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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, NEW YORK 10278

HUDSON RIVER PCBs SITE REASSESSMENT RI/FS

SCIENTIFIC AND TECHNICAL COMMITTEE
THURSDAY, MARCH 24, 1994
LATHAM, NEW YORK

MINUTES

On March 24, 1994, a meeting of the Scientific and Technical Committee (STC) for the Hudson River PCBs Reassessment RI/FS was held at the Holiday Inn Express in Latham, New York. The purpose of the meeting was to provide STC members with information and an opportunity for questions on the 1) fate and transport modeling and 2) bioaccumulation modeling. Dr. Bill Nicholson of Mt. Sinai Medical School served as the moderator. The following STC members were in attendance:

Name	Agency
Dan Abramowicz	General Electric Research and Development
Donald Aulenbach	Rensselaer Polytechnic Institute
Jim Bonner	Texas A&M University
Richard Bopp	Rensselaer Polytechnic Institute
John Brown	General Electric Research and Development
Brian Bush	NYS Dept. of Health
John B. Davis	NYS Attorney General's Office
Bob Dexter	EVS Consultants
Jay Field	NOAA
Leonard Frost	US Geological Survey
Bill Nicholson	Mt. Sinai School of Medicine
George Putnam	SUNY- Albany
Gabriel Raggio	Simultec
G-Yull Rhee	NYS Dept. of Health
John E. Sanders	Barnard College
Ron Sloan	NYSDEC- Fish and Wildlife

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Also attending and participating were:

Name	Agency
Doug Tomchuk	USEPA
Victor Bierman	Limno-Tech, Inc.
Jon Butcher	Cadmus Group
Helen Chernoff	TAMS
Jerry Cura	Menzie-Cura Associates
Al DiBernardo	TAMS
Ed Garvey	TAMS
Paul Rodgers	Limno-Tech, Inc.
Trina von Stackelberg	Menzie-Cura Associates

In addition, approximately 10 non-participating individuals, representing government and private agencies, sat in on the meeting.

Doug Tomchuk welcomed everyone to the meeting and introduced John Brown from General Electric, who was invited to this session of the STC. The committee members and other participants then introduced themselves. Al DiBernardo of TAMS Consultants gave an overview of the presentations planned (see attached Agenda).

Jon Butcher gave a brief overview how we got to where we are today. The Hudson River PCBs Reassessment Project is focused on the contaminated sediments in the Upper Hudson River. There has been an historic decline in PCB levels in the fish; however, recently PCB levels in the fish have gone back up. The PCB concentration loading data were examined in the Phase I report. Since this time, the source at Baker's Falls has been identified. The Phase II report will be a predictive tool, analyzing future risks. The central question is still what to do with the contaminated sediments. The role of the modeling is to predict future conditions and evaluate potential remediation actions. There are three informal questions, which the modeling attempts to answer. These are:

- When will PCBs in fish reach acceptable levels under no action?
- Are there remedial actions we can take to significantly shorten the time?
- Are buried PCBs [in Thompson Island Pool] likely to be resuspended by a major flood event?

The modeling team is comprised of Limnotech and Menzie-Cura, with input from Jon Butcher of Cadmus. Limnotech will model the long-term mass balance and a short-term resuspension model. Menzie-Cura will model bioaccumulation processes (food chain), with input from TAMS. Cadmus will develop an empirical bioaccumulation model and coordinate efforts between modelers.

Dr. Paul Rodgers of Limnotech discussed aspects of the fate and transport modeling. He reiterated that the focus of Limnotech's work was the long-term mass balance and the short-term flood event model. The model will provide data to be used by the toxicology people to calculate future risks. The short-term resuspension event model also has to consider what actually goes over the dam once material is resuspended. In the Lower Hudson, Thomann's model will be examined in conjunction with the Menzie-Cura modeling effort. The Lower Hudson will only be modeled to the extent of the salt front.

The steps in the modeling processes are iterative steps, consisting of:

- Data evaluation, interpretation and reduction;
- Calibration to field data (synoptic);
- Validate model to field sets; and
- Diagnostic and sensitivity analyses.

The validated models should provide predictions of conditions under no action, remedial action and hydrometerological scenarios. Validation will be based on examining data from the early 80s to the present. Beyond the early 80s, the events are not considered to be representative enough for prediction. The exact number of scenarios is not fully articulated at this point. The answer to what is important in a given system is not constant, and changes according to the system. The design flows of the hydrometerologic events will cover 5, 10, 25, 50 and 100 year flows. Three scenarios are being evaluated: 1) no action; 2) remediation; and 3) the resuspension of contaminated sediments.

Throughout all the modeling a screening level steady state model is being evaluated for the Upper Hudson River. Dr. Vic Bierman discussed the screening level results. He began with a conceptualization discussing the generic framework of atmosphere, water column, active sediment (5 cm deep) and deep sediment. The chemicals evaluated depend on the inputs. The model has been configured to represent total PCBs in the Upper Hudson River. The conceptual framework is similar to a full-blown time variable model, with the exception that dissolved organic carbon is not considered in the screening model. The existing data set will be analyzed to get mass balance closure and to determine if results make sense in light of the data analyzed. The Upper River will be separated into 12 segments, based on hydrological information, stretching from Rogers Island to Federal Dam. All data shown was demonstration only and applied to 1992 water data.

The model seems to systematically over compute sediment concentrations in the lower portion of the system. This forces us to think about our assumptions. There are three possibilities: 1) the model is not accurate; 2) there may be a disequilibrium, or 3) there could be data inconsistencies. The computation was taken apart to break the mass balance down and determine the dominant processes. Advection "in" represents the PCB loading rate (mass per time) at the northern boundary, advection "out" represents the PCB loading

out at the southern end. The two values are similar. In the middle there is a large settling flux, balanced by a large resuspension flux. So although there appears to be a piping effect, there are other factors involved, which may minimize the importance of these events. External load refers to loading from sources outside the mainstem (tributaries), which are not that significant in this case. We are systematically over computing, but why?

A this point, Dr. Richard Bopp and John Haggard provided a short clarification of data that were collected by GE.

Sediments take years to respond contrasted with the water column, which only takes weeks or months. One hypothesis is that the sediments have not equilibrated with the changes in water column yet, which have taken place over a shorter time scale. The concentrations of PCBs in the sediment appear high. The decay rate of 0.003/day was tested and seemed to agree with Dr. Abramowicz's experiments (discussed March 23, 1994). However, this number does not translate well from the laboratory to the field. It appears that decay of PCBs in the sediment is a possible explanation for the discrepancy in PCBs seen in the model. This, or perhaps disequilibrium, could explain discrepancies in the data.

Settling rates were then discussed, as the solids dynamics of settling and resuspension are crucial in the modeling processes. If the model has been misrepresented, the long-term predictions will be wrong. Settling terms means that a particle will drop a certain amount per day. This is a net settling/resuspension term. Most results of this exercise (net settling run) were similar to the base runs. The point is unless you get the solids dynamics right, you can't get the PCB results right. It is crucial to understand solids dynamics, because this controls how a model behaves in a predictive mode.

Dr. John Sanders brought up the engineering term of "wash load." A suspended load may have continuous exchange with particles as they flow. The wash load is defined as what's passing through, and this may describe the model well. He said it is crucial to look at the data as paired solids and flow data.

Dr. Jim Bonner then said there is evidence there can be large amounts of settling and resuspension associated with resuspension and this can be measured by observation.

Vic reiterated that the model is a simple screening model for diagnostic purposes.

Bob Dexter asked if the adsorption capacity was covered. Vic responded that the F_{oc} (fraction organic carbon) was covered and that it varied by segment. Sensitivity analysis runs would be performed.

Dr. Brian Bush asked why did you start [the model] so high at 250 ng/l? Vic responded that this was based on observed data at that location and also we had to start so high to

match the first data point. Paul Rodgers added that the 1990-1991 period had higher values present, which emphasized looking at a time response, i.e., how long will it take a system to respond?

Another important part of the modeling, the resuspension of buried sediments in the Thompson Island Pool, was then discussed by Dr. Rodgers, who demonstrated potential activation of buried sediment. He mentioned that a full go-ahead on the model can not proceed until the full data set is received. Evidence of event-driven resuspension of sediment was seen in the Sheboygan and Fox Rivers. However, each system is unique, as each chemical is unique. Dr. Willy Lick was able to capture measurements of a 5-year flow event, which influenced the transport of PCBs out to Green Bay. With the field measurements, Dr. Lick could then calculate the event-driven flows. Physical theory suggests that events express more energy than the sum of non-events for the same return period. Sediment resuspension potential is dependent on sediment characteristics (cohesiveness, compaction and porosity), type (coarse, fine, TOC) and critical shear stress. Hudson River has both fine grained sediments at the side of the river and coarser material in the center of the river. Computing event-driven sediment resuspension includes mapping sediment information in a Geographic Information Sytem (GIS) and a 2-dimensional flow velocity computed by hydrodynamic modeling and converted to shear stress. Critical shear stress will be assigned based on literature and site-specific information.

A map of the Thompson Island Pool was shown. Modeling will cover the area from Rogers Island to the Thompson Island Dam. Most of the area is coarse grained, with the finer grains in depositional areas on the side. The bathymetry work is from GE and the sediment data is from NYSDEC's 1984 effort. Output from the FASTTABS model grid was shown as a modeling example. The lower flow selected was 20,000 cfs, which is considered to be a high flow in the Hudson River. The higher flow event selected was 40,000 cfs. The higher flow produced much higher velocities and affected a greater area. With all required information, you can compute sediment resuspension. A flow of 20,000 cfs produces relatively few areas with significant resuspension. At 40,000 cfs a much larger area is subject to resuspension. These areas where you have high resuspension are the interface between fine sediment and coarser sediments. This was all performed for illustrative purposes. Ultimately, the question becomes at what flow events is there the potential to affect hot spots? These hot spots are in areas of fine sediments, which will experience shear stress generally at higher flows.

Jerry Cura then brought up the point that critical shear stress is related to the peak flow, however, new material can be resuspended at lower velocities. Paul responded that the data collected thus far indicates that the total mass suspended is a function of the peak flow. This appears to make sense from a shear stress point of view.

Brian Bush asked if ice-scouring had been considered. Dr. Rodgers replied, no, not at all, but if someone wanted to know you'd have to know the expressed shear stress.

Jim Bonner commented that the observations expanded the wetted perimeter and had a flow velocity of about 1 ft per second, which appeared to be the depositional velocity. Paul responded that there is reason to believe that even in a large resuspension event not all resuspended matter will make it to the Thompson Island Dam. In the same event there is resuspension and deposition, especially for large particles.

Jim Bonner asked if there is any data in the flood plain, and Dan Abramowicz and John Haggard from General Electric said they were not aware of any. Jim then asked how dispersion was being handled and Paul replied that it was only being handled in the loading model.

Ron Sloan added that the 40,000 cfs area affected some of the prime fish habitat in the Thompson Island Pool.

Bob Dexter commented that he assumed that the loading model only concerned bedload and not dispersion in the flood plain. The characterization for the model requires different soil types and compositions, but how do you calibrate? There is currently no information on how the distribution changes. Dr. Nicholson asked if there are any data on past large scale events that may have altered the river since the initial PCBs were deposited. Limnotech replied a grandiose event cannot be modeled; you would have to allow time for the sediments to settle and then proceed with the model from there.

Dr. Ed Garvey pointed out that Limnotech's modeling is very preliminary effort based on data that was given to them to get them started. The planned approach is the important take-home from this discussion, rather than the initial implications of the model.

Dr. Dan Abramowicz asked how sediment loading from the tributaries will be determined. Paul replied that it will be based on whatever information is available. In addition, he stressed that you have to work with the data available.

Bob Dexter asked how the link to chemical substances will be made and Vic replied that there are two parts, calibration and prediction. First, congeners will be selected to represent approximately five K_{oc} (partition coefficient for the compound in question between water and organic carbon; used to characterize the affinity of the compound for suspended matter or sediment related to water) values across a wise span of numbers. Then, you can predict other congeners of interest from the initial calibration. Total PCBs will be modeled, according to best judgement numbers, cognizant that there are uncertainties associated with them. The assemblage of congeners is an unknown because you never know how the composition changes. The selection of the congeners for calibration will include a range of

K_{oc}s. This range can help address different sources or different compositions of PCBs. However, at this stage what will be predicted has not been addressed.

John Brown suggested a simplification to predict levels of PCB congeners in fish. He said since the existing NYSDEC fish database only measured about six peaks as Aroclors, for practical purposes there are only about three K_{ow}s (partition coefficient for the compound in question between octanol and water; used to characterize the affinity of the compound for suspended matter or sediment relating to water). Therefore, comparisons should only look at these. Paul said that type of information is good for calibration and that you can use prediction for others later on. Jon Butcher added currently we are at a first pass stage.

Al asked Jon Butcher to expand upon the congener discussion. Jon presented several sets of data for stretches of the river. The composition of the congeners represented the surface sediments (0-2 cm) and were only a first pass based on 60% presence criteria. Dan asked if different stretches of river would be examined. Jon said probably, based on the majority of congeners correlated to the total. Water column transects (dissolved and particulate phases) were also shown along with the pilot fish samples (n=10). Congeners were compared across media. Congener selection will also be based on what is important in the fish and help us make the interpretation to Aroclors, both real Aroclors and the representation of Aroclors used in previous data. Some congeners are well correlated with each other, and can be predicted from other congeners.

Dan asked it this is the way the whole river will be modeled. Jon replied that the same processes are not being uniformly identified across the whole river, but we want to look at congeners that change across samples leading to a good representation of what's changing. Principal components should be seen as an exploratory data characterization.

Ed Garvey pointed out that what were seeing now are not our final thoughts, but our best thoughts at the moment in terms of what to model.

After a short break, George Putnam presented his data on solids balance and the question of resuspension.

George indicated that a critical point in the model is based on river flow velocity and shear stress. There are complications in getting the calibration: 1) sediment concentration and PCB relationship is poor; 2) sedimentation concentrations are not particularly well related to peak discharges; and 3) high event discharges don't act the same way. Looking at an individual high flow event (peak 35,000 cfs) from April 1982, at the maximum discharge point the [suspended] sediment levels were already falling. The PCB loading appears to be erratic. All data appear to support the decrease of sediment peak before the discharge peak. This is on a very short time scale, so if measurements are only taken on a daily basis they will be missed. In addition, tributaries' watersheds contribute some sediment to the

mainstem concentrations, which can distort the PCB signal, because not all sediments are linked to PCBs.

Dr. Putnam's data was discussed by Dr. Don Aulenbach, Ed Garvey, George Sanders, Doug Tomchuk, Brian Bush, Jim Bonner, Vic Bierman, Jon Butcher and Richard Bopp.

After lunch Doug Tomchuk made a brief statement about how the Phase 2 reports will come out. The Phase 2 reports will come out in five reports. The first two reports to be issued will be the data management report and geochemical report, which may be released by the end of the summer. The public comment period will be approximately 30 days after release of the report. A partial modeling report will also be issued with the remainder of the modeling in the Phase 3 report. The last two Phase 2 reports to be issued will be the human health and ecological risk assessments.

Dr. Jerry Cura then spoke about the bioaccumulation modeling. The bioaccumulation modeling is not as far along as the fate and transport modeling, partially because it is a linear process and bioaccumulation results are dependent on fate and transport results. Ultimately the bioaccumulation model will be driven by concentrations derived by the fate and transport model. Bioaccumulation transfer coefficients will be used to move the PCBs through the food chain. In the water and sediment PCB concentrations will be normalized to sediment. The time period is not determined at this point.

The food chain is viewed in three levels: the zooplankton/phytoplankton, filter feeders and deposit feeders (infaunal). Sediment to biota and water column to biota transfer factors will be calculated. Biota accumulation factors will be normalized to lipid content and sediment PCB concentration will be normalized to TOC. Fish will be defined by habitat and feeding patterns. Migratory species will be separated out due to their unique requirements.

For data, information from the Phase 1 and 2 Reports will be used when possible. Otherwise, literature values or information will be used. Each species will be evaluated according to its feeding habitats. For example, the largemouth bass was shown to feed on 90% fish (piscivorous). Pumpkinseed was looked at as a food for largemouth bass.

Calculations were approached in a probabilistic way using Monte Carlo simulations in an excel spreadsheets. Calculations were run iteratively, with the endpoints of PCB body burdens in the filets of the adult fish for the human health risk assessment. Whole fish body burdens will be used in the ecological assessment. The Monte Carlo analysis produced a range of potential body burdens.

Questions were raised by Dan Abramowicz, Don Aulenbach, Jay Field, and Bob Dexter. The following points were clarified: 1) The end result is a distribution of bioaccumulation factors; 2) The decision hasn't been made as to exactly what will be modeled (PCBs,

Aroclors, congeners); 3) The distribution of bioaccumulation factors will take place across a feeding season; and 4) The probabilistic output will most likely be interpreted in terms of current EPA guidance.

Brian Bush asked if there was a reason to convert water concentrations to TOC. Jerry answered that this was because of lipid normalization. Brian commented that the concept of TOC in water can be nebulous because of all the algae and other material containing organic carbon in the water column. Jon Butcher said that probably water should be examined on a normalized and non-normalized basis. The same question was asked for sediment. At this point, it is difficult to determine what is necessary; what is being done is almost a scoping concept.

Brain Bush mentioned if PCBs are strongly bound to the sediment, there may not be a good chance of the bond being loosened in a fish stomach.

John Brown said that a simplistic approach concentrating on the water and sediment data may be justified based on the data. Jon Butcher replied that we are taking two parallel approaches to look at bioaccumulation, a simplistic empirical approach and a more complex food chain model. Everyone agreed we have to look at what's driving the fish.

Brian Bush said that in a recent experiment, it was shown that the fish had approximately a 10,000 times higher PCB concentration than was in the water. They were fed fish chow. One question left is how fast is the uptake in the fish? Paul Rodgers felt that based on previous work, the lag time question should not dominate the processes.

John Brown said he felt that for the heavier congeners (log K_{ow} > 6.0), most of the PCBs are anticipated to come through the food, rather than the water.

Jon Butcher then spoke about analysis of K_{oc} numbers. Lab reported numbers are between about 3.5 and 8.0, but what you actually see is more in the ranges of 5s and 6s. It was clarified that this number represented congener concentration per unit mass of suspended organic carbon divided by the congener concentration per unit volume dissolved.

Ed Garvey then gave an update of the preliminary analysis so far on the Phase 2 effort. Four different programs have been completed so far. These are:

- Water Column Sampling
- Flow-averaged Sampling
- High Resolution Coring
- Geophysical Surveys

The water column sampling has allowed the Bakers Falls source to be fingerprinted relative to what's entering the water at Thompson Island Pool. Ed showed graphs with preliminary data. This showed a shift from suspended matter-dominated mixture to a dissolved phase-dominated mixture when moving downstream.

The high resolution cores generally indicate no major transport event in the last ten years or so. There were a discussion including John Brown, Bob Dexter, George Putnam and Dan Abramowicz concerning dating and aging of the sediments.

The deposition rate averages out to approximately 1-1.5 cm per year. Looking at the lighter ortho-congeners (final dechlorination products), there does not appear to be a significant amount of dechlorination in the sediments of the lower river. There appeared to be no relationship with time. Brian Bush sees the same sort of pattern.

The geophysical program has mapped the bottom of the river in terms of sediment texture. We have defined fine and coarse grained zones. These zones seem to match up well with the 1984 NYSDEC data (fine grained= hot spots). Ed then showed an example of the bottom of the river, determining fine and coarse grained zones based on reflectivity.

There are three sampling efforts left in the program:

- Archived samples
- Total Suspended Solids (TSS) Sampling
- Low Resolution Coring

The archived sampling program, which should be on-going in the next few months, will examine how the current congener pattern compares to the historic congener pattern. The TSS program will be conducted by Dr. Richard Bopp and should be beginning in the next week or two. The low resolution coring will establish the validity of the 1984 surveys for the current use. This program is scheduled for June.

Doug Tomchuk then opened the floor for questions. He encouraged people to ask the modelers questions, since they would probably not coming back for a while.

Some aspects of the water sampling were clarified, such as which stations had water collected by hand and which stations were taken from bridges. The flow rate during sampling ranged from 3,000 - 20,000 cfs during the 8-month sampling season.

The spatial separation of the model was questioned by Dan Abramowicz. Vic Bierman responded that most likely the Upper Hudson would be divided into 12 segments. Dan asked how this would compare with the remedial options. Vic responded that they should be comparable, but they would be assessed as we move along.

Jay Field asked if the input to the Thomann model on the lower river would be changed, particularly with regard to sediment concentrations. Vic responded that the Thomann Model would not be recalibrated, but the model would be run with different forcing functions.

Bob Dexter asked how dredging and capping scenarios would be treated in the model. Vic said that the model would be affected by remedial alternatives, particularly if the capping had a fine grained, not easily resuspendable cap. In a dredging scenario, the main change would be a reduction in PCB concentrations. Vic stated that the modeling would look only at before and after conditions, and not conditions during the actual remediation.

Dan asked for the definition of quasi-steady state model. Vic responded that this is a time-variable model which operates on a time scale of weeks to months, if only because the calibration data is on that scale.

There was a discussion between Brian Bush and Vic Pierman on what the model will eventually predict. Vic explained there are different approaches, many of which are limited by the data.

John Brown discussed NYSDEC's 1985 caged minnow study in light of bioaccumulation related to the sediment organic matter ratio, rather than the total PCB. The minnow seemed to have similar concentrations to the gravel. Ron Sloan pointed out that there were problems with the study including one cage being exposed to the mud and and suspended sediments accumulating on the cages. John Brown asked what is it that determines fish uptake potential.

Jerry Cura said that even in gravelly sediments the driving force should be TOC, which is why they were normalizing to TOC. Brian Bush brought up Karl Simpson's caddisfly work.

Dr. Nicholson then asked if there were any other questions. He thanked the presenters and said he thought the transport model was well underway, and even though the biota model had just begun, he had a favorable impression of it.

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REASSESSMENT RI/FS
SCIENTIFIC AND TECHNICAL COMMITTEE
8:30 AM, THURSDAY, MARCH 24, 1994
LATHAM, NEW YORK

AGENDA

Welcome and Introduction (5 minutes)	Douglas Tomchuk, USEPA Project Manager
Fate and Transport Modeling Presentation (45 minutes)	Dr. Paul Rodgers, Limno-Tech Dr. Victor Bierman, Limno-Tech Dr. Jon Butcher, Cadmus
Introduction to Fate and Transport Modeling Discussion Topics (15 minutes)	• • •
Discussion on Fate and Transport Modeling (2 hours)	Moderated by: Dr. William Nicholson Mt. Sinai Medical Center
Lunch Break (1 hour)	
Bioaccumulation Modeling (45 minutes)	Dr. Jerry Cura, Menzie-Cura Dr. Jon Butcher
Introduction to Bioaccumulation Modeling Discussion Topics (15 minutes)	• • •
Discussion on Bioaccumulation (2.0 hours)	Moderated by: Dr. William Nicholson
Summary	Dr. William Nicholson

Observers will only be allowed to participate if the STC membership has a specific question of a particular observer.