

**South River Science Team  
January 30, 2007 Web Meeting**

8:30	Welcome, Introductions, roll call	Don Kain
<b>Communications</b>		
8:40	Announcements	All
8:45	Database & GIS Tutorial	Craig Bartlett
<b>Science Discussions and Presentations</b>		
9:30	Ecological Study Update (SR ECO Study Update SRST 10_30_07.pdf)	Todd Morrison
10:00	Bird Study Plans for 2007 (SRST_1.30.07_Cristol_birds-smaller.pdf)	Dan Cristol
10:15	Invista Plant Site Investigations (RFI Update 1-30-07.ppt)	Ron Wesley
10:45	Geomorphology Update (geomorph.pdf)	Jim Pizzuto
11:00	Break	
11:15	Hydroqual – Modeling	Aaron Redmon
11:35	Bat Studies	Dave Evers
<b>12:00 Lunch</b>		
1:00	Amphibian / Reptile Proposal	Bill Hopkins
1:20	Ongoing South River Hg Studies (SRST-013007.pdf)	Dick Jensen / Ralph Turner
1:45	Shifflet Farm GW and Pond Data (Shifflett_Farm_GW_and_Pond_data_2006.pdf)	Mike Jacobi
<b>Related South River Activities</b>		
2:15	Status of DGIF Habitat Modifications & Dam Removal (Fish Habitat Improvement.ppt)	Paul Bugas
2:30	Waynesboro STP Upgrade (no slides)	DEQ Joe Winfield
2:45	Wrap-up, Discussion, Plans for Next Meeting (April - May)	Don Kain / Ralph Stahl / All
<b>3:00</b>	<b>Adjourn</b>	

## Welcome and Introductions. Don Kain

- Meeting was web based/conference call.
- Not everyone was able to follow through web due to computer issues, so some participants (including DEQ) downloaded available presentations.

### Participants listed below:

Don Kain – DEQ	Calvin Jordan – DEQ
Bill Van Wart – DEQ	Ted Turner – DEQ
Robert Brent – DEQ	Graham Simmerman – DEQ
Ralph Turner – RT GeoSciences	Dick Jensen – contractor
Mike Liberati – DuPont	Nancy Grosso – DuPont
Rich Landis – DuPont	Todd Morrison – URS
Jim Pizzuto – U of DE	Brenda Kennell – Invista
Craig Bartlett – DuPont	Erin Mack – DuPont
Bill Berti – DuPont	Jack Eggleston – USGS
J.R. Flanders – URS	John Green – DuPont
Mike Newman – VIMS	Dan Cristol – William & Mary
Tom Benzing – JMU	Aaron Redmond – Hydroqual
Bob Santore – Hydroqual	Ed Garland – Hydroqual
Mike Jacobi – EPA	Alex Barron – DEQ
Bill Jordan – VDH	Allen Gutshall – VDH
Dean Cocking – JMU	Paul Bugas – DGIF
Ron Wesley - URS	

## Database and GIS Tutorial. Craig Bartlett

- New look to website
- Access GIS through website
- Fish tissue data is not available on website
- X scale on graphs not accurate. Pts are evenly spaced.
- Lots of progress, impressive database and GIS

## Ecological Study Update. Todd Morrison

### **Loading Investigations**

- Hydrologic and Hydraulic Analyses Progress Update:
  - HEC-RAS Hydraulic model complete; calibration and review in progress
  - Floodplain mapping in progress
  - Histogram analysis for flows at the Harriston Gage
  - South River hydrologic model complete; review in progress

### **Storm Event Sampling**

- Sampling Update:
  - Target one storm event each season; sample at 8 bridge locations during
    - baseline conditions
    - 3-hr intervals during rising discharge
    - 1, 3, 5, and 7-days during falling discharge
- Three storms:

<b>Date</b>	<b>Peak Flow at Harriston (CFS)</b>	<b>Storm Return Interval (yrs)</b>
28-Jun-06	2,640	0.2
31-Aug-06	3,010	0.31
16-Nov-06	3,690	0.44

#### **Recent Changes to the Baseline Sampling Program**

- In October, the NRDC agreed to removing several analytes from the baseline sampling program. They include:
  - PAHs, OCPs, and Metals (Cd, Cr, Cu, Pb, Se, Zn) in Surface Water
  - PAHs and Metals (Cd, Cr, Cu, Pb, Se, Zn) in Sediment and Crayfish
- The study resulted in 8 months of data for these constituents

#### **Reach Specific Baseline Loading**

- Methodology:
  - Used drainage area based interpolation to calculate discharge (Q) at each South River sampling location in accordance with USGS guidance.
  - Calculated loading by:
    - multiplying average concentration of analyte (n=3) by Q to get a base loading rate
    - subtracting the loading rate at an upstream location from the downstream location (propagated analytical errors) to get a reach specific loading rate
    - Dividing the reach specific loading rate by reach area (to account for difference in reach sizes) to get a reach specific flux

#### **Reach Specific Filtered Total Mercury Flux Spring and Summer Results:**

- Highest fluxes observed between RRM-2.0 and RRM-3.0 in April
- Generally positive fluxes in Spring along the length of the river
- Positive fluxes continue during summer months to RRM-11.8 and trend near zero below RRM-11.8

#### **Reach Specific Filtered Methylmercury Flux Spring and Summer Results:**

- Highest fluxes observed at RRM-8.7 in April and May
- Strong increasing trend between March and April MeHg fluxes at most locations
- Generally positive fluxes during summer months above RRM-11.8 and trend near zero below RRM-11.8

#### **Sediment Mercury Data Total Mercury:**

- Concentrations in sediment relatively constant at stations during six months of collection
- Noticeable increase at RRM-3.0 in July (510 µg Hg/g OC at RRM-3.0 in July); not elevated in August

#### **Sediment Mercury Data Methylmercury:**

- Data indicate spatial variability in MeHg concentrations in interstitial sediment at individual locations
- Strong increasing trend between March and April data
- Highest concentrations at RRM-8.7

#### **Methylmercury Tissue Summary**

- Seasonal decrease in invertebrate MeHg tissue concentrations at most locations for most invertebrates from Spring to Summer
- Corbicula MeHg tissue concentrations remained relatively constant

- Seasonal increase in fish MeHg tissue concentrations at most locations from Spring to Summer

#### **Scheduled Activities for 2007**

- Finish Phase I, Year 1 studies:
- Complete monthly baseline monitoring along the South River and reference areas (last sampling Feb. 2007)
- Complete 4 quarters of storm event sampling (last quarter ends March 2007)
- Data evaluations and Year 1 Report (April)
- Meet with NRDC in beginning of May
- Currently planning for Year 2 studies

#### **Bird Study Plans for 2007. Dan Cristol**

- Hg elevated in almost all species of birds to date
- Young South River tree swallows produce one less chick (that means one less chick surviving from eggs)
- Spatial pattern of Hg availability not consistent
- Songbird diets superficially similar despite differing Hg
- Young bluebirds remain below adult levels

#### **Next step:**

- 2<sup>nd</sup> year of swallow survival rates
- 3<sup>rd</sup> year of swallow reproductive effects
- fine tune sampling of diets focusing on distance from river, size of prey and trophic level of prey item
- sub-lethal biomarkers/immune suppression

#### **Invista Plant Site Investigation. Ron Wesley**

- **Phase I (2003)**
  - Sampled 8 plant outfalls and 10 upstream locations
  - One baseflow and one stormflow event in 2003
  - No significant Hg detected in baseflow or first flush storm samples
  - Hg was detected in flow weighted composites (up to 1.7 µg/l) during storm event
  - Estimated loading rates were low relative to mass observed in the South River.
- **Phase II (2004-2005)**
  - Sampled 8 plant outfalls and 2 other locations, 3 baseflow events and 1 stormflow event
  - Utilized low level Hg detection method (1631) allowing a more accurate assessment of loading
  - Conservative estimate of bioavailable Hg under baseflow conditions was 20-29% of the total observed Hg loading (assumes dissolved fraction is bioavailable)
  - Bioavailable Hg for the storm event was estimated to be 32% for the first flush and 33% for the composite.
  - The highest concentrations of Hg in sewer sediments and water occur upstream of 001D near the Chemical Building and SWMU-1
- **Phase III (2005 – present)**
  - Sampling of 10 outfall locations

- 18 month program supporting TMDL ends Mar 07
- 14 baseflow, 5 storm events sampled to date
- Highest loading is at outfall 011, but water is in diversion to the WWTP
- Highest loading of outfalls discharging to the river is at 001
- **Sewer Strategy Plan submitted in August 2006**
  - Focus is to characterize presence of Hg and determine sources
  - Three Phase Program
    - Phase I: Review existing information, conduct field survey, and prepare GIS database (began in Jan 2007)
    - Phase II: Physical testing and inspection to verify condition of sewer system and identify potential sources of Hg
    - Phase III: Develop strategy for Hg removal and analysis of sewer rehabilitation alternatives
- **Phase III RFI under way – Scheduled completion in June 07**
- **Semiannual Groundwater Monitoring Program - On-going semiannual sampling**
- **Stormwater Monitoring – Phase scheduled completion in Mar 07**
- **Storm Sewer Investigation – Phase I near completion**

## **Geomorphology Update. Jim Pizzuto**

### **Bank Erosion Lidar Mapping**

- Goal- document bank morphology and patterns of bank migration
  - Spatial scale ~ 100m
  - Temporal Scale
    - Annual
    - 1 site ~ monthly
- Survey Protocol
  - Bank surveyed from at least 2 instrument locations at each site
  - 2 permanent bench marks in concrete at each site
    - left level with ground, unobtrusive
  - photo panorama of each site
  - detailed descriptions of eroding bank sediments

### **Historical Aerial Photo Progress Report**

- Scanned large scale 1976 photos
- Rectified 1957, 1974 aerial photo set
- Future work
  - Analyze decadal changes to supplement 1937-2005 analysis completed last year
- Prognosis
  - Difficult to resolve decadal changes, but some useful and interesting results will emerge
  - Changes in channel centerlines near Dooms between 1957 and 1974 are not resolvable
  - All change at RRM 8.8-8.9 occurred between 1974 and 2005
  - Several pictures presented showing centerline changes
  - Picture of Hopeman Pkwy not clear whether is showing two migrations or noise

## **Bend Migration Modeling**

- Goal—understand and predict 1937-2005 patterns of channel migration
- Assumptions:
  - Bend migration driven by “near-bank velocity”
  - Extent of migration also related to a coefficient that describes resistance of the bank to erosion
- Approach
  - Apply analytical hydraulic theory to determine velocity field
  - Determine erosion “coefficients” using 1937-2005 patterns of channel migration
    - Stratify observed erosion by:
      - Vegetation
      - Bank material type
      - Other important variables
  - Modify theory to account for:
    - Variable discharge
    - Influence of tributaries and islands
- Status
  - Programming of theory nearly complete
    - In testing phase
  - Next steps:
    - Apply to actual South River bends where migration has been determined
      - Statistical methods used for model calibration

## **Bank Profile Erosion Modeling**

- Why?
  - Bend model does not determine locations of erosion along the bank profile
    - Need to determine where erosion occurs to predict short term loading of Hg
  - Bend model not suitable for predicting erosion by
    - “small events”
    - any individual events
- Approach
  - Use data of Pizzuto and Mecklenburg (1989) and Mecklenburg (1989)
  - Obtained from 3 year study of the Brandywine creek at Chadds Ford, PA
    - Results of every “flow event” surveyed at 9 locations around the bend
    - Brandywine at Chadds Ford similar in size and floodplain materials to South River
- Surveys Documenting Erosion 11/20/87-12/3/87
  - High flow date: 11/30/87
  - Water surface elevation: 2.8 m (bankfull)
  - High flow duration: 39 hours
  - Since last high flow:
    - 19 days
    - 14 freeze-thaw events
  - Total erosion: 0.107 square meters

- Approach
  - Create empirical model that includes the effects of:
    - Water level
    - Flow velocity “near the bank”
      - Implicitly includes protection of the bank by vegetation, since the sites have varying vegetation characteristics
    - Freeze-thaw
    - Time between surveys
    - Bank geometry (overhangs)
  - 3 variables needed to quantify erosion by water
    1. erosion normal to bank
    2. vertical extent of erosion
    3. elevation of erosion centroid
- An example of predicted vs measured variables- “noisy” but statistically significant
- Predict overhang failure by geometry
- Empirical stability field for overhangs
  - 80% of blocks correctly classified
- Predicted bank profiles for 19 erosion events, 4/16/86-3/5/88
  - Evaluation: algorithm overpredicts extent of erosion at this site

## Hydroqual – Modeling. Aaron Redman

- **Data and Loading Analyses**
  - Suggested trends at baseflow:
    - Hg
      - Filtered is 10% of unfiltered
      - Net positive load between RRM 0-10, net negative load downstream
    - meHg
      - Filtered meHg is 50% of unfiltered meHg
      - Net positive load throughout River, peak between RRM 0-10
  - Suggested trends at high flow:
    - Loads
      - Large net positive load that peaks at RRM 10-15 that migrates toward RRM 5 as the flow (and subsequent loadings) decrease with time after the flood
    - Hg
      - Filtered ranges from 0.1% of unfiltered at highest flows (related to high TSS) and approaches baseflow profiles as stream approaches normal flows
    - meHg
      - Filtered ranges from 5% of unfiltered at highest flows and approaches baseflow profiles as stream approaches normal flows
- **Initial Conclusions**
  - Flood: Initial dilution of Hg and meHg on suspended particles by cleaner upstream solids
  - Possible downstream source that participates only during high flow events (peak between RRM 10-15)

- At baseflow apparent peak Hg and meHg input between RRM 0-5
- Apparent peak loads at high flow between RRM 10-15
- **Other ongoing work**
  - Speciation calculations
  - Review Mason's report on Hg release due to resuspension of sediment and soil material
  - Evaluate other baseflow (Aug, Sept) and high flow (Sept, Nov) events with same approach
  - Analyze fish and prey Hg concentrations including preliminary bioaccumulation calculations

## **Bat Studies. Dave Evers**

- **Objectives for South River**
  - Primary emphasis
    - Use Sonobat technology for on-site determination of potential bat species on the South River. Emphasis is to locate federally listed Indiana Bats
    - Emphasize further bat capture for blood/fur sampling
    - For any riverine areas with Indiana Bats
    - From reference areas and near- and far- downstream areas
  - Secondary Emphasis
    - Determine potential behavioral effects from Hg using on-site flight chambers
    - Use comet assay to determine DNA damage
    - Use bioassays to determine baseline and pilot data
    - Use stable isotope analysis of foodweb baselines, prey, and bats to determine dietary emphasis, trophic level, and percent use of aquatic-based prey items
- Fur and blood Hg levels were significantly correlated ( $r^2=0.82$ ,  $p<0.001$ ,  $n=28$ ). Blood and fur represent multiple species from the N. Fork of the Holston River.
- **Discussion**
  - Researchers in Japan examined various species of Chiroptera from areas sprayed with mercury fungicides.
  - They measured total fur Hg in 1965 and 1966 and, found 33.0 ppm (+/-6.3) and 33.7 ppm (+/-4.2), respectively.
  - The fur Hg concentrations found in Chiroptera from the contaminated area of North Fork of the Holston River (mean Hg 49.9 +/- 10.3ppm) and the South River (mean Hg 144.8 ppm) exceeded these values from Japan.
  - In Arkansas, researchers examined various Chiroptera species from rivers in Arkansas that were under fish consumption advisories.
  - They found Hg concentrations ranging from 1 to 30 ppm in fur.
  - They concluded that Hg accumulation had exceeded the hazard criteria set by USFWS and that Hg accumulation in the bats is a serious problem that warranted further investigation.
  - In eastern Ontario and Quebec, researchers found
  - 1997 pooled samples from 5 sites had Hg concentrations ranging from 2.0 to 7.6 ppm in fur.



- 1998 samples from the same sites with fur Hg concentrations that approached 10 ppm.

## **Amphibian / Reptile Proposal. Bill Hopkins**

### **Reptiles**

- 4 species of turtle examined: snapper, stinkpot, painted, red-bellied
- carnivores had higher Hg content, especially stinkpots (may use stinkpots instead of snappers in future)
- Hg levels peak about 10 river miles

### **Amphibian**

- Herpetofauna have different role than birds and mammals
  - Endotherms are important in relation to the energy they consume
  - Herps are important in terms of biomass they produce and make available to other trophic levels
- Hg concentrations in amphibians warrant further studies on reproductive success
  - Salamander whole body concentrations up to 9.3 ppm dry mass
  - Frog and salamander egg concentrations up to 1.7 ppm dry mass

### **Hypotheses**

1. Amphibians accumulate high concentrations of Hg in their tissues, making them important to the fate and transport of Hg within the South River foodweb.
2. Accumulation of Hg in amphibians follows the same spatial pattern observed in other biota along the South River.
3. Tail tissue is a useful nondestructive index of Hg exposure for amphibians that exhibit tail autonomy.

### **Plan**

1. Will document distribution of species
2. Hg concentrations in species/lifestages
3. Strategically archive specimens for Mike Newman

### **Timeline**

Jan: Preliminary Assessment (wetlands full but no breeding activity yet)

Feb-May: Intensive surveys

Jun-Jul: Hg analysis in South Carolina

Fall 07: Data analysis and writing

Oct 07: Present findings at SRST

Dec 07: Final report to Dupont

## **Mercury Source Tracing and Mechanistic Studies Update. Dick Jensen / Ralph Turner**

### **Synopsis from October**

- Getting closer to answering the question “How is Hg getting into the South River in Bioavailable form?”
  - Very likely not from point source(s)
  - Likely related to presence of Hg in floodplain/bank/bed solids in form(s) that can be released continuously into surface water
  - Role of shallow alluvial groundwater still being quantified

### **Activity Since October**

- Storm (large) sampled in river near plant site (results not presented here)

- Additional hyporheic water sampling at BP
- Analysis/interpretation of additional “diffusion bucket” data.
- Additional results for soil leaching study.
- Planning and equipment acquisition.

#### **New”Near Bank Results Sep/Oct 06**

- Sediments perhaps more “localized” than previously expected? Flux buckets now confirm.
- Near-bank sediments sometimes appear to release Hg at rates comparable to apparent “whole” river releases.
- But in many cases, release rates are much lower than river average.
- This might point to the other substrates as important contributors: sand, gravel, cobble, etc.

#### **Soil/Sediment Leaching Studies -Continuing**

Objective: Determine whether Hg release from bank soils and near-bank sediments follows a “simple” desorption equilibrium.

#### **Experimental Approach**

- Collect representative soil and sediments from study area at Basic Park.
- Perform four (4) successive extractions of each sample with DI\* water at solution/solid=10 (40 mL/4g)
- Analyze extracts for filtered (0.4 micron) mercury.
- Compare leaching patterns.
- River water for ongoing work!

#### **May 2006 Leaching Caveats**

- D.I. Water may be unrealistic extraction fluid. Should compare actual river water.
  - All that passes a 0.4 µ filter is not truly bioavailable particulate-attached, colloids
  - DOC bound
- Does extraction routine produce an unrealistic amount of DOC or colloidal particles? What is nature of “Particle Effect”

#### **D.I. vs. River Water for soil extractions**

DI= 2500 ng/l

South River at SR01=936 ng/l

**While much lower, 936 ng/L still represents a strong driving force for mass transfer of Hg.**

#### **Two Main Purposes for Centrifuge**

- Ultrafiltration of water samples to remove colloidal particles and give a better measure of “dissolved” -better measure of “bioavailable”
- Rapid removal of pore water samples from fine sediments. Another way to measure “driving force” for mass transfer of Hg to water column.

#### **Path Forward-Leaching Study**

- Verify high aqueous [Hg] associated with the sediments by spinning porewaters from shallow sediments by centrifuge.
- Repeat selected extractions with filtered river water (high/low spec cond) from SR-01 (Lyndhurst)
- Characterize the physical/chemical nature of Hg in these kinds of leachates (e.g., volatility, molecular weight, reactivity)
- Use centrifuges in SRST office and Seattle to begin characterizing truer “dissolved” samples

## Shifflet Farm GW and Pond Data. Mike Jacobi

### Shifflett Farm Sampling October 16 – 19, 2006

- Direct Push sampling at 18 locations
  - Soil sampling (Hg – surface and 4 subsurface; grain size upper 2.5 feet at 4 locations)
  - 16 temporary groundwater wells
  - 2 permanent wells
  - Groundwater sampling (filtered and unfiltered Hg, Methyl Hg, TSS, TOC, VOCs in 9 wells)
  - Groundwater elevation all locations, transducers installed at 3 permanent wells
- Surface water sampling at 4 locations
  - 3 cow ponds
  - 1 surface water runoff channel
  - filtered and unfiltered Hg, Methyl Hg, TSS, TOC, VOCs (ponds only) EPA, USACE, ICOR
  - Total Hg in soil – EPA SW-846 Method 7471A
  - Soil grain size analysis – ASTM Method 422-63
  - VOCs in GW – EPA SW-846 Method 8260B
- VADEQ
  - Filtered & Unfiltered Hg in GW & SW
  - TSS, TOC
- USGS
  - Methyl Hg in GW & SW

### Results

- Soil
  - Total Hg: < 0.034 mg/kg to 136 mg/kg
- Groundwater
  - Unfiltered Hg: <1.5 ng/l to 778 ng/l
  - Filtered Hg: < 1.5 ng/l to 25.8 ng/l (detected in 5 wells)
  - Filtered Methyl Hg: < 0.04 ng/l to 0.23 ng/l (detected in 5 wells)
  - TOC: < 2.0 mg/l to 3.4 mg/l
  - TSS: 2.0 mg/l to 274 mg/l
- Surface Water
  - Unfiltered Hg: 37.1 ng/l to 281 ng/l
  - Filtered Hg: < 1.5 ng/l to 56 ng/l
  - Filtered Methyl Hg: 1.5 ng/l to 3.52 ng/l
  - TOC: 2.9 mg/l to 10.8 mg/l
  - TSS: 2.0 mg/l to 11 mg/l

## Status of DGIF Habitat Modifications & Dam Removal. Paul Bugas

### Habitat Improvement

- SRST's interest in this project might be to measure Hg in the water column pre and post disturbance
- DGIF and Trout Unlimited plan to construct three rock structures in South River between Main Street and the railroad trestle for fish habitat

- Heavy equipment would be used to install a J-hook, 3 rock cross veins, and a rock W-weir, causing significant disturbance to the substrate
- Work to begin at undisclosed time in summer 07

### **Dam Removal**

- The dam that is being considered for removal is the Rife Loth Dam
- Historically, this dam was a liability to the owners, who wanted it out
- Currently, there is a new landowner's association who are reviewing their options
- The dam is a fish barrier and it creates higher water temps with a one-mile power pool
- Some riparian landowners are not in favor of removal
- Status: on hold for now

### **Waynesboro STP Upgrade. DEQ Joe Winfield**

In 2006, Waynesboro asked for a modification to their permit that would include effluent limitations and monitoring requirements for a proposed expansion and upgrade to a 6 MGD facility. The permit was modified on October 6, 2006 to add effluent limitations, monitoring requirements, and special conditions for an **expanded facility discharging at a new location, approximately 2000 feet downstream of the current outfall.**

The TP and TN limits in the reissued permit were replaced by limits based on the Water Quality Management Plan Regulation and a schedule of compliance to meet the limits was included in the modified permit. The upgraded treatment plant will require an advanced biological treatment process to meet annual average concentration limits of 3.0 mg/L for TN and 0.3 mg/L for TP. Compliance with the Water Quality Management Plan Regulation will be assessed under the Nutrient Trading General Permit as required by a special condition to the modified permit.

### **Discussions**

Augusta County Comprehensive plan was bought up. The South River area is slated for increased growth. Concern was bought up about flood plain contamination and effects increased development will have on Hg levels in river.

Riverfest Week is the week of the April 24<sup>th</sup>  
 Roundtable on the 24<sup>th</sup>  
 Riverfest 28<sup>th</sup>

**Next SRST meeting April 17th**