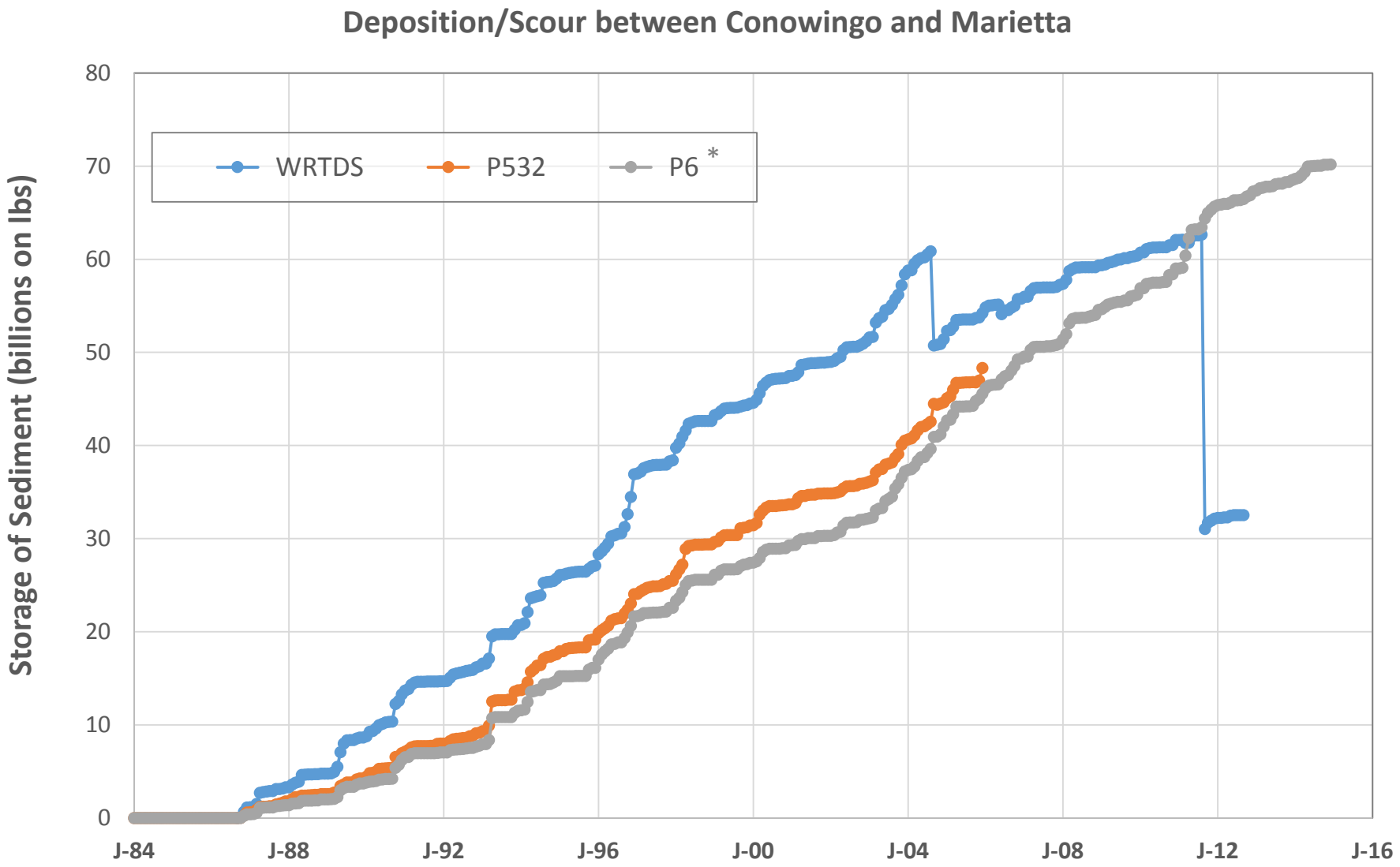


Table 3. Predicted change in average flux of total nitrogen, total phosphorus, and suspended sediment from the mid 1990s to the time when reservoir sediment-storage capacity is reached (Langland and Hainly, 1997), and observed change in flow-normalized flux, water years 1996–2011.

Constituent	Predicted change in average flux (Langland and Hainly, 1997) (percent)	Observed change in flow-normalized flux, water years 1996–2011 (percent)
Total nitrogen	+2	-3.2
Total phosphorus	+70	+55
Suspended sediment	+250	+97

- 1996 to 2011 bathymetry change resulted in a
  - 10-percent increase in total sediment load to the Bay
  - 67-percent increase in bed scour
  - 33-percent decrease in reservoir sedimentation

Total Sediment Dynamics between Marietta and Conowingo



* Phase-6 Aug 2015

Summary

- Lots of information exists
- Flexible methods to implement models
- P6 Beta1 will have a reasonable representation
- STAC recommendations will drive development in 2016