**Summary comments from SRST, October 5-6, 2010**

Submitted by William H. Clements, Ph.D.

## I. General comments

This is a phenomenal dataset and members of the South River Science Team (SRST), principal investigators and other participants in this program are commended for producing such an impressive group of studies. I expect that the South River watershed represents one of the best studied ecosystems in North America with respect to Hg contamination. The focus on quantifying linkages between aquatic and riparian ecosystems, which has recently received much attention in the ecological literature, is especially forward thinking and innovative.

As the focus of the SRST shifts from data gathering and investigation to evaluating restoration alternatives, I believe the most important challenge will be to develop a program that strengthens collaboration among investigators. Potential synergistic activities among investigators would clearly benefit the trustees, the South River resources and DuPont's restoration efforts. A few ideas were discussed at the October meeting, but I believe a more specific plan to move forward is needed. Without exception the individual presentations of independent research were excellent, but there were numerous examples where the quality of the research and the scope of the questions could be enhanced by a greater level of collaboration among investigators.
Many of the issues identified in my responses to the 4 expert panel feedback questions could be addressed by a more collaborative effort. Because my own research is focused on the application of mesocosm experiments in ecotoxicology, I will use these studies as examples to illustrate a few potential collaborative activities among PIs:

- Streamside mesocosms using stable isotopes could be employed to quantify transport of Hg through the aquatic food web and into terrestrial systems;
- The field experiments using transplanted communities could be integrated with streamside mesocosm experiments to quantify ecological effects;
- As described below, the relative importance of periphyton in the South River remains a significant data gap. Stream mesocosm experiments could be conducted to estimate the role of periphyton in the transport and dynamics of Hg;
- Stream mesocosm experiments could be designed to quantify the effectiveness of various amendments and other proposed remediation treatments to reduce Hg bioavailability.

Conducting collaborative research is not easy, especially for PIs located at separate institutions that are busy with their own independent projects. Therefore, I believe the most effective way to implement a collaborative program will be to provide incentives to the PIs during the next round of funding. I also believe it would be useful to assign the responsibility of identifying and assessing potential collaborative opportunities to someone (or a committee) from the SRST that works directly with PIs and is reasonably familiar with all aspects of the ongoing studies in the South River.

**II. What critical gaps remain in our understanding of the South River aquatic environment that specifically impact remedial options selection and implementation?**

a. *Limited understanding of ecological effects*- The fundamental question for the aquatic studies is: Are fish and macroinvertebrate communities in the South River similar to those from a larger population of streams in the region. Unlike the terrestrial studies, which have focused on understanding ecological effects on birds, reptiles and amphibians, most of the research conducted in the aquatic environment has examined fate and dynamics of Hg. The food web and physical transport models that have been developed to predict Hg concentrations in aquatic consumers are excellent. However, these models are not sufficient to demonstrate effects of Hg on fish and macroinvertebrates in the field. At the very least, we would like to know if the high body burdens of Hg in fish populations increase their susceptibility to other stressors. The significant increase in fish and macroinvertebrate abundance and diversity that was observed after the 1970s is encouraging, but are we certain this change is a direct result of reduced Hg contamination or are other factors responsible? It is difficult to answer this question without also seeing data from other watersheds. Another compelling reason to better quantify ecological effects in the watershed is because most of the risk models being developed by Landis and colleagues use ecological effects (not Hg body burden) as an endpoint.

It is possible that previous studies have provided convincing evidence that ecological effects are not an issue for aquatic populations and communities in the South River. However, I remain unconvinced of this for several reasons. Most importantly, are the reference sites that were used to compare abundance and diversity of macroinvertebrates and fish communities appropriate and representative of our expectations for this system? We heard some concerns expressed in the October 2010 meeting that South River reference sites may not be appropriate or that additional "least impacted" sites are required to characterize this system. For example, results presented showed that abundance of sculpin and shiners was greater at the upstream reference site compared to the downstream sites. This difference was attributed to natural habitat variation and is expected, but it underscores the critical point that reference sites in the watershed are spatially variable.

There are much more sophisticated ways to define reference conditions in a watershed than simply relying on a small number of nearby tributaries or upstream reference sites. Streams in the southern Appalachians are among the most extensively studied ecosystems in the continental U.S. There are several spatially extensive datasets available in this region that can provide a much better characterization of reference conditions than the handful of sites employed in the aquatic studies. I would strongly encourage the investigators to take advantage of these existing datasets and develop a more defensible approach to defining reference conditions. Furthermore, there are much more sophisticated statistical approaches that can be employed to demonstrate similarity (or dissimilarity) of South River sites to the larger population of streams in the region (e.g., reference condition approach, observed to expected values, multivariate approaches).

b. *More appropriate metrics to quantify ecological effects*- In addition to a better characterization of reference conditions, a more comprehensive set of metrics should be developed to assess potential ecological effects on fish and macroinvertebrates. Abundance and richness metrics are useful, but measures of fish health, condition and other physiological endpoints would be more effective at convincing skeptical reviewers that ecological effects are not a concern. Similarly, other metrics and statistical approaches should be developed for the macroinvertebrate data. For example, the frequently cited EPT index is not very useful for assessing effects of chemical stressors because of the relatively high tolerance of caddisflies (Trichoptera) for many environmental contaminants. There are also multimetric indices of biotic integrity, analogous to Karr's index of biotic integrity (IBI), which have been developed specifically to assess effects on macroinvertebrate communities. Using the existing data it would be possible to develop a macroinvertebrate index that is specific to the South River benthic communities. Finally, a rigorous analysis of the macroinvertebrate data using more sophisticated statistical techniques, such as NMDS, would be more appropriate than simply showing longitudinal patterns of abundance and diversity.

Finally, one of the most significant developments in the field of ecology is recognition of the importance of ecosystem function and services. The field of ecotoxicology has also recently embraced this important concept (Munns et al. 2010). The aquatic studies presented at the October 2010 meeting focused exclusively on structural measures (e.g., abundance, diversity, composition). While this information is useful for assessing ecological integrity, there should be some attempt to link these structural measures to ecosystem processes. Information on functional measures, such as leaf litter processing or secondary production, would complement studies of community structure and provide a more direct connection to ecosystem services. Ultimately, it is these ecosystem services that we hope to restore in the South River.

Munns, W.R., Jr., R. C. Helm, W. J. Adams, W.H. Clements, M.A. Cramer, M. Curry, L.M. DiPinto, D. M. Johns, R.Seiler, L.L. Williams, and D. Young. 2009. Translating ecological risk to ecosystem service loss. Integrated Environmental Assessment and Management 5: 500-514.

c. *Field experiments with benthic communities*- The ongoing field experiments with benthic macroinvertebrate communities are an important exception to the focus on fate and transport in the aquatic studies. These experiments are critical and should allow investigators to separate water and sediment quality effects from other potential confounding factors. These studies should also provide a better understanding of causal relationships between Hg and responses of benthic communities.

Because we developed many of these experimental techniques in my laboratory, I am very familiar with the problems and pitfalls of these approaches. Our experience with this technique suggests that caution is needed when interpreting effects because of reduced water flow through the exposure chambers (Clements 2004; Courtney and Clements 2004; Clark and Clements 2006). In other words, survival of certain macroinvertebrate groups will likely be reduced in chambers with fine mesh, regardless of Hg effects. Therefore, some assessment of the impact of reduced current velocity on macroinvertebrate communities within these chambers will be necessary.

Clements, W.H. 2004. Small-scale experiments support causal relationships between metal contamination and macroinvertebrate community responses. Ecol. Appl. 14: 954-967.

Clements, W.H., D.M. Carlisle, L.A. Courtney, and E.A. Harrahy. 2002. Integrating observational and experimental approaches to demonstrate causation in stream biomonitoring studies. Environ. Toxicol. Chem. 21: 1138-1146.

Clark, J.L. and W.H. Clements. 2006. The use of in situ and stream microcosm experiments to assess population- and community-level responses to metals. Environ. Toxicol. Chem. 25:2306-2312.

d. *Role of periphyton as a source of Hg contamination*- The precise role of periphyton as source of Hg to grazing macroinvertebrates remains uncertain. Previous studies of shallow streams dominated by relatively coarse substrate have shown that periphyton can be a major source of metal contamination. Because of the relative paucity of fine sediments in some reaches of the South River, periphyton is likely to be the major source of Hg to macroinvertebrates and higher trophic levels. I believe our understanding of the role of periphyton in determining the distribution of Hg in the South River could be improved by invoking nutrient spiraling theory to examine Hg dynamics. Nutrient spiraling is one of the dominant paradigms in stream ecology and has recently received attention in the ecotoxicology literature (Stewart et al. 1993; Kirchner et al. 2000). Similar to nutrients, watershed features such as stream morphology, hydrology, number of snags, and water temperature are likely to influence Hg retention. From a restoration perspective, the critical question is can any of these factors be manipulated to affect Hg retention and transport. The observation that Hg accumulated significantly faster in forested sites compared to pasture sites suggests that Hg retention is influenced by similar watershed features that determine nutrient dynamics.

Kirchner, J.W., Feng, X.H., and Neal, C. 2000. Fractal stream chemistry and its implications for contaminant transport in catchments. Nature **403**: 524-527.

Stewart A.J., Hill, W.R. 1993. Grazers, periphyton and toxicant movement in streams. Environmental Toxicology and Chemistry **12**: 955-957.

e. *Integration of mesocosm studies into the overall research program*- As noted above, I believe the ongoing mesocosm studies offer an ideal opportunity to demonstrate collaborative and potential synergistic activities among investigators. While some of this appears to be underway, more can be accomplished with a better coordinated effort among researchers. For example, mesocosm studies could be employed to assess the effectiveness of proposed amendments (e.g., application of biochar). Mesocosm studies could complement ongoing efforts that document Hg movement within food webs. It would be relatively simple to collect emerging adult insects from Hg-dosed mesocosms to estimate potential transport to terrestrial ecosystems. Although not much experimental work has been conducted in lotic systems, recent studies by James Oris and colleagues (unpublished) at Miami University have addressed this question in stream mesocosms.

The landscape level risk assessment conducted by Landis and colleagues identified the importance of considering Hg fate and effects within the context of multiple stressors. One of the key strengths of mesocosm studies (and a primary justification for their use in ecotoxicology) is the opportunity to examine interactions among stressors. Therefore, mesocosm studies could be designed to examine how Hg in the South River watershed interacts with and influences responses to other stressors.

**III. What strengths and weaknesses do you see in our current programs for innovative watershed management & remedial technology options?**

a. *Trophic modifications*- The trophic modification studies highlighted important links between management of the coldwater and warm water fisheries and the level of Hg contamination. They also described the important socioeconomic and other human dimensions issues that will ultimately determine how this system is restored. Despite the tremendous interest in trout, it appears highly unlikely that the South River would ever be managed exclusively as a coldwater fishery. Furthermore, only a handful of studies have successfully implemented food web manipulations to achieve a specific management goal, and these have been primarily in lentic ecosystems. Although a food web manipulation would be interesting from an academic perspective, I do not believe that removing a trophic level from the South River food chain is a practical way to reduce Hg levels in top predators. Therefore, assuming that bass are a permanent component of the fishery, I believe that promoting the South River as a trophy warm water fishery and maintaining catch-and-release restrictions on bass to maintain this status appears to be the most reasonable alternative.

However, I do believe that some level of trophic modification in the South River could be an important component of the final restoration. A somewhat less ambitious plan to reduce Hg levels in bass could involve a continuous stocking program of uncontaminated fingerling trout. The goal of this manipulation would not be to remove a trophic level or change the fishery from bass to trout, but would provide less contaminated prey for these top predators. Assuming that bass would shift their feeding habits from native forage fish to less contaminated prey, Hg levels could theoretically be reduced.

b. *Bank stabilization*- The results of the pilot bank stabilization project are interesting; however, it remains unclear if this program could be implemented on a spatial scale sufficient to affect Hg input to the watershed. Bank stabilization and other proposed alterations will likely have positive indirect effects on the watershed and these alterations should be considered. For example, will reduced input of fine sediments influence methylation rates? Will the improvements in habitat quality and riparian vegetation increase abundance and growth rates of bass?

**IV. What critical gaps remain in our understanding of the fate & dynamics of Hg in the terrestrial environment adjacent to the South River?**

a. *What is the primary source of Hg to terrestrial food webs*- The most significant data gap associated with the terrestrial studies is the limited understanding of the source of Hg to terrestrial food webs. For example, there remains considerable uncertainty regarding the relative importance of emerging aquatic insects versus floodplain prey items as sources to terrestrial consumers.

The diet studies conducted with birds and spiders provided some important insight into this question. However, do we know for certain that songbirds are foraging adjacent to nest boxes? Is it possible that birds forage disproportionately in riparian areas? Perhaps quantifying feeding habits of a particular species (using stable isotopes) along an Hg gradient away from the river could be used to address this question. The genetic study of wolf spiders also provided some interesting results related to Hg sources, although it is not surprising that these mostly ground-dwelling spiders did not consume mayflies. It would be useful to know the importance of other spiders in the area (e.g., tetragnathids) relative to wolf spiders. To better understand the role of emerging insects, I would encourage the investigators to expand the scope of their study to include web-building spiders in the riparian zone. These spiders are much more likely to consume aquatic insects. A comparison of Hg levels in riparian versus upland spiders would be useful to address the source of Hg to songbirds.

Finally, is there convincing evidence that mayflies are the most important potential source of Hg export to terrestrial ecosystems? Previous studies that quantified export of contaminants from aquatic to terrestrial ecosystems focused on chironomids, primarily because of the high turnover rates and greater secondary production of this group. I believe that estimates of Hg transport in other emerging aquatic insects are necessary to fully understand the contribution of these organisms to terrestrial consumers.

b. *Terrestrial trophic models*- The terrestrial trophic models provided important insights into the transfer of Hg and the relative importance of food chain structure in determining concentrations in top predators. One of the more interesting findings of these studies was the variation in the slope of the relationship between Hg and trophic level among sites (e.g., the trophic magnification factor). Assuming that differences among sites are consistent and reproducible, it would be useful to explore their implications for remediation. For example, would we modify the restoration strategies employed at a site with a small versus a large trophic magnification factor?

c. *Effects on amphibians and reptiles*- The terrestrial studies on amphibians and reptiles represent one of the most comprehensive and sophisticated investigations in terrestrial ecotoxicology. These studies have demonstrated critical mechanistic linkages between Hg effects at lower levels of organization and population-level consequences at higher levels. These studies have moved well beyond traditional questions related to Hg transport and biomagnifications to ask how exposure may influence population demographics. I agree that the next step for these studies is to employ more sophisticated stage-based population models to estimate risk from Hg exposure and interpret these results within the context of other environmental factors.

**V. What critical gaps remain in the identification and communication of potential human exposure?**

The leads on this initiative have done an outstanding job communicating potential risks (and lack thereof) to the public regarding human exposure to Hg. However, I agree with the other members of the expert panel that at some point this program needs to move beyond communication of risk to direct quantification of Hg exposure in humans.

I would also encourage this group to promote greater participation by the general public in the SRST meetings and other deliberations. I believe greater involvement of local stakeholders with the SRST would facilitate the process of restoration planning.

**Comments from SRST, October 5-6, 2010**

David J. Hirschman, Center for Watershed Protection, Inc.

I agree with others that this effort is quite impressive, and I am unaware of other watersheds of this scale that have had as comprehensive an assessment as the South River. Since my expertise deals with developing and implementing watershed plans, my comments will focus on topic #2:

**I. What critical gaps remain in our understanding of the South River aquatic environment that specifically impact remedial options selection and implementation?**

As a new member of the panel, I am still not up-to-speed on all of the research and ongoing efforts, so I apologize if some of these issues have already been thoroughly addressed.

1. Clearly-articulated, achievable goals

One aspect of watershed planning that has plagued efforts ranging from small watershed plans to the Chesapeake Bay to the Clean Water Act is the lack of clear and/or achievable goals. One way to think about this is defining desired future conditions for the South River. How will we know when the river is "clean enough," and what exactly does that mean in terms of Hg levels, the health of individual species, the health of ecosystems, and the safety of human populations. Some of these goals may have external or internal regulatory or programmatic drivers, so of course those need to be accounted for. Others may be arrived at through a collaborative process that involves the SRST and other stakeholders.

2. Link with other local, regional efforts

After sitting through the SRST meeting on October 5-6, I think there are fantastic opportunities for synergy between the SRST and other efforts. The SRST has much to share, and some sort of Roundtable may help the SRST with a broader "coming out" to the wider watershed community. I think it is great that SRST representatives participate in local and regional meetings, but this does not really give allied agencies an opportunity to learn about the SRST, the interdisciplinary research, and the lessons learned that are pertinent to other watershed efforts.

A quick scan of allied efforts is below (many of which SRST representatives already interact with):

- NRCS CREP Program (Conservation Reserve Enhancement) – buffers on ag land
- Headwaters SWCD Agricultural Cost-Share Program
- South River TMDL, DCR Watershed Planning and pending NFWF grant proposal
- Chesapeake Bay TMDL, state Watershed Improvement Plan (WIP) and local WIPs
- Augusta County Comprehensive Plan
- Department of Game & Inland Fisheries – hunting outreach, creel surveys, stream restoration program
- Farm Bureau
- Angler groups, South River fishing initiatives (upstream)

3. Stream Reach Classification & Links to Bank Restoration

I think some of this is well-covered in Jim Pizzuto's research, but there seems to be a broader opportunity to characterize individual reaches of the South River main stem and tributaries. The purpose of such a characterization would be to identify the following:

- Prediction of future bank erosion rates (good start with Pizzuto).
- Role, potential opportunity for "natural" stabilization if stressors were removed (e.g., ag operations up to the top of bank) and vegetation was allowed to reestablish on its own.
- Particular benefits of revegetated streambanks for the reach-scale and broader ecosystem
- Areas where stabilization needs more of an engineering "fix" due to instability and sediment loading issues
- Interplay of these various factors with Hg levels
- Prioritization of "soft" and "hard" stabilization efforts (e.g., priority map of stabilization sites)

What I am thinking here is an emphasis on scaling-up the streambank effort, if that appears to be one of the main remedial technologies. Ideally, we want to stabilize miles of streambank, and not just a few demonstration projects. This item has a strong link with the watershed partners identified in #2. Pizzuto's findings about elevated levels of Hg at forested sites also needs to be considered, as this may inform whether forested buffers are the best intended condition for streambanks in the short-term and long-term.

I hope these comments are helpful for our upcoming conference call.

## Combined Responses from Gary Bigham, Mike Newman, and Ralph Turner

**What critical gaps remain in our understanding of the South River aquatic environment that specifically impact remedial options selection and implementation?**

1. The program has amassed an impressive data base and is generally on track. There is not so much a knowledge gap as incomplete integration and presentation of findings to substantiate conclusions. The integration that is necessary is one that pulls the existing information together in a way that is most useful for formulating and judging potential remedial or compensation actions.

2. A more explicit understanding is needed of mercury sources to the base of the food web (eroding banks, reworked bed sediments, etc). More support (or more transparent exposition) is needed for the hypotheses regarding relative contributions and mass balance. For example, does the high fraction of methylmercury contributed to realized fish tissue concentrations from the transport zone (embedded gravel) derive entirely from the area covered by this substrate or is there some feature of the cycling of Hg in this zone that enhances methylation? Can inputs from each source also be expressed on a unit area basis to show that it is or isn't the high flux per unit areas that drive loading distributions?

3. The relative contributions of storm versus base flow Hg inputs to the river have been studied extensively. A sound database of water column concentration and loading of Hg species, both filtered and unfiltered, has been established. From this, loadings can be determined for a fairly wide range of flow conditions and selected stream reaches. However, the behavior of the hyporheic zone during storm flows is not well known. Do IHg and MeHg in the pore water of the embedded gravels change significantly following a storm event? The evaluation of pre- and post-storm pore water concentrations, perhaps using Reible's passive sampling techniques, could help clarify the significance of soils transported during storm events and pore water concentrations expressed during the return to baseflow.

4. It remains unclear what intervention could be made in the transport zone short of dredging. Pizzuto's work on the residence time of fine particles in the gravel beds suggests that natural recovery might take on the order of 20 yrs and thus possibly this zone can be excluded from any active intervention if the source of particles supplying these beds is cut off or curtailed significantly. If nothing is contemplated for the transport zone then a very good case for "why not" needs to be made. If a sound answer is forwarded, the need for any further research in this area becomes important to discuss. For example, it should be made clear if amending the transport zone with Sedimite® or similar material, is infeasible for this zone. On the other hand if suspended and bed load transport processes require ~20 years to replace embedded gravel deposits, it would be important to determine whether we couldtake advantage of this natural process to manage the content of these deposits to accelerate the process (by processes other than bank stabilization).

5. A nutrient spiraling framework for Hg movement down the river has been mentioned as worth initial exploration. . One might attempt to determine the existing, and then seek means to lengthen spiraling distance, within this context. The concept is applicable to organic matter, which is an important "carrier" of Hg in streams (see Mierle & Ingram 1991, WASP56:349-357).. It may also be applicable to MeHg as it is produced in the bed but migrates downstream in mainly "filter-passing" form. Like the non-conservative behavior of phosphorus, MeHg is either adsorbed to surfaces, taken up by biota or demethylated in some period of time that can be related to travel time/distance in the South River. We do not recommend, however, that the nutrient spiraling concept be pursued as a core or central theme during DuPont's shift in focus toward remediation. The spiraling length would be a convenient framework for judging effectiveness of remediation.

**What strengths and weaknesses do you see in our current programs for innovative watershed management & remedial technology options?**

1. There has not been so far a clear statement of the desired/target final state after remediation.
2. Explicit options generally remain unclear, especially those related to innovative and integrated watershed management.
3. Wider application of bank stabilization technology is a desirable goal. However, it is unclear what other areas along the river are available for such actions vs allowing vegetation to stabilize banks. Specify areas amenable to/needing this technology and detail plan/priorities/need (Hg levels). What areas are amenable to natural remediation? [See comments by Dave Hirschman]
4. Methylation control options remain very nebulous and, consequently, it is difficult to assess the promise of solutions from this option. Viable options should be expressed explicitly along with possible means of implementing and assessing. Enough detail is needed so that one can estimate the likelihood that the option will result in a real world improvement.
5. Trophic modification options, as presented to date, remain unclear and seem to have uncertain outcomes. Change of nutrient concentrations may increase or decrease available mercury and may also reduce growth rates of fishes and hence lead to higher fish Hg concentrations. Fine sediment reduction would change habitat and trophic structure. All of the features of this option have not been clearly articulated and, therefore, it is difficult to judge to level of the promise afforded by any related activities.
6. Explore partnering opportunities other agencies and community groups as plans progress (see also comments by Dave).

**What critical gaps remain in our understanding of the fate & dynamics of Hg in the terrestrial environment adjacent to the South River?**

1. The pathway of Hg from aquatic and floodplain sources into the terrestrial food web to birds.
2. How/where is mercury in the floodplain getting methylated and entering the terrestrial food web.
3. Clarify the amount of MeHg in plants (review literature data) and soil.
4. Why the difference in trophic model slopes among models? Is there a tool/opportunity here relative to remediation?
5. What are the ways that the associated insights can be used to lessen exposure to valued avian species? This question requires attention if the results of current studies are to be useful.

**What critical gaps remain in the identification and communication of potential human exposure?**

1. Overall excellent job. Perhaps implement program of monitoring, i.e., human hair concentration (as much as education/outreach as source of data).
2. Some additional two-way communication versus one-way communication efforts to further engage the community could be helpful.

**How can we close these knowledge/ understanding gaps?**

We recommend that available information on the nature of the problem and potential remediation options be assembled on a reach-by-reach basis. What are the characteristics of the Hg sources in the reach compared to other reaches? How eroded are the banks and what are the Hg concentrations? Are there opportunities for bank stabilization? What are the physical characteristics of the bed and associated sediment and porewater Hg concentrations? What are the characteristics of the aquatic food web and the potential for Hg to enter? Are there remediation techniques that could be applied on a limited basis to the river bed?

An effort to relate the results from South River to other similar systems is needed. Such an effort should be focused on other similar systems that have had some sort of remediation action. The effectiveness of that remediation could be assessed relative to implementation for the south River.

**What would laboratory/field studies look like?**

1. The work at JMU and Waterloo both represent reasonable lab and field studies to identify and evaluate possible remedies. The JMU work would support trial treatments focused on instream processes while the Waterloo work supports possible soil treatments.

2. Efforts to characterize the “bioavailable” fraction of Hg in water and porewater seem to have been side-tracked or abandoned. If an innovative or elegant solution is to be found it will likely involve an intervention to reduce the bioavailability of mercury, not the total concentration or mass of mercury. Having a tool or toolkit to characterize bioavailable Hg seems imperative. Three approaches have been investigated at least briefly for the South River: ultrafiltration, chemical reducibility and a bioreporter. Others might include biomimetic techniques and also the alkylatable Hg (AHg method) of CEBAM.

**If additional data collection & study are recommended, is it even feasible to collect these data?**

Given preliminary results of the new porewater sampling approach being evaluated by Reible it may be appropriate and necessary to revisit making measurements over a wider area of the river for the purpose of better defining the relative importance of the storage and transport zones as sources of bioavailable Hg.