CONNECTING THE DOTS TO INNOVATION

CONOWINGO RESERVOIR MODELING STUDY UPDATE

USACE-ERDC – Jodi L. Ryder, Earl J. Hayter, and Danielle R. Tarpley
APR 2026

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OVERVIEW APR 2026

Background
- Objectives of the effort
- Team and Partnerships

Modeling approach
- Hydrodynamics
- Nutrient water quality
- Sediment transport

Data Acquisition
- Physical sediment characterization
- Biological sediment characterization
- Other data

Model applications
- Dredging scenarios
- Extreme event scenarios

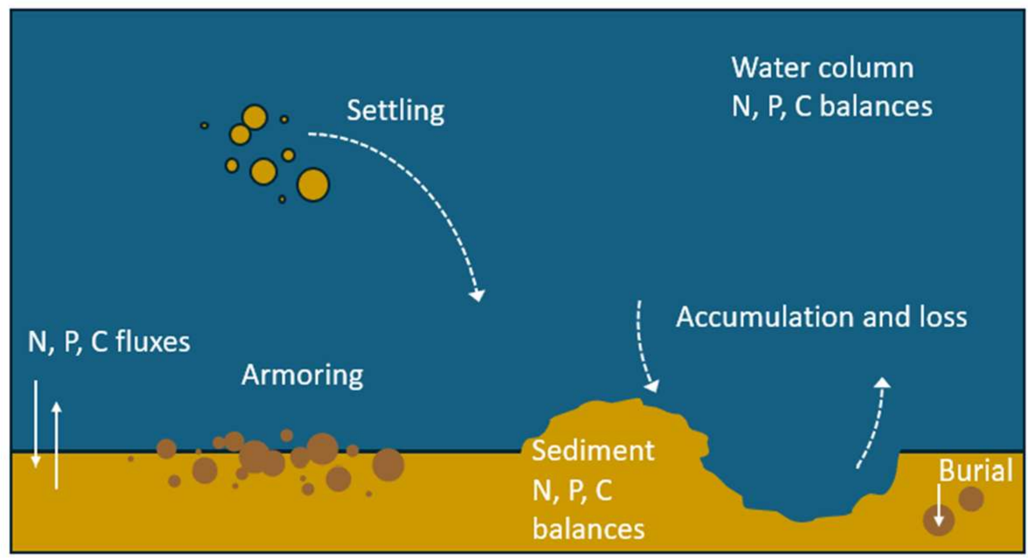
Project and reporting schedule

Questions

Regional View of Conowingo Reservoir

MODEL REQUIREMENTS

- Continuous simulation of the reservoir pool including selected hydrometeorological events; (1991-2000)
- Change in hydrodynamics from reservoir infill of sediments from the CR watershed, and removal of material through dredging
- Biogeochemistry in the reservoir pool, responding to the amount and speciation of nitrogen, phosphorus, and sediment inputs from upstream and bottom sediment
- Biogeochemical changes in sediments, including burial, species changes, and water column exchanges
- Physical changes in sediment characteristics due to erosion, bed armoring, and deposition of sediment and the resulting morphological changes in the reservoir
- Dredging of the reservoir.



PROGRESS SUMMARY

Project components
- Hydrodynamics
- Sediment transport
- Nutrient water quality

→ Dredge scenarios
Climate scenarios

- EFDC+ selected as model code
- EFDC+ installed on ERDC HPC system
- ERDC team trained and consulted on WQ modeling with DSI
- Updates made to EFDC+ vHPC to achieve agreement with EFDC+ vPC

Hydrodynamics Development
- Fine grid used to develop coarse grid (~86,490 cells)
- Boundary conditions, met conditions developed
- Preliminary test runs (PC)
- Model moved to HPC

Sediment Transport Development
- Collection and physical characterization of samples
- 6 layers / 7 size classes enacted in each grid cell
- 3 mo. trial run (1 mo. spin up) on coarse grid
- Identification of flow and stage data

Water Quality Development
- Biological characterization of samples
- Development of parameterization strategy
- Link watershed HSPF to boundary conditions
- Identification of WQ calibration data

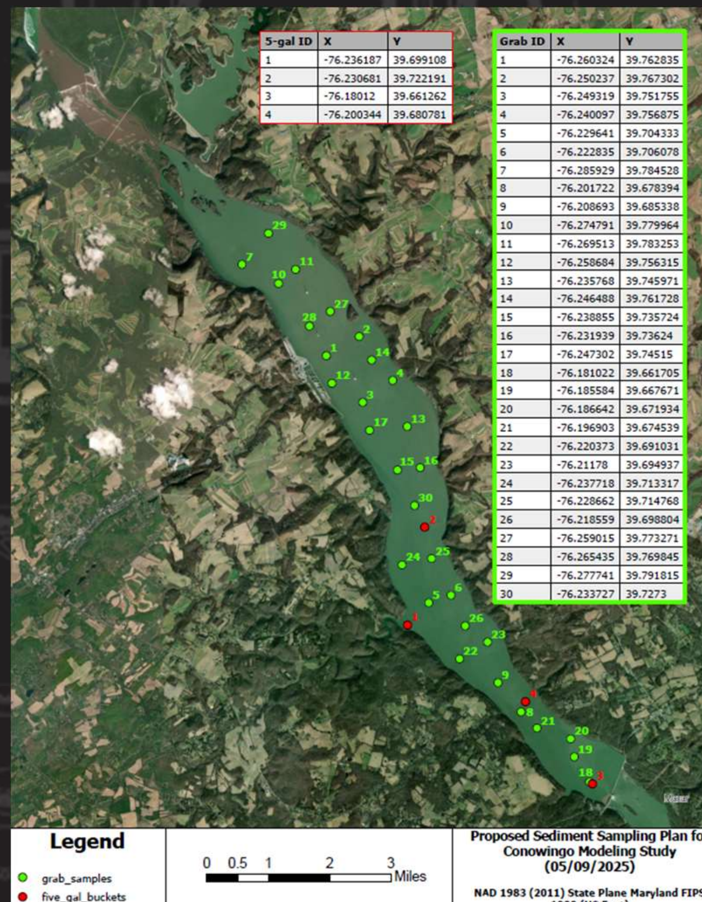
Dredge Scenario Development
2 discussion sessions with technical review panel

CONOWINGO RESERVOIR SEDIMENT SAMPLING

USACE-ERDC

Danielle Tarpley, PhD
Jodi Ryder, PhD
Earl Hayter, PhD

Chesapeake Bay Program
Modeling Quarterly Review



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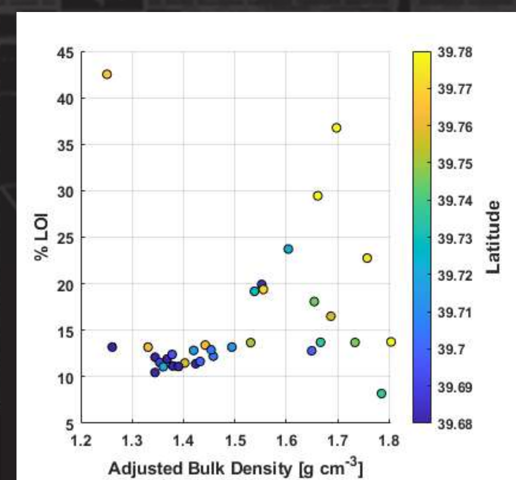
14	-76.246488	39.761728
15	-76.238855	39.735724
16	-76.231939	39.73624
17	-76.247302	39.74515
18	-76.181022	39.661705
19	-76.185584	39.667671
20	-76.186642	39.671934
21	-76.196903	39.674539
22	-76.220373	39.691031
23	-76.21178	39.694937
24	-76.237718	39.713317
25	-76.228662	39.714768
26	-76.218559	39.698804
27	-76.259015	39.773271
28	-76.265435	39.769845
29	-76.277741	39.791815
30	-76.233727	39.7273



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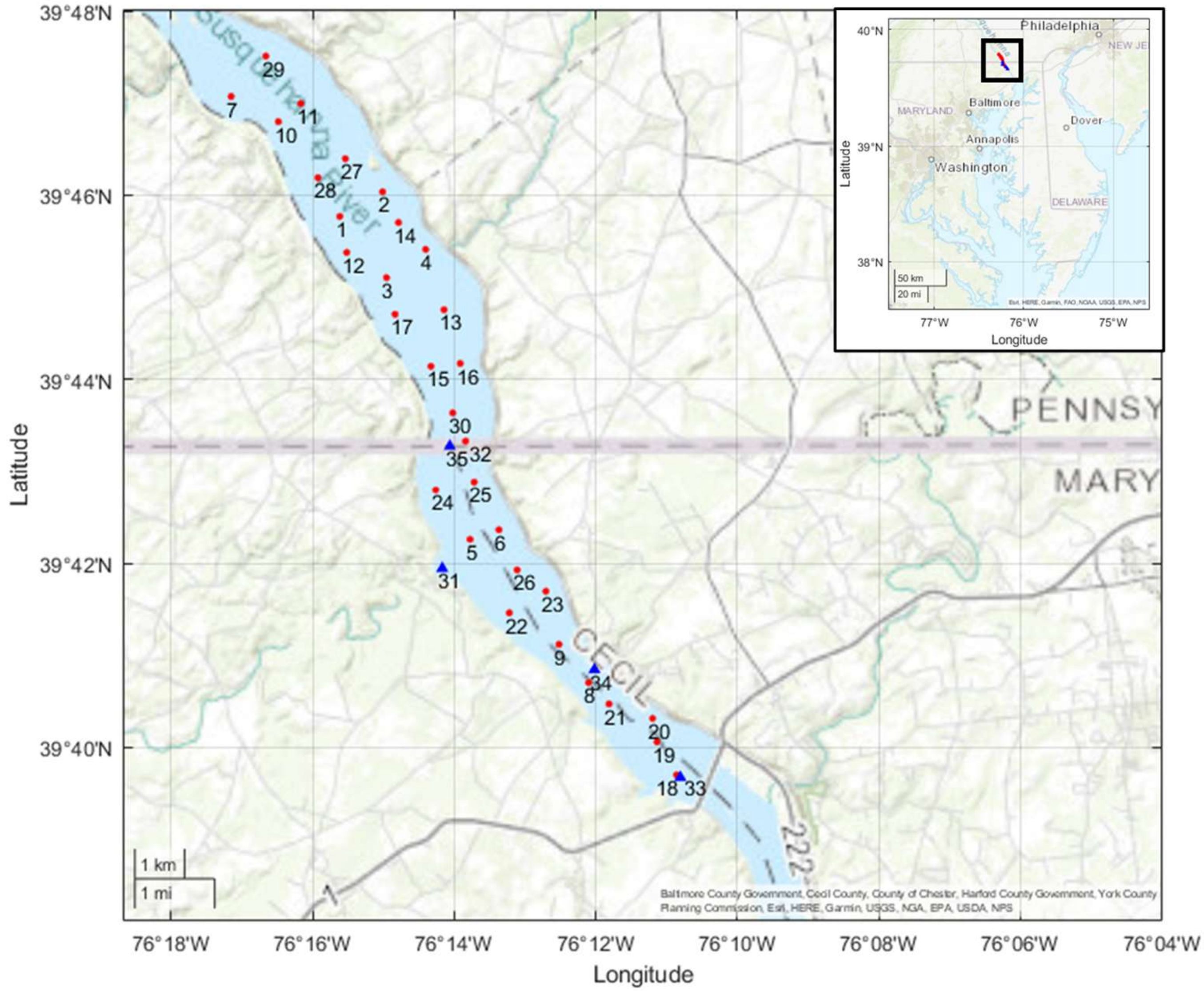
Sample Locations Conowingo Reservoir

Bottom Sediment Characterization

- Grain size distribution (all)
- Bulk density (all)
- Erosion testing (blue triangles)
- Long-term bed oxygen demand (blue triangles) – Environmental Lab

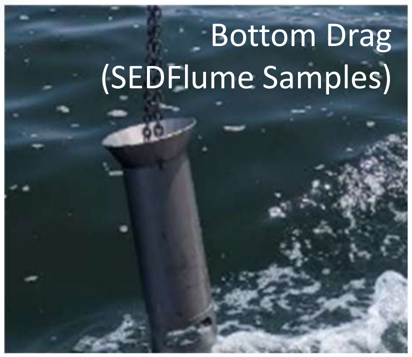
Sampling method

- Ponar (red dots)
- Bottom drag (blue triangles)
- Ekman dredge (blue triangles)
- Gravity core (blue triangles)

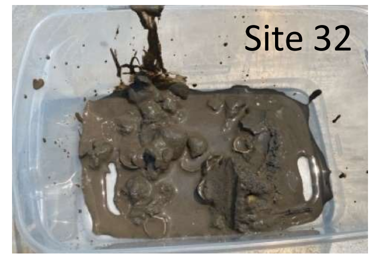


Sample Collection – June 2025

Example of Sampling Devices



Sediment Samples



Bottom Samples:
Bulk Density and LOI (@500 C & 815 C)

Bulk Density

- Water: 1 g cm^{-3}
- Sediment: 2.65 g cm^{-3}
- Coal: 1.3 g cm^{-3}
- Adjusted Bulk Density is modified using the density of coal using LOI values.

LOI

- 1 hour @ 500 C
- 1 hour @ 815 C

Note: Missing a value for sample location 10.


Conowingo Sta 3 >0.7mm

Bottom Samples: Bulk Density and LOI (@500 C & 815 C)

Bulk Density

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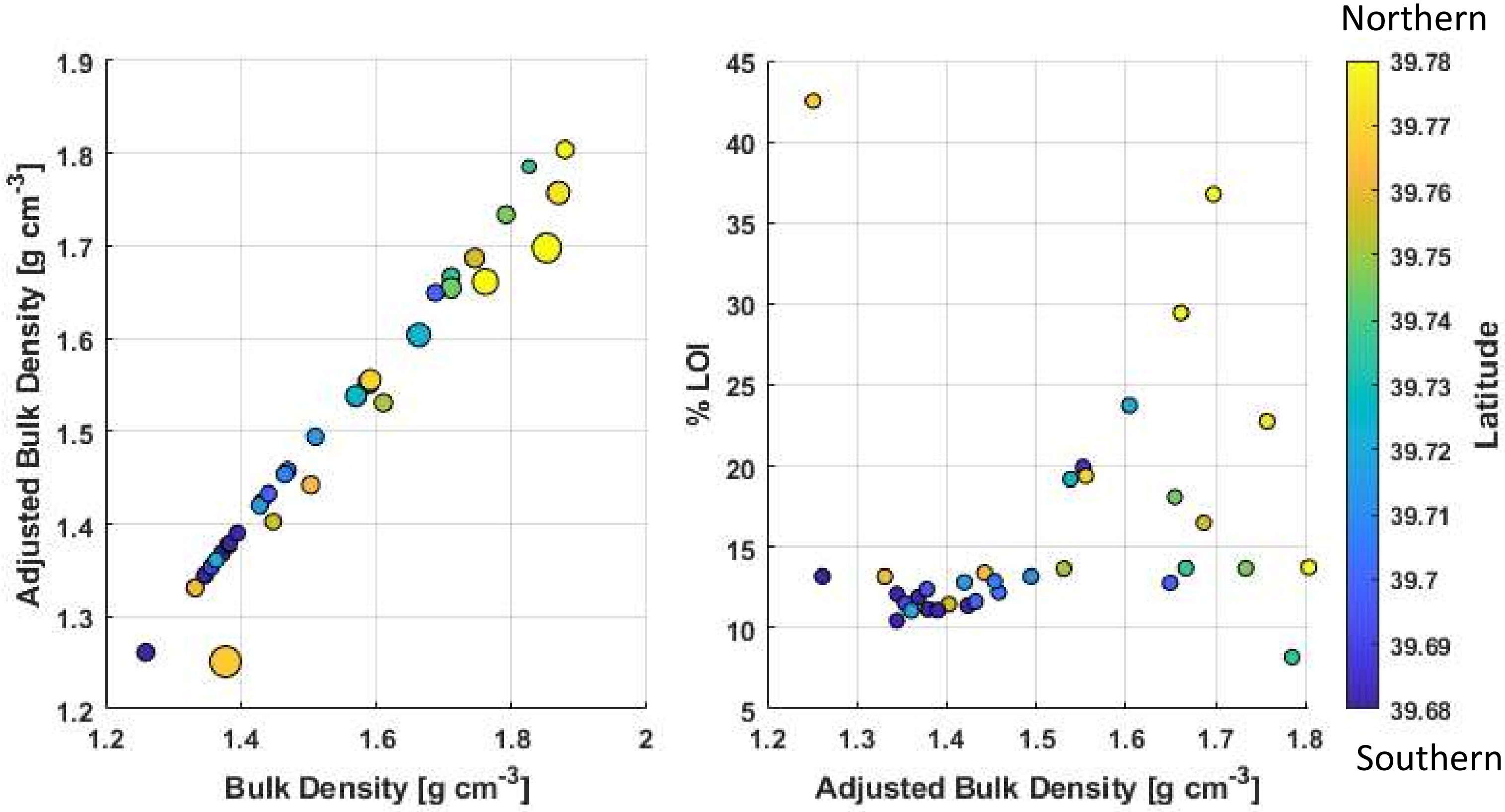
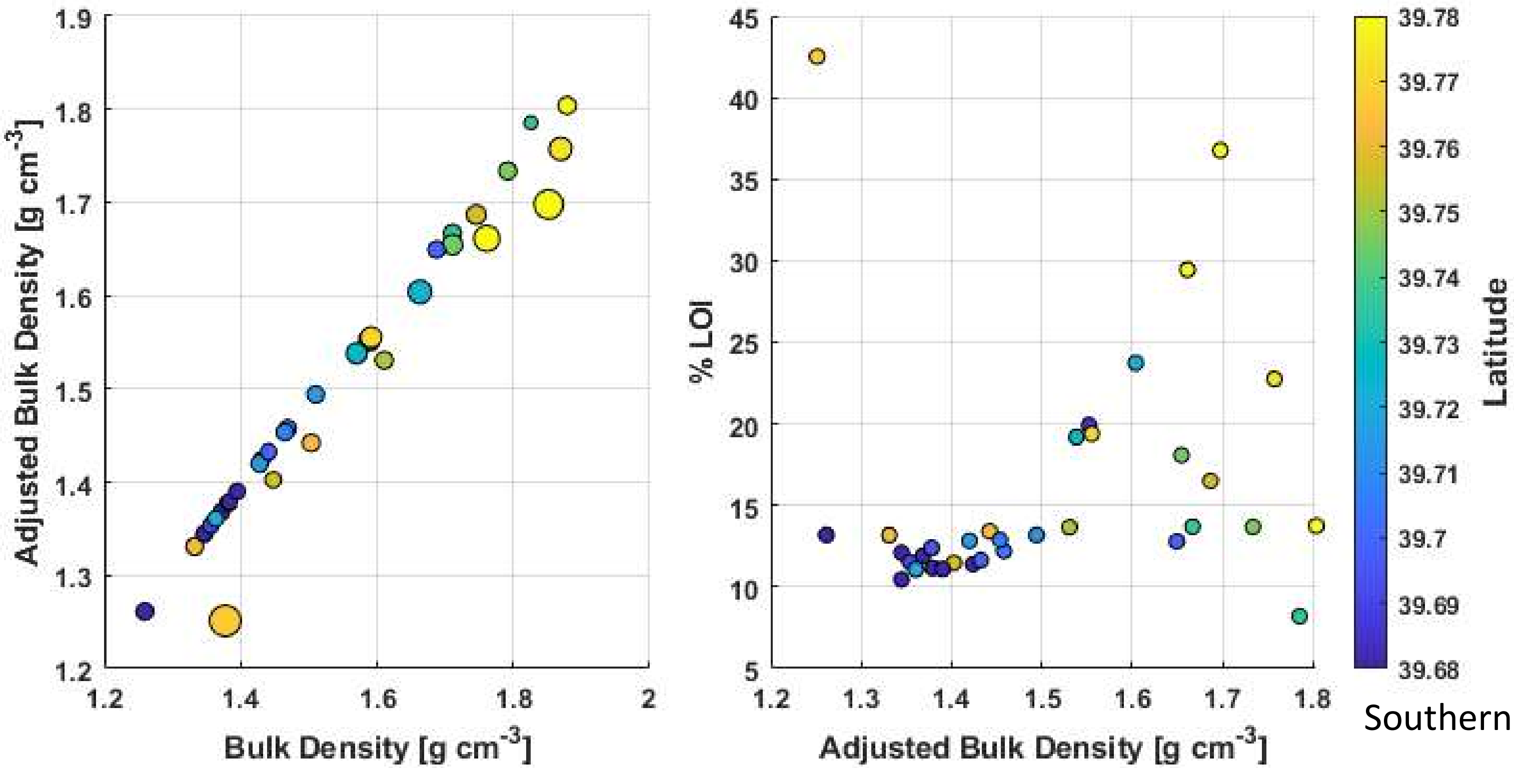


Note: Size of marker represents % LOI

Bottom Samples: Bulk Density and LOI (@500 C & 815 C)

LOI greater for sizes 600 – 1500 µm



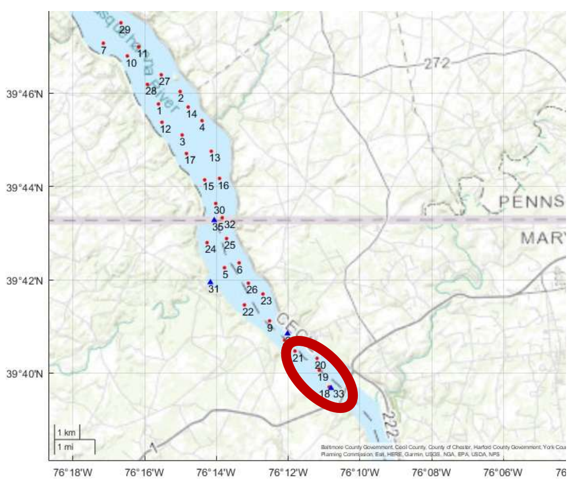
Note: Size of marker represents % LOI

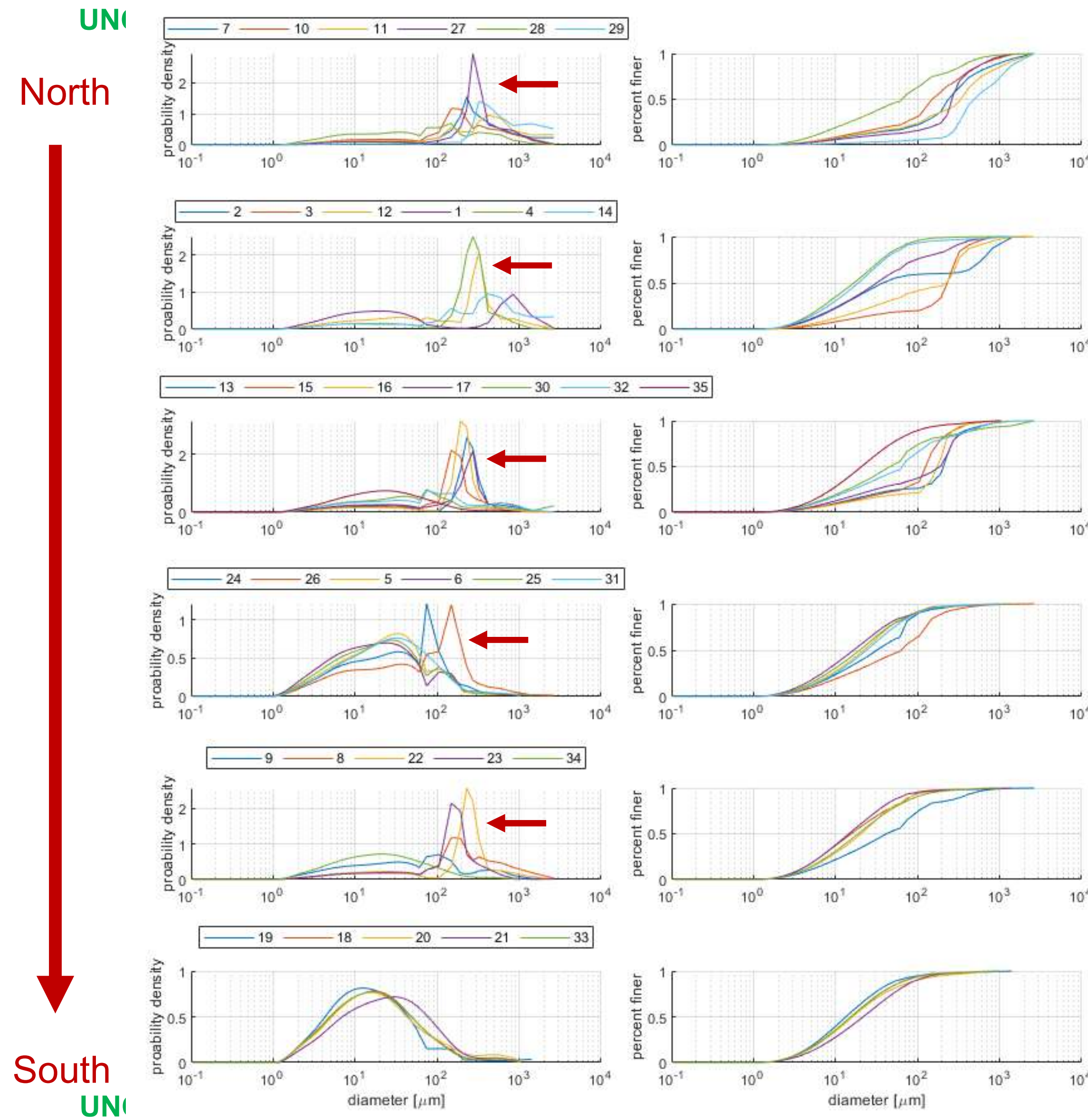
Bottom Samples: Grain Size Distributions

Probability Density (left column)

Cumulative Percent Finer (right column)

Finer material from samples closer to the dam (toward the south; as expected from previous sampling studies).

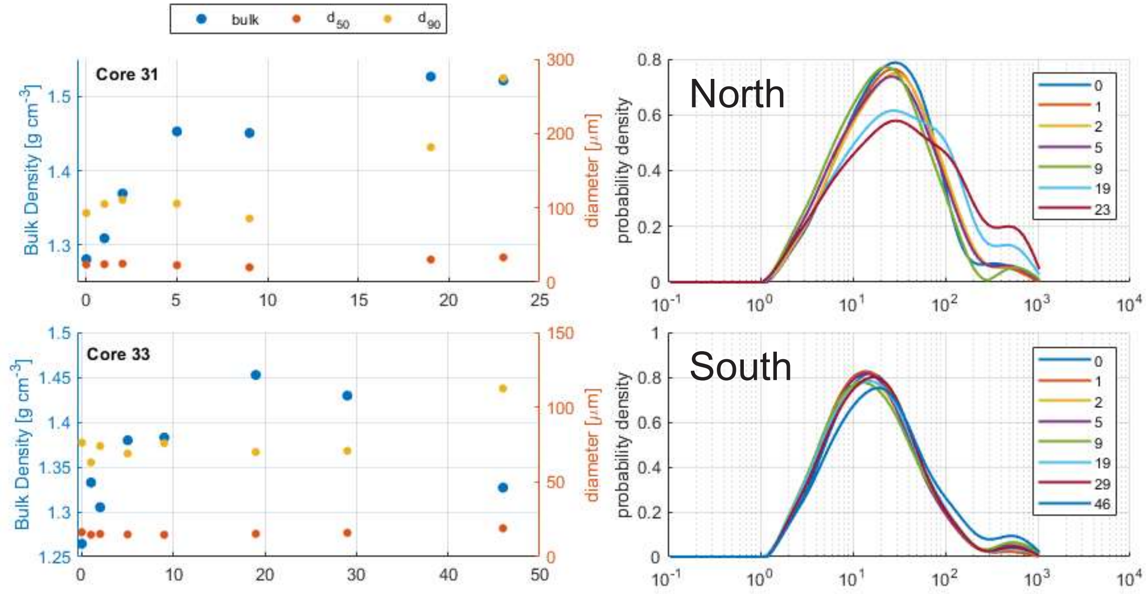


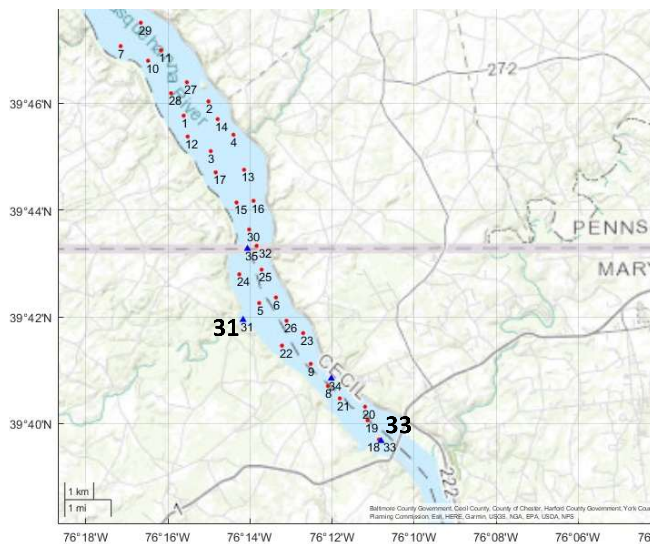


Sediment Cores: Bulk Density & Grain Size (Sites 31 & 33)

Gravity Core Analysis

- Grain Size distribution was obtained using laser diffraction on a Malvern Mastersizer 3000E.
- Legend for the grain size distribution indicate the core depth (cm).





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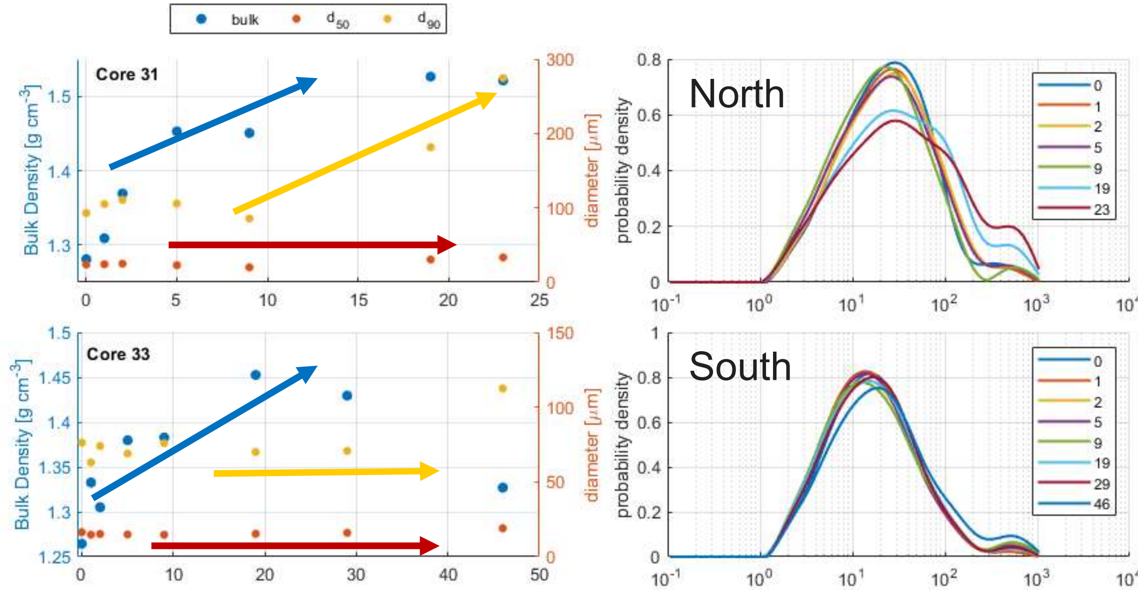

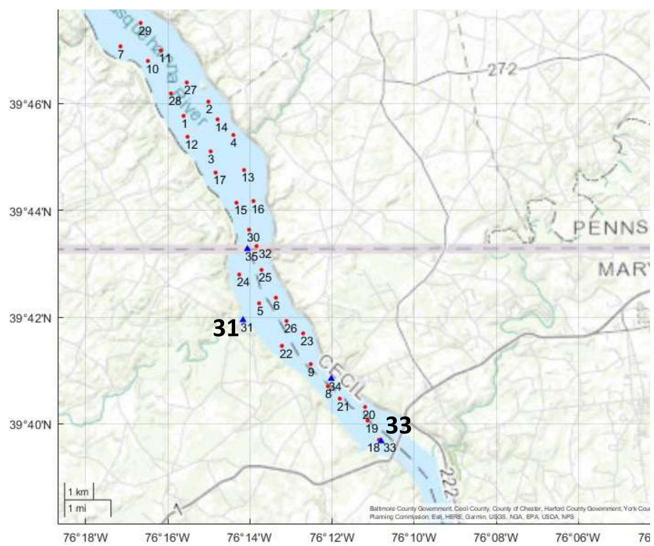

Increasing bulk density with depth (expected)

Little to no variability in median grain size (d_{50}) with depth

Increase in the larger grain sizes (d_{90}) with depth further from the dam.

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Sediment Cores: Bulk Density & Grain Size (Sites 31 & 33)

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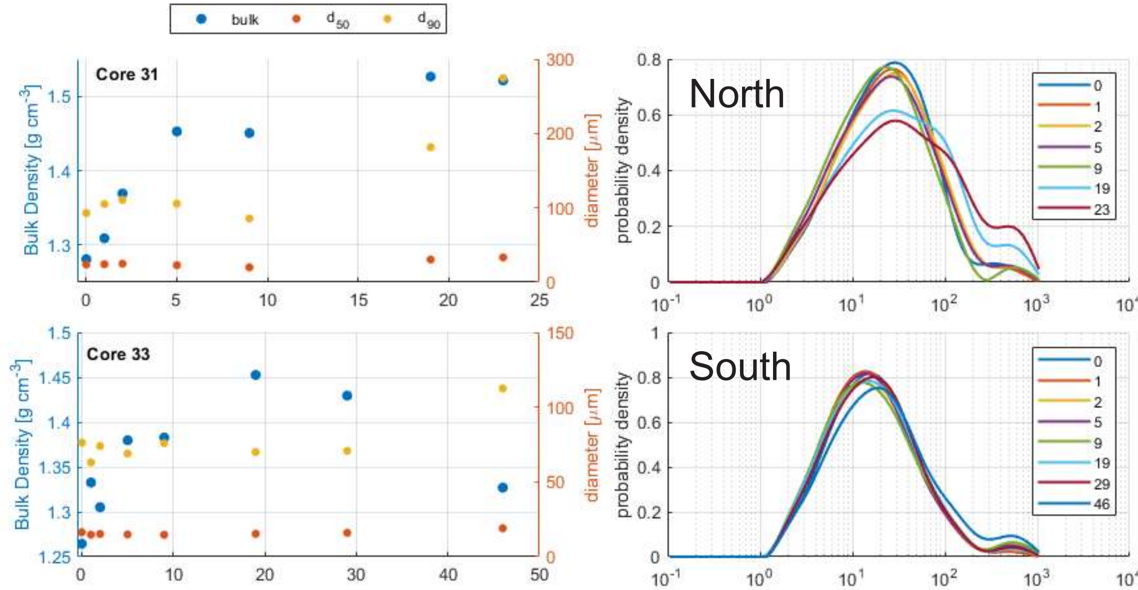

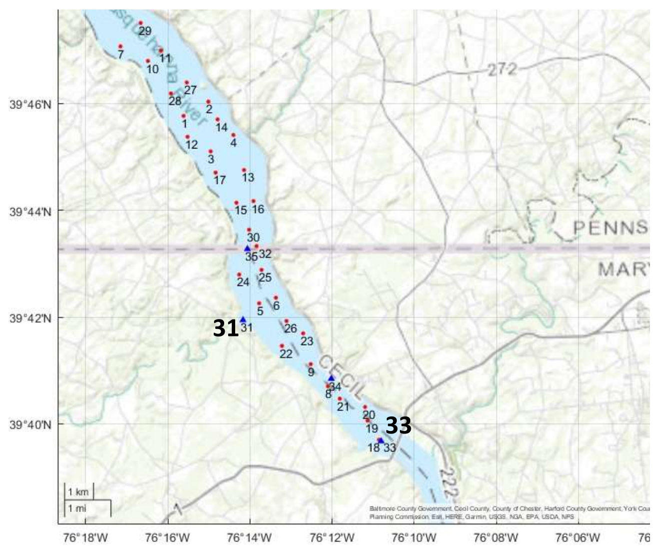

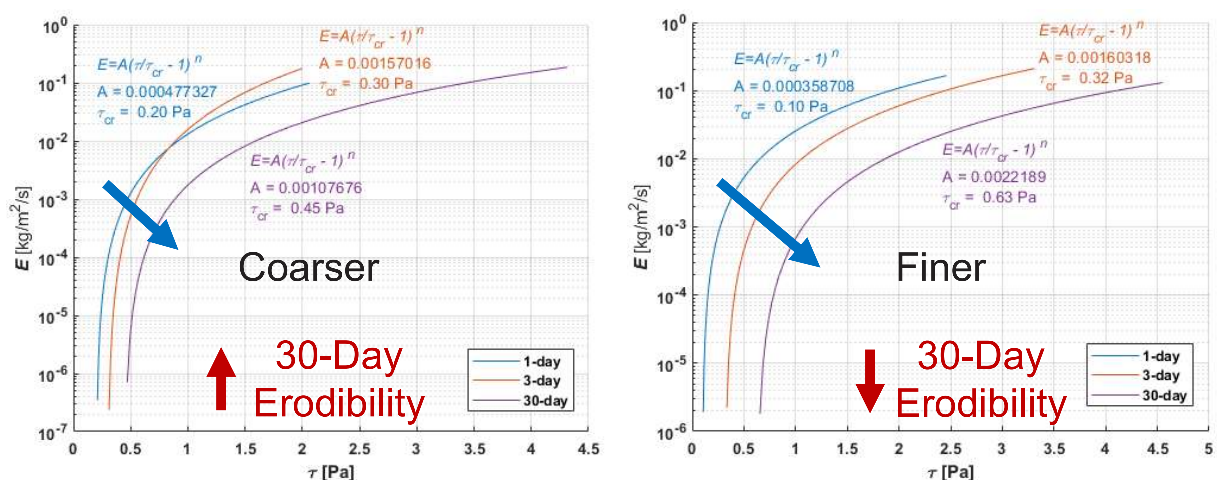

Decrease in erodibility with **time** (expected) & **finer material** (expected).

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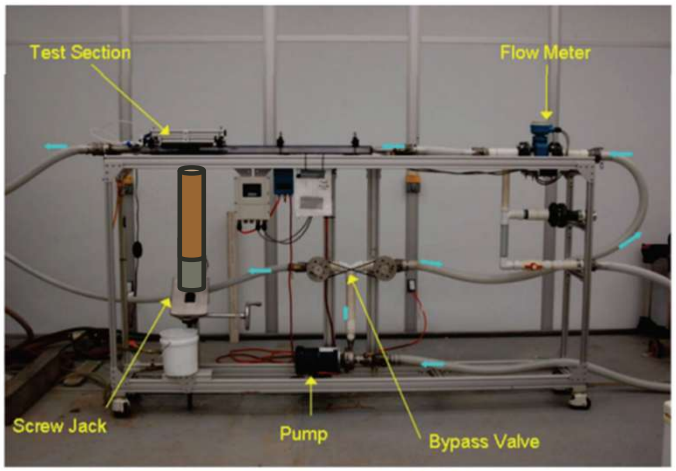
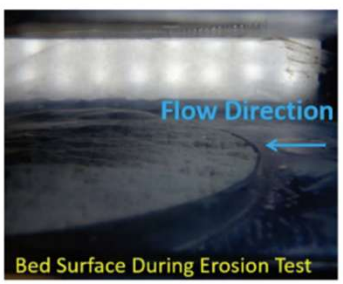
SEDFLUME (SEDIMENT EROSION W/ DEPTH FLUME

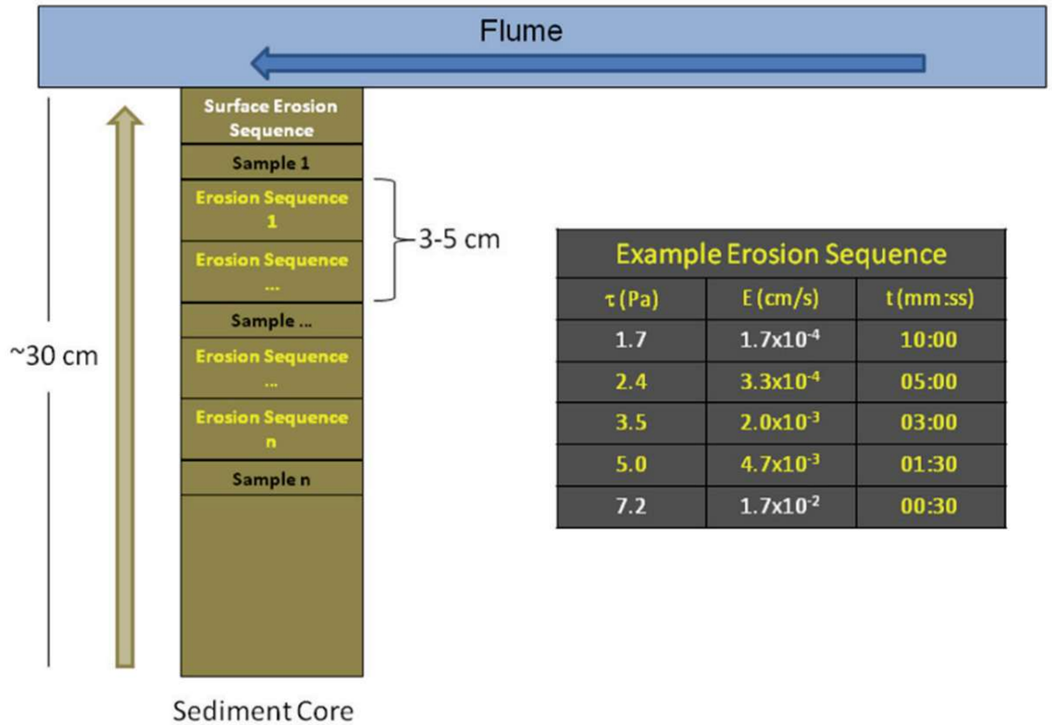
Flume Setup





Shear Stress (Pa)	Flow Rate (GPM)
0.1	5.2
0.2	7.9
0.4	11.5
0.8	17.8
1.5	25.8
1.0	20.3
1.5	25.8
2.0	30.6
2.5	34.9
3.0	38.8
4.0	46.0
5.0	52.4
6.0	58.3
8.0	69.1
10.0	78.8
12.0	87.7

Example Erosion Sequence



Example Erosion Sequence		
τ (Pa)	E (cm/s)	t (mm:ss)
1.7	$1.7x10^{-4}$	10:00
2.4	$3.3x10^{-4}$	05:00
3.5	$2.0x10^{-3}$	03:00
5.0	$4.7x10^{-3}$	01:30
7.2	$1.7x10^{-2}$	00:30

BIOLOGICAL SEDIMENT CHARACTERIZATION AND NUTRIENT MODEL PARAMETERIZATION

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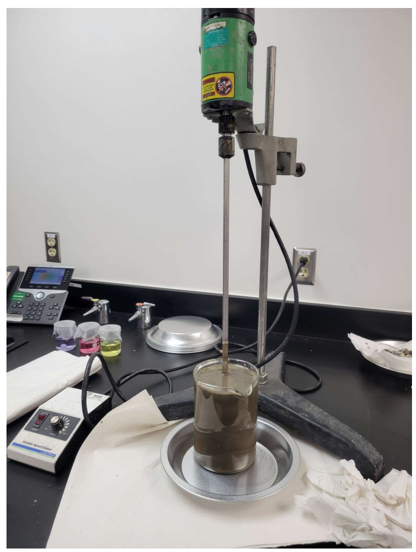
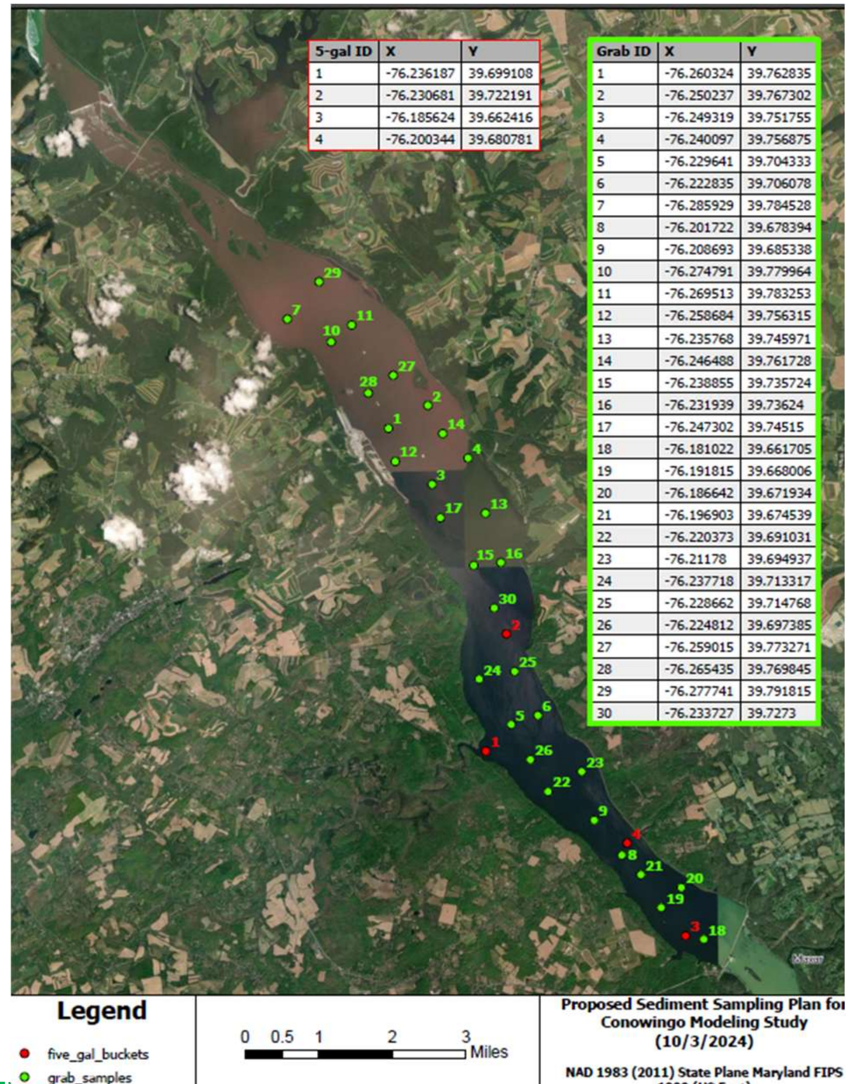
SEDIMENT BOD ANALYSIS

Objective is to develop field derived G1, G2, and G3 fractions

- Samples collected 30JUN2025
- Surficial Eckman dredge (red)
- Stored at ERDC @ 30-40°F fridge

- Hand removed macros – shells
- Homogenized





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SEDIMENT CARBON ANALYSIS

Initial 300 ml trial –
- Determined sample dilutions (2 replicates of 3 dilutions)
- Incubated at 25^{o}C
- Confirmed use of nutrient seed
- Confirmed use of nitrification inhibitor
- Many survived 10+ days
- Recorded daily Temp, DO, pH

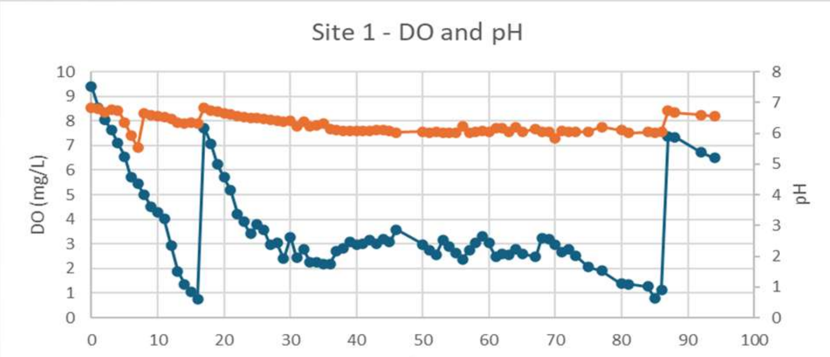
500 ml gas tight bottles
- Stirred
- Climate controlled room but AC went out for several days
- Consumed DO very fast

2L flasks→ best result
- Climate controlled room
- Reoxygenated near 2 mg/L DO target

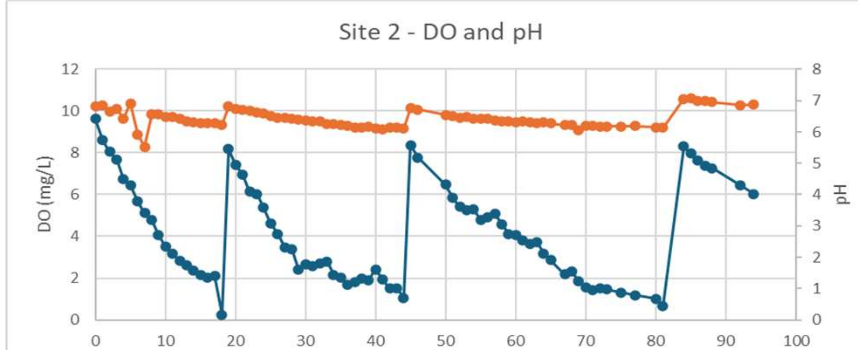
- Recorded daily Temp, DO, pH

2L – 90 DAY BOD DIGESTIONS

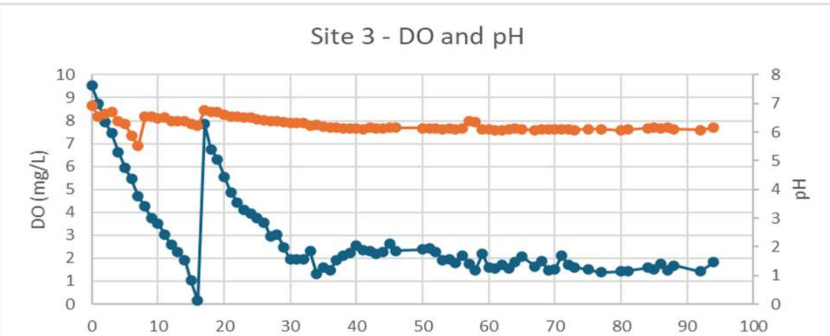
Average BOD_u = 15.15 mg/L



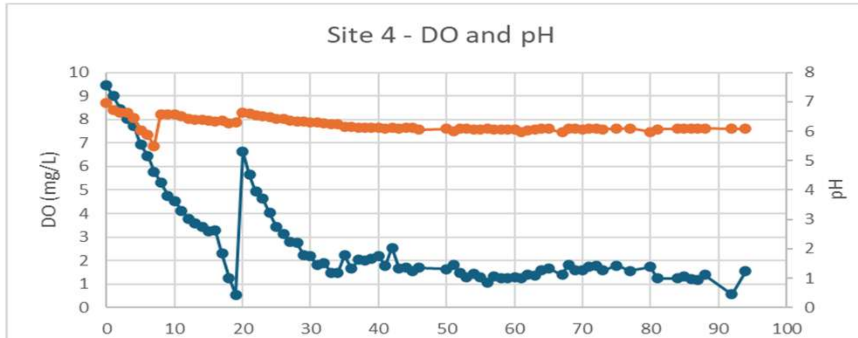
Ultimate BOD = 16.08 mg/L
G1+G2 = 90.04
G3 = 9.96



Ultimate BOD = 26.14 mg/L
G1+G2 = 90.57
G3 = 9.43



Ultimate BOD = 15.4 mg/L
G1+G2 = 91.86
G3 = 8.14



Ultimate BOD = 13.98 mg/L
G1+G2 = 91.41
G3 = 8.59

Repeats in development
Alternative C digestion methods in consideration
Comparing to previous observations with an eye toward seasonal patterns

CURRENT DATA NEEDS AND RECENT COLLECTION

Historical data to leverage:

Reservoir stage time series or ops events
2004-2018 OPS stage info obtained
1996-2007 Holtwood flows obtained
2008-2014 Muddy Run flows and heads obtained

Sediment characteristics
2015 core study data obtained

Water quality profiling events, 1991-2000.
1996 – 1999, 2002, 2007 Temp and DO profiles obtained
1996-2007 Holtwood discharge temps obtained

Water Quality parameter data (parameter list->), 1991-2000
Outreach to counties, states ongoing

Is atmospheric nutrient deposition significant to this system and if so, can we leverage rates applied to upper CB?

Parameter ID	Parameter Description
1	Refractory Particulate Organic Carbon
2	Labile Particulate Organic Carbon
3	Dissolved Organic Carbon
4	Refractory Particulate Organic Phosphorous
5	Labile Particulate Organic Phosphorous
6	Dissolved Organic Phosphorous
7	Total Phosphate
8	Refractory Particulate Organic Nitrogen
9	Labile Particulate Organic Nitrogen
10	Dissolved Organic Nitrogen
11	Ammonia Nitrogen
12	Nitrate Nitrogen
13	Particulate Biogenic Silica
14	Dissolved Available Silica
15	Chemical Oxygen Demand
16	Dissolved Oxygen
17	Cyanobacteria
18	Diatoms
19	Green Algae

CONNECT WITH US

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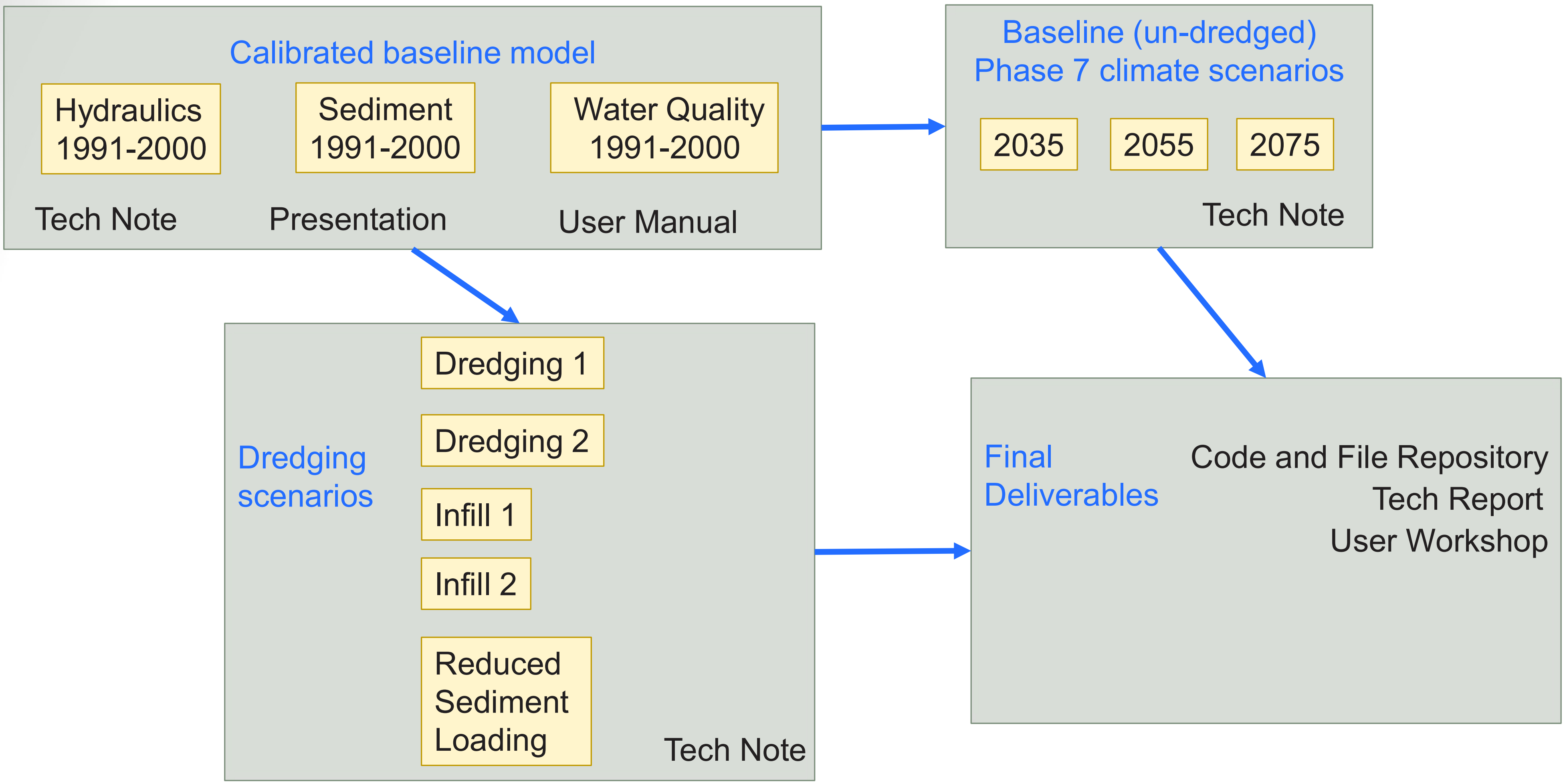
Potential Scenario plan



APPLICATIONS – DREDGING SCENARIOS

- Continuous simulation period (of 1991-2000)

Dredging 1 & 2: Different dredging scenarios in different locations in the CR to determine associated nutrients reduction within the CR and transported to Chesapeake Bay

Infill 1& 2: Different infill scenarios based on availably of bathymetry (e.g., 1995 and 2010 conditions or other years depending on data availability).

Reduced loading: A scenario that simulates watershed BMPs and in-reservoir dredging to reduce sediment loading from CR to Chesapeake Bay.

Technical Review Panel currently assisting in discussion of potential dredging options.

MDE collecting data on dredging constraints (primarily physical)
-Power cable location
-City of Baltimore water intake location and operation
-Proximity limits to dam

APPLICATIONS – EXTREME EVENT SCENARIOS

Scenario selection Q1 FY25

Initial loads:
Based on 1991-2000 hindcast

Critical period:
1993-1995
Big melt 1996

Scenario characteristics:
Two back-to-back extreme storms (probably in excess of 400,000 cfs) during the warm season (April-September) in close succession

Now: Potentially revising timeline plan to use Phase 7 climate inputs

TIMELINES

MODELING TIME DOMAIN

2011 TS Lee

1991

2000

2035, 2055, 2075 un-dredged climate scenarios

Baseline Calibration

2 dredge scenarios

2 infill scenarios

Reduced Loading

Scenario specifics TBD
-simulation duration?
-dredging scale and location?
-TS Lee like event inclusion

CURRENT PROJECT AND REPORTING SCHEDULE

Description	FY25				FY26				FY27			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
DATA ACQUISISTION	X											
DEVELOPMENT OF CRMS												
Hydrodynamics	X	X										
Nutrient Water Quality		X	X	X								
Sediment Transport		X	X	X								
DEVELOPMENT AND SIMULATION OF DREDGING SCENARIOS												
dredging 1				X	X	X	X					
dredging 2				X	X	X	X					
Infill 1				X	X	X	X					
Infill 2				X	X	X	X					
Reduce sediment loading to ChesBay				X	X	X	X					
DEVELOPMENT AND SIMULATION OF EXTREME EVENT SCENARIOS				X	X	X	X					

CBP phase 7

Recent ERDC milestones:

-Installation of EFDC+ on HPC (Sept. 2025)

-1st run CBOD reached 90 days – Quantization begins

Next ERDC milestone:

-Initial parameterization of Water Quality Model Underway

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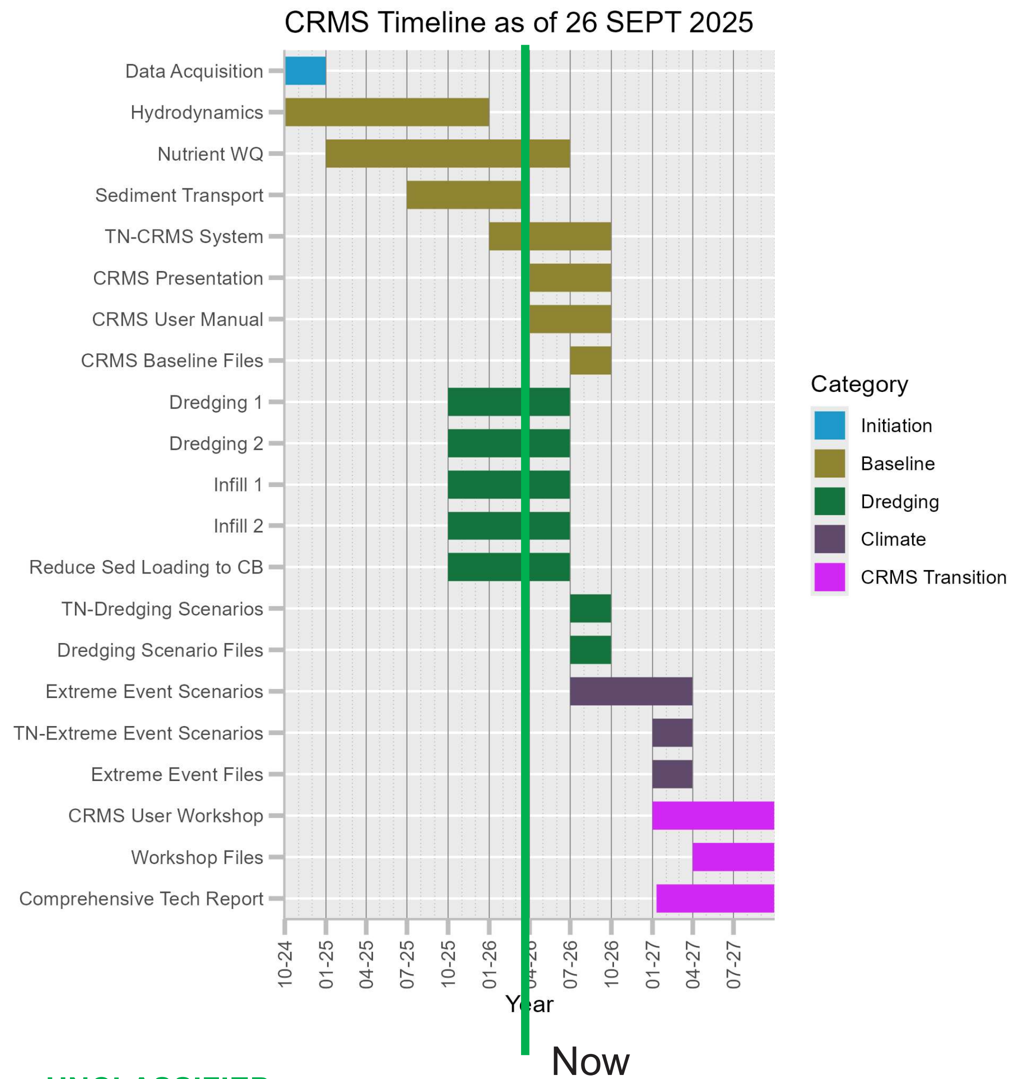
POTENTIAL PHASE 7 EXTENDED PROJECT TIMELINE



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BACKGROUND / SAVE

TEAM AND PARTNERSHIPS

Maryland Department of the Environment

Matt Rowe
Christina Lyerly

Cost Share

US Army Corps of Engineers

Baltimore District (NAB)
Planning Assistance to States Program
Karl Kerr – Program manager
Vanessa C. Campbell – Project manager

Chesapeake Bay Program
Science. Restoration. Partnership.

USEPA Chesapeake Bay Program Office
Lewis Linker - CBP Modeling Coordinator and SAIB Team Leader for Science and Analysis

Data Share

Conowingo Reservoir Model

Dredging scenarios

Extreme event scenarios

Data Share

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

Dr. Jodi L. Ryder – Technical manager
Dr. Earl J. Hayter – Technical lead

OBJECTIVES

1. Develop a non-proprietary, 3D water quality modeling system of Conowingo Reservoir for the purpose stated above. The modeling system should be capable of simulating hydrodynamics, biogeochemical, and sediment transport processes within CR. Modeling package output will be consistent with requirements of the CBP modeling suite.

2. Application of the modeling system to current and future dredging scenarios, specifically the evaluation of sediment and associated nutrient reductions from different dredging scenarios. It must leverage the additional CR sediment characterization work done and lessons learned through Maryland's innovative and beneficial reuse pilot.

3. Application of the modeling system to future hydrologic-climate scenarios. This information will help various Chesapeake Bay partnerships better understand and institutionalize the resiliency and response of CR to extreme weather events, flows, future climate change hydrology, and determine CR scour and sediment resuspension and associated nutrient/contaminant increases within the reservoir and transport downstream.

SITE OVERVIEW

Conowingo Reservoir:
Lowest impoundment on the Susquehanna
94' tall dam (owned by Constellation Corp.)
9,000 acre impoundment

Concern:
Increased risk of intense summer and winter season storms leading to increased risk of sediment and nutrient releases to Chesapeake Bay

Previous Models:
-proprietary
-lack of spatial sediment capability
-not integratable (as is) to CBP models

US Army Corps of Engineers

MODEL REQUIREMENTS

- Continuous simulation of the reservoir pool including selected hydrometeorological events; (1991-2000)
- Change in hydrodynamics from reservoir infill of sediments from the CR watershed, and removal of material through dredging
- Biogeochemistry in the reservoir pool, responding to the amount and speciation of nitrogen, phosphorus, and sediment inputs from upstream and bottom sediment
- Biogeochemical changes in sediments, including burial, species changes, and water column exchanges
- Physical changes in sediment characteristics due to erosion, bed armoring, and deposition of sediment and the resulting morphological changes in the reservoir
- Dredging of the reservoir.

MODELING APPROACH – DATA ACQUISITION

- Bathymetry in the model domain, i.e., the CR.

- Meteorological data time series
  - wind speed and direction
  - atmospheric pressure
  - incident solar radiation
  - air temperature (both wet and dry bulb)
  - precipitation

- Hydrologic data time series for watershed
  - CBP will provide Phase 6 → Phase 7
  - Constellation Energy for dam operations (Muddy Run)

- Water quality in-situ
  - water temperature, DO, SOD, nitrogen, phosphorus, and other

- Sediment characteristics
  - grain size distributions (including percentage of organic matter)
  - historical cores and new collection for performing SEDFLUME erodibility tests

MODELING APPROACH

Modeling approach

Hydrodynamics
Nutrient water quality
Sediment transport
Baseline calibration

Model Selection

Environmental Fluid Dynamics Code+ (EFDC+)
Based on EFDC (originally developed by John Hamrick @ VIMS)

- Refined by DSI, LLC
- Code is Open source
- 3D hydrodynamics that uses a curvilinear (structured) grid
- Fully coupled hydrodynamics, sediments, water quality

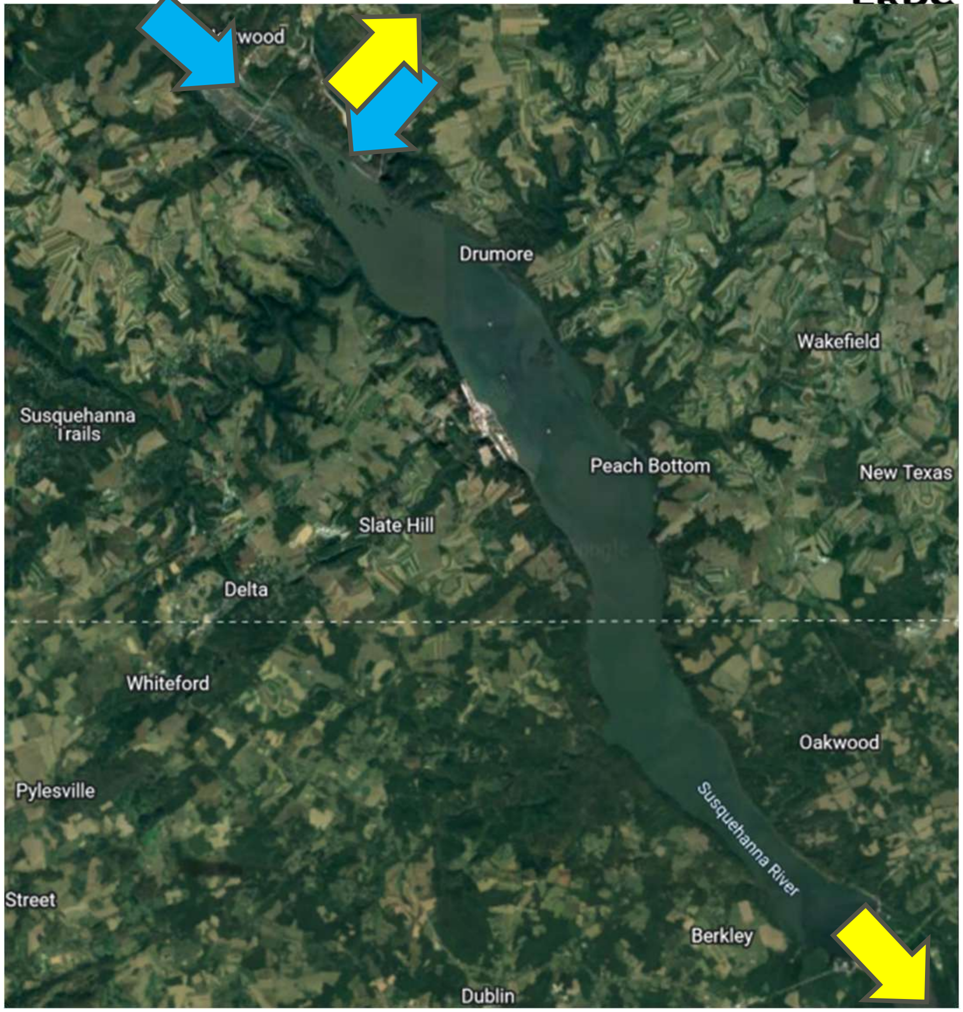
Description	FY25			
	Q1	Q2	Q3	Q4
DEVELOPMENT OF CRMS				
Hydrodynamics	X	X		
Nutrient Water Quality		X	X	X
Sediment Transport		X	X	X

Team trained and consulted on water quality model with DSI in December 2025

MODELING APPROACH - HYDRODYNAMICS

Major Inflows
Holtwood Dam (Upstream)
Muddy Run Power Reservoir
Operational boundary
Watershed Direct runoff
Initiate with Phase 6 HSPF
Upgrade to Phase 7

Major Outflows
Muddy Run Power Reservoir
Conowingo Dam (Downstream)
outlet grid constructed to
mesh with CBP model



EFDC+ 3D MODEL

UNCLASSIFIED

EFDC+ 3D MODEL

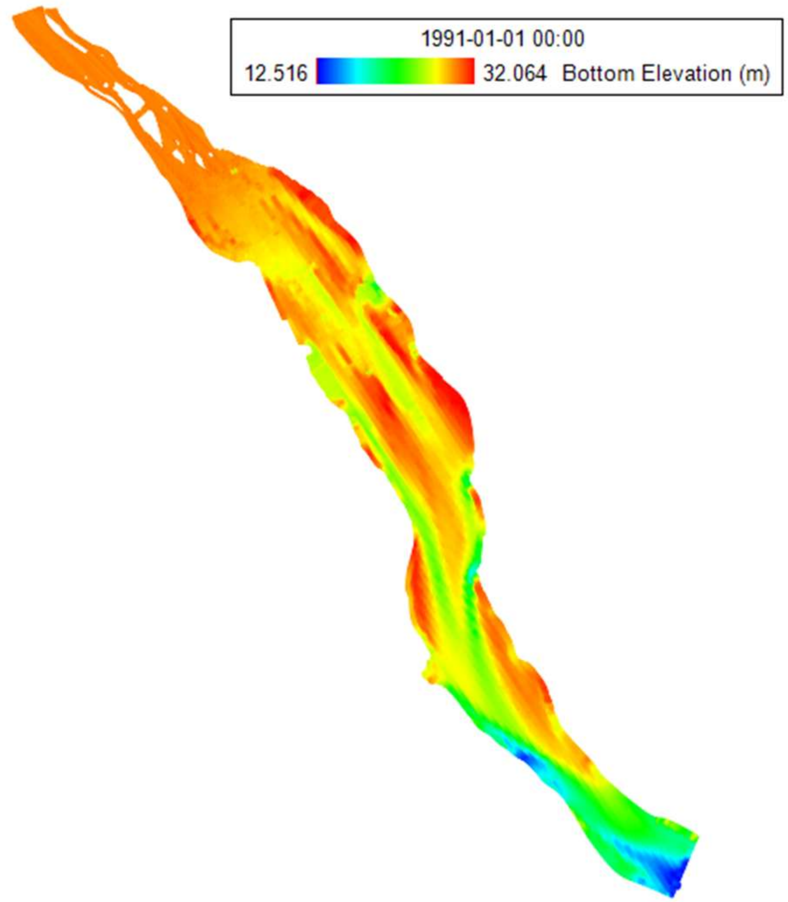
UNCLASSIFIED

COARSE GR

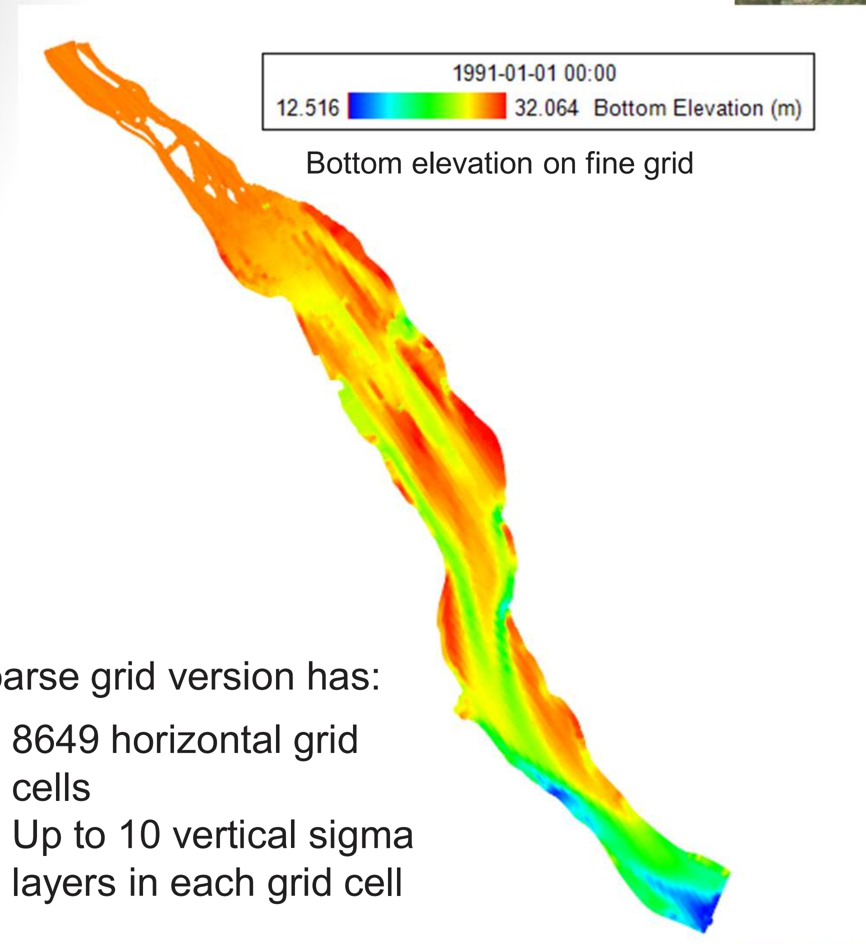
EFDC+ 3D MODEL

Fine grid version of the model has:

- 49,051 horizontal grid cells
- 10 vertical sigma layers in each grid cell



COARSE GRID



Bottom elevation on fine grid

Coarse grid version has:

- 8649 horizontal grid cells
- Up to 10 vertical sigma layers in each grid cell

Final coarse grid

MODELING APPROACH

EFDC+ and Model Runtime Considerations

Initial grid ~ 490,000 cells
Coarse grid ~ 86,490 cells

During WQ and sediment simulations runtimes on a PC could be prohibitive for efficient calibration.

Custom installation of EFDC+ on two DoD High Performance Computing (HPC) systems completed September 2025.

HPC Installation validation completed for Carpenter – HPC at ERDC

- Comparison of the two-month long sediment transport simulation run on a Windows workstation and HPC initially showed significant differences in calculated changes to the sediment bed between the two runs in some grid cells.
- The comparison was performed as part of the QA/QC performed on the HPC installation.
- The differences are believed to be caused by different versions of the Fortran compiler as well as the other libraries utilized by EFDC+.
- Earl updated the EFDC+ code and implementation to achieve successful agreement

MODELING APPROACH – SEDIMENT TRANSPORT

- Model will represent the different bed layer sources as scour occurs during different limbs of the hydrograph

- Will simulate the different classes and composition of sediment as well what's eroded into the water column. **Size classes: 5, 15, 50, 125, 250, 500, and 1100 *μm*. In each grid cell, the sediment bed is dividing into six bed layers.**

- Use field observations to set up the sediment bed model vertical variation of the different components - with spatial variation in the vertical composition in different parts of the reservoir

Data development:

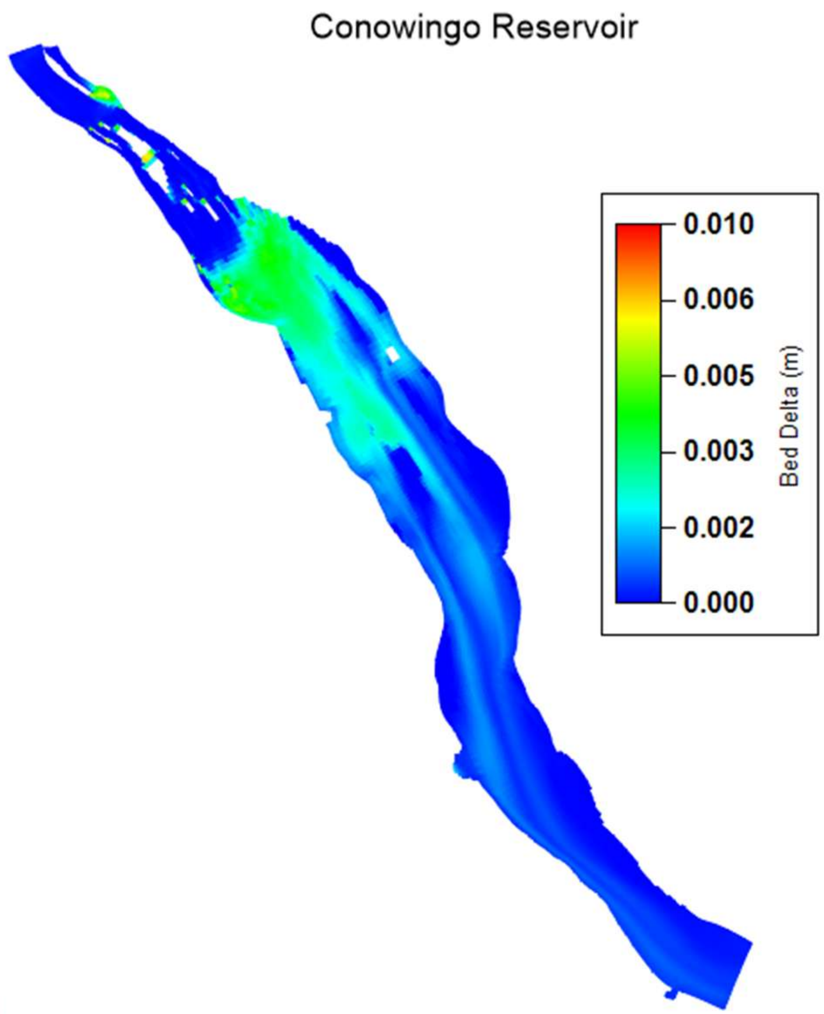
- Historical cores with chemical analysis

- Additional data collection for erosion rates with SEDFLUME
  - Facilitated through MDE
  - 30 sediment grabs
  - 4x5 gal buckets

Model runtime:
1 week for EFDC+
Model emulation may be used for linkage to Bay model

MODELING APPROACH – SEDIMENT TRANSPORT

For testing purposes, a three-month long hydrodynamic and sediment transport simulation was completed using the coarse grid. The hydrodynamic model was spun-up for one month prior to the three-month long hot start model run.



MODELING – NUTRIENT WATER QUALITY

Based on CE-QUAL-ICM kinetics

Unlimited algae and macrophyte groups
- Mostly defined through half-saturation and uptake rates
- Utilizes temperature effects on coefficients
- Currently deciding – 2 or 3 groups

Carbon treatment
- DOC
- Labile G1
- Refractory G2+G3

Processes
- Reaeration
- Benthic mass fluxes\sediment diagenesis
  - DiToro kinetics that can be spatially varying

Boundaries
- Point sources
- Wet/dry deposition

Parameter ID	Parameter Description
1	Refractory Particulate Organic Carbon
2	Labile Particulate Organic Carbon
3	Dissolved Organic Carbon
4	Refractory Particulate Organic Phosphorous
5	Labile Particulate Organic Phosphorous
6	Dissolved Organic Phosphorous
7	Total Phosphate
8	Refractory Particulate Organic Nitrogen
9	Labile Particulate Organic Nitrogen
10	Dissolved Organic Nitrogen
11	Ammonia Nitrogen
12	Nitrate Nitrogen
13	Particulate Biogenic Silica
14	Dissolved Available Silica
15	Chemical Oxygen Demand
16	Dissolved Oxygen
17	Cyanobacteria
18	Diatoms
19	Green Algae

SEDIMENT SAMPLING

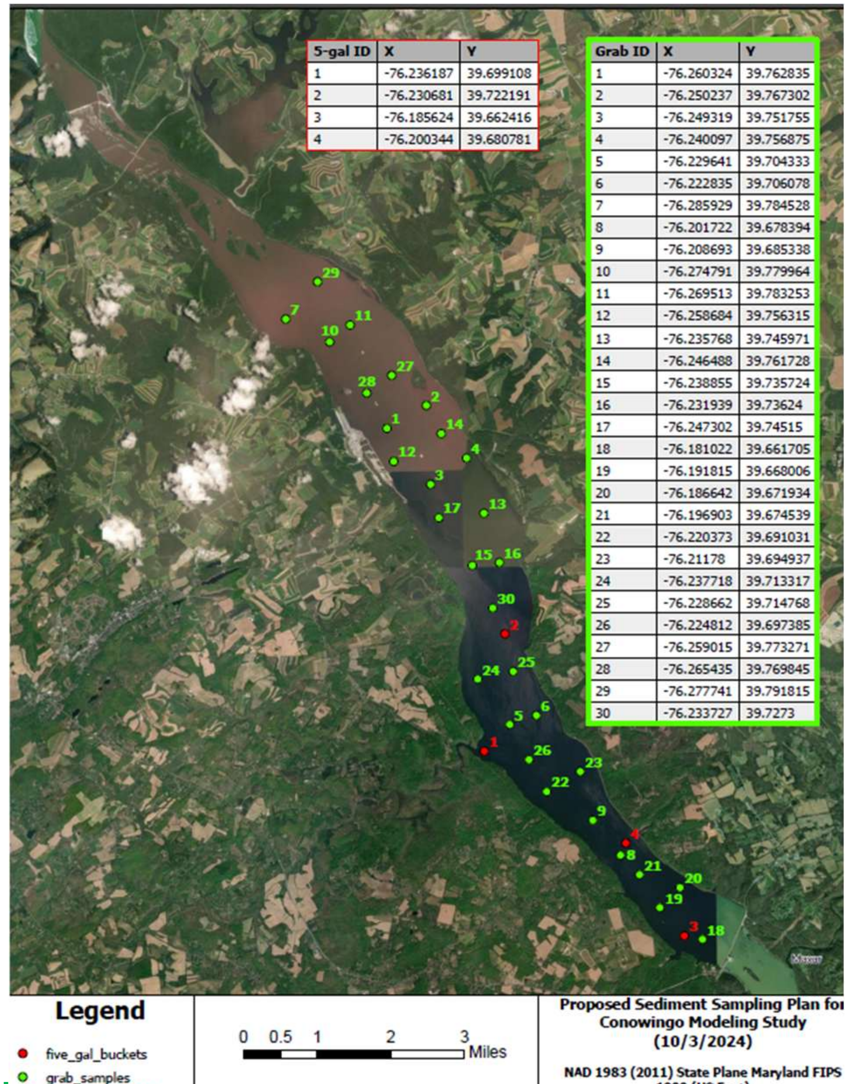
Sampling supported two needs:

SEDFLUME

- Ponar grab samples for grain size distribution (green)
- 4x 5GAL Buckets for SEDFLUME (red)
- Push core/gravity core (red)
- Sampling occurred on 6/27/25

BOD → sediment carbon fractionation

- Surficial Eckman dredge (red)
- Sampling occurred on 6/30/25
- First 90-day digestion completed 10/16/25
- 3 of 4 reached low steady state @ 2 mg/L around day 30.
- Reoxygenation necessary



5-gal ID	X	Y
1	-76.236187	39.699108
2	-76.230681	39.722191
3	-76.185624	39.662416
4	-76.200344	39.680781

Grab ID	X	Y
1	-76.260324	39.762835
2	-76.250237	39.767302
3	-76.249319	39.751755
4	-76.240097	39.756875
5	-76.229641	39.704333
6	-76.222835	39.706078
7	-76.285929	39.784528
8	-76.201722	39.678394
9	-76.208693	39.685338
10	-76.274791	39.779964
11	-76.269513	39.783253
12	-76.258684	39.756315
13	-76.235768	39.745971
14	-76.246488	39.761728
15	-76.238855	39.735724
16	-76.231939	39.73624
17	-76.247302	39.74515
18	-76.181022	39.661705
19	-76.191815	39.668006
20	-76.186642	39.671934
21	-76.196903	39.674539
22	-76.220373	39.691031
23	-76.21178	39.694937
24	-76.237718	39.713317
25	-76.228662	39.714768
26	-76.224812	39.697385
27	-76.259015	39.773271
28	-76.265435	39.769845
29	-76.277741	39.791815
30	-76.233727	39.7273

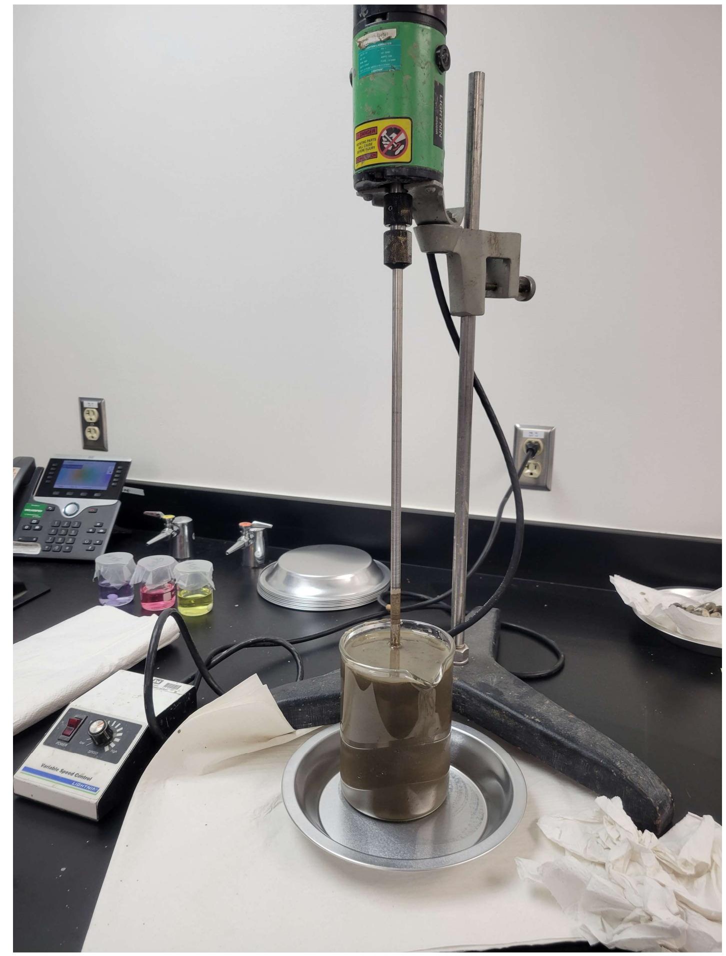
SEDIMENT CARBON ANALYSIS

4 sites, replicate samples
3 dilutions of each with nitrification inhibition
Total carbon measurements at days 0, 5, 90, and potentially longer
Day 90 = October 7

Preliminary model parameterization using fractionization from Palinkas, 2019:
G1: 26%
G2: 20%
G3: 54%

We measured a more active sediment: Average NPOC 201.134 mg/L
G1 + G2: ~90%
G3: 9%

Planning repeat large volume BOD
And exploring alternative chemical digestion for comparison



MODEL LINKAGE WATER QUALITY

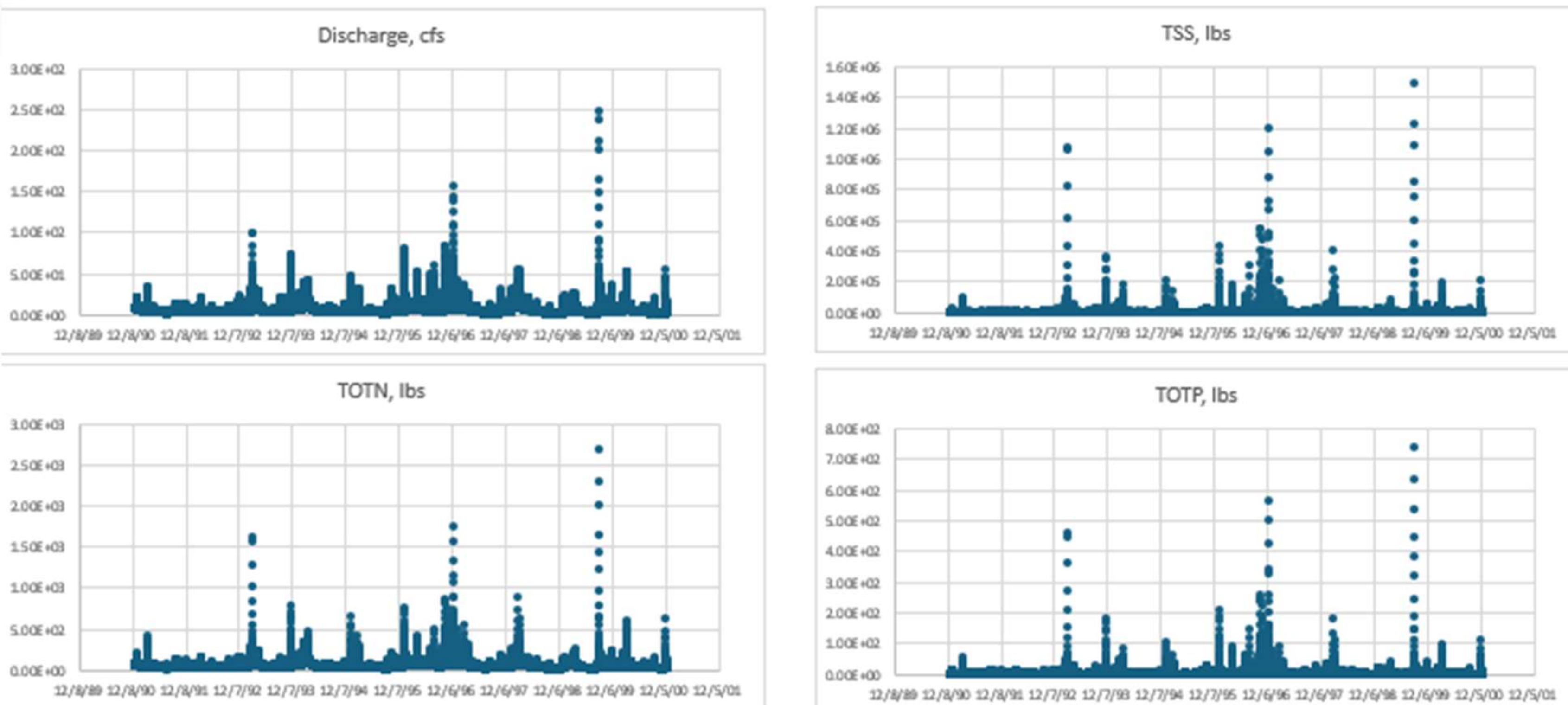
ERDC

Table 1. Linkage of constituents simulated in HSPF to the constituents simulated in EFDC+

	EFDC+ Input	Units	Conversion factor / Equation	HSPF Output1	HSPF Output Description	Units
1	Flow	m3/s	1	HYDR:RO or HYDR:O	Total Outflow or Outflow from a Reach	m3/s
2	Water temperature	Â°C	1	HTRCH:TW	Water Temperature	Â°C
3	Inorganic cohesive solids	mg/l	1	SEDTRN:SSED:2, SEDTRN:SSED:3	Silt Concentration, Clay Concentration	mg/l
4	Inorganic non-cohesive solids		1	SEDTRN:SSED:1	Sand concentration	mg/l
5	Algae concentration for each group	g Carbon /ml	(C/Chl)2 * fraction of the algae group	PLANK:PHYTO	Phytoplankton as Chlorophyll *a*	Âµg/l
6	Refractory Particulate Organic Carbon	mg/l	(CBOD3/(CVBO4/CDW5)+ORC6)*F_R7	OXRX:BOD and PLANK:PKST3:3	CBOD concentration, dead refractory carbon concentration	mg/l
7	Labile Particulate Organic Carbon	mg/l	(CBOD/(CVBO/CDW) + ORC)* F_L8			mg/l
8	Dissolved Organic Carbon	mg/l	(CBOD/(CVBO/CDW) + ORC)* F_D9			mg/l
9	Refractory Particulate Organic Phosphorus	mg/l	(CBOD/(CVBO/CDW) *P/C10 + ORP11)* F_R	OXRX:BOD and PLANK:PKST3:2	CBOD, dead refractory phosphorus	mg/l
10	Labile Particulate Organic Phosphorus	mg/l	(CBOD/(CVBO/CDW) *P/C + ORP)* F_L			mg/l
11	Dissolved Organic Phosphorus	mg/l	(CBOD/(CVBO/CDW)*P/C + ORP)* F_D			mg/l
12	Total Phosphate	mg/l	1	NUTRX:DNUST:4	Orthophosphorus as phosphorus	mg/l
13	Refractory Particulate Organic Nitrogen	mg/l	(CBOD/(CVBO/CDW)*N/C12 + ORN13)* F_R	OXRX:BOD and PLANK:PKST3:1	CBOD, dead refractory nitrogen	mg/l
14	Labile Particulate Organic Nitrogen	mg/l	(CBOD/(CVBO/CDW)*N/C + ORN)* F_L			mg/l
15	Dissolved Organic Nitrogen	mg/l	(CBOD/(CVBO/CDW)*N/C + ORN)* F_D			mg/l
16	Ammonia as Nitrogen	mg/l	1	NUTRX:DNUST:2	Total ammonia as nitrogen	mg/l
17	Nitrate as Nitrogen	mg/l	1	NUTRX:DNUST:1 and NUTRX:DNUST:3	Nitrate as nitrogen, nitrite as nitrogen	mg/l
18	COD	mg/l	n/a	NA		mg/l
19	DO	mg/l	1	OXRX:DOX	Dissolved oxygen	mg/l

From: https://eemodelingsystem.com/efdc-insider-blog/coupling-hspf-water-quality-model-with-efdc

MODEL LINKAGE HSPF DERIVED BOUNDARY LOADS



Scenario plan