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US Environmental Protection Agency
Hudson River PCBs Reassessment Remedial Investigation/Feasibility Study
Community Interaction Program

Joint Liaison Group Meeting
May 18, 1999
Albany, NY

On May 18, 1999, a Joint Liaison Group meeting was held at the Albany Marriott, Wolf Road, Albany, NY to present the findings of the Baseline Modeling Report. This report is the fifth of the Phase II investigation reports. The agenda for the meeting is Attachment 1. Sign-in sheets are found in Attachment 2. The use of brackets - [ ] - indicates clarifications made by the writer in cases where the text would otherwise be unclear to those not at the meeting. Copies of the audio tapes recorded at the meeting are available on request.

Ann Rychlenski, United States Environmental Protection Agency (EPA) Public Affairs Specialist and Community Relations Coordinator for the project, opened the meeting with introductions: Doug Tomchuk, EPA Project Manager; Vic Bierman, Limno-Tech, Inc.; Trina von Stackelberg, Menzi-Cura & Associates; and Dr. Ed Garvey, TAMS. Also present from EPA were William McCabe, Deputy Director of the Superfund Program for USEPA Region II; Alison Hess, Project Manager; and Doug Fisher, Attorney. Ms. Rychlenski announced that copies of the Baseline Modeling Report will be available in the repositories. The report will be open to public comment; the comment period closes on June 23, 1999.

The Executive Summary of the Baseline Modeling Report, Attachment 3, contains the salient points around which Mr. Tomchuk framed his presentation (Attachment 4). He began by reviewing the three questions to be answered using the models as tools (page 1, Executive Summary), and emphasized that this is a "baseline" modeling report, supplying comparative information under a "no action" scenario for use in the risk assessments. Remedial alternatives have not yet been evaluated and are not evaluated in this report.

EPA's technical approach is to develop "useful and scientifically credible computer models for use in the human health and ecological risk assessments, and in the Feasibility Study." Credibility of models is based on how they recreate data, and calibration is an important factor in the process. Mr. Tomchuk presented several examples of EPA's calibrations. He then discussed the development of the fate and transport and bioaccumulation models, and touched on key elements of the following individual models:

- Upper Hudson River Toxic Chemical Model (HUDTOX);
- Depth of Scour Model (DOSM);
- Empirical Probabilistic Food Chain Model; and
- Gobas Mechanistic Time-Varying Model (FISHRAND).

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The models that were developed and the analyses they allowed provided EPA with nine findings relating to PCBs in the Upper Hudson River. The remainder of the presentation focused on these findings, which are also described in more detail in the Executive Summary. Mr. Tomchuk summarized with the following points:

- While it is clear [PCB levels in fish] are decreasing, determination of how long it will take for the river to recover depends upon the [PCB level] used as a standard. The next processes in the reassessment, the human and ecological health risk assessments and the Feasibility Study, is where that standard will be determined. Remedial alternatives will be evaluated with the models at the same time.
- Sediments are still contributing to the PCB contamination problem.

Mr. Tomchuk concluded his talk by pointing out that EPA had not yet had an opportunity to look at the General Electric modeling results, and would not be commenting on the report at this meeting. EPA will look at the GE model as part of the comments received on its own model, and will respond in the Baseline Modeling Report responsiveness summary.

A long Q&A and discussion period ensued. Major points are as follows:

Question: Did you develop a mechanistic sediment transport model for both cohesive and non-cohesive sediments?
Response: Mr. Bierman: EPA has [separate] empirically derived submodels for both cohesive and non-cohesive resuspension in the HUDTOX model.

Question: Given that the average PCB concentrations in largemouth bass at Stillwater dropped by 4 ppm from 8 ppm in 1993 to 4 ppm in 1997, and the fish at Thompson Island Pool (TIP) were still at 9 or 13 ppm in 1997, why are the fish at Thompson Island Pool projected to reach 2 ppm sooner at the TIP than at Stillwater?
Response: Ms. von Stackelberg explained that the water concentrations are driving [these numbers]. The hydrograph used that was projected into the future shows that water concentrations below the dam are at certain times of the year higher than above the dam; fish species that are water-dependent reflect this phenomenon. This is still being looked at by analysts. In the historical data, the minor flood event in 1979 [happening early in the modeling period] is translated into the future period is reflected in the fish. If another flow regime were used to drive the model, these results would likely change.

Follow-on question: Given this reasoning, shouldn't you see the same shape of the curve in the TIP, or are the fish models different?
Response: The fish models are not different. Dr. Garvey explained that the results are also a function of the relationship between the hydrodynamics in the TIP and [the hydrodynamics] downstream. The yield of the region above Rogers Island vs. the watershed yield below the TIP produces a balancing effect reflected in summertime concentrations at low flow conditions. The question is 'how is Ft. Edward's flow related to the flow at Schuylerville relative to the yields?'. There were differences in yields in the early periods of the studies, the late 70s and early 80s, with lack of dilution at Stillwater.

Question: Why, when the flows just addressed were less than a 100-yr flood event, the modeling showed that a 100-yr flood would have little or no impact, in fact a modest increase in PCB levels.
Response: Mr. Bierman: Much of the sediment contribution to the water column occurs at low flows, and is

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not associated with flow-driven particle scour. One of the consequences of this, discovered when fish results were combined with exposure concentrations, is that the summer average flows are very important in driving the fish body burdens for those fish receiving their body burdens through the pelagic food chain.

It is actually the summer average flows that determine the degree of dilution that are much more important than the floods/peak flows. When one has a substantial sediment/water PCB mass transfer that is not flow-driven, water column concentrations become quite sensitive to the flood sequences used; what becomes important is the long-term summer average (May through September average) flows. Fish body burdens compared to the degree of dilution indicate that there is a dilution effect: water column concentrations are very much dependent upon the flow sequences. Predictive simulations, particularly the time required to achieve 2 ppm, becomes quite dependent upon the flow sequences in general and the summer average flows in particular. The relationship between summer average flows and Stillwater PCB fish levels is also seen in the historical data (shown in the Baseline Modeling Report).

Question: Mr. Adams expressed concern that EPA used "all the data to calibrate" rather than calibrating up to some time where the agency could then forecast data that is presently available to see if the calibration would in fact forecast what is known to have happened (referring primarily to HUDTOX). He suggested EPA might want to look at doing this.
Response: Mr. Bierman: In comparison to data for 1977 through 1984, where there is much uncertainty, data from 1991 through 1997 reflects more frequent sampling, data sets are more internally consistent, and sampling occurred at more locations, so those data more tightly constrain the model. EPA therefore focused [the calibration on] the period 1991 through 1997 because it was the most data-rich period, and those data had the highest value for constraining the calibration. An attempt was made to calibrate from 1977 through 1997, but the data from 1977 through 1984 were not sufficient to constrain the model.

Question: Suggestion to hindcast and see if the model comes up with the 1977-1984 data.
Response: Total PCBs and congeners were not available prior to 1991. Only tri-plus data are available for the 20-year period, and for the first seven years of that period, those data were not constrained enough to be of value. Hindcasting was done for solids, where a long-term internally consistent data set was available. Calibration focused on the data-rich 1994 high-flow event. Parameters from that calibration were tested against the period 1991-1997, resulting in a very good fit. Then a 20-year solids hindcasting was done using those parameters, again with very good results.

Question: [Given that the forecasts are highly dependent on the flow sequences used,] can you describe the uncertainty in a model that uses one particular sequence of flows through the forecasting period? If a model is so sensitive to the flow sequence, the predictability of the model is not terribly great [using only one flow sequence]. And also please define "flow" sequence in this context.
Response: Mr. Tomchuk: this is one of the areas of uncertainty of the whole modeling effort. There are limitations and assumptions must be made [relative to how much flow will be moving down the river]. Where tools are used for making predictions and then making remedial decisions, it is important that the decision-makers know that there is an area of uncertainty to consider. One of the results [of the baseline modeling] is that EPA will do some additional work to evaluate how much impact different flow sequences have.

Mr. Bierman: The model "balances" water. Flow comes into the river at Ft. Edward and into the mainstem from various tributaries between Ft. Edward and Federal Dam. A flow balance is done by putting in flow data from USGS stations at Ft. Edward and at the tributaries. The flow is added and balance down the river is ascertained. These flows are model inputs developed utilizing a daily time scale from measured USGS gauge data; they are not computed by the model. This was done using data for the years from 1977 to 1997. This is part of the calibration.

To make a forecast, flows and solids need to be predicted and model inputs must be provided. Prior to using the model [as a whole] as a predictive tool, therefore, predictions of the model inputs must be made, and one of those is flows. Analysts could have constructed some kind of an average flow and synthesized a flow sequence, but instead chose to use the flow sequence that actually had occurred for the last 21 years, simply projecting them out for the next 21 years.

Question: Mr. Haggard: What is the next thing to do to help reduce uncertainty in the model? What additional on-going efforts are going to be made to fine-tune the model?
Response: Mr. Tomchuk: on-going activities have not been completely defined yet. Plans include looking at other congeners (BZ 101+90 and BZ 138) and potentially running the forecast into a longer time frame, but the important point is that the report has indicated certain areas where additional work is anticipated as the project goes forward.

Follow-on: Mr. Haggard wanted a professional modeler's point of view, referring to Mr. Bierman, whom he accused of being "tongue-tied."
Response: Mr. Tomchuk explained that Mr. Bierman makes recommendations but that there is a back-and-forth between him and EPA. Mr. Bierman added that the impact of flow sequences on the predictive simulations, and how the response time of the system in terms of fish burdens is impacted by changes in flows, are possibilities for additional investigation, along with solids loadings from the tributaries.

Question: In the calibration or validation of the model, are you using solids input into the system from the time frames 1977 to 1979 at all?
Response: Yes.

Question: Question re TIP average sediment rates for cohesive and non-cohesive areas from 1984 to 1994. Were the rates different?
Response: Yes, they were substantially different. The estimated net burial of solids in cohesive sediments is about 0.4 cm per year, and in non-cohesive sediments the pool-wide [TIP-wide] number was about 0.02 cm per year.

Follow-on question: Mr. Adams: the fact that PCBs are being carried out of the TIP does not say that burial is not occurring, and PCBs are not being buried in certain areas. You could have burial occurring in the fine sediments even though there is a loss [of PCBs] coming out of the TIP.
Response: Mr. Bierman: PCBs sorb to/stick to solids. One cannot accurately describe PCB dynamics without solids dynamics. Although the data tell us that the TIP is net depositional, and there is solids burial that occurs in the TIP, that does not mean there is not PCB mass transfer from the sediments to the water column. The data are consistent with solids burial in the TIP and PCB loss from the pool. What happens on a pool-wide basis and what happens at certain locations must be distinguished; both spatial and temporal variability are factors.

Follow-on question: Of the 2000 kg of PCBs [emanating from the TIP], how much came from fine-grained and how much from coarse-grained sediments? Do you have different mass transfer coefficients [for the other processes]?
Response: Mr. Bierman: The PCBs do come from both cohesive and non-cohesive sediments; most of the sediment-to-water mass transfer of PCBs in the TIP is from non-flow-dependent processes. We have different mass transfer coefficients for bioturbation, or biodiffusion. We have a mass transfer coefficient that we apply

to the sum of DOC-bound and truly dissolved phase. That coefficient is much higher than molecular diffusion, and it differs between cohesive (where more benthic activity occurs) and non-cohesive sediments.

Question: Are the non-flow-dependent processes proven mechanisms, or are they just hypotheses?
Response: Mr. Tomchuk: These are some processes that may cause [sediment-to-water transfer]. They are well-documented mechanisms in other systems and in the literature.

Dr. Garvey: the mechanisms themselves are not hypotheses; you can observe them. The question is, is their magnitude sufficient to drive the source?

Mr. Bierman: In attempting to calibrate solids and PCB concentrations in the sediment, and in attempting to match the observed in-river, mainstream fluxes of solids and PCBs, it was evident that PCBs were being transferred from the sediments to the water column. It also became evident that more PCBs were being transferred from the sediment to the water column than could be explained by solids resuspension; other processes had to be occurring to transfer PCBs from sediments to the water column that did not also simultaneously transfer solids.

One process that occurs is molecular diffusion, but not enough molecular diffusion occurs to match the data; something else must be happening. It is well known that the presence or absence of benthic organisms greatly enhances the sediment/water mass transfer of PCBs. We cannot be sure whether the process of bioturbation by itself is the sole explanation for the mass transfer coefficients that are needed in the model calibration to match the data. These other explanations are offered as other possible explanations as to why the transfer of PCBs from sediments to the water column could be enhanced beyond just simple molecular diffusion.

Question: Are you biasing the predictions by assigning a higher exchange coefficient to cohesive areas, therefore ascribing a mechanism of enhanced flux from those sediments?
Response: Mr. Bierman: There is a "trading range" in terms of [the magnitudes of the rates of exchange of] the processes that can be ascribed to [occurring in the areas of cohesive sediments and to non-cohesive sediments. The data do not allow sharp discrimination between processes particular to cohesive sediments and those particular to non-cohesive sediments. There is a range of uncertainty.

Question: Mr. Haggard: How can one get access to the modeling computer codes? It would be helpful if they were available to help in making comments on the report.
Response: Mr. Tomchuk stated he did not have the answer as to when, but it would have to be decided at what point in the process they would be available. It is not likely they would be available by June 23.

Follow-on Question: Once they are available, it would not be unreasonable to provide additional time to comment? You won't shut the comments down on the 23rd, and never look at comments again?
Response: Mr. Tomchuk: We have always accepted comments on other reports, and we have a final responsiveness summary after the Proposed Plan. We have a record established of looking at comments.

Question: EPA uses the 2 ppm FDA level as a target, refers to Great Lakes 1.1 ppm, and then refers to a 5.5 pm level. What level is needed to be protective of fish-consuming wildlife? What will be used as the target, and how are you going to determine that?
Response: Mr. Tomchuk: The level chosen makes a big difference in when projections say an acceptable level has been attained. Two ppm is the FDA action level for fish going into the commercial market because a

certain level of dilution is assumed. This is not meant to protect a local fisherman on a water body. A recreational fisherman would be exposed to fish only from that water body, and one generally would have more protective [ppm action] levels.

The Great Lakes numbers are 1.1 to 1.9 ppm looked at for consuming six fish meals per year under the Great Lakes sport fish advisory. New York has not adopted the Great Lakes advisory, but it is another point of reference. EPA will look at risk-based numbers from its site-specific risk assessments, and at whatever other standards are available that would be applicable, in the Feasibility Study to determine what the appropriate goal is. There are many potential values that can be assigned. Two ppm is actually the standard used to determine whether New York State sets an advisory on a water body; it has some value but it does not ensure for a Superfund site that there is no risk from consuming fish at that site.

Question: In a graphs showing water concentrations at the TIP, in the later years of the simulations, approximately 50 percent of the water load was attributed to what is coming in upstream. Given that the pelagic food web is important, is it that 50 percent of the fish in those later years are from upstream sources?
Response: Ms. Von Stackelberg indicated that in her opinion it was not a direct linear connection. There are plans to run zero boundary condition for the purposes of the report.

Question: Could you use a variety of flow regimes in a predictive capability? Would that be useful?
Response: Mr. Bierman: Yes, we can; yes, it would be useful; and yes, we will do it. The flow every day of the 21-year forecast simulation flows were the same as they were every day during the 1977-through-1997 21-year hindcast. Especially after seeing results that appear to indicate that the flows do matter, it is important to do forecasting simulations under several different alternative hypotheses, one of them being alternative flows. We did not go back farther [in time] because the dam was removed in 1973 and that could have changed the hydraulics. Among the options: we could project the 21 years again for a 42-year simulation, or we could construct a simulated hydrograph and repeat that for a period of time, superimposing different flows onto it.

Questions: Mr. Haggard: 1)The estimates in the calibration period '84 to '94 indicated that approximately 2,000 kg of tri+ PCBs exported from the TIP, which is somewhere about 15 percent of the PCBs exported from the pool during the simulation. Looking at the Low Resolution Coring Report analysis, it indicates that on a tri+ to tri+ basis, upwards of 80 percent of PCBs are lost. 2) Let's say you have the five to 59 percent range, though "if you did tri+ to tri+ it's higher"... 3) So it's 15 percent; using a much more rigorous analysis, you got 15 percent, so that's your best estimate at this point, not the 40 percent.

Responses: 1) Mr. Tomchuk: No. When you take into account dechlorination, there was an average of 43 percent, with a range from five percent to 59 percent. 2) We did do tri+ to tri+. 3) They're different. The finding for the Low Resolution Coring Report was that the cohesive sediments with concentrations greater than ten grams per square meter lost PCBs in the five to 59 percent range, giving the 43 percent median value. That finding says it is not in the cohesive sediment; it does not say it went over the dam. It is within the uncertainty range.

Follow-on Question: Does the non-cohesive sediment inventory go up to the amount that would account for the difference between 43 and 50 [percent]? Did all the material in your model actually go from cohesive to non-cohesive, so you had a net increase, a significant increase, in PCBs in the non-cohesive sediment in that period? So the model shows an increase in the inventory over the ten-year period in the non-cohesive? Of 25 percent of the inventory [going] from cohesive to non-cohesive?
Response: Mr. Bierman: There was redistribution between cohesive and non-cohesive [sediments] We are losing PCB mass from both cohesive and non-cohesive by flow-driven resuspension as well as non-flow-driven

processes. I do not have the break-out numbers for changes in cohesive and non-cohesive. We broke it into total mass loss for the sediment, which is approximately 15 percent of the inventory over that period. The five to 59 percent range corresponds to the change of mass in [the mass that left] the hot spots, or the most highly contaminated cohesive sediment areas. Not all left the pool. Some was redeposited either in the non-cohesive sediments or in less contaminated cohesive sediment areas. This range does not represent the PCB mass that left the sediments and left the pool; [EPA's] 2,000 kg number represents the PCB mass that left the sediments AND left the pool.

Question: 1) What other models and sites did you look at that might have given you insights into the approach for this model? 2) Could you take the model used here and use it elsewhere?
Response: Mr. Bierman: 1) Mass balance transport and fate models such as this have been in wide use for several decades; used in many systems, rivers, and lakes. Mr. Bierman cited similar modeling in the James River and the Great Lakes. The HUDTOX model is a conceptual descendent of a PCB mass balance model of Green Bay, an EPA-funded site-specific study in the early 90s. 2) The principles of mass balance are generic and global. The principle of conservation of mass stands by itself as a fundamental principle of physics; the application of that principle, how tightly you can constrain a mass balance [model], is a function of the data available for a site. We need to draw a distinction between the model itself, the conceptual framework, the equations, which all balance mass, and the application of the model to a given site. The model is generic, based on fundamental principles of physic, but its application is always site-specific.

Question: Will the modeling report be peer reviewed, and if so, when?
Response: Mr. Tomchuk: The modeling will definitely be peer reviewed, as will the risk assessments. The peer review would happen sometime in the fall.

Question: A follow-on request for EPA to look at GE's modeling report in addition to its own generated considerable discussion about EPA's peer reviewing GE's report. It was suggested that EPA do that, and if not, why not.
Response: Both Mr. Tomchuk and Mr. McCabe spoke to the issue. Mr. Tomchuk began by saying that EPA was looking at GE's information. EPA will prepare a responsiveness summary prior to the peer review. EPA will take the GE model, look at it, and treat it as a comment in the responsiveness summary, along with GE's other comments highlighting the differences and issues. EPA will respond to all this, and will update the [EPA] model as appropriate, resulting in a predictive tool that will address the issues that are raised. This is what has been done previously: EPA looks at the comments, resolves the issues to its satisfaction, and gives it to the independent group to ascertain if the right decision was made.

A side-by-side peer review of the two documents would not occur. A peer review is to review a certain document, not to compare two documents. The peer reviewers have gotten all GE's comments in the past, and they will continue to do so.

Various comments during the discussion: 1) The peer review process is "not working" and is "not satisfying any of us," generating disagreement from the audience: "Any of who?" 2) If EPA did not peer review GE's model with theirs, it indicated EPA may lack confidence in its model; 3) The only way to ensure good science is for all material to be peer reviewed; 4) It would be in EPA's interest to have the panel look at both studies; 5) Suggestions to use the same peer reviewers for the next review(s); 6) The process is a dispute perpetuation process, not a dispute resolution process, as long as there are parallel tracks with GE going down one and EPA the other. The only way to resolve that dispute...is to have the same individuals evaluate both products; 7) The results from the model will go into the risk assessment, the basis for evaluating the need for remedial action. Because this is so critical, everything [should] be done that needs to be to be sure the general public has confidence [in the final model]. GE and EPA cannot objectively evaluate each other's model; therefore let the independent body evaluate both.

Question: This model was used in risk assessments that will be available in August of this year, prior to peer review. What happens if peer reviewers say there is a problem and it has already been used? Should we not get the model peer reviewed before we proceed with any other step?
Response: The risk assessments will also be peer reviewed. If the peer review [of the modeling report resulted in] a significant change, the risk assessments would have to be adjusted prior to any decision's being made. Risk assessments have a wide range of factors in their results [factors of ten]; overall predictive capabilities of the model are within the uncertainty range of the risk assessment values. The [existing] model calibrated well to [known] data. This is not to say that is couldn't be adjusted, but it is not necessarily true that the model must be peer reviewed prior to taking the next step. Rather, before a decision is made based on [the cumulative set of reports], the model must be peer reviewed.

Question: 1) What number have you decided to use for meeting your recovery definition in your selection of the remedy process? 2) Regarding the term "increase in contamination" in objective 3, would EPA consider any increase? Or is the term related to something EPA already has in mind? 3) Since this modeling effort is all directed at recovering to certain levels in fish, and fish consumption, will there be a "risk of remedy" element calculated as part of the remedy selection process - a comparative risk assessment comparing the risks of remedies vs. the risks being identified with this process?
Response: 1) EPA has not decided the number. That will be done in the Feasibility Study. That decision involves two things: calculating risk and determining what would be an acceptable risk, and then doing the back calculation into [PCB] concentrations from the modeling results. Also, EPA looks at standards that are applicable at the time; at present, there are none. 2) That objective was for [a scenario] where a flood caused a terrible event that would turn up everything that was buried and move it down the river, thus resetting the conditions. 3) There will be a risk assessment done in the Feasibility Study, comparing effectiveness of different remedies (concentrations after the remedy is implemented). This assessment does not necessarily calculate risks during the actual implementation period.

Observation: EPA would not be opposed to having GE do a peer review on its own study. Normally it is the responsibility of the group or entity doing a study to arrange for a peer review of that study if they want one done, and that all information is available to the peer review group if they want it.
Response: Mr. Tomchuk agreed, and stated the information is available in two fashions. GE's comments are recreated as part of the responsiveness summary that is given to the peer reviewers, and, as he understands it, GE sends the peer reviewers information separately.

Question: 1) When will EPA's model be presented to the Scientific and Technical Committee? 2) Will there be an opportunity for the GE model to be presented to that committee?
Response: 1) The date is June 16, but the location has not yet been established. 2) We have a volunteer STC group, it is EPA's panel, and they look at EPA's work. If [GE] wants to invite them, and they showed up on their own accord to look at GE's information, not as EPA's STC on the Hudson River, that is GE's choice. EPA did not empanel this group to look at GE's work.

Question: Why does this always have to be so confrontational? It blows my mind that you won't be more open-minded and accept all the scientific information you can to come up with the best possible solution. Why don't you come out with the best of both [models]?
Response: Mr. Tomchuk: I think your premise is unfounded. If you look at the comments from the peer reviewers for the DEIR and Low Res Coring [Report], they were impressed with the number of changes we've

made based on comments. We've made changes based on comments throughout. Why do we have to look at the document per se if we are looking at the issues? If we do adopt the aspects of the GE model and plug that into our model, that's not acceptable to most people here. You have said that *is* acceptable - and that's what I have said we are going to do in the responsiveness summary, and we will have revised models at that time, based on the comments we receive. The responsiveness summary reflects the revised model.

Question: GE's reports are not in the form of comments; they are independent analyses. How will you develop a responsiveness summary to something that is not a comment document?
Response: We will look at differences we perceive in the two models and issues that are raised [by those differences], and evaluate which [approach] is better. We will break it down issue by issue, and GE will highlight all those issues in the comments. Between the two, we will cover all the scientific issues. If we cover everything, and incorporate changes as appropriate to our model, I am not sure why the GE model per se is so critical.

Comment: You are evaluating one element: you decided to look at fish, and then you are going to make a decision. You are not going to assess the risks, potential harm, and impacts of your decision. You can't lose sight of the fact that your decision impacts the communities that have been meeting with you for a decade. I suggest you assess the risks of the remedy as part of your decision-making process.
Response: Mr. Tomchuk: we try to implement a remedy that will provide protective levels for human health and the environment. When you look at long-term lifetime exposure scenarios rather than at other short-term exposure scenarios, the time for implementation of a remedy generally doesn't increase the exposure that much. We will take the suggestion under consideration.

Question: A thick responsiveness summary will not give the people on Main Street the answers they need. Peer review of both models will give the people on Main Street the answers they need.
Response: Mr. Fisher clarified what peer review should accomplish. The peer review is being conducted in accordance with EPA's peer review policy: we subject major scientific agency work that support decisions the agency makes to peer review, to ensure that those decisions are made on the basis of credible science. The purpose of the peer review is not to have peer reviewers judge among different approaches and select what they perceive as "the best" among alternative approaches. They are charged to determine whether EPA has done its science in a credible way. The peer reviewers are given the benefit of GE's as well as other comments on the model; they will see the criticisms other people have raised on the model.

Comment: "...The people on Main Street aren't going to be able to understand the differences between strengths and weaknesses of two different models. What they need to know is that EPA checked their work with independent experts, and their decisions are based on work that people think - not everybody - is sound. That's the bottom line. There's always going to be people in public policy debates that disagree with a decision a governmental agency makes....All models have strengths and weaknesses, even GE's models have weaknesses. You can't eliminate all the weaknesses; it's getting them into a range of uncertainty that is acceptable given the science that is out there. That's what environmental agencies try and do; that's all they can do....All we can do as citizens is ask EPA to do their science, ask the hard questions, and come up with the best answer...that everyone can live with."

Comment: Mr. McCabe again addressed the purpose of the peer review. The most appropriate way to go is: "here's what the agency is putting forward; will it get the job done?" Any other comments - GE, citizen, group - will go into the responsive summary and will have to be answered, and changes will be made to the model if necessary just as changes have been made to other reports. The point is, will [EPA's model] get the job done? If it won't, we have to change it. It's really that simple. If you say it won't, tell us why not.

Follow-on: The speaker disagreed with the supposition that a joint peer review of both EPA's and GE's models will bring everyone to the same point of view. He felt it would be good if both studies are peer reviewed, but it is not essential that they be done at the same time. He also pointed out that all information will be looked at, regardless of where it comes from, and noted potential impacts added work would have to the schedule.

Question: What happened to the May 5 meeting, and will it be rescheduled?
Response: EPA needed the time to prepare for the release of the BMR, and ran into scheduling conflicts because the same people were involved in both. EPA is looking at the usefulness of that meeting and whether or not it will be rescheduled. We are well beyond the topics on the table for that meeting.

Question: Ms. Ruggi: 1) When the PCB issue was first addressed, the federal limit on PCBs was 5 ppm. Just about the time we reached that, [the limit] was dropped to 2 ppm; .05 is about 40 times lower than 2 ppm. Are we looking...to again drop that [acceptable] level? 2) Why would EPA say it would "go as low as" 1.1, etc?
Response: 1) The 0.5 [not .05] [was mentioned] to show that none of the levels reached that. Understanding of the risk from these chemicals has increased since 1984; there were discussions for seven years prior to lower the FDA level, which did occur in 1984 [to 2 ppm]. EPA has always said that the FDA level is not the applicable standard for Superfund risk and has not used it as a standard or an objective during the last eight years [of the project]. It is a point of comparison for many reasons, but EPA always said it would do a risk-based calculation.

2) When analyzing acceptable risk, you must calculate the exposure a person has. [Given basic assumptions such as average weight] what we are really looking at is the concentration in fish and the number of fish meals [people] eat per year. The 1.1 number was from the Great Lakes Sport Fishery Advisory program for recreational fishermen, fishing on and consuming fish from a particular water body. These are the recommended values; they change if the toxicity values change. Current toxicity values are based not as much on cancer as on non-cancer effects - reference doses multiplied by the exposure calculation to determine the hazard index. In Superfund we look at from 10^{-4} to 10^{-6} cancer risk (one in 10,000 to one in 1,000,000 increased chance of getting cancer from consuming recreationally caught fish) and at the hazard index, which is 1. Greater than 1 presents a problem.

Two ppm is where New York State implements a fish advisory on a water body. Lifting an advisory on that basis does not necessarily mean that there is no risk on a Superfund-type risk analysis: if a person consumes a number of fish meals from the Hudson, even if there were no advisory, it could cause a risk. The analysis is not complete yet.

Mr. Tomchuk closed the meeting by reminding the audience of the availability sessions to discuss the report scheduled for June 15, 1999, from 2:30 to 4:30 PM and 6:30 to 8:30 PM at the Marriott on Wolf Road in Albany.

ATTACHMENT 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

U.S. EPA Hudson River PCBs Reassessment
Community Interaction Program

Phase 2 Baseline Modeling Report
Joint Liaison Group Meeting
Tuesday, May 18, 1999
7:30 p.m.
Albany, New York

AGENDA

Welcome & Introduction	Ann Rychlenski, Public Affairs Specialist, U.S. EPA
Presentation on Baseline Modeling Report	Doug Tomchuk, Project Manager, U.S. EPA
	Vic Bierman, Limno-Tech, Inc. Trina von Stackelberg, Menzie-Cura & Asso. (Contractors to EPA)

Questions & Answers

ATTACHMENT 2
1-3

US ENVIRONMENTAL PROTECTION AGENCY
HUDSON RIVER PCBs REASSESSMENT
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

Community Interaction Program
Joint Liaison Group Meeting
Albany, NY
May 18, 1999

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Paul McDowell	New York Farm Bureau	
Robert Gibson	General Electric One Computer Drive So. Albany, NY 12012	GE
Sage Ruckterstuhl	17 Euclid Ave Delmar NY 12054	475 9548

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US ENVIRONMENTAL PROTECTION AGENCY
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May 18, 1999

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John J. Santacrose	PO Box 3705 Albany, NY 12203	Environmental Liaison Group
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ATTACHMENT 2
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US ENVIRONMENTAL PROTECTION AGENCY
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Albany, NY
May 18, 1999

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BRAD CUSHING	EXTON, PA	APPLIED ENV. MGT., INC.

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US ENVIRONMENTAL PROTECTION AGENCY
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May 18, 1999

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ATTACHMENT 3
3-3

US ENVIRONMENTAL PROTECTION AGENCY
HUDSON RIVER PCBs REASSESSMENT
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May 18, 1999

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ATTACHMENT 3

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Baseline Modeling Report
Executive Summary
May 1999

This report presents results and findings from the application of mathematical models for PCB transport and fate and bioaccumulation in the Upper Hudson River. The modeling effort for the Hudson River PCBs Site Reassessment has been designed to predict future levels of PCBs in Hudson River sediment, water and fish. This report provides predictions under baseline conditions, that is, without remediation (equivalent to a No Action scenario). The outputs from the models, baseline sediment, water and fish PCB concentrations will be used as inputs in the Human Health and Ecological Risk Assessments. Subsequently, the models will also be used in the Feasibility Study (the Phase 3 Report) to evaluate and compare the impacts of various remedial scenarios.

The Baseline Modeling Report (BMR) consists of four books. Books 1 and 2 are on the transport and fate models, with Book 1 containing the report text and Book 2 containing the corresponding tables, figures and plates. Similarly, Books 3 and 4 are on the bioaccumulation models, with Book 3 containing the report text and Book 4 containing the corresponding tables, figures and plates. Predictions from the transport and fate models are used as input values for the bioaccumulation models.

Modeling Objectives - The overall goal of the modeling is to develop and field validate scientifically credible models in order to answer the following principal questions:

1. When will PCB levels in fish populations recover to levels meeting human health and ecological risk criteria under continued No Action?

2. Can remedies other than No Action significantly shorten the time required to achieve acceptable risk levels?

3. Are there contaminated sediments now buried that are likely to become "reactivated" following a major flood, possibly resulting in an increase in contamination of the fish population?

The work presented in this Baseline Modeling Report provides information relevant to the first and third questions. Predictions regarding the potential impacts of various remedial scenarios, the second question, will be conducted in the future and be presented in the Feasibility Study (the Phase 3 Report).

Model Development

A large body of information from site-specific field measurements (as found in Hudson River Database Release 4.1), laboratory experiments and the scientific literature was synthesized within the models to develop the transport and fate and bioaccumulation models. Data from numerous

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sources were utilized including USEPA, the New York State Department of Environmental Conservation, the National Oceanic and Atmospheric Administration, the US Geological Survey and the General Electric Company.

The proposed modeling approach, a description of the data sets to be used for calibration, and demonstrations of model outputs were made available for public review in the Preliminary Model Calibration Report (PMCR), which was issued in October 1996. In addition, in September 1998, an independent peer review was held on the modeling approach. The modeling framework of the PMCR was revised based on the peer review and public comment. A major revision was the addition of a mechanistic bioaccumulation model, the Gobas Model, as described below. Because of the many uncertainties inherent in modeling bioaccumulation, EPA has used a weight-of-evidence approach employing three different bioaccumulation models at varying levels of complexity, ranging from empirical to mechanistic.

The following models were developed and calibrated for the Baseline Modeling Report:

HUDTOX - The backbone of the modeling effort is the Upper Hudson River Toxic Chemical Model (HUDTOX). The HUDTOX model covers the Hudson River from Fort Edward to Troy, New York. HUDTOX is a transport and fate model, which is based on the principle of conservation of mass. It balances inputs, outputs and internal sources and sinks for the Upper Hudson River. Mass balances are constructed first for water, then sediment and then PCBs. External inputs of water, sediment and PCBs are specified from field observations. Once external inputs are specified, the internal model and system outputs, can be calibrated against field observations. Outputs of PCB concentrations in water and sediment from HUDTOX are used as inputs for the forecasts of the bioaccumulation models.

Depth of Scour Model (DOSM) - The Depth of Scour Model was developed to provide spatially-refined information on sediment erodibility in response to high-flow events such as a 100-year flood. The DOSM model is a two-dimensional, GIS-based sediment erosion model that was applied to the Thompson Island Pool. It is linked with the output from a hydrodynamic model that predicts the velocity and shear stress (force of the water acting on the sediment surface) during a flood. The model was also used to develop relationships between river flow and cohesive sediment resuspension. These relationships were used in the HUDTOX model for evaluating flow-dependent resuspension.

Bivariate BAF Analysis - The Bivariate BAF (Bioaccumulation Factor) Analysis for fish body burdens looks at the data for sediment and summer average water-column PCB concentrations (two variables or "bivariate") and compares them to measured PCB levels in fish tissue. This allows for the interpretation of the relative importance of water and sediment sources to a particular species of fish, in turn reflecting its feeding behavior. As the BAF calculated from this model does not take into account causal relationships, this analysis has limited predictive capabilities compared with the more mechanistic models, described below.

ATTACHMENT 3
2-4

Empirical Probabilistic Food Chain Model - The Empirical Probabilistic Food Chain Model relies upon feeding relationships to link fish body burdens to PCB exposure concentrations in water and sediments. The model combines the information from available PCB exposure measurements with knowledge about the ecology of different fish species and the relationships among larger fish, smaller fish, and invertebrates in the water column and sediments. The Empirical Probabilistic Food Chain Model provides information on the expected range of uncertainty and variability around average body burden estimates (in contrast to the Bivariate BAF Analysis, which just provides the average body burden estimates).

Gobas Mechanistic Time-Varying Model (FISHPATH and FISHRAND) - As a result of the peer review for the Modeling Approach held in September 1998, it was determined that a time-varying, mechanistic model should be included in the suite of models being used to evaluate the potential for PCB uptake into fish tissue. Consequently, two additional mechanistic models were developed describing the uptake, absorption and elimination of PCBs in fish over time. The models are based on the approach of the peer-reviewed uptake model developed by Gobas (1993 and 1995). This is the same form of the model that was used to develop criteria under the Great Lakes Initiative (USEPA, 1995). Two versions of the model were developed for the Reassessment, a deterministic version (average body burdens) referred to as FISHPATH, and a probabilistic version (the average body burdens including estimates of uncertainty and variability, predominantly variability) referred to as FISHRAND. The predictions of future fish tissue concentrations from FISHRAND will be utilized for estimating potential risk in the Human Health and Ecological Risk Assessments.

MODEL CALIBRATION

The HUDTOX model was calibrated for four different forms of PCBs: total PCBs, Tri+, BZ#4, and BZ#52. Total PCBs represents the sum of all measured PCB congeners and represents the entire PCB mass. Tri+ represents the sum of the trichloro- through decachlorobiphenyl homologue groups. This allows for the comparison of data that was analyzed by congener-specific methods with data analyzed by packed column methods that did not separate the various PCBs as well and did not measure many of the mono- and dichlorobiphenyls. Therefore, use of the operationally defined Tri+ term allowed for a consistent basis for comparison over the entire period for which historical data were available. BZ#4 is a dichloro congener that represents a final product of PCB dechlorination in the sediments. In addition, the physical and chemical properties of BZ#4 are different from the other forms of PCBs (*e.g.*, it is more soluble and has a lower partitioning coefficient), which adds to the rigor of the calibration. BZ#52 is a tetrachlorobiphenyl that was selected as a normalizing parameter for congener patterns based on its presence in Aroclor 1242, the main Aroclor used by General Electric at the Hudson River capacitor plants, and due to its resistance to degradation or dechlorination in the environment.

A long-term hindcasting application was conducted for Tri+ for the period of record, from 1977 to 1997. However, the period from 1977 to 1984 had limited PCB data for estimating external Tri+ loadings. The uncertainty introduced by this limited PCB data required that an additional PCB load be added in order for the model to match sediment concentrations in Thompson Island Pool in 1984 and water column observations downstream. Consequently, the long-term hindcast calibration for Tri+ was actually only conducted for the period from 1984 to 1997.

The period from 1991 to 1997 was the principal focus of the calibration effort because this period was relatively data rich in terms of parameters measured, spatial-temporal coverage and data quality. Applications for this period included all four PCB forms: total PCBs, Tri+, BZ#4, and BZ#52.

The HUDTOX model was successful in representing the hydraulics, solids and PCB dynamics of the Upper Hudson River over the historical period of record. This period was characterized by a significant transition from an early phase of high upstream PCB loads, followed by a long declining phase to present-day conditions with upstream PCB loads now very close to detection limits. Results from the HUDTOX calibration applications were consistent with the magnitudes and trends of the best available data for the historical period.

MODEL FORECAST

The models were run for a forecast period of 21 years beginning January 1, 1998. The 21-year time frame was selected because it matched the time frame of the 1977 to 1997 hindcast. All flows, solids loadings and other external forcing functions were the same as those used in the hindcast, with the exception of PCB concentrations at Fort Edward. The initial PCB concentrations for the forecast were the same as the final PCB concentrations from the 1991 to 1997 calibration simulation. Forecast simulations were run for two different assumptions for PCB loadings at the upstream boundary at Fort Edward: first, water column PCB concentrations were held constant at a level equal to the annual average PCB concentration that was observed in 1997 (9.9 ng/l); and second, water column PCB concentrations were held constant at zero. Note that these simulations assume that there will be no future load increases from any upstream sources. In particular, it was assumed that during the forecasts PCB migration from the GE Hudson Falls Plant site would not increase and that there would not be any type of event similar to the releases that occurred with the alleged partial failure of the Allen Mill gate structure in 1991. Based on the expectation that the PCB load from the GE Hudson Falls Plant site would decrease in the future due to the implementation of remedial measures there, these forecasting simulations were designed to bound the estimates of system responses.

Appropriate target levels for fish body burdens have not yet been established. In the Feasibility Study, site-specific target levels to be protective of human health and the environment will be developed from the risk assessments. However, it is beneficial at this time to compare forecasted fish body burden levels against certain available criteria as a matter of perspective. These include: the 2 ppm wet weight Action Level used by the Food and Drug Administration (FDA) for regulating fish in commerce, and the Great Lakes Sport Fish Advisory Task Force values of 1.1 ppm wet weight for consumption of six fish meals per year, and 0.2 ppm wet weight for consumption of one fish meal per month. Again, these are not endorsements of these values for decision making, and appropriate values will be developed in the Feasibility Study for the site.

ATTACHMENT 3
3-4

Forecasts using the mechanistic Gobas model, FISHRAND, were run only under the constant upstream boundary condition because predicted sediment and water exposure concentrations from HUDTOX were virtually the same for the constant and zero upstream boundary conditions, which would result in virtually the same body burden predictions. Species modeled were largemouth bass, brown bullhead, yellow perch, white perch and pumpkinseed. The reported time period for achieving target values for fish body burdens may extend beyond the 21-year forecast period after consideration of the uncertainty around the best estimated values.

MAJOR FINDINGS

The primary objective in the modeling effort is to construct a scientifically credible tool to help in the understanding of PCB transport and fate and bioaccumulation in the Upper Hudson River, and to use that tool for making forecasts of what will happen in the future. As such, one of the major findings was that it was possible to construct a suite of models that generate output that matches the observed data reasonably well. Subsequent to this report, the model predictions can be used to evaluate ecological and human health risks and to assess the time it takes for the river to recover under various remedial scenarios.

There are numerous general observations about the river that are apparent from the mass balance exercises. Some important observations that impact USEPA's understanding of the system include: the tributaries along the length of the river contribute the vast bulk of the solids load carried by the system; the river is net depositional in the Thompson Island Pool and apparently also in the downstream reaches; and, the models indicate a gradual decline in the mass transport of PCBs down river over time.

Beyond the general observations above, the development of the models and the analysis of model outputs have provided USEPA with the following findings regarding PCBs in the Upper Hudson River:

1. The future projection for PCB concentrations in the water column is controlled by inputs from the sediment. Although the constant upstream PCB load in the forecast simulations contributes to the PCB concentration in the water column, the shape of the response curve is set by the sediment-to-water PCB fluxes.

    - Predicted PCB concentrations in the surface sediments are **not** controlled by PCB loads generated above Fort Edward. Sediment PCB concentrations are controlled primarily by sediment-to-water flux and exchange between deep and surface sediments.

    - Water column PCB concentrations are influenced by upstream PCB loadings, with the relative degree of influence increasing with time, due to declining PCB concentrations in the surficial sediments.

2. A 100-year peak flow event would not be expected to have substantial impacts on the recovery rate of the Upper Hudson River.

   - The models predict that approximately 60 kg (130 lbs.) of PCBs would be lost from the Thompson Island Pool in response to a 100-year peak flow (47,330 cubic feet per second).

   - Long-term, summer average PCB concentrations in the water column with and without the 100-year peak flow are virtually indistinguishable one year after the event. (Note that this does not account for potential impacts from PCBs that moved into the Lower Hudson River.)

3. Although there has been net deposition of sediment in the Thompson Island Pool (as well as the entire upper Hudson), there have been losses of PCBs from the sediment. In other words, net deposition does not mean that PCBs will be unavailable to the water column. For example, from 1984 to 1994 (the same time frame analyzed in the Low Resolution Sediment Coring Report) the model estimated that 2000 kg of Tri+ were lost from the Thompson Island Pool sediment inventory, while at the same time 1.6 cm of net sediment deposition occurred on a poolwide basis.

4. There is a contribution of PCBs from the sediment that is not dependent on the flow of the river. Some of the processes that may cause non-flow dependent resuspension are: wind driven dispersion, bioturbation by benthic organisms, bioturbation by demersal fish, mechanical scour by propwash, boats and floating debris, and uprooting of macrophytes by flow, wind or biological action. Such a non-flow dependent load is important because the model calibration suggests that approximately 80 percent of the total PCB transport down the river from 1991 to 1997 took place during low-flow periods.

5. Forecasts for the FISHRAND model suggest that largemouth bass will achieve 2.0 ppm on an average wet weight basis between 2008 and 2014, with the best estimate of 2011 for river mile 189 (within the Thompson Island Pool), and between 2011 and 2019 (best estimate 2015) for river mile 168 (Stillwater) under constant upstream boundary conditions. Largemouth bass average values will not achieve target levels of 1.1 ppm or 0.2 ppm within the 21-year forecast period at these locations. In addition, the 95th percentile value (a statistically important value that is frequently used in evaluating a high-end risk and/or as part of the evaluation of uncertainty around the range of predicted values) will not achieve any of the target levels in the forecast period. Note that the target levels are for comparison purposes only, and that appropriate levels will be determined in the Feasibility Study.

6. Forecasts suggest that for river mile 189, average values for yellow perch will achieve 2.0 ppm between 2007 and 2014 (best estimate 2010), and 1.1 ppm between 2015 and 2021. 95th percentile values would not reach any of the targets within the forecast period. Average yellow perch values will achieve 2.0 ppm between 2008 and 2014 (best estimate 2011) for

ATTACHMENT 4-4

river mile168, but the lower target values and the 95th percentile values will be not reached within the forecast period.

7. For brown bullhead, the average fish body burden is forecasted to reach 2.0 ppm between 2014 and 2020 (best estimate 2017) at river mile 168. Within the 21-year forecast period, no other target levels will be achieved for average brown bullhead at river mile 168, and none of the target levels are achieved at river mile 189.

8. At river miles 157 and 154, forecasts for all species modeled achieved the FDA action level of 2 ppm by 2021, even at the 95th percentile value.

9. For all locations and species modeled, predicted average body burdens did not fall below 0.5 ppm within the 21-year forecast period.

SUMMARY

The principal processes that control contemporary PCB dynamics in the Upper Hudson River are hydraulics, external solids load, sediment-to-water fluxes, water-to-air fluxes and PCB fate in the bedded sediments. It appears that the river is currently on the tail of a long PCB washout curve controlled largely by the rate at which PCBs are being reduced in the upper mixed sediment layer. Consequently, forecasts of system responses depend on an accurate representation of processes controlling solids dynamics and PCB interactions across the sediment-water interface.

The forecasting results suggest that the water column and sediments of the Upper Hudson River will not have reached steady-state by 2018 (the end of the forecast period). At that time, even with constant upstream PCB loads, water concentrations still show a declining trend, suggesting that the sediments continue to be a source of PCBs to the system.

In their present forms, the models are useful tools for providing information on PCB exposure concentrations for the Human Health and Ecological Risk Assessments. Additional modeling efforts will be conducted to fine tune the model for predicting the time it takes for the system to recover. The results of these additional modeling efforts will be made available as part of the Responsiveness Summary for this report.

ATTACHMENT 4
1-7

Hudson River PCBs Site
Reassessment RI/FS
Phase 2
Baseline Modeling Report

May 1999

Principal Reassessment Questions

- When will PCB levels in fish meet human health and ecological risk criteria under continued No Action?
- Can remedies other than No Action significantly shorten the time required to achieve acceptable risk levels?
- Could a flood scour sediments, exposing and redistributing buried contamination?

Technical Approach

Develop useful and scientifically credible computer models to predict future water column, sediment and fish concentrations for:

- Human Health Risk Assessment
- Ecological Risk Assessment
- Feasibility Study
  - Determination of Acceptable Risk-Based Levels
  - Comparison of Remedial Alternatives

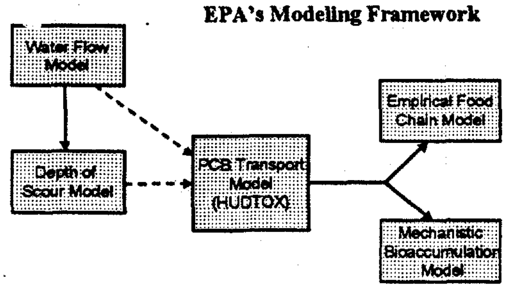
Model Calibration

In order to evaluate the credibility of the models they are compared to historic data. However, "data fit" alone does not ensure accuracy or forecasting capability.

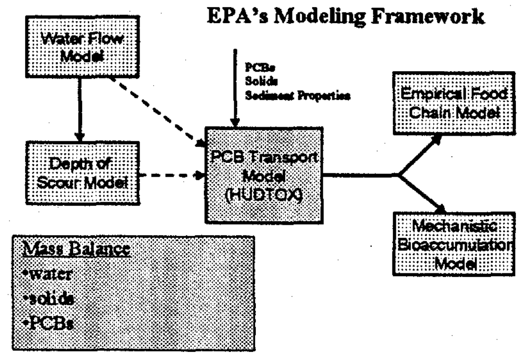
HUDTOX was calibrated for four different forms of PCBs:

- total PCBs
- Tri+ (the sum of trichloro and higher congeners)
- BZ#4 (a dichloro congener)
- BZ#52 (a tetrachloro congener)

EPA's Modeling Framework



EPA's Modeling Framework



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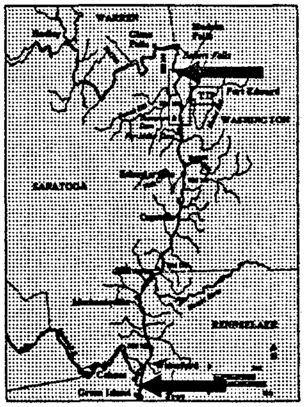
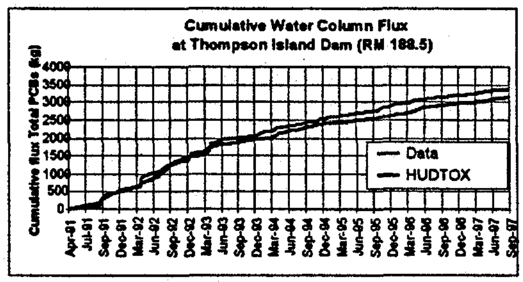


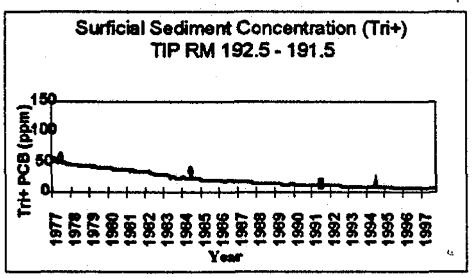
Upper Hudson River

HUDTOX model includes the portion between the northern end of Rogers Island in Fort Edward to Federal Dam in Troy

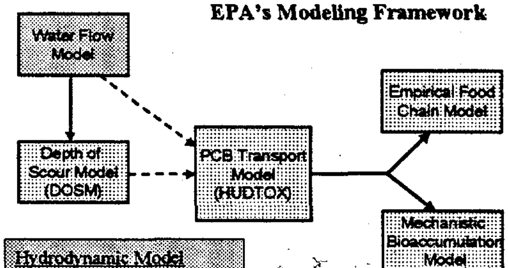
HUDTOX Calibration Results



HUDTOX Calibration Results



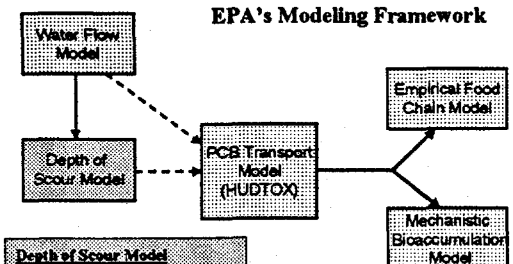
EPA's Modeling Framework



Hydrodynamic Model

Provides flows, velocities and stresses for HUDTOX and DOSM

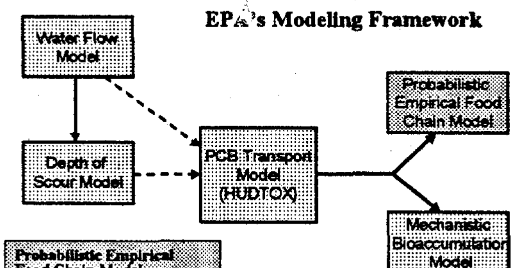
EPA's Modeling Framework



Depth of Scour Model

Predicts erosion from sediments in 100-year flood. Relationship of flow and resultant scour used in HUDTOX.

EPA's Modeling Framework



Probabilistic Empirical Food Chain Model

Uses ratios from the data to predict PCB levels in fish. Provides comparison to mechanistic model.

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ATTACHMENT 4

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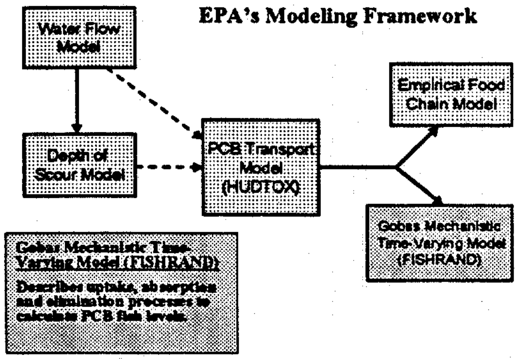
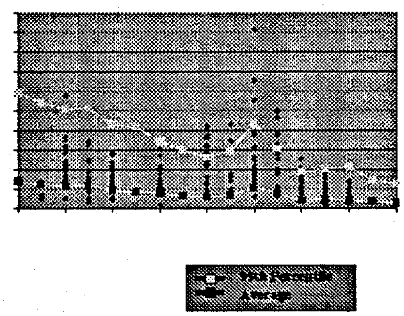
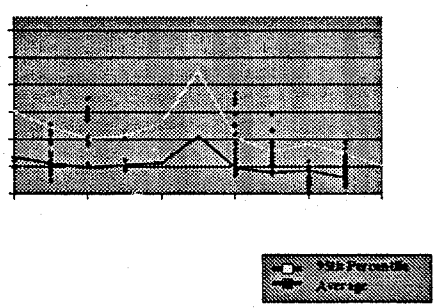
EPA's Modeling Framework



FISHRAND Calibration Results



FISHRAND Calibration Results



Model Forecasts

Models were run for a forecast period of 21 years, beginning in January 1998.

Predict PCB concentrations in water, sediment and fish.

Two scenarios were used for upstream conditions:

- ♦ A constant upstream input of 9.9 ng/l (the average Ft. Edward observation in 1997)
- ♦ An input of zero PCBs at Ft. Edward.

Model Forecasts (continued)

The species modeled by the bioaccumulation models were:

- ♦ largemouth bass
- ♦ yellow perch
- ♦ brown bullhead
- ♦ white perch
- ♦ pumpkinseed
- ♦ spottail shiner

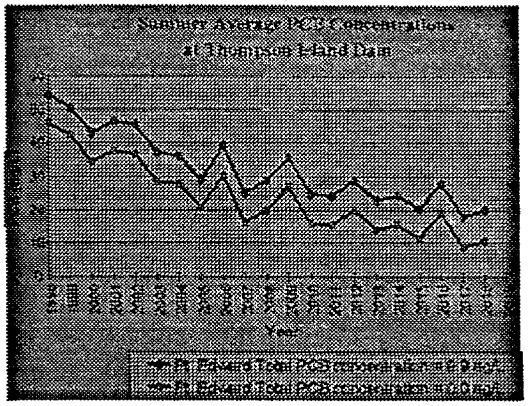
FINDINGS

Major Finding 1

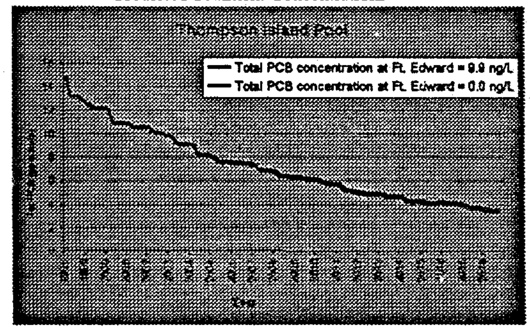
Predicted water column concentrations between 1998 and 2018 are governed by sediment, not upstream sources (e.g., GE Hudson Falls Plant site).

Predicted PCB concentrations in the surface sediments are *not* controlled by PCB loads generated above Fort Edward. Sediment PCB concentrations are controlled primarily by sediment-to-water flux and exchange between deep and surface sediments.

Upstream controls will not substantially change the rate of recovery



Predicted Sediment Concentrations



Major Finding 2

The prediction for a 100-year flood does not yield substantial impacts on the PCB levels in the Upper Hudson River.

- **130 lbs PCBs lost from Thompson Island Pool**

- **Impact of flood on water PCB levels is minimal after one year.**

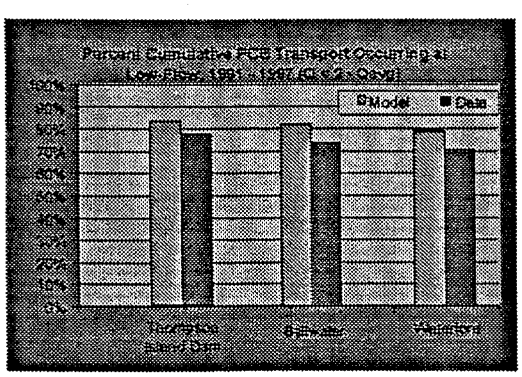
100-year flood scenario not a critical factor

Major Finding 3

Although there has been net deposition of sediment in the Thompson Island Pool, there have been losses of PCBs from the sediment over the same period of time.

From 1984 - 1994, the model estimated that 2000 kg of PCBs (Tri+ only) were lost from the Thompson Island Pool sediments, while at the same time <2.0 cm of net sediment deposition occurred across the pool.

Burial does not isolate PCBs in the sediments.



Major Finding 4

There is a contribution of PCBs from the sediment that is not dependent on the flow of the river.

Some of the processes that may cause non-flow dependent resuspension are:
- **wind driven dispersion**
- **bioturbation by benthic organisms and fish**
- **mechanical scour by propwash, boats and floating debris**
- **uprooting of aquatic plants by flow, wind or biological action.**

Some processes are not fully understood.

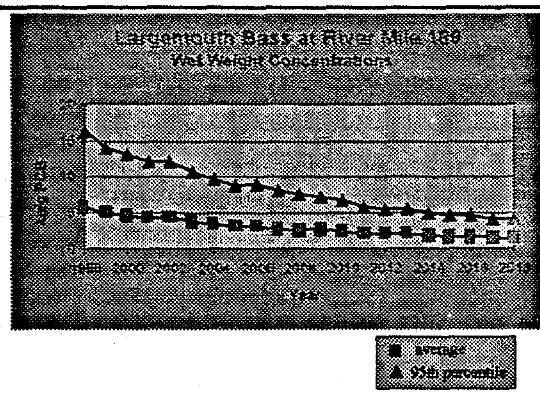
ATTACHMENT 4
3 - 3

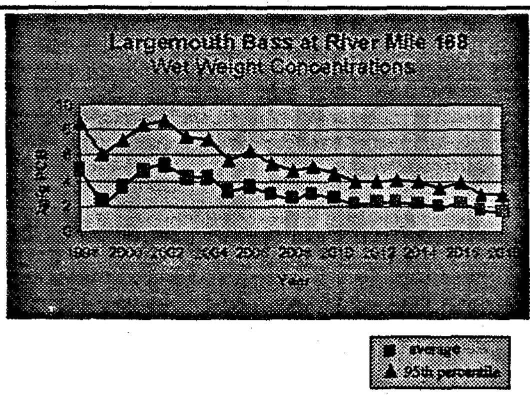
Major Finding 5

Forecasts for the model suggest that average largemouth bass will achieve 2.0 ppm (FDA action level) between 2008 and 2014 within the Thompson Island Pool, and between 2011 and 2019 at Stillwater.

Largemouth bass average values will not achieve the more stringent target levels of the Great Lakes Sports Fishing Advisory (<1.1 ppm) within the 21-year forecast period at these locations.

Largemouth bass recovery is decadal in scale

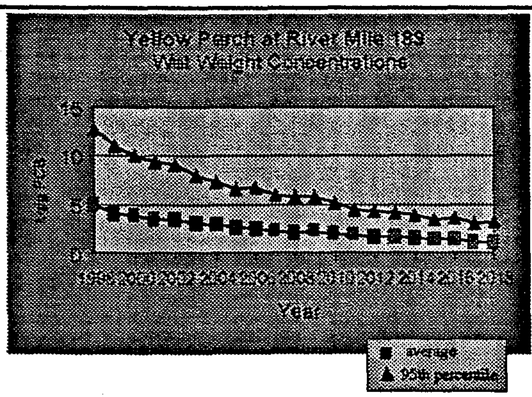


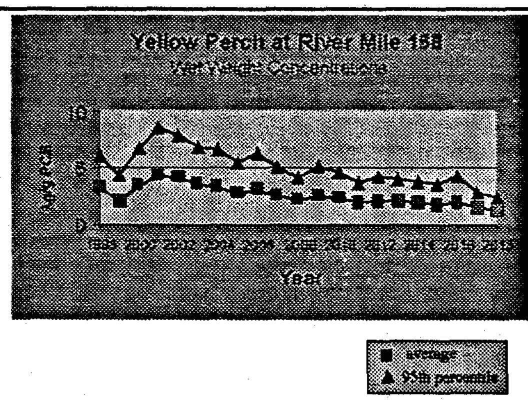


Major Finding 6

Forecasts for the model suggest that average yellow perch will achieve 2.0 ppm (FDA action level) between 2007 and 2013 within the Thompson Island Pool, and between 2008 and 2014 at Stillwater.

Average yellow perch values will reach 1.1 ppm in the Thompson Island Pool within the forecast period.





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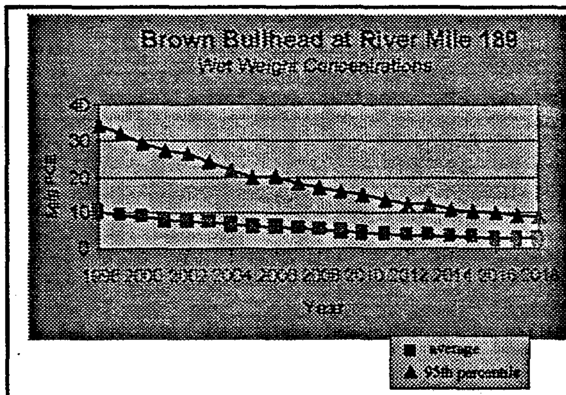
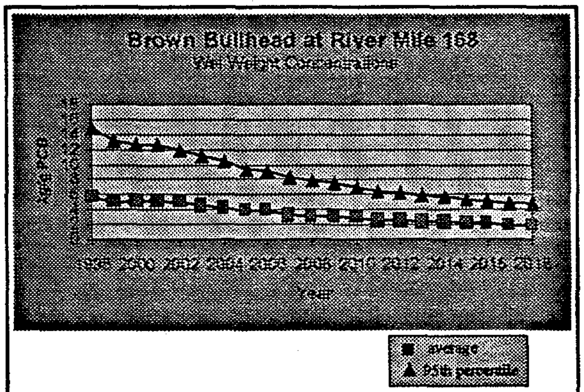
Major Finding 7

Average brown bullhead are forecasted to reach 2.0 ppm between 2014 and 2020 at Stillwater. No other target levels will be achieved for average brown bullhead at Stillwater, within the 21-year forecast period. None of the target levels are achieved at the Thompson Island Pool.

It will take longer for bottom feeding fish to reach acceptable levels due to the contribution from the sediments.





Major Finding 8

At river miles 157 and 154, forecasts for all species modeled achieved the FDA action level of 2 ppm by 2021.

Major Finding 9

For all locations and species modeled, predicted average body burdens did not fall below 0.5 ppm within the 21-year forecast period.

While it is clear fish levels are decreasing, it depends on what you use as a standard to determine how long it will take for the river to recover.

Use of Modeling Results

- Human Health Risk Assessment
- Ecological Risk Assessment
- Feasibility Study
  - Determination of Acceptable Risk-Based Levels
  - Evaluation of Remedial Alternatives

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ATTACHMENT 4
4-7

Hudson River PCBs Site
Reassessment RI/FS

Phase 2
Baseline Modeling Report

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

May 1999

Principal Reassessment Questions

- When will PCB levels in fish meet human health and ecological risk criteria under continued No Action?
- Can remedies other than No Action significantly shorten the time required to achieve acceptable risk levels?
- Could a flood scour sediments, exposing and redistributing buried contamination?

Technical Approach

Develop useful and scientifically credible computer models to predict future water column, sediment and fish concentrations for:

- Human Health Risk Assessment
- Ecological Risk Assessment
- Feasibility Study
  - Determination of Acceptable Risk-Based Levels
  - Comparison of Remedial Alternatives

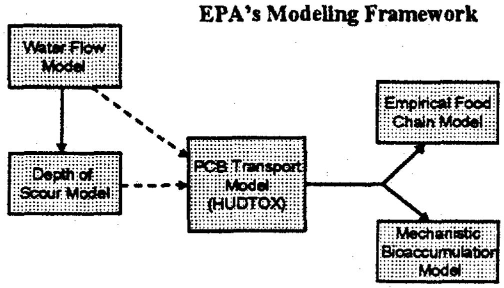
Model Calibration

In order to evaluate the credibility of the models they are compared to historic data. However, "data fit" alone does not ensure accuracy or forecasting capability.

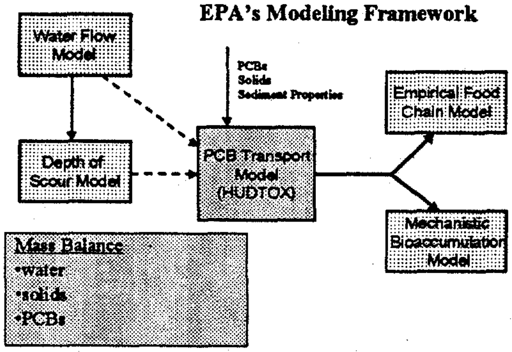
HUDTOX was calibrated for four different forms of PCBs:

- total PCBs
- Tri+ (the sum of trichloro and higher congeners)
- BZ#4 (a dichloro congener)
- BZ#52 (a tetrachloro congener)

EPA's Modeling Framework



EPA's Modeling Framework



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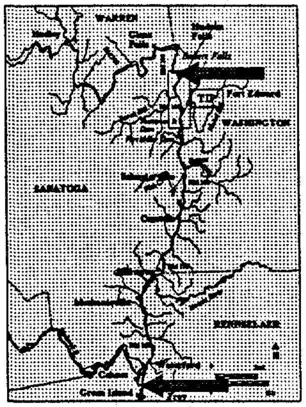
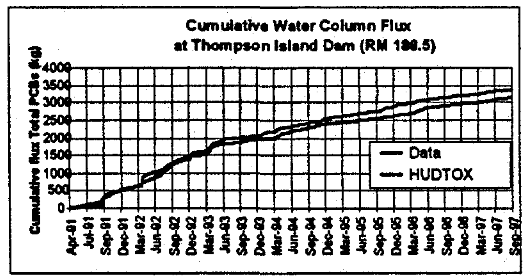


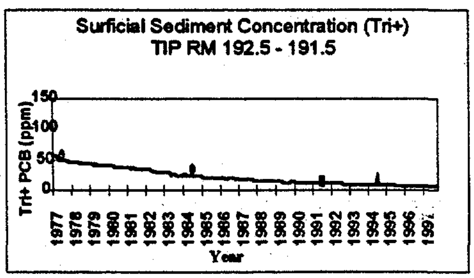
Upper Hudson River

HUDTOX model includes the portion between the northern end of Rogers Island in Fort Edward to Federal Dam in Troy

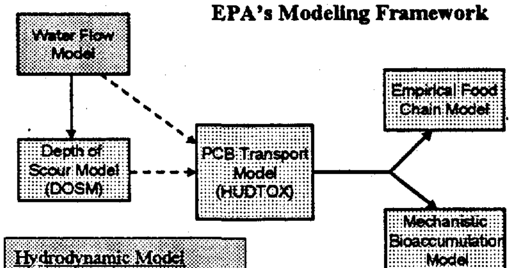
HUDTOX Calibration Results



HUDTOX Calibration Results



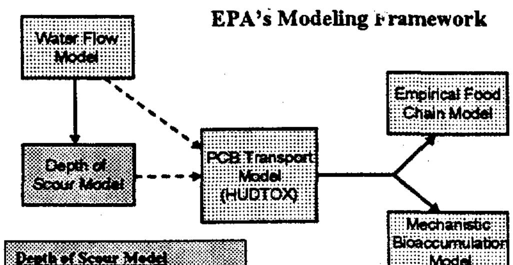
EPA's Modeling Framework



Hydrodynamic Model

Provides flows, velocities and stresses for HUDTOX and DOSM

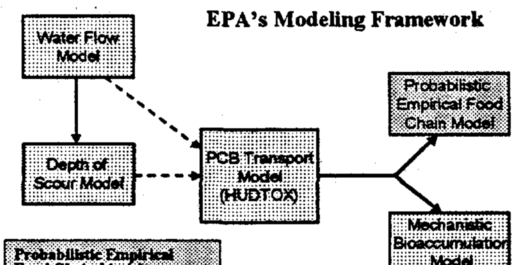
EPA's Modeling Framework



Depth of Scour Model

Predicts erosion from sediments in 100-year flood. Relationship of flow and resultant scour used in HUDTOX.

EPA's Modeling Framework



Probabilistic Empirical Food Chain Model

Uses ratios from the data to predict PCB levels in fish. Provides comparison to mechanistic model.

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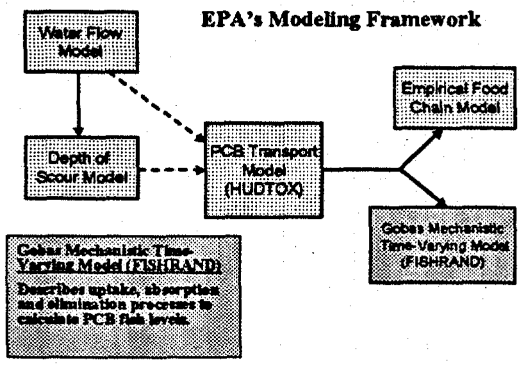
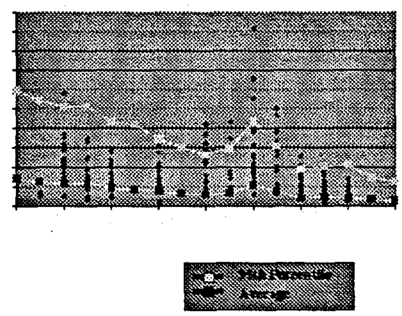
ATTACHMENT 4
5-7

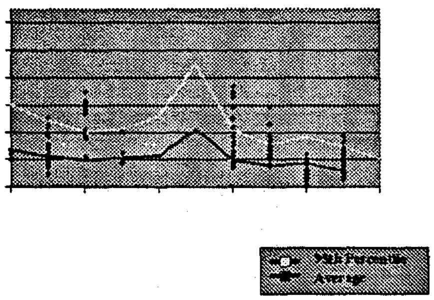
EPA's Modeling Framework



FISHRAND Calibration Results



FISHRAND Calibration Results



Model Forecasts

Models were run for a forecast period of 21 years, beginning in January 1998.

Predict PCB concentrations in water, sediment and fish.

Two scenarios were used for upstream conditions:

- A constant upstream input of 9.9 ng/l (the average Ft. Edward observation in 1997)
- An input of zero PCBs at Ft. Edward.

Model Forecasts (continued)

The species modeled by the bioaccumulation models were:

- largemouth bass
- yellow perch
- brown bullhead
- white perch
- pumpkinseed
- spottail shiner

FINDINGS

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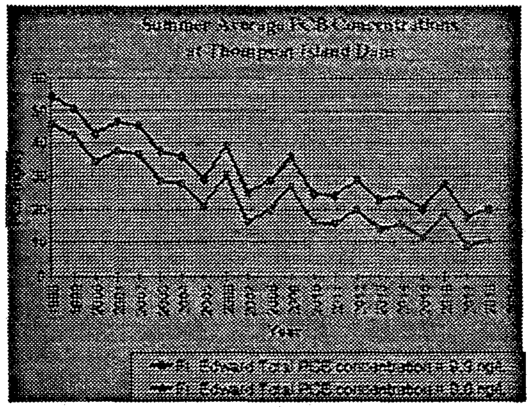
Major Finding 1

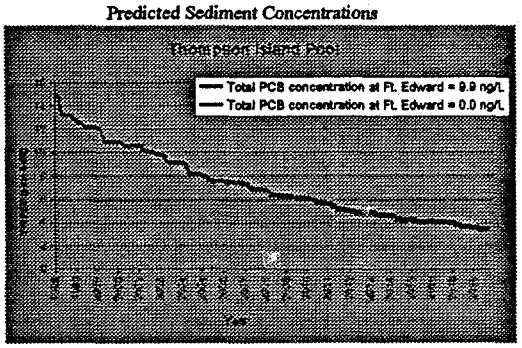
Predicted water column concentrations between 1998 and 2018 are governed by sediment, not upstream sources (e.g., GE Hudson Falls Plant site).

Predicted PCB concentrations in the surface sediments are ***not*** controlled by PCB loads generated above Fort Edward. Sediment PCB concentrations are controlled primarily by sediment-to-water flux and exchange between deep and surface sediments.

Upstream controls will not substantially change the rate of recovery



Predicted Sediment Concentrations



Major Finding 2

The prediction for a 100-year flood does not yield substantial impacts on the PCB levels in the Upper Hudson River.

- 130 lbs PCBs lost from Thompson Island Pool
- Impact of flood on water PCB levels is minimal after one year.

100-year flood scenario not a critical factor

Major Finding 3

Although there has been net deposition of sediment in the Thompson Island Pool, there have been losses of PCBs from the sediment over the same period of time.

From 1984 - 1994, the model estimated that 2000 kg of PCBs (Tri+ only) were lost from the Thompson Island Pool sediments, while at the same time <2.0 cm of net sediment deposition occurred across the pool.

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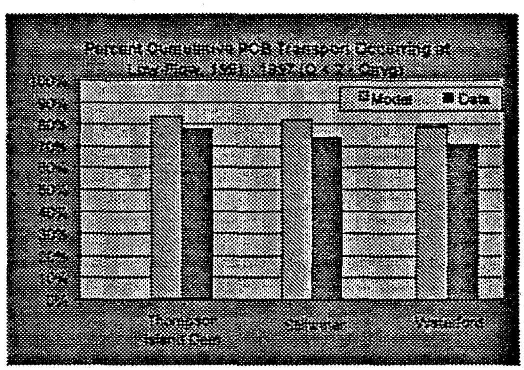

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ATTACHMENT 4
6 – 7

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Some processes are not fully understood.

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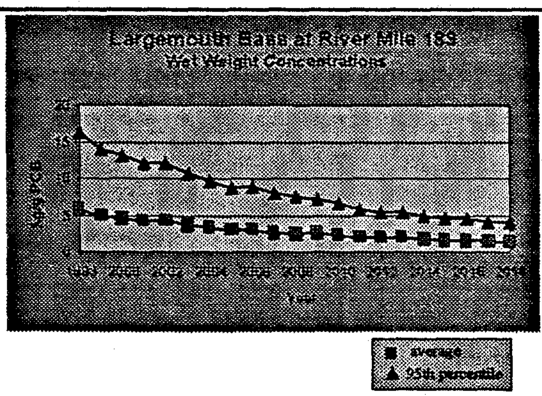

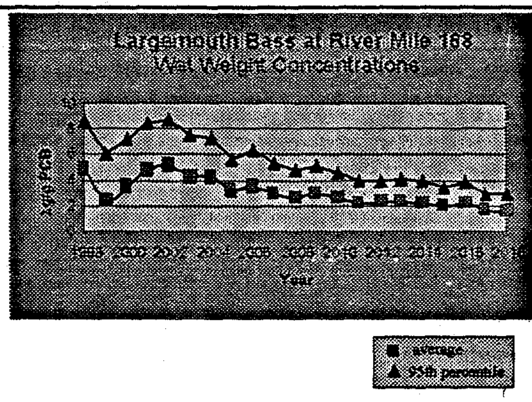

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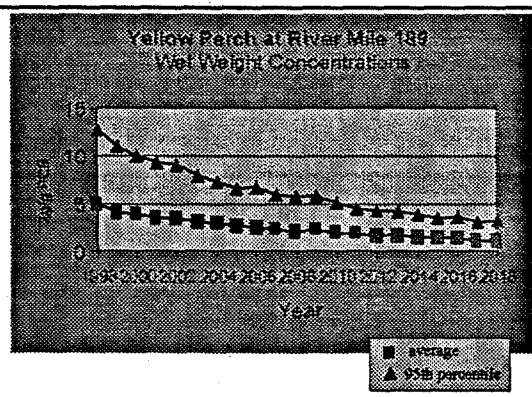

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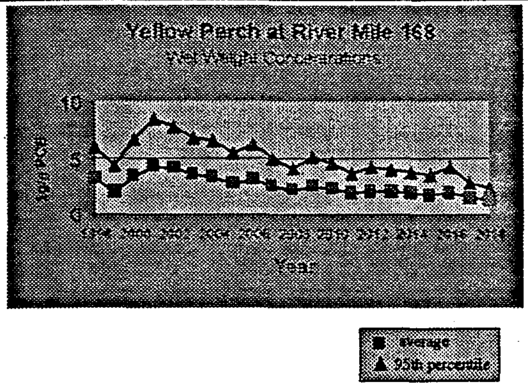

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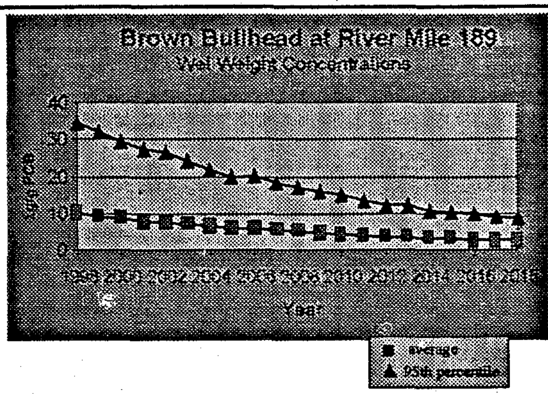

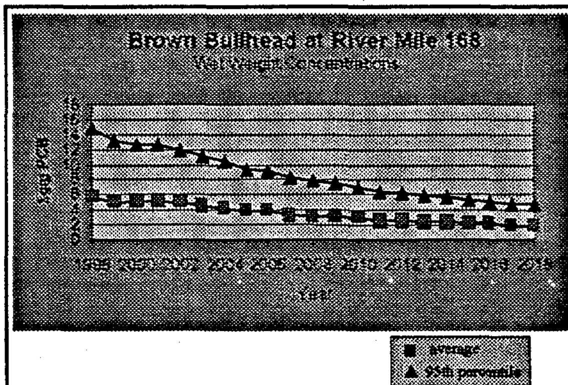

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ATTACHMENT 4

7-7

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- Ecological Risk Assessment
- Feasibility Study
    - Determination of Acceptable Risk-Based Levels
    - Evaluation of Remedial Alternatives