

South River Science Team Expert Panel Meeting

October 12-13, 2011

October 12

Welcome, Introductions: *Don Kain, DEQ*

Session I: What we know so far.....

Current Status of the Former DuPont Plant Site: *Ron Wesley, URS*

- Interim Measures
 - Stream trap removed, connection to sewer sealed
 - Roof drains redirected to sewer along Middle Ave
 - Solids pits vacuumed, sealed and abandoned
 - Pumphouse sewer cleaned in conjunction with Phase III Sewer Investigation
- Sewer Investigation
 - Water concentrations up to 286 ug/l; sediment up to 156 mg/kg
 - Pumphouse sewer and 011 sumps impacted by Hg
 - Free Hg observed in debris jettted out of PHS and Chemical Sewer along Railroad Ave
 - Jettted out approx. 27cubic yards of sediment and debris
 - Post cleaning monitoring shows improvement in Chemical Sewer, temporary increase in PHS which has decreased
- Conclusions
 - IM and Sewer work represent first major remediation effort at the plant
 - IM successful in eliminating specific sources of Hg from impacting sewer
 - Sewer cleaning removed significant hg mass from system
 - No significant sediment sources of Hg were found in upstream reaches of 003, 010 and 011 basins
 - PHS and Chemical Sewer most impacted
 - Sections of PHS show cracking and deformation
 - Numerous unused connections to PHS
- Future Activities
 - Recommendations from Sewer Investigation to be incorporated in overall site corrective action program
 - Corrective Measures Study (CMS)
 - NE Area well drilling
 - Continue routine groundwater and outfall monitoring

Update on South River Geomorphology: *Jim Pizzuto, UD*

- Predictions
 - Model created to predict bank Hg inventory
 - 2/3 of variance "explained" by calibrated model
 - To predict Hg loadings from bank erosion, combine Hg inventory predictions with bank erosion rate estimates
 - Bank loadings separated to 3 categories; high, medium, low

- High (19 banks) account for 2/3 of total loading
 - Loading from high banks localized RRM 2.5-5, 7-7.6, 8.5-10
 - Medium (63 banks) account for 1/3 of total loading
 - Constant spatial loading rate for medium loading banks (0.4 kg/yr/mi)
 - Low loading banks contribute little total loading
 - 99% of loading accomplished by ~76 banks with Cumulative length of ~8.3 miles
 - 75% of loading accomplished by ~24 banks with cumulative length of ~4.2 miles
- Residence time of hyporheic zone particles from radiometric dating (new interpretations/results)
 - A mixture of “young” and “old” sediment from:
 - Contamination during coring?
 - Deposition at depth of small amounts of new sediment during recent events?
 - No way to know which is correct
 - Mean age= ~32 years; Residence time (assuming no net erosion or deposition) = ~36 years
- Measurements of bed scour using scour chains and repeat surveys
 - 4 events capable of transporting bed material
 - The overwhelming majority of measurements indicates no scour or fill
 - Several decades are likely needed to scour the entire streambed!
- Ongoing influence of past events on Mid-Atlantic Streams
 - Pleistocene periglacial processes deliver a load of untransportable boulders to stream valleys? A new, but compelling hypothesis.
 - Catastrophic debris flows destroy alluvial valleys in Virginia every few hundred years.
 - European settlement increased sediment yield from deforestation and agriculture and there was sediment trapping by mill dams.
 - 20th century: flood control, urbanization, reforestation
 - Hg release by plant at Waynesboro, into South River, 1929-1950
- History of Hg concentration on particles in the South River (see slide for diagram)
- Why does Hg persist in the South River decades after the initial release?
 - Particles with adsorbed Hg are stored rather than transported downstream
 - Stored sediment is released by episodic particle erosion (and geochemical processes?)
- Centennial floodplain accumulation rates determined from Hg inventories (see slide for diagram)
- Conceptual models of near-channel Hg and sediment accumulation, 1930-present (see slides for hand drawn diagrams)
- Mill dams
 - 14 in place from Waynesboro-Port republic in 1930. All breached at present. These likely enhanced Hg and sediment storage over a short reach upstream of each dam. After breaching, some of the stored sediment and Hg has been removed. Little data or analysis documents these processes.
- Hg is released to the South River through bank erosion
- Implications

- Particles transported into a reach in suspension by the South River are completely replaced by new particles from storage after an average distance of 28 +/- 13 km.
- Once in storage, the average particle remains in storage for 4800 +/- 2800 years.
- This gives a spatial and temporal average downstream transport velocity for suspended particles of 6 +/- 4 m/yr.

Ecostudy Findings and Status: *Ceil Mancini, J.R. Flanders, Josh Collins, URS*

- Surface Water Monitoring
 - Coordinated sampling with DEQ
 - Sample quarterly at 7 bridge stations
 - TOC, DOC, TSS, cations, anions, nitrogen, phosphorus, FTHg, FMeHg, THg, MeHg
 - See slides for graphs
- Fish Tissue Monitoring
 - Sampled broad reaches around previous sampling locations: RRM 0.1, 3.5, 11.8, 23.5
 - Each fish tagged with unique ID
 - 3 size classes: 130-174 mm, 175-250 mm, >250 mm
 - Increasing Hg concentrations downstream
 - 33 total recaps
 - 3 fish moved between sites, all upstream
 - 5 fish have been recaptured multiple times
 - THg increase with length and days at large
- Benthic Colonization Study
 - Spring/Summer 2011, six week exposure
 - RRM 0.1, 3.5, 11.8, 23.5, SR-01 and MR-01 (23.5 lost high flow event)
 - 6 trays collected per site at weeks 2, 4 and 6
- Co-located resident benthic communities, interstitial sediment (Hg), and colonization tray grain size analysis at week 6
 - See slides for pictures of change of embeddedness over time and graphs
 - Taxonomic results anticipated in October 2011
- Next Steps
 - Surface water monitoring in October and November
 - Data evaluations
 - Final Ecological Study Report

Nutrient/Hg Monitoring Study: *Robert Brent, JMU*

- Waynesboro WWTP was upgraded in 2010
- 65% reduction in Nitrogen and 88% reduction in Phosphorus predicted
- 4 sites chosen to bracket outfall
- Algae colonization trays used
- Unable to separate fall algae samples
- Phosphorus levels dropped 95% in discharge, nitrate dropped 99%.
- Phosphorus levels dropped 85-88% at downstream sites, nitrate 39-53%.
- Periphyton growth rates did not change
- Methylmercury in algae was generally higher in 1-yr post upgrade monitoring than in pre-upgrade monitoring

- This includes site 1, upstream from STP, which saw a 280% increase in methylmercury.
 - There has been an increase in Hg in Invista discharge.

The Conceptual Model: *Jim Dyer, DuPont*

- Path Forward
 - Ongoing activity in support of remedial options team
 - CSM will be updated/expanded when new information is available and our understanding of what is going on evolves
 - Updated bank erosion model, SAV study, latest substrate mapping study, Invista site cleanup, other reaches and storm conditions
 - Document findings in evergreen CSM report

Session II: The People Side-Risks and Communications

Update from Exposure Task Team: *Annette Guiseppi-Elie, DuPont*

- Working on factsheet for waterfowl consumption
- Will hopefully have risk assessment finished for waterfowl consumption soon. There is also data for snapping turtles to be looked at.
- Deer tissue collections continue. Collection permit runs out end of year.

Angler Survey 2011: *Paul Bugas, DGIF*

- A stratified "roving" angler survey was conducted on South River from Waynesboro to Port Republic.
- 5 reaches were sampled with average length of 4.9 miles
- Results
 - 90% anglers were Caucasian, 87% were male
 - Most were fishing from bank or wading
 - Most were generalists, with the rest either fishing for bass or trout
 - 89% were spin fishing and most were using artificial bait
 - 84% were catch and release anglers
 - Most fish South River because it is close to home
 - Pollution is the main dislike of the river.
 - 87% know about the advisory and know about it mainly from signs or word of mouth
 - 73% answered the advisory question correctly
 - 73% said they release fish from river and 80% said they do not eat fish from the river
 - 47% said they visit the river >20 times a year
 - June is the most visited month between May-Sept
 - Trout harvest rate is 52%, bass is 2 %
 - About \$17,000 spent on fishing South River in 2011
 - 83% of money spent on trip spent within 20 miles of river.

Promotores Outreach Project: *Joanna Jensen, JMU*

- Lay Health Advisors deliver scientifically accurate information in a culturally appropriate way to a population that is difficult to reach and high risk
- They get 40 hours of training on common health topics and 1 full day of Hg education
- 18 graduated from Luray and Harrisonburg
 - Represented 5 Latin American countries
- Community Based Education
 - Through distribution of bookmark, wallet cards and brochures
 - Health Encounters
 - Hg and Fish advisory
- Percent of client reported unawareness decline from June to August from 95% to 59%
 - Community partners such as Health Dept., Gus Bus, etc distribute educational materials.
- Community outreach events such as Riverfest, Harrisonburg international Festival, Mexican and Honduran Consulate Visits, Apple Blossom Festival, Community Resource Fair, Goodwill Stores Client Appreciation Even, Festival El Salvador.
- Advisories being listed in Hispanic newspapers and bilingual PSA on English speaking radio.
- Monthly meetings to replenish materials, Promotora reporting, continued education and opportunities for collaboration.

Session III: Some Possible Fixes

Remedial Options Program-Research and Pilot Studies: *Nancy Grosso, DuPont; Ceil Mancini, URS*

- Objectives:
 - Reduce fish tissue Hg concentrations to allow human consumption.
 - Ensure protection of aquatic and terrestrial ecology with respect to Hg exposure .
- Hg Management-proposed Short-term and Long-term Actions
 - Aquatic Environment Approach-Short term:
 - Control significant ongoing sources from banks.
 - Refine Hg loading model estimates and validate with field program.
 - Prioritize actions for bank stabilization.
 - Conceptually design stabilization options on reach-by-reach basis.
 - Establish stakeholder group.
 - Test proposed actions using relative risk model for potential unintended consequences.
 - Implement on selected reach and monitor.
 - Aquatic Environment Approach-Long term:
 - Continue to explore innovative approaches to control/reduce methyl mercury in system.
 - Employ adaptive management to test.
 - Test transport zone bed turnover model.
 - Integrate possible actions with overall watershed vision.
 - Test proposed actions using relative risk model for potential unintended consequences.
 - Floodplain:

- Test sorbent amendment in floodplain pond.
- Design and implement floodplain amendment study.
- Track terrestrial/avian food web studies and identify potential options for reducing Hg in biota.
- Integrate with overall watershed vision.
- Test proposed actions using relative risk model for potential unintended consequences.
- Implement feasible management options.
- Ongoing Activities Overview
 - Bank stabilization pilot
 - Bank loading verification program
 - Pond amendment pilot
 - Proposed floodplain soil amendment study plan
 - Role of SAV in MeHg production in river
 - University Studies:
 - Smithsonian/U. MD BC work (Cindy Gilmour)
 - Objective: test carbon based amendment effectiveness in reducing biological uptake of Hg within the South River.
 - Data is expected late November.
 - UT Austin DGT Probe (Danny Reible)
 - Objective: Develop a tool to passively measure total Hg and MeHg gradient with depth in sediment porewater
 - Some technical issues with the analytical instrument; next deployment in week 12.
 - Need to compare DGT PA data to Henry Probe method and Benthic Hg burden data.
 - U. Waterloo (Ptacek)
 - Objective: Mercury release from sediments and strategies for remediation, testing biochars.

NRDA Process-Restoring the Resource: *Erin Mack, DuPont; Anne Condon USFW*

- NRDA = Natural Resource Damage Assessment and Restoration
 - Dept. of Interior program (CERCLA, Clean Water Act, Oil Pollution Act), state and federal agencies act as trustees of natural resources for the public.
 - Cooperative Process
 - Purpose = restoration of injured resources and services
 - Determine the amount /extent of injury to trust resources including air, water, land, fish and wildlife.
 - Restore injured natural resources and services they provide.
- Outlined process in regulation but there is some flexibility.
 - Pre Assessment gathers data to determine that release occurred and injury was likely.
 - Injury Assessment studies designed to try to quantify and describe injury (spatially).
 - List of things to look at for each organism such as effects on reproduction, immune system function, survival, genetic damage, etc.
 - For this project, injury assessment started in 2005 and is wrapping up in 2011.
 - Injury Quantification is next step and is where we are now. The process involves determining the amount of injury and the amount of restoration needed. Also,

restoration scoping taking place by talking with natural resource agencies in state to start list of potential restoration ideas.

- Achieving Restoration
 - Increase amount of quality habitat for species by restoration or acquisition.
 - Enhance or restore quality of existing habitat.
 - Increase populations through reintroduction or restocking.

October 13

Session IV: South River Visions

Relative Risk Model: *Wayne Landis, Huxely College Western Washington University*

- Goals of risk assessment program:
 - Perform a multiple stressor multiple endpoint ecological risk assessment for the South River Region.
 - Create an assessment framework to calculate risk and to run scenarios to assist the planning of restoration efforts for the region.
- River divided into 6 regions all with diverse landscape with multiple uses and sources. Data collected by SRST used in model.
- The relative risk model method can be found at Landis and Weigers 2004 and Colnar and Landis 2007.
- The RRM and the use of Bayesian networks can be found in Ayre and Landis in press, preprint download at www.wwu.edu/toxicolgy.
- Structure of Conceptual Model lends itself to using Bayesian Networks.
- Bayesian Networks use conditional probabilities-based on the available data, models or expert opinion
- Explicit about uncertainties.
- See presentation for information on construction of models, data and references used, etc.
- Results
 - Model worked. Large site with a number of stressors and endpoints.
 - There are a number of patterns of risk to various endpoints and to different stressors with the South River Study area.
 - The risk has moved downstream of the original source of Hg and is now combined with agriculture and other sources.
- Patterns of risk (regions number going downstream with Region 1 upstream of Waynesboro and Region 6 the upper South Fork)
 - Region 6: Highest percent of risk due to Hg.
 - Region 5: Highest risk to smallmouth bass and second highest risk overall.
 - Region 2: Highest risk overall
 - Region 1: Does have risk similar to Regions 3,4,6
 - Data gaps
 - Regions 1 and 6 have little coverage in data.
 - Sampling in other rivers not useful for understanding risk in South River.
- Summary

- The river and watershed are providing a pattern of risks analogous to a chromatography column and chemicals.
- The risk assessment also allows the calculation of restoration strategies and specific goals.
- The RRM provides an overview of the risk within the region with uncertainty. Requires less data but it is a trade for less specificity.
- The BN is very specific and deals very explicitly with uncertainty. The trade off is that sufficient data are required to construct a reasonable CPT.
- Wayne is asking for water-quality-recreation expert solicitation. Asking experts to comment on model structure, focusing on specific problems and outcomes.
 - Does the structure contain parameters that influence endpoints?
 - Are any parameters missing?
 - Are the states for each parameter reasonable?
 - Are the state definitions realistic?
 - Conditional Probabilities
 - How much weight to place on parent nodes?
 - Most likely outcome for each combination of parent node states?
 - Least likely outcome?
- **Sign up sheet was passed around for volunteers to provide expert opinion and help answer above questions. If interested and didn't sign up, contact Wayne Landis.**

Watershed Management: What is It and Lessons Learned: *Dave Hirschman, Center for Watershed Protection*

- Dave gave an in-depth presentation on watershed planning and management and the lessons that have been learned with many examples. Please see presentation for details. During the presentation, Dave asked several questions to the SRST and had them write their answers down on index cards. Dave planned on placing the results on the FTP site. The questions asked are listed below:
 - The SRST will have been successful when the South River is.....
 - Is the South River restoration effort a stream corridor project or a watershed project?
 - What kind(s) of (additional) assessments should a South River Watershed Plan include?
 - Potential South River restoration projects should be ranked by.....
 - What are your recommendations for improving chances of successful plan implementation?

Using Long Term Monitoring to Evaluate Restoration Effectiveness: *Will Clements, Colorado State University*

- Average duration of "long-term" biological monitoring in aquatic ecosystems is 9 years.
 - This is insufficient to evaluate restoration effectiveness or recovery.
- Meta-Analysis: Failure to observe recovery attributed to short duration of monitoring.
- Will and team have been conducting monitoring of the Arkansas River, CO (NRDA site with remediation starting in 1990). The unique features of this dataset include:
 - 22 year record of chemical, physical, biological data.
 - All data collected by same investigator using consistent methods.
 - Response to restoration treatments.

- Influence of long-term climatic changes.
- See presentation for details of monitoring.
- Recommendations and Lessons Learned
 - Maintain consistent methods.
 - Start “big” and scale back as necessary (sampling frequency, spatial scale, endpoints)
 - Monitoring alone may not be sufficient (may need experiments)
 - Use regional reference conditions.
 - Consider long-term climatic trends.

Recap-What we’ve learned in the last 10 years and where we are headed in 2012 and beyond: *Ralph Stahl, DuPont*

- Ralph gave a summary of the beginnings of the SRST and the evolution of theories and models over the last 10 years. See presentation for more detail.
- South River Management Goals “Draft-Revisit in 2011”
 - Minimize human exposure
 - Reduce or eliminate fish consumption advisory
 - Reduce or eliminate Hg loading to wildlife
 - Restore human uses and ecological resources
 - Maintain water supply for irrigation and agriculture
 - Enhance and improve cold water fishery
 - Improve overall water quality
 - Identify and eliminate sources of Hg to South River and adjacent floodplain
 - Identify and prioritize remedial and restoration options
- Input from Experts:
 - Accelerate Shift in Emphasis for SRST
 - From data collection by individual investigators to multidisciplinary, collaborative efforts leading to insight generation, joint studies and remedial options testing.
 - From SR Hg-centric to regional watershed multi-stressor centric such as impact of other ecological stressors on Hg-contaminated fish; comprehensive, site-specific set of metrics; reconsider reference site selection; additional statistical tools; link structural measure to ecosystem processes.
 - Better Articulate and Substantiate Conceptual Models
 - On a reach-by-reach basis.
 - Include: inorganic Hg sources, methyl Hg production compartments, linkages to base of aquatic food web, role of periphyton and pathways from aquatic to terrestrial food webs
 - Consider nutrient spiraling framework as way to better understand Hg retention and transport.
 - Get More Specific on Remedial Options
 - Reconcile feasible options with conceptual models on reach-by reach basis.
 - Consider: streamside mesocosm experiments, amendment testing, prioritizing bank stabilization sites, natural vs. revegetated vs. engineered bank stabilization techniques

- Ralph's Personal Observations
 - Getting a good understanding was harder, and took more time than we anticipated.
 - Getting the experts and academics involved was one of our best ideas.
 - Working as a SRST has paid substantial dividends; and will in the future.
 - More study/investigation will not significantly change our conceptual model.
 - Working as a team will continue to be important as we test remedial and mitigation options.

Next meeting March 14, 2012

No January meeting. Look for new format with more emphasis on task teams.