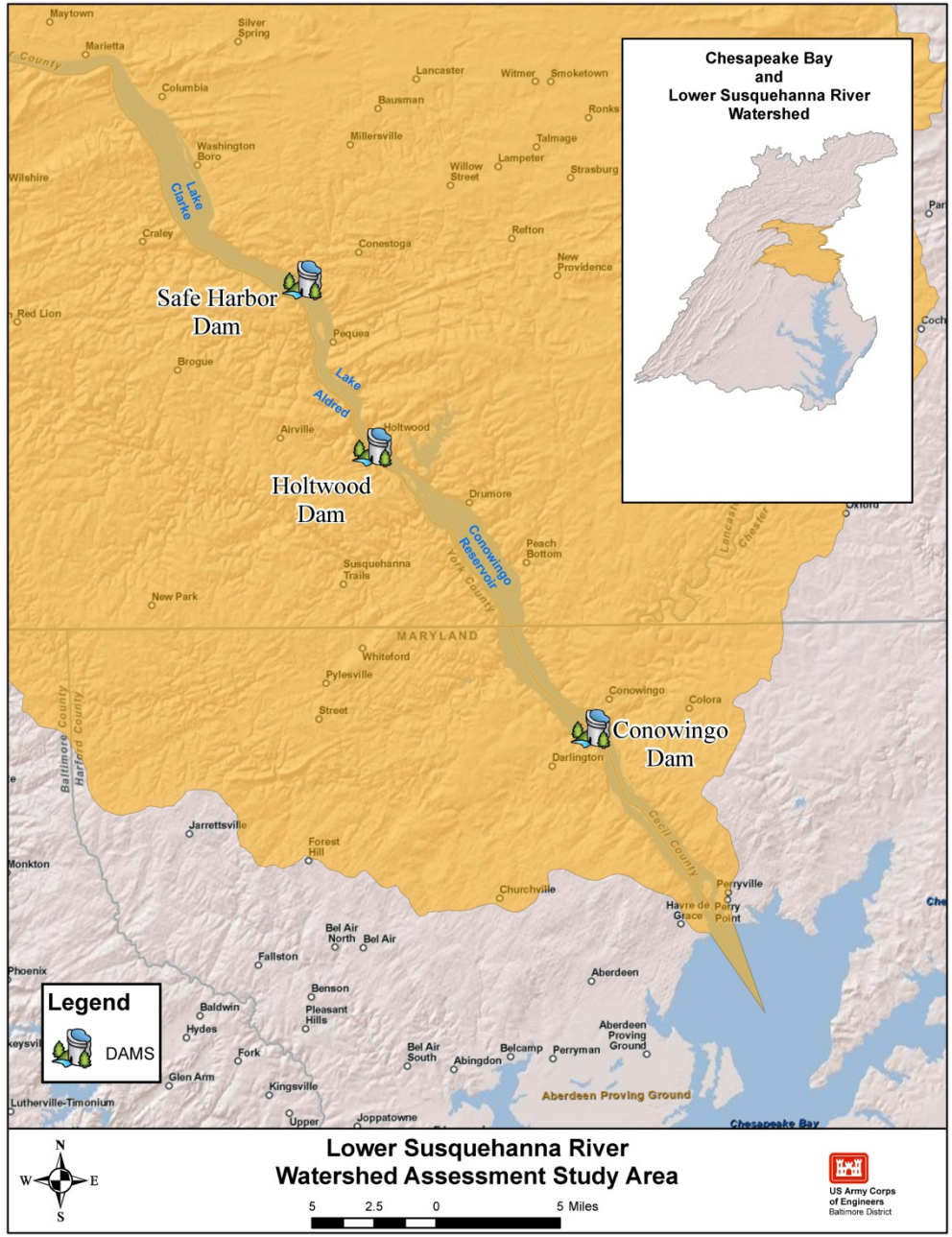
Lower Susquehanna River Watershed Assessment

STAC Quarterly Meeting
December 4, 2012

Bruce Michael
Maryland Department of Natural Resources

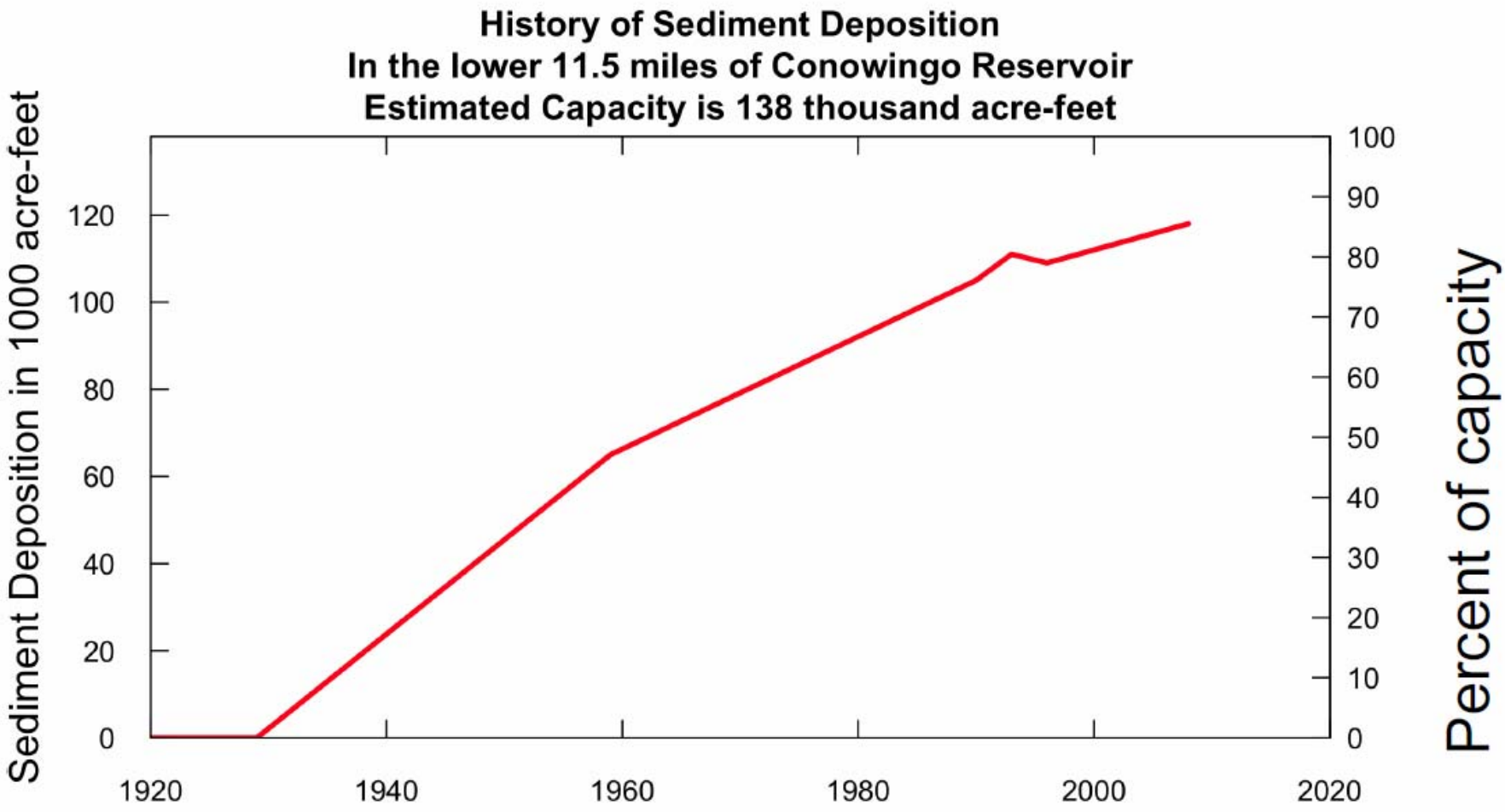


Susquehanna River Dams

- Conowingo Dam
  -- expires 2014
- Muddy Run (Pump/Storage)
  – expires 2014
- Holtwood Dam
  – amended to 2030
- Safe Harbor Dam
  – expires 2030
- York Haven Dam
  – expires 2014

Sediment

- Holtwood and Safe Harbor already at maximum capacity
- 3 million tons/year loading with 2 million tons/year captured
- Sediment Capacity at ≈86%
- 10-15 yrs of storage capacity?
  - Dynamic equilibrium
- Tropical Storm Lee (2011) scoured about 4 million tons of sediment / added 2 yrs
- Hurricane Agnes (1972)



Source: Langland, 2009
http://pubs.usgs.gov/sir/2009/5110/

Assessment Summary

- Watershed assessment (Authorized by Section 729 of Water Resources Development Act of 1986)
- Cost: $1.376 million
- Cost-sharing sponsor = Maryland Department of the Environment with contributions from MD DNR, Susquehanna River Basin Commission and The Nature Conservancy
- Cost sharing = 75% Federal, 25% non-Federal
- Agreement executed September 2011
- Study duration expected to be 3 years (assuming funding comes in timely fashion)

Assessment Partners

- Each agency will be providing funding and/or conducting specific tasks for the assessment.

Goals and Objectives

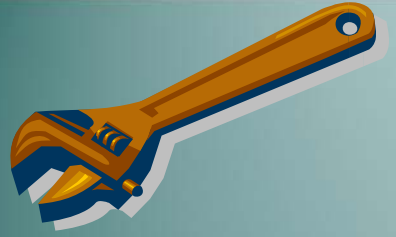
1. Evaluate strategies to manage sediment and associated nutrient delivery to the Chesapeake Bay.
   - Strategies will incorporate input from Maryland, New York, and Pennsylvania Total Maximum Daily Load (TMDL) Watershed Implementation Plans.
   - Strategies will incorporate evaluations of sediment storage capacity at the three hydroelectric dams on the Lower Susquehanna River.
   - Strategies will evaluate types of sediment delivered and associated effects on the Chesapeake Bay.

2. Evaluate strategies to manage sediment and associated nutrients available for transport during high flow storm events to reduce impacts to the Chesapeake Bay.

3. Determine the effects to the Chesapeake Bay due to the loss of sediment and nutrient storage behind the hydroelectric dams on the Lower Susquehanna River.

Assessment Components

- Identification of sediment management strategies (Dredging? Innovative Re-use? By-passing? Alter Reservoir Operations? More BMP's? Other?).
- Use of models to link incoming sediment and associated nutrient projections to in-reservoir processes at the hydroelectric dams.
- Use of models to forecast effects of sediment management strategies to living resources in Chesapeake Bay.
- Integration of the MD and PA Watershed Implementation Plans (WIPs) associated with the Baywide TMDL.
- Concept-level designs and costs.
- Will *not* lead directly to construction.



Modeling Tools

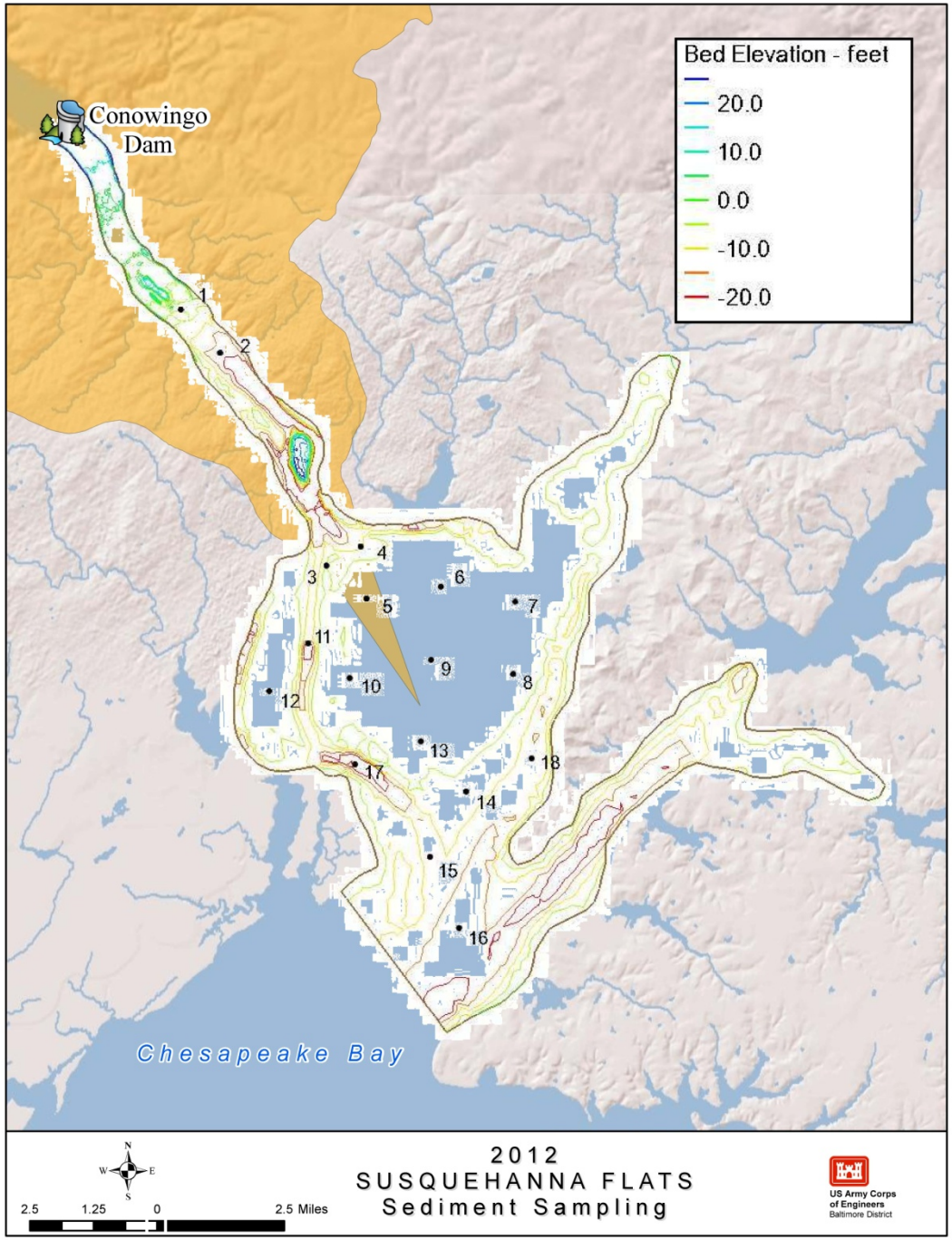
1. CBP Partnership-Watershed Model
   - Sediment and nutrient loads from the watershed at key locations into the reservoirs/Susquehanna River
2. HEC-RAS 1D Model
   - Hydrologic conditions and sediment transport into Conowingo Reservoir (from upper 2 reservoirs)
3. 2D Adaptive Hydraulics Model (ADH)
   - Erosion/deposition within Conowingo reservoir
   - Sediment transport out of Conowingo reservoir
   - Response of reservoir and Susquehanna flats to various scenarios
4. CBP Partnership - Chesapeake Bay Model
   - Impact of sediments and nutrients on light attenuation, submerged aquatic vegetation, chlorophyll, and dissolved oxygen on Bay

Suspended Sediment Sampling

- USGS collected suspended sediments at Conowingo dam during several 2010 and 2011 high flow events (March/October/December 2010) and during March 2011 and Tropical Storm Lee (September 2011).
  - Supplemental to regular monitoring
  - Suspended-sediment chemistry
  - Grain-size analysis
- Data provides
  - C, N, P particle size distribution; will help determine what grain size each is associated with.
  - Measures of Particulate P with Fe and Mn to determine if P is organic or associated with Fe and Mn (i.e. inorganic).
- Data here: http://waterdata.usgs.gov/nwis

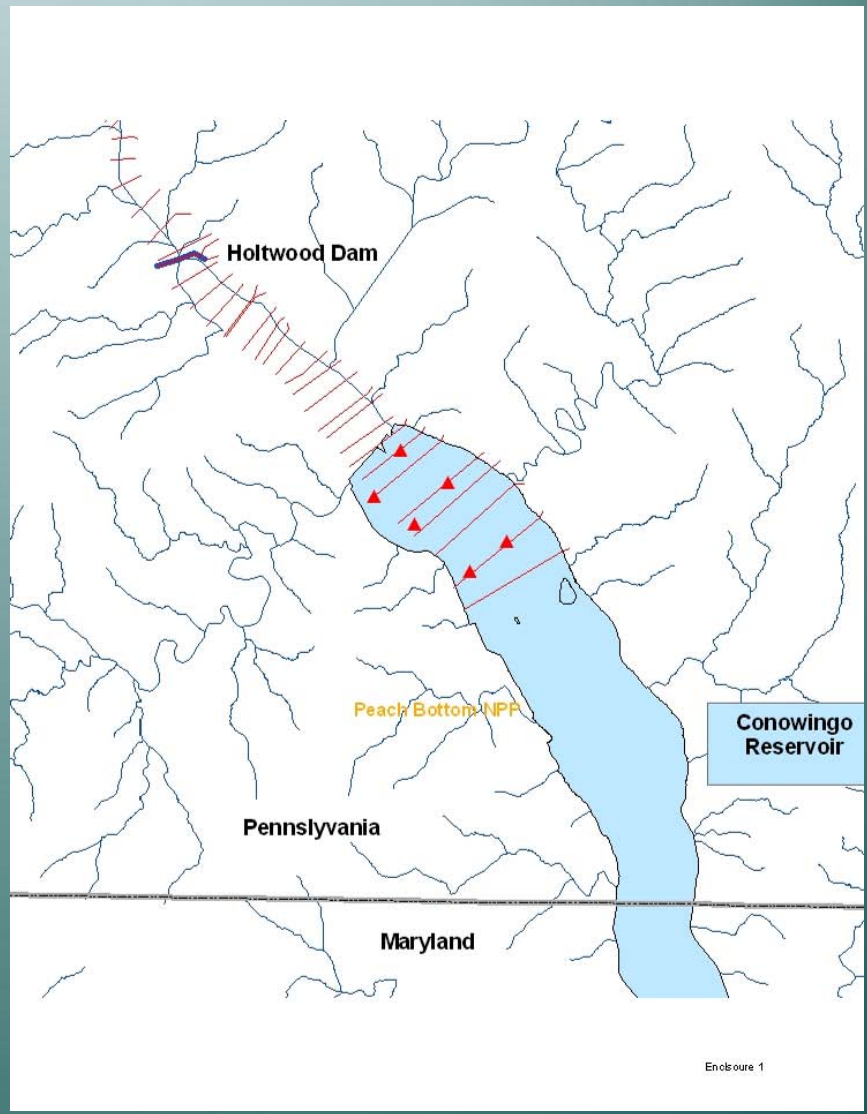
Susquehanna Flats Sediment Sampling

- MD Geological Survey collected surficial grab samples in May 2012
- Grain-size analysis
- Data used to refine 2D ADH model



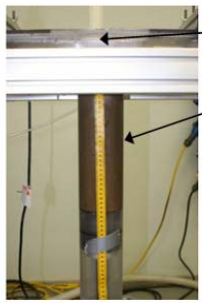
Conowingo Reservoir Sediment Sampling

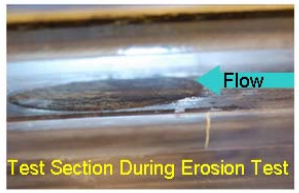
- USGS collected grab surface sample sediment in June 2012
- 96-99% sand in upper reservoir



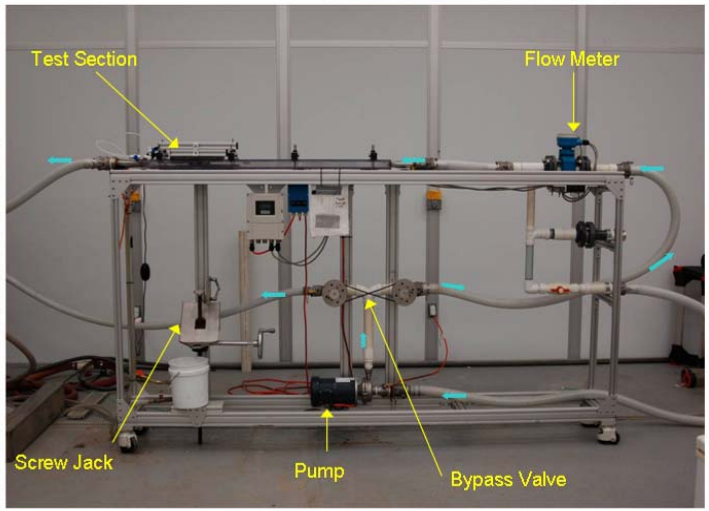
SEDFlume Data and Analysis ERDC-Lead

- 15 sediment cores were collected in Conowingo Reservoir (April 2012) and run through SEDflume.
- Analysis determined erodability and critical shear stress of sediments.





Shear stress t (Pa)	Flow Rate (GPM)
0.1	6.1
0.2	9.1
0.4	13.5
0.6	17.0
0.8	20.1
1.2	25.3
1.6	29.8
2.4	37.4
3.2	44.0
4	49.9
5	56.6
6.4	65.0
8	73.7
10	83.5
12	92.5
13	96.7
14	100.8



A) Gravity Corer

B) Plungers with Bentonite paste

C) Core with plunger inserted.

Figure 3. Sampling devices.

Sediment Management Literature Search

1. Reviewed Sediment Task Force Findings:
   - Primarily recommended watershed strategies.
   - Recommended dredging feasibly study.
   - Ruled out by-passing and modifying dam operations.
2. Database Literature Search
   - Sediment management strategies fell into three categories:
     1) Reduce sediment yield from watershed
     2) Minimizing sediment deposition (routing sediments around or through reservoirs)
     3) Increasing or recovering volume (recover, increase or reallocate storage volume of reservoir).
   - Common Factors Considered:

✓Goals
✓Sediment composition
✓Effectiveness of strategies
✓Costs (capital and maintenance)
✓Optimization
✓Impacts
✓Short and long-term Implementation
✓Benefits
✓Combining strategies

Prospective Modeling Scenarios

1. Base Condition –
   - Water Quality (WQ)/sediment accumulation rate under existing conditions.
2. Watershed Management –
   - WQ/sediment accumulation rate after implementation of TMDL's.
3. What Happens when the Reservoir Fills –
   - Impact on WQ/sediment accumulation rate to the Bay (assume TMDL's are being met).
4. Effect of Scouring during Winter/Spring Runoff –
   - WQ/sediment accumulation rate with scouring of the bottom of a full reservoir (utilize Jan '96 event).

Prospective Modeling Scenarios (cont.)

5. Effect of Scouring from a Tropical Storm –
   - Same as Scenario 4 except event will occur in summer (substitute the Jan '96 event).
6. Reservoir Bypass –
   - Impacts on WQ/sediment accumulation rates with a system bypassing sediment from behind Conowingo to below the dam.
7. Reservoir Strategic Dredging –
   - WQ/sediment accumulation rate impacts from dredging fines in potentially any reservoir.
8. Modify Dam Operations –
   - Effects of altering the flow and/or the way the Conowingo is currently operated.

Activities Completed to Date

- ✓ Sediment Data Collection (sediment cores, suspended sediment water quality, grain size analysis)
- ✓ Bathymetric Surveys
- ✓ Sediment Characterization
- ✓ Outreach Activities (project website, quarterly email updates, ...)
- ✓ Literature Search for Potential Strategies – Watershed and Reservoir-Specific
- ✓ Development of the HEC-RAS Hydraulic Model
- ✓ Development of the 2-D Sediment Transport Model (AdH)
- ✓ Set-Up of the Chesapeake Bay Environmental Modeling Package (Bay impacts of sediment effects)
- ✓ Initial Brainstorming of Available Alternatives
- ✓ Modeling of Existing and projected conditions of No Action (just started)

Schedule of Upcoming Activities

Modeling of Baseline Conditions	Oct-Dec 2012
Modeling of Initial Scenarios	Oct-Dec 2012
Sediment Management Strategy Identification and Site Evaluation	Winter 2012-13
Modeling of Alternative Scenarios	Apr-Jun 2013
Sediment Management Strategy Development	Jul-Sep 2013

Stakeholder Outreach

- ✓ Study Initiation Notice February 2012
- ✓ Agency Coordination Letters February 2012
- ✓ Facebook Page:

http://www.facebook.com/pages/Lower-Susquehanna-River-Watershed-Assessment/359608094092593

- ✓ LSRWA Website: http://bit.ly/LowerSusquehannaRiver
- ✓ Stakeholder Involvement Plan
- ✓ Email updates: to be added email

bmichael@dnr.state.md.us