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

Joint Liaison Group Meeting
January 11, 2000 Poughkeepsie, NY

On January 11, 2000, the United States Environmental Protection Agency (EPA) hosted a Joint Liaison Group meeting at the Sheraton Civic Center Hotel, Poughkeepsie, NY, to present the findings of the human health risk assessment for the Mid-Hudson River and of the ecological risk assessment for future risks in the Lower Hudson River. Both risk assessment reports were released to the public on December 29, 1999 and a press release was issued on January 4, 2000. The executive summaries of both reports are in Attachment 1. Hard copies of Ms. Olsen's presentation slides are found in Attachment 2; note that the handouts available at the meeting were hard copies of some of these slides. 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 meetings are available on request.

Ann Rychlenski, EPA Public Affairs Specialist and Community Relations Coordinator for the Hudson River PCBs Reassessment RI/FS, opened the meeting. Participating in the formal presentation were Alison Hess, EPA Project Manager, and EPA environmental scientists Marian Olsen (human health risk assessment) and Gina Ferreira (ecological risk assessment). Other EPA and contractor team members present included Melvin Hauptman, Leader, Sediments/Caribbean Team; Susan Kane Driscoll, Menzie-Cura & Associates; and David Merrill, Gradient Corp.

In her opening remarks, Ms. Rychlenski reminded the audience that copies of the reports are available in the information repositories, including the Adriance Library and Marist College. The reports will be open to public comment. The comment period closes on January 2[illegible]; all comments must be received by close of business that day. Comments should be sent to Alison Hess. Ms. Rychlenski announced that a public availability session will be held at this Sheraton Civic Center Hotel one week hence on January 18, 2000, from 6:30 to 8:30 PM, at which time the team will be available to answer questions individually.

Ms. Rychlenski introduced Congressman Maurice Hinchey and Mr. Robert Ostrander from the office of Congresswoman Sue Kelley, both in the audience.

Ms. Hess began with a brief project overview. Tonight's presentations cover two companion reports to the previously presented human health and baseline ecological risk assessments for the Upper Hudson River. EPA is addressing human health risk assessment for the Mid-Hudson River particularly because of concerns in the community. EPA is not looking below the Mid-Hudson River because risks generally decrease down the river. Ecological risks are being addressed in the Lower Hudson, however, particularly because of the significant habitats in that stretch of the river.

These reports are being released after the August reports because they rely on a computer model developed independently by Dr. Kevin Farley of Manhattan College and others for the Hudson River Foundation. The risk assessments are baseline risk assessments in that they presume no remediation of the PCBs in the river sediments and no institutional control such as the fish consumption advisories currently in place.

Ms. Hess concluded by touching on the upcoming schedule. A peer review of the risk assessments is scheduled for May. In December of 2000, EPA will release its proposed plan that will identify the Agency's preferred cleanup for the Hudson River. EPA will consider all remedial alternatives, including "No Action" as required by the Superfund law. There will be a public comment period on that document as well, and Ms. Hess urged members of the audience to participate in the public process as EPA approaches its decision.

Human Health Risk Assessment for the Mid-Hudson River

Ms. Olsen's presentation opened with an overview of risk assessment in general: the ability to look at risks from various chemicals (in this case, PCBs); relative risks from different routes of exposure; and risks to different populations and different age groups, all enabling better understanding of potential health threats. EPA uses information on both the reasonably maximally exposed individual (RME) [the maximum exposure that is reasonably expected to occur in the Hudson River under baseline conditions, in this case adults consuming one ½-lb [fish] meal per week] and on "central tendency," which is the average exposure.

Following are the major findings of the human health risk assessment for the Mid-Hudson River:

- Eating fish is the primary pathway for humans to be exposed to PCBs from the Mid-Hudson.
- Under the RME scenario for eating fish, the calculated risk is approximately four additional cases of cancer for every 10,000 people exposed. This excess cancer risk is more than 100 times higher than USEPA's goal of protection and within the upper bound of the cancer risk range generally allowed under the federal Superfund law.
- Under baseline conditions, the RME cancer risks and non-cancer hazards for eating fish would be above USEPA's generally acceptable levels for a 40-year exposure period beginning in 1999.
- For non-cancer health effects, the RME scenario for eating fish from the Mid-Hudson results in a level of exposure to PCBs that is 30 times higher than USEPA's reference level (Hazard Index) of one.
- For the fish consumption pathway, central tendency cancer risks lie within the risk range of 10^{-6} to 10^{-4}, and non-cancer hazards under central tendency assumptions fall slightly above the USEPA's reference level (Hazard Index) of one.
- Risks from being exposed to PCBs in the Mid-Hudson River through skin contact with contaminated sediments and river water, residential ingestion of river water for drinking water, incidental ingestion of sediments, and inhalation of PCBs in air are significantly below USEPA's levels of concern for cancer and non-cancer health effects.

Ms. Olsen concluded her remarks by offering to distribute copies of the fish advisories issued by the New York State Department of Health (DOH) that provide specific recommendations relative to the Mid-Hudson.

Future Ecological Risks in the Lower Hudson River

Ms. Ferreira followed Ms. Olsen with an overview of the results of the ecological risk assessment for future risks in the Lower Hudson River. After enumerating the major conclusions, Ms. Ferreira reviewed how those conclusions were drawn and showed some graphic representations of the results. Among the points of Ms. Ferreira's presentation were the following: 1) EPA looked at PCBs, the contaminants of concern, in two different ways: total PCBs and PCBs that have qualities similar to dioxin; 2) EPA used 17 receptors of concern in its assessment, including fish, mammals, and birds; 3) EPA looked at exposure pathways - ingestion of food, sediment, and water - from three different perspectives: dietary dose, egg concentration, and body burden, assessing total PCBs and TEQ dioxin-like PCBs; 4) EPA emphasized reproductive and developmental effects because those have more impact on the populations of concern.

Major findings of that risk assessment are enumerated below.

- Fish in the Lower Hudson River are at risk from future exposure to PCBs; fish that eat other fish (*i.e.,* which are higher on the food chain), such as the largemouth bass and striped bass, are especially at risk. PCBs may adversely affect fish survival, growth, and reproduction.
- Mammals that feed on insects with an aquatic stage spent in the Lower Hudson, such as the little brown bat, are at risk from future PCB exposure.
- Birds that feed on insects with an aquatic stage spent in the Lower Hudson, such as the tree swallow, are not expected to be at risk from future exposure to PCBs.
- Waterfowl feeding on animals and plants in the Lower Hudson River are at risk from PCB exposure. Future concentrations of PCBs may adversely affect avian survival, growth, and reproduction.
- Birds and mammals that eat PCB-contaminated fish from the Lower Hudson River, such as the bald eagle, belted kingfisher, great blue heron, and river otter, are at risk. Future concentrations of PCBs may adversely affect avian survival, growth, and reproduction.
- Omnivorous animals, such as the raccoon, that derive some of their food from the Lower Hudson River, are at risk from PCB exposure. Future concentrations of PCBs may adversely affect avian survival, growth, and reproduction.
- Fragile populations of threatened and endangered species in the Lower Hudson River, represented by the bald eagle and shortnose sturgeon, are particularly susceptible to adverse effects from future PCB exposure.
- Modeled PCB concentrations in water and sediments in the Lower Hudson River generally exceed standards, criteria, and guidelines established to be protective of the environment. Animals that use areas along the Lower Hudson designated as significant habitats may be adversely affected by the PCBs.
- The future risks to fish and wildlife are greatest in the upper reaches of the Lower Hudson River and decrease in relation to decreasing PCB concentrations down river. Based on modeled PCB concentrations, many species are expected to be at risk through 2018 (the entire forecast period).

Further information relative to both Ms. Olsen's and Ms. Ferreira's presentations are found in the executive summaries of both reports in Attachment 3, and complete details are available in the reports themselves.

Ms. Rychlenski invited Congressman Hinchey to make a few remarks. The Congressman opened by expressing his appreciation to EPA for the work that is done generally across the country, but particularly in the work being done to focus attention on the problems of the Hudson River and propose ways to correct these problems. Congressman Hinchey talked about the Hudson River itself: its beauty and historical significance; its contribution to North America's first school of art, the Hudson River School of Art; and its status as a American Heritage Area and first among the country's National Heritage rivers.

Congressman Hinchey acknowledged widespread concern about the impact of PCBs on the river, and the intuitive sense and preliminary scientific evidence that PCBs constituted a "threat to public health, human health, and to the health of the entire ecological system which is the Hudson River." He asserted that EPA's studies "show definitively that these fears have been well-grounded," that the threat increases as one moves up the food chain, and he anticipates that EPA's findings will indicate that cleanup of the river - removal of the PCBs from the river - will be the only way to remediate the system. The Congressman observed that EPA's findings are based upon scientific evidence, they have been very carefully and meticulously peer reviewed, and they are strong and valid scientific documents."

Congressman Hinchey disagreed with the position that PCBs in the Upper Hudson River are being buried with clean sediment; he pointed to evidence showing clearly that PCBs are not only a serious threat above the

[Federal] dam [at Troy] but are migrating down the river. He further disagreed with GE's position that a cleanup is taking place. Congressman Hinchey contended this was an attempt "to confuse people and to obfuscate the actual facts." The cleanup being referenced by GE is one to prevent additional PCBs from leaching into the river; there is, and has not been, a cleanup of the hot spots above the Federal Dam at Troy. "That is what needs to be done if the river is ever going to be free of these PCBs...which are causing a serious treat to human life...but also to every aspect of life within the river system."

The Congressman observed that the world was watching what is being done on the Hudson River as an "example of how an industrial society deals with the residue of its industrial processes, and the care, or lack of care, that it takes to protect itself and its citizens from exposure to the results of those industrial processes. We have an opportunity to demonstrate...the right way of correcting wrongs of the past. I believe we are well on our way to doing that in the construct of the study that you are conducting and will continue to conduct. I support the work you are doing....we look forward to your recommendations." He concluded, "Finally, it is my vote that the only way to remediate this problem is in fact to do so...meticulously, carefully, and thoroughly, and remove all of the PCBs from the river and put them into a place where they cannot escape out into the environment."

Highlights of the question and comment period are in the following section.

1. Regarding cumulative effects of exposure to PCBs, if a child lived along the Hudson and was continually exposed through the indicated pathways, wouldn't that child almost certainly reach the [limits of the safe reference dose] threshold somewhere in his life, over 30 or 40 years of exposure?

   Response: PCBs do bioaccumulate over time. The reference dose level EPA is looking at is based on studies in animals exposed over a period of time; that information is used to protect sensitive populations, including children. It is hard to predict how much PCB exposure would occur over time, and hard to say when a child would reach that threshold without knowing how he or she would be exposed.

2. Usually children are shown as being more vulnerable, though you showed the risk to children as being lower. Can you explain that?

   Response: EPA looked at cancer risks to children based on consumption and body weight. Their consumption would be about 1/3 of an adult.

3. Are there any studies that have evaluated concentrations of PCBs in human fat tissue in our area, or in any human tissue. Are there other sources [of PCBs] that we are not aware of? We are given a sense of safety if your exposures are from this river, at this level. The speaker gave an example of someone unknowingly eating contaminated fish another distribution source. Are we all walking around with certain levels of PCBs, and then are the levels we are picking up from here going to surpass the safety level because it is additive?

   Response: Ms. Olsen is not aware of any studies in the Mid-Hudson area that have looked at blood PCB levels. Studies of workers who have had higher exposures because they worked directly with PCBs have been published and are the basis for EPA's determination that PCBs are probable human carcinogens. Ms. Olsen is aware of studies of people ingesting fish from the Great Lakes, in North Carolina, and internationally. As a general statement, populations of both fish-eaters and non-fish-eaters have been part of epidemiological studies, and levels of PCBs have been found in the blood. These levels have been declining over time because PCBs have been removed from the workplace and the environment. The national population levels in general are approximately one to two parts per billion in blood in individuals not working in an occupational environment [where they are exposed to PCBs] or ingesting [PCB-contaminated] fish. Commercial fish are regulated by the FDA, which sets tolerance levels to be met. Additionally, many health departments have set fish advisories recommending against ingesting fish if there is contamination in an area. It is important to follow those recommendations.

4. There appears to be an assumption that cleaning up the Upper Hudson will decrease the toxicity of the fish to zero. Speaker understands that there are other toxins going into the river such as dioxins from "water treatment plants and other sources" that build up concentrations of toxic substances in fish, so fish will remain toxic and inedible for many years after the cleanup.

Response: Ms. Hess said EPA will consider beneficial effects on the Mid-Hudson region that may arise from [implementation of] various remediation alternatives in the Upper Hudson, and assess what kind of impacts on fish could be expected due to cleanup in the Upper Hudson. There are no immediate sources in the Mid-Hudson region that contribute as much as the PCBs from the GE capacitor plants in the Upper Hudson; it is clear that the GE PCBs are the main contributor of PCBs and dioxin-like PCBs in fish in the Mid-Hudson.

Follow-on: When will we be able to take the "don't fish" signs down after spending billions of dollars to clean the Upper Hudson?

Response: Part of EPA's evaluation will include what kind of changes may be able to be made to the fish consumption advisories, and if so, when that would occur.

5. Speaker complimented EPA on its research and efforts toward "such a cogent presentation on issues that greatly concern virtually everyone not only in the Mid-Hudson but also everyone who likes to eat fish and enjoy the Hudson River." He referenced the body of evidence in literature, particularly in relation to breast cancer, that it is not necessarily any one particular carcinogen but rather a combination of them viewed synergistically as causative. He cited exposure to PCBs, women taking estrogen, people with a long history of tobacco use, and psychotropic medication, said it appeared that EPA's estimates of concern are "very much on the conservative side." He asked if EPA were considering, or would consider, the synergistic or cumulative causes of carcinogenicity along the river.

Response: Ms. Hess thanked the speaker on behalf of the team for his comments. Synergistic effects, she said, is an area of on-going research. EPA used the most current toxicity values that the Agency has for both cancer and non-cancer health effects. There is a tremendous amount of on-going research on various health effects, particularly endocrine effects, that EPA is aware of, but there is not yet an Agency position on that emerging research.

6. A speaker stated her understanding that in other areas where dredging had occurred, PCB levels in fish did go down after a number of years.

Response: Ms. Hess said this is true [i.e., the fish respond relatively quickly to increases or decreases in PCBs] in other locations, and it is specifically true in the Hudson, though not the result of remediation [by dredging]. There had been an increase in PCBs in 1991 due to the Allen Mill failure. The fish monitoring that New York State Department of Environmental Conservation (DEC) has done showed that the fish recovered relatively rapidly within a couple of years or so [after the Allen Mill event] to regain their decreasing trend that was seen historically.

Follow-on: Since the fish seem to be keeping at a fairly constant level of PCB contamination, it would seem there is a constant source.

Response: There are the two plant sites that continue to release PCBs into the river. There are proposed plans DEC has released, one for each plant site, and additional plans forthcoming, to help control those releases of PCBs to the river.

7. Rich Schiafo, Scenic Hudson, stated these findings seem to underscore the need for an aggressive PCB cleanup of the Upper Hudson River, and Scenic Hudson encourages that to happen. He pointed out that the DOH survey revealed that from Catskill to the Tappan Zee Bridge, 2/3 of anglers questioned are either consuming the fish or sharing it with their families. The DOH concluded that families who are consuming Hudson River fish are at risk from consuming PCBs. Further, Mr. Schiafo stated he believed EPA should look at a much lower tolerance level for cleanup of PCBs than the FDA's two ppm for commercially sold fish; he suggested that a level as low as 0.1 ppm is a more appropriate action level. Scenic Hudson supports EPA's work and the decision deadline of December of 2000. Scenic Hudson's complete comment is Attachment 5.

Mr. Schiafo asked about a difference between the two risk assessments: the ecological risk assessment stated that PCB concentrations in water and sediment in the Lower Hudson generally exceed standards, criteria, and guidelines. The human health risk assessment said there is not a risk to safe drinking water and for skin contact. Why is this so?

Response: Ms. Hess pointed out that different standards are used for each risk assessment. For human health, EPA looks at a maximum contaminant level (MCL) established to be protective of human health; in the Mid-Hudson River region, [PCB] concentrations in river water are below that standard. For the ecological risk assessment, EPA looks at water quality standards established to be protective of fish and wildlife; EPA found current and future concentrations to be above these water quality criteria.

Follow-on: So water quality criteria [for fish and wildlife] are more restrictive than MCLs [for human consumption of drinking water].

Response: Exactly.

8. Mr. Adams, technical advisor for the Saratoga County Environmental Management Council 1) asked for clarification as to the status of the bald eagle; he understood it to have been removed from the endangered list. 2) In the two reports, inputs from the Troy area to the Upper Hudson are being based on a revised Upper Hudson model that apparently has not been published yet. "It is not easy to review the reports not having all the information. Is that revised model going to be published in the Responsiveness Summary to the comments on the Baseline Modeling Report?" 3) "The Farley Model used directly in the Mid- to Lower Hudson is not described in the report at all." He requested that Dr. Farley's report to the Hudson River [Foundation] be put into the repositories.

Response: 1) The bald eagle is "threatened" on the federal list and "endangered" on the New York State list. 2) Yes. The Revised Baseline Modeling Report will be issued by the Agency at the end of January. 3) It was not EPA's intent to review all the models used in preparing the risk assessment in the risk assessments themselves. The Agency does have a copy of Dr. Farley's report and will make it available to Mr. Adams and anyone else interested.

Follow-on Comments: 1) Mr. Adams contended that "uncertain approximations" were made to get the inputs to the model, specifically that the Farley model uses homologues and the input from the Upper Hudson is on a congener basis. He accused EPA of failing to plan ahead once again, either by obtaining the data that would have been needed by the Farley model, or by developing a model that used the data available. 2) Mr. Adams took issue with one of Congressman Hinchey's statements, that "it was GE's position that PCBs weren't being transported downriver." Mr. Adams stated that he hasn't seen that in anything, and that GE's model predicts that PCBs will be transported downriver.

Response: 1) Dr. Farley's model was prepared independently of EPA. The ecological risk assessment describes the conversion that was used. 2) Congressman Hinchey had left the meeting earlier in the Q&A period so was not available for comment.

9. Speaker expressed the hope that EPA would not exercise the No Action alternative. He stated that "most people believe GE is to blame for PCB contamination in the river. In the past, GE had been made to pay for the cleanup. When there was an assessment done in that situation, how do the numbers compare to here?" Speaker asked if the Hudson situation could be compared to the Housatonic with respect to risk, etc.

Response: Ms. Hess stated the more that is learned about the Hudson and the Housatonic, the less valid comparisons between the two rivers seem to be. The Housatonic is a very small river; many of the PCBs there are on land, and that is where initial remediation has occurred; the investigation for most of the Housatonic is just beginning. The Hudson River project is in a different place in terms of coming to a decision-making point. A similar human health and ecological risk assessment, however, will ultimately be performed for the Housatonic. EPA Region 2 is working with Region 1 to give that region the benefit of Region 2's experience.

10. John Connolly of QEA, GE's modeling consultant. Are there any plans to review the Farley model? He questioned whether or not the model would be likely to over or underestimate the response of the Lower Hudson to remediation in the Upper Hudson. What is EPA going to do to determine its level of confidence in the model?

Response: EPA did review the Farley model in order to look at whether it could be used to help evaluate future risks in the Lower Hudson River. EPA agreed to look at the Mid-Hudson human health risk assessment because the Agency was aware that the Farley model was being developed by Dr. Farley for the Hudson River Foundation. Ms. Hess indicated that it is her understanding that Dr. Farley's report will be published, so there will be a [peer] review of the model. EPA is not currently planning any other separate independent [peer] review of the Farley model.

11. 1) What are the different remediation options? 2) Who has legal financial responsibility for the remediation?

Response: 1) EPA prepared a scope of work (SOW) for the Feasibility Study that looked at broad categories of remedial options; this SOW is available in the information repositories and on the EPA website. 2) Under the Superfund program, if there is a viable responsible party, as "we certainly have here in General Electric," that company would be responsible for the cost of the remediation.

12. George Hodgson of the Saratoga County Environmental Management Council asked if it would not be appropriate to peer review the Farley model in the context of EPA's upcoming peer review of its Baseline Modeling Report (BMR). "If you are using the Farley model, wouldn't it be appropriate to look at both?"

Response: Ms. Hess stated that EPA's peer review for its BMR will occur in March and will be on EPA's model, not on the model developed by Dr. Farley. The Farley model was used in the risk assessment as EPA had indicated [to the community that] it would do, and it is not clear as to its further application in the

Agency's decision-making process; that [i.e., EPA's use of the model in its decision-making] would inform EPA's decision about its [need to] peer review [the Farley model].

13. **Follow-on**: [The Farley model] is used in the [Lower Hudson] assessment the same way the BMR is used in the Upper Hudson; why is a distinction being made between Upper and Lower Hudson River? Is there some difference in the quality of the work being done?

Response: The primary difference is that EPA is looking at remedial action alternatives for the Upper Hudson.

14. Could you assure some of us here that drinking Hudson River water is not a problem? You say the maximum contaminant level was not reached; how is the maximum level designated? What studies were done; does it take into account neuro-toxicity and endocrine problems that could result, particularly with children? Have all necessary studies been done?

Response: Ms. Olsen explained that the maximum contaminant level is developed by the EPA under the Safe Drinking Water Act and is a regulation. The Office of Water within EPA has a process that is set for every drinking water source in the country. They do a risk assessment; they evaluate the level of consumption of water and technological feasibility. In its assessment, EPA looked at the drinking water pathway specifically. The regulatory level within Superfund is one in a million [excess cancer risk]. EPA found with regard to ingestion drinking water that exposure was one in ten million, a factor of ten lower than the goal of protection. For non-cancer, the hazard [from this pathway] was 0.02, or about fifty times less than the hazard index of one, based on the reference dose.

15. **Follow-on**: When was that level established? How old is it? What studies have been done recently?

Response: The standard was developed in the early 1980s and the Agency has not identified a need to develop a new MCL. To calculate the non-cancer hazards and cancer risks in its risk assessment [for the Mid-Hudson], however, EPA evaluated them based on the latest scientific information. EPA used current information from the cancer reassessment conducted in 1996 and used data developed in 1993 and 1995 for the [non-cancer] reference doses. [The risk assessment results] are significantly below the reference dose.

The Agency evaluates new data available for animal and human systems to see if the data will significantly change the cancer slope factor, the indication of carcinogenic toxicity.

16. In addition to animal studies, has EPA had any community studies of high occurrence of cancer rates either in the Hudson Valley or in the Upper Hudson, or any other area that has high PCB contamination?

Response: Scientific literature is evaluated, and most of that literature on the cancer side is occupational studies, where workers are exposed for their working history (25 years) to higher levels of PCBs than the general environment. This is where some of the health effects are evident. Though the Agency has determined that PCBs are probable human carcinogens, the Agency does not feel the study data are adequate to develop a cancer slope factor. Workers may have been exposed years ago; exposure levels may not have been well documented, etc. The animal studies offer the ability to control exposure method and amount, assess exposure over the animals' lifetime (two to three years), and document pathology in organs. EPA then can look at different exposures and extrapolate the results to humans, based on agency guidelines. NYSDOH is currently conducting a study near Glens Falls, looking at neuro-toxic effects within people not exposed through occupational exposure. Ms. Olsen is not aware of any other studies.

17. Will any such study be done before the remediation is decided?

Response: There are limitations to epidemiological study: finding people (time intensive), determining what they have been exposed to and what their illnesses are, etc. Ms. Olsen cannot comment on whether the NYSDOH is planning to do this type of study.

18. Speaker expressed concern about dredging as a "sloppy" technique. Where does the dredged material go? He feels it goes downriver. How would dredging affect extrapolation time lines, what will PCB concentrations be at the intake point at Poughkeepsie, and what is the risk to citizens as the result of dredging? Is there any possibility of limited dredging, and "looking at what you have?" The Hudson River is very different from other rivers; would a pilot dredging be in order?

Response: The SOW for the FS describes different criteria EPA will use to evaluate remedial alternatives, and one of those is evaluating the short-term effectiveness of each alternative. Ms. Hess could not comment further because the FS is still underway. Ms. Hess stated she would take the second part of the question as a comment, and reminded the audience that there will be a comment period on the FS.

19. For purposes of the human health risk assessment, EPA assumed a half pound fish meal per week; what concentration in fish was assumed? Did EPA assume all fish that would be consumed would be at 0.8?

Response: Just slightly under 1 ppm; 0.8. It is below the FDA level for fish, which is 2 ppm. Ms. Olsen clarified that the FDA level is based on market basket and consumption within commercial markets; EPA is looking at protecting the angler fishing from the Hudson. The 0.8 [ppm concentration in Hudson River fish] is an average concentration over a 40-year period of consumption. Looking at the declining concentration in fish, if you average the concentration over that 40-year time frame, over the three locations in the Mid-Hudson for which concentrations were predicted, the average concentration would be 0.8 [ppm]. The same approach was adopted in the Upper Hudson was taken, but the concentration was slightly higher: 1.4 ppm. The concentration of PCBs in fish is lower in the Mid-Hudson than in the Upper Hudson. The concentration is highest in fish at the uppermost part of the river and declines as one moves down the river.

20. One cannot compare the risk of developing cancer of a person consuming a half pound of fish per week 50 times a year to the same [in the Mid-Hudson]. When you say one in 1000 you are talking different levels of fish contamination.

Response: David Merrill from Gradient Corp., EPA's contractor, answered that a person's [cancer] risk tracks with total intake of PCBs over a lifetime. Your lifetime risk of contracting cancer is higher as you increase PCB consumption; consuming upriver fish yields a higher consumption of PCBs than comparable consumption of the same number of fish from the Mid-Hudson. Ms. Hess added that the cancer risks and the non-cancer hazards are about three times greater for someone eating fish from the Upper Hudson than for someone eating fish from the Mid-Hudson. In the Upper Hudson, risks are about 1,000 times higher than EPA's goal for protection on the cancer side, and more than 100 times higher [than EPA's goal for protection] for someone in the Mid-Hudson.

21. Why does the FDA allow people to eat fish with 2 ppm contamination?

Response: FDA takes a market basket approach in that they assume people get fish on the commercial market from many different sources, some of which would not be contaminated. The FDA limit is more of an upper threshold, whereas the consumption in a risk assessment targets an average or an upper estimate of an average.

22. To what extent did EPA address human health impacts to people who are on the river either in recreational or occupational situations: breathing the air, having contact with soil, etc.? What was the assumption about duration?

Response: EPA looked at pathways other than ingestion of fish -- dermal contact, ingestion of water -- and those pathways did not pose any risk above EPA's level of concern. EPA considered 40 years' exposure duration for the reasonably maximally exposed person on the cancer side and for non-cancer, exposure duration is seven years. There is a potential for someone to be exposed at levels higher than what EPA defines as reasonably maximum exposure.

23. Would OSHA be responsible for seeing if working conditions for people working on the river are adequate, or is the river so polluted that simply working there is a risk to your health? What about fishermen who may ingest fish?

Response: Ms. Hess stated that she could not comment on OSHA regulations, which are not administered by EPA. Ms. Olsen said EPA did not evaluate the worker's scenario. She would run numbers on occupational exposure and provide the results. However, EPA did look at recreational exposure; for example adolescent exposure for 39 days per year [3 days a week for the 13 weeks of summer] for 12 years. [Note: EPA also evaluated adult recreational exposure for 13 days/year for a period of 23 years and child exposure for 13 days/year for a period of 6 years, resulting in an exposure to an individual (first as a child, then an adolescent, and finally as an adult) for period of 41 years]. An occupational exposure would involve 250 days per year but only for 25 years. Ms. Olsen would not anticipate the risks and hazards from occupational exposure to be greater than those for the fish ingestion pathway. EPA looked at the 1991 angler survey that included individuals consuming large amounts of fish. She would assume a fisherman consuming fish would be within that population. [Note: In response to the above request, EPA has calculated that an adult working in the Mid-Hudson River under baseline conditions would have an excess cancer risk of 9.6 x 10-E-7 and a non-cancer hazard of 0.07. These risks and hazards are both below EPA's levels of concern].

24. How much exposure could one expect as a result of volatilization, such as someone living near the river?

Response: EPA did look at volatilization in the human health risk assessment for the Upper Hudson River, and risk was found to be below levels of concern; although EPA did not do volatilization calculations for the Hudson, the expectation would be that results would be even lower based on the lower concentrations. Ms. Olsen added that calculations done in the Upper Hudson were for people exposed 350 days per year for 41 years, living right on the river, and the risks were about one in a million. This is basically the goal of protection.

25. What does it mean to say that non-cancer health risks are increased 30 times for fish consumption in this area? What would those health effects be?

Response: EPA sets the reference dose, which is basically a daily level of exposure. A person whose exposure level is below that would have less concern about adverse health effects than a person above the level. Effects evident in Rhesus monkeys were impairment of the immune system, low birthweight in offspring, etc. at a specific level. This level was reduced by a factor of 100 for Aroclor 1016 and 300 for Aroclor 1254 to protect humans that may be exposed, including children and elderly. The population is 30 times higher than the level of exposure considered to be safe, but EPA cannot say what the health effects would be specifically in that population. The closer exposure gets to what is being seen in the animals, the higher the concern.

26. Has there been consideration given to the spread of PCBs to areas away from the river, for example by bird droppings from contaminated raptors?

Response: This risk assessment looks at PCBs in the river and river sediments. There are other studies by other groups addressing effects of PCBs elsewhere, in other ecological receptors of concern. There is also an on-going natural resources damage claim by the trustees of the Hudson - NYSDEC, NOAA, and US Fish and Wildlife - looking at the impact of PCBs to natural resources.

27. Speaker pointed out a typo or error in the schematic in a slide that indicated water contact risk higher for the Mid-Hudson than the Upper Hudson.

Response: EPA agreed that it was a typo.

28. What will EPA do with PCBs if they are removed from the river?

Response: The FS process looks at the alternatives and is currently on-going. A report will be prepared and released to the public which will contain a discussion of all alternatives and the preferred alternative. Comments will be taken on that report which will be considered before making a remedial decision.

Ms. Rychlenski reminded the audience that the public comment period on the risk assessments is through close of business January 28, 2000. Comments should be addressed in writing to Alison Hess. The document is in the Adriance Library and other repositories. She also urged anyone interested to join the community outreach program and to indicate that interest on the sign-in sheets. The final announcement was for the public availability session scheduled for January 18, 2000, from 6:30 to 8:30 PM at the Sheraton Civic Center Hotel. The meeting was adjourned.

ATTACHMENT 1
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Human Health Risk Assessment: Mid-Hudson River
Executive Summary
December 1999

This document presents the baseline Human Health Risk Assessment for the Mid-Hudson River (Mid-Hudson HHRA), which is a companion volume to the baseline Human Health Risk Assessment for the Upper Hudson River that was released by the U.S. Environmental Protection Agency (USEPA) in August 1999. Together, the two risk assessments comprise the human health risk assessment for Phase 2 of the Reassessment Remedial Investigation/Feasibility Study (Reassessment RI/FS) for the Hudson River PCBs site in New York.

The Mid-Hudson HHRA quantitatively evaluates both cancer risks and non-cancer health hazards from exposure to polychlorinated biphenyls (PCBs) in the Mid-Hudson River, which extends from the Federal Dam at Troy, New York (River Mile 154) to just south of Poughkeepsie, New York (River Mile 63). The Mid-Hudson HHRA evaluates both current and future risks to children, adolescents, and adults in the absence of any remedial action and institutional controls, such as the fish consumption advisories currently in place. The Mid-Hudson HHRA uses the most recent USEPA policy and guidance as well as additional site data and analyses to update USEPA's 1991 risk assessment.

USEPA uses risk assessment as a tool to evaluate the likelihood and degree of chemical exposure and the possible adverse health effects associated with such exposure. The basic steps of the Superfund human health risk assessment process are the following: 1) Data Collection and Analysis, to determine the nature and extent of chemical contamination in environmental media, such as sediment, water, and fish; 2) Exposure Assessment, which is an identification of possible exposed populations and an estimation of human chemical intake through exposure routes such as ingestion, inhalation, or skin contact; 3) Toxicity Assessment, which is an evaluation of chemical toxicity including cancer and non-cancer health effects from exposure to chemicals; and 4) Risk Characterization, which describes the likelihood and degree of chemical exposure at a site, the possible adverse health effects associated with such exposure, the quantification of cancer risks and non-cancer health hazards, and a discussion of the uncertainties associated with the risk assessment.

The Mid-Hudson HHRA shows that cancer risks and non-cancer health hazards to the reasonably maximally exposed (RME) individual associated with ingestion of PCBs in fish from the Mid-Hudson River are above levels of concern. Consistent with USEPA regulations, the risk managers in the Superfund program evaluate the cancer risks and non-cancer hazards to the RME individual in the decision-making process. The Mid-Hudson HHRA indicates that fish ingestion represents the primary pathway for PCB exposure and for potential adverse health effects, and that cancer risks and non-cancer health hazards from other exposure pathways are significantly below levels of concern. The results of the Mid-Hudson HHRA will help establish acceptable exposure levels for use in developing remedial alternatives for PCB-contaminated sediments in the Upper Hudson River, which is Phase 3 (Feasibility Study) of the Reassessment RI/FS.

Data Collection and Analysis

USEPA previously released reports on the nature and extent of contamination in the Hudson River as part of the Reassessment RI/FS (e.g., February 1997 Data Evaluation and Interpretation Report, July 1998 Low Resolution Sediment Coring Report, August 1998 Database for the Hudson River PCBs Reassessment RI/FS [Release 4.1], and May 1999 Baseline Modeling Report) and on human health risks for the Upper Hudson River (e.g., August 1999 Volume 2F - Human Health Risk Assessment for the Upper Hudson River). The Ecological Risk Assessment for Future Risks in the Lower Hudson River (Federal Dam at Troy, New York to the Battery in New York City), which is being issued by USEPA concurrently with this report, provided the forecasted concentrations of PCBs in fish, sediments, and river water used to conduct the Mid-Hudson HHRA.

Exposure Assessment

Adults, adolescents, and children were identified as populations possibly exposed to PCBs in the Mid-Hudson River due to fishing and recreational activities (e.g., swimming, wading), as well as from residential ingestion of river water. The exposure pathways identified in the Mid-Hudson HHRA are ingestion of fish, incidental ingestion of sediments, dermal contact with sediments and river water, and residential ingestion of river water. For these exposure pathways, average (central tendency) and RME estimates were calculated using point estimate analyses, whereby an individual point estimate was selected for each exposure factor used in the calculations of cancer risks and non-cancer health hazards. The RME is the maximum exposure that is reasonably expected to occur in the Mid-Hudson River under baseline conditions; the RME is not a worst-case exposure scenario.

Risks and hazards through inhalation of volatilized PCBs were not assessed in the Mid-Hudson HHRA because calculated risks for this pathway were shown to be de minimus (insignificant) in the Human Health Risk Assessment for the Upper Hudson River. Given that concentrations of PCBs found in the sediment and river water in the Mid-Hudson are lower than concentrations in the Upper Hudson, the risks from volatilization also would be expected to be insignificant (and lower) in the Mid-Hudson. Similarly, because the concentrations of PCBs in the Mid-Hudson River are lower than in the Upper Hudson, USEPA determined that a Monte Carlo analysis of cancer risks and non-cancer hazards for the fish ingestion pathway was not warranted for the Mid-Hudson HHRA. An assessment of the exposure and risks from dioxin-like PCBs was not performed because the findings for the Human Health Risk Assessment for the Upper Hudson River showed that the risks for dioxin-like PCBs were comparable to those calculated for total PCBs.

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Ingestion of Fish

For fish ingestion, both average (central tendency) and RME estimates were developed for each of the parameters needed to calculate the cancer risks and non-cancer health hazards. Based on the 1991 New York Angler survey of fish consumption by licensed anglers (Connelly et al., 1992), the central tendency fish ingestion rate was determined to be approximately six half-pound meals per year and the RME fish ingestion rate was determined to be 51 half-pound meals per year.

Both cancer risks and non-cancer health hazards to an adult angler and a child were calculated. Population mobility data from the U.S. Census Bureau for the six counties surrounding the Mid-Hudson River (i.e., Albany, Columbia, Dutchess, Greene, Rensselaer, and Ulster) and fishing duration data from the 1991 New York Angler survey were used to determine the length of time an angler fishes in the Mid-Hudson River (i.e., exposure duration). The exposure duration for fish ingestion was 12 years for the central tendency exposure estimate for cancer and non-cancer and 40 years for cancer (7 years for non-cancer) for the RME estimate. Standard USEPA default factors were used for angler body weight. Future concentrations of PCBs in fish were derived from forecasts presented in the Ecological Risk Assessment for Future Risks in the Lower Hudson River, which were then grouped by fish species and averaged over species for the entire Mid-Hudson River. PCB losses during cooking were assumed to be 20% for the central tendency exposure estimate and 0% (no loss) for the RME estimate, based on studies reported in the scientific literature.

Other Exposure Pathways

For the direct exposure scenarios for river water and sediment, the average (central tendency) exposure estimates for adults and young children (aged 1-6 years) were assumed to be one day every other week for the 13 weeks of summer (7 days/year) and for the RME were assumed to be one day per week for the 13 weeks of summer (13 days/year). Adolescents (aged 7-18 years) were assumed to have about three times more frequent exposure, with a central tendency exposure estimate of 20 days/year and an RME estimate of 39 days/year. The risks and hazards due to ingestion of river water for drinking water purposes were evaluated for residents living adjacent to the Mid-Hudson River. The concentrations of PCBs in water and sediment were derived from the Baseline Ecological Risk Assessment for Future Risks in the Lower Hudson River. Standard USEPA default factors were used for certain exposure parameters (e.g., body weight) in the cancer risk and non-cancer hazard calculations for these pathways.

Toxicity Assessment

The toxicity assessment is an evaluation of the chronic (7 years or more) adverse health effects from exposure to PCBs (USEPA, 1989b). In the federal Superfund program, two types of adverse health effects are evaluated: 1) the incremental risk of developing cancer due to exposure to chemicals and 2) the hazards associated with non-cancer health effects, which for PCBs include reproductive impairment, developmental disorders, disruption of specific organ functions, and learning problems. The cancer risk is expressed as a probability and is based on the cancer potency of the chemical, known as a cancer slope factor, or CSF. The non-cancer hazard is expressed as the ratio of the chemical intake (dose) to a Reference Dose, or RfD. The chronic RfD represents an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive populations (e.g., children), that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chemical exposures exceeding the RfD do not predict specific diseases. USEPA's Integrated Risk Information System, known as IRIS, provides the primary database of chemical-specific toxicity information used in Superfund risk assessments. The most current CSFs and RfDs for PCBs were used in calculating cancer risks and non-cancer hazards in the Mid-Hudson HHRA.

PCBs are a group of synthetic organic chemicals consisting of 209 individual chlorinated biphenyls called congeners. Some PCB congeners are considered to be structurally similar to dioxin and are called dioxin-like PCBs. USEPA has classified PCBs as probable human carcinogens, based on a number of studies in laboratory animals showing liver tumors. Human carcinogenicity data for PCB mixtures are limited but suggestive. USEPA (1996) described three published studies that analyzed deaths from cancer in PCB capacitor manufacturing plants (Bertazzi et al., 1987; Brown, 1987; and Sinks et al., 1992). Recently, Kimbrough et al. (1999) published the results of an epidemiological study of mortality in workers from two General Electric Company capacitor manufacturing plants in New York State. In September 1999, two Letters to the Editor regarding the Kimbrough et al. (1999) study and a response from Kimbrough et al. were published in the Journal of Occupational and Environmental Medicine. Due to the limitations of the Kimbrough et al. (1999) study identified by USEPA and others, USEPA expects that the findings of the Kimbrough et al. (1999) study will not lead to any change in its CSFs for PCBs, which were last reassessed by USEPA in 1996. The toxicity of PCBs is discussed in detail in the Human Health Risk Assessment for the Upper Hudson River.

Risk Characterization

For known or suspected carcinogens, acceptable exposure levels for Superfund are generally concentration levels that represent an incremental upper-bound lifetime cancer risk to an RME individual of 10-6 to 10-4 (USEPA, 1990). Ingestion of fish to an RME individual results in the highest cancer risks of approximately 4 × 10-4 (4 additional cancers in a population of ten thousand). Ingestion of fish for the average (central tendency) scenario results in an incremental upper-bound lifetime cancer risk to approximately 9 × 10-6 (9 additional cancers in a population of one million). If it is assumed that a child meal portion is approximately 1/3 of an adult portion, then the RME child risk for ingestion of fish is approximately 1 × 10-4. Estimated cancer risks for all other exposure pathways are below 10-6 (i.e., less than one in a million). The cancer risks are based on uniform exposure throughout the Mid-Hudson River (i.e., that the exposure occurs throughout the Mid-Hudson study area).

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Cancer Risk Summary		
Pathway	**Central Tendency Risk**	**RME Risk**
Ingestion of Fish: Adult Child	 9×10^{-6} (9 in 1,000,000) 3×10^{-6} (6 in 1,000,000)	 4×10^{-4} (4 in 10,000) 1×10^{-4} (1 in 10,000)
Recreational Exposure to Sediment*	2×10^{-8} (2 in 100,000,000)	2×10^{-7} (2 in 10,000,000)
Recreational Dermal Exposure to Water*	9×10^{-9} (9 in 1,000,000,000)	6×10^{-8} (6 in 100,000,000)
Consumption of Drinking Water*	2×10^{-8} (2 in 100,000,000)	1×10^{-7} (1 in 10,000,000)

Total risk for child (aged 1-6), adolescent (aged 7-18), and adult (over 18).

The evaluation of non-cancer health effects involved comparing the average daily exposure levels (dose) to determine whether the estimated exposures exceed the RfD. The ratio of the site-specific calculated dose to the RfD for each exposure pathway is summed to calculate the Hazard Index (HI) for the exposed individual. An HI of one (1) is the reference level established by USEPA above which concerns about non-cancer health effects must be evaluated.

Ingestion of fish by the RME individual results in the highest value for non-cancer health hazards (HI = 30). Ingestion of fish by the average (central tendency) individual results in an HI of 3. Note that the average daily dose decreases as the exposure duration increases, so the average concentration over a 7-year exposure period used as the RME for non-cancer is greater than the average concentration over the 40-year exposure period used as the RME for the cancer assessment. Even if the average concentration of PCBs in fish over 40 years rather than the average concentration over 7 years is used to evaluate non-cancer health hazards (i.e., 0.8 ppm PCBs instead of 1.3 ppm PCBs), the HI would be 18. If it is assumed that a child meal portion is approximately 1/3 of an adult portion, then the RME child HI for ingestion of fish is 10. Total HIs for the recreational exposure pathways are all significantly less than one. The calculated HIs are based on uniform exposure throughout the Mid-Hudson River (i.e., that the exposure occurs throughout the Mid-Hudson study area).

Uncertainties are inherent in the risk assessment process and may exist in PCB concentrations in environmental media, derivation of toxicity values, and estimating potential exposures. The uncertainties in risk characterization for the Mid-Hudson HHRA are expected to be similar to those found in the Human Health Risk Assessment for the Upper Hudson River.

Non-Cancer Hazard Summary		
Pathway	**Central Tendency Non-Cancer Hazard Index**	**RME Non-Cancer Hazard Index**
Ingestion of Fish:		
Adult	3	30
Child	1	10
Recreational Exposure to Sediment*	0.002	0.004
Recreational Dermal Exposure to Water*	0.005	0.007
Consumption of Drinking Water*	0.01	0.02

Non-Cancer Hazard Summary

Pathway

**Higher of value for child or adolescent, which are both higher than adult for these pathways.*

Major Findings of the Mid-Hudson HHRA

The Mid-Hudson HHRA evaluated both cancer risks and non-cancer health hazards to children, adolescents and adults posed by PCBs in the Mid-Hudson River. USEPA has classified PCBs as probable human carcinogens and known animal carcinogens. Other long-term adverse health effects of PCBs observed in laboratory animals include a reduced ability to fight infections, low birth weights, and learning problems. The major findings of the report are:

- Eating fish is the primary pathway for humans to be exposed to PCBs from the Mid-Hudson.
- Under the RME scenario for eating fish, the calculated risk is approximately four additional cases of cancer for every 10,000 people exposed. This excess cancer risk is more than 100 times higher than USEPA's goal of protection and within the upper bound of the cancer risk range generally allowed under the federal Superfund law.
- For non-cancer health effects, the RME scenario for eating fish from the Mid-Hudson results in a level of exposure to PCBs that is 30 times higher than USEPA's reference level (Hazard Index) of one.
- Under baseline conditions, the RME cancer risks and non-cancer hazards for eating fish would be above USEPA's generally acceptable levels for a 40-year exposure period beginning in 1999.

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- For the fish consumption pathway, central tendency cancer risks lie within the risk range of 10-6 to 10-4, and non-cancer hazards under central tendency assumptions fall slightly above the USEPA's reference level (Hazard Index) of one.

- Risks from being exposed to PCBs in the Mid-Hudson River through skin contact with contaminated sediments and river water, residential ingestion of river water for drinking water, incidental ingestion of sediments, and inhalation of PCBs in air are significantly below USEPA's levels of concern for cancer and non-cancer health effects.

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Ecological Risk Assessment Addendum: Future Risks in the Lower Hudson River Executive Summary December 1999

This document presents the baseline Ecological Risk Assessment for Future Risks in the Lower Hudson River (ERA Addendum), which is a companion volume to the baseline Ecological Risk Assessment (ERA) that was released by the U.S. Environmental Protection Agency (USEPA) in August 1999. Together, the two risk assessments comprise the ecological risk assessment for Phase 2 of the Reassessment Remedial Investigation/Feasibility Study (Reassessment RI/FS) for the Hudson River PCBs site in New York.

The ERA Addendum quantitatively evaluates the future risks to the environment in the Lower Hudson River (Federal Dam at Troy, New York to the Battery in New York City) posed by polychlorinated biphenyls (PCBs) from the Upper Hudson River (Hudson Falls, New York to the Federal Dam at Troy, New York), in the absence of remediation. This report uses current USEPA policy and guidance as well as additional site data and analyses to update USEPA's 1991 risk assessment.

USEPA uses ecological risk assessments to evaluate the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to one or more chemical or physical stressors. The Superfund ecological risk assessment process includes the following: 1) identification of contaminants of concern; 2) development of a conceptual model, which identifies complete exposure pathways for the ecosystem; 3) identification of assessment endpoints, which are ecological values to be protected; 4) development of measurement endpoints, which are the actual measurements used to assess risk to the assessment endpoints; 5) selection of receptors of concern; 6) the exposure assessment, which describes concentrations or dietary doses of contaminants of concern to which the selected receptors are or may be exposed; 7) the effects assessment, which describes toxicological effects due to chemical exposure and the methods used to characterize those effects to the receptors of concern; and 8) risk characterization, which compares the results of the exposure assessment with the effects assessment to evaluate the likelihood of adverse ecological effects associated with exposure to chemicals at a site.

The ERA Addendum indicates that, for some species, future concentrations of PCBs in the Lower Hudson River generally exceed levels that have been shown to cause adverse ecological effects through 2018 (the entire forecast period). The results of the ERA Addendum will help establish acceptable exposure levels for use in developing remedial alternatives for PCB-contaminated sediments in the Upper Hudson River, which is Phase 3 (Feasibility Study) of the Reassessment RI/FS.

Contaminants of Concern

The contaminants of concern identified for the site are PCBs. PCBs are a group of synthetic organic compounds consisting of 209 individual chlorinated biphenyls called congeners. Some PCB congeners are considered to be structurally similar to dioxin and are called dioxin-like PCBs. Toxic equivalency (TEQ) factors, based on the toxicity of dioxin, have been developed for the dioxin-like PCB congeners. PCBs have been shown to cause adverse reproductive and developmental effects in animals. Ecological exposure to PCBs is primarily an issue of bioaccumulation rather than direct toxicity. PCBs bioaccumulate in the environment by both bioconcentrating (being absorbed from water and accumulated in tissue to levels greater than those found in surrounding water) and biomagnifying (increasing in tissue concentrations as they go up the food chain through two or more trophic levels).

Site Conceptual Model

The Hudson River PCBs site is the 200 miles (322 km) of river from Hudson Falls, New York to the Battery in New York City. As defined in the ERA and ERA Addendum, the Lower Hudson River extends approximately 160 miles (258 km) from the Federal Dam at Troy (River Mile 153) to the Battery.

The Hudson River is home to a wide variety of ecosystems. The Lower Hudson River is tidal, does not have dams, and is freshwater in the vicinity of the Federal Dam, becoming brackish and increasingly more saline towards the Battery. Spring runoffs and major storms can push the salt front well below the Tappan Zee Bridge, and sometimes south to New York City. The Lower Hudson has deep water environments, shallow nearshore areas (shallows, mudflats, and shore communities), tidal marshes, and tidal swamps.

PCBs were released from two General Electric Company capacitor manufacturing facilities located in the Upper Hudson River at Hudson Falls and Fort Edward, New York. Many of these PCBs adhered to river sediments. As PCBs in the river sediments are released slowly into the river water, these contaminated sediments serve as a continuing source of PCBs. During high flow events, the sediments may be deposited on the floodplain and PCBs may thereby enter the terrestrial food chain. High flow events may also increase the bioavailability of PCBs to organisms in the river water.

Animals and plants living in or near the river, such as invertebrates, fish, amphibians, and water-dependent reptiles, birds, and mammals, may be directly exposed to the PCBs from contaminated sediments, river water, and air, and/or indirectly exposed through ingestion of food (*e.g.*, prey) containing PCBs.

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Assessment Endpoints

Assessment endpoints are explicit expressions of actual environmental values (*i.e.*, ecological resources) that are to be protected. They focus a risk assessment on particular components of the ecosystem that could be adversely affected due to contaminants at the site. These endpoints are expressed in terms of individual organisms, populations, communities, ecosystems, or habitats with some common characteristics (e.g., feeding preferences, reproductive requirements). The assessment endpoints for the ERA Addendum were selected to include direct exposure to PCBs in Lower Hudson River sediments and river water through ingestion and indirect exposure to PCBs *via* the food chain. Because PCBs are known to bioaccumulate, an emphasis was placed on indirect exposure at various levels of the food chain to address PCB-related risks at higher trophic levels. The assessment endpoints that were selected for the Lower Hudson River are:

- Benthic community structure as a food source for local fish and wildlife
- Protection and maintenance (survival, growth, and reproduction) of local fish populations (forage, omnivorous, and piscivorous)
- Protection and maintenance (survival, growth, and reproduction) of local insectivorous bird populations
- Protection and maintenance (survival, growth, and reproduction) of local waterfowl populations
- Protection and maintenance (survival, growth, and reproduction) of local piscivorous birds populations
- Protection and maintenance (survival, growth, and reproduction) of local insectivorous wildlife populations
- Protection and maintenance (survival, growth, and reproduction) of local omnivorous wildlife populations
- Protection and maintenance (survival, growth, and reproduction) of local piscivorous wildlife populations
- Protection of threatened and endangered species
- Protection of significant habitats

Measurement Endpoints

Measurement endpoints provide the actual measurements used to evaluate ecological risk and are selected to represent mechanisms of toxicity and exposure pathways. Measurement endpoints for future risk generally include modeled concentrations of chemicals in water, sediment, fish, birds, and/or mammals, laboratory toxicity studies, and field observations. The measurement endpoints identified for the ERA Addendum are:

1) Modeled concentrations of PCBs in fish and invertebrates to evaluate food-chain exposure;

2) Modeled total PCB body burdens in receptors (including avian receptor eggs) to determine exceedance of effect-level thresholds based on toxicity reference values (TRVs);

3) Modeled TEQ-based PCB body burdens in receptors (including avian receptor eggs) to determine exceedance of effect-level thresholds based on TRVs;

4) Modeled concentration of PCBs in river water to determine exceedence of criteria for concentrations of PCBs in river water that are protective of benthic invertebrates, fish and wildlife;

5) Modeled concentrations of PCBs in sediment to determine exceedence of guidelines for concentrations of PCBs in sediments that are protective of aquatic health; and

6) Field observations.

Receptors of Concern

Risks to the environment were evaluated for individual receptors of concern that were selected to be representative of various feeding preferences, predatory levels, and habitats (aquatic, wetland, shoreline). The ERA Addendum does not characterize injury to, impact on, or threat to every species of plant or animal that lives in or adjacent to the Hudson River; such a characterization is beyond the scope of the Superfund ecological risk assessment. The following receptors of concern were selected for the ERA Addendum:

Aquatic Invertebrates

- Benthic macroinvertebrate community (e.g., aquatic worms, insect larvae, and isopods)

Fish Species

- Pumpkinseed (*Lepomis gibbosus*)
- Spottail shiner *(Notropis hudsonius)*

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- Brown bullhead *(Ictalurus nebulosus)*
- White perch (*Morone americana)*
- Yellow perch (*Perca flavescens)*
- Largemouth bass (*Micropterus salmoides)*
- Striped bass (*Morone saxatilis)*
- Shortnose sturgeon (*Acipenser brevirostrum)*

Birds

- Tree swallow (*Tachycineta bicolor*)
- Mallard (*Anas platyrhychos*)
- Belted kingfisher (*Ceryle alcyon*)
- Great blue heron (*Ardea herodias*)
- Bald eagle (*Haliaeetus leucocephalus*)

Mammals

- Little brown bat *(Myotis lucifugus)*
- Raccoon (*Procyon lotor*)
- Mink (*Mustela vison*)
- River otter (*Lutra canadensis*)

Exposure Assessment

The Exposure Assessment describes complete exposure pathways and exposure parameters (*e.g.,* body weight, prey ingestion rate, home range) used to calculate the concentrations or dietary doses to which the receptors of concern may be exposed due to chemical exposure. USEPA previously released reports on the nature and extent of contamination in the Hudson River as part of the Reassessment RI/FS (*e.g.,* February 1997 Data Evaluation and Interpretation Report, July 1998 Low Resolution Sediment Coring Report, August 1998 Database for the Hudson River PCBs Reassessment RI/FS [Release 4.1], and May 1999 Baseline Modeling Report). The Reassessment RI/FS documents form the basis of the site data collection and analyses that were used in conducting the ERA Addendum. Future (*i.e.,* modeled) concentrations of PCBs in fish, sediments and river water are provided in the ERA Addendum, based on fate and bioaccumulation models by Farley *et al.* (1999) and USEPA's Revised Baseline Modeling Report (USEPA, 2000). Exposure parameters were obtained from USEPA references, the scientific literature, and directly from researchers as reported in the ERA.

Effects Assessment

The Effects Assessment describes the methods used to characterize particular toxicological effects of PCBs on aquatic and terrestrial organisms due to chemical exposure. These measures of toxicological effects, called TRVs, provide a basis for estimating whether the chemical exposure at a site is likely to result in adverse ecological effects.

In conducting the ERA Addendum, USEPA used the TRVs selected in the ERA based on Lowest Observed Adverse Effects Levels (LOAELs) and/or No Observed Adverse Effects Levels (NOAELs) from laboratory and/or field-based studies reported in the scientific literature. These TRVs examine the effects of PCBs and dioxin-like PCB congeners on the survival, growth, and reproduction of fish and wildlife species in the Lower Hudson River. Reproductive effects (*e.g.*, egg maturation, egg hatchability, and survival of juveniles) were generally the most sensitive endpoints for animals exposed to PCBs.

Risk Characterization

Risk Characterization examines the likelihood of adverse ecological effects occurring as a result of exposure to chemicals and discusses the qualitative and quantitative assessment of risks to ecological receptors with regard to toxic effects. Risks are estimated by comparing the results of the Exposure Assessment (*e.g.*, modeled concentrations of chemicals in receptors of concern) to the TRVs developed in the Effects Assessment. The ratio of these two numbers is called a Toxicity Quotient, or TQ.

TQs equal to or greater than one ($TQ \geq 1$) are typically considered to indicate potential risk to ecological receptors, for example reduced or impaired reproduction or recruitment of new individuals. The TQs provide insight into the potential for adverse effects upon individual animals in the local population resulting from chemical exposure. If a TQ suggests that effects are not expected to occur for the average individual, then they are probably insignificant at the population level. However, if a TQ indicates risks are present for the average individual, then risks may be present for the local population.

At each step of the risk assessment process there are sources of uncertainty. Measures were taken in the ERA to address and characterize the uncertainty. For example, in some cases uncertainty factors were applied in developing TRVs. The purpose of these uncertainty factors is to ensure that the calculated TRVs are protective of the receptor species of concern. Another source of uncertainty is associated with the future PCB concentrations in fish. The PCB concentrations in fish presented in the ERA Addendum (forecast from models in Farley *et al.* (1999) and the Revised Baseline Modeling Report (USEPA, 2000) may be significantly underestimated, which may underestimate risks to fish species. However, based on a comparison of measured concentrations of PCBs in fish to modeled concentrations, the forecasts presented in the ERA Addendum are not expected to overestimate future PCB concentration in fish, so that the risks to fish are not expected to be overestimated.

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To integrate the various components of the ERA Addendum, the results of the risk characterization and associated uncertainties were evaluated using a weight-of-evidence approach to assess the risk of adverse effects in the receptors of concern as a result of exposure to PCBs in the Lower Hudson River. The weight-of-evidence approach considers both the results of the TQ analysis and field observations for each assessment endpoint. For the mammals and most birds, TQs for the dioxin-like PCBs were greater than the TQs for total PCBs.

Benthic Community Structure

Risks to local benthic invertebrate communities were examined using two lines of evidence. These lines of evidence are: 1) comparison of modeled water column concentrations of PCBs to criteria and 2) comparisons of modeled sediment concentrations to guidelines. Both suggest an adverse effect of PCBs on benthic invertebrate populations serving as a food source to local fish in the Lower Hudson River. Uncertainty in this analysis is considered low.

Local Fish (Forage, Omnivorous, Piscivorous and Semi-piscivorous)

Risks to local fish populations were examined using five lines of evidence. These lines of evidence are: 1) comparison of modeled total PCB fish body burdens to TRVs; 2) comparison of modeled TEQ fish body burdens to TRVs; 3) comparison of modeled water column concentrations of PCBs to criteria; 4) comparison of modeled sediment concentrations to guidelines; and 5) field-based observations. Multiple receptors were evaluated for forage and semi-piscivorous/piscivorous fish.

Collectively, the evidence indicates that future PCB exposures (predicted from 1993 to 2018) are not expected to be of a sufficient magnitude to prevent reproduction or recruitment of common fish species in the Lower Hudson River. However, based upon toxicity quotients, future exposure to PCBs may reduce or impair the survival, growth, and reproductive capability of some forage species (*e.g.*, pumpkinseed) and semi-piscivorous/piscivorus fish (*e.g.*, white perch, yellow perch, largemouth bass, and striped bass), particularly in the upper reaches of the Lower Hudson River.

There is a moderate degree of uncertainty in the modeled body burdens used to evaluate exposure, and at most an order of magnitude uncertainty in the TRVs (for the TEQ-based TRVs, no uncertainty factors were needed).

Modeled concentrations of PCBs in river water in the Lower Hudson River show exceedances of criteria developed for protection of fish and wildlife through the duration of the forecast period (1993 - 2018).

Insectivorous Birds

Risks to local insectivorous bird populations were examined using six lines of evidence. These lines of evidence are: 1) comparison of modeled total PCB dietary doses to TRVs; 2)

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comparison of modeled TEQ dietary doses to TRVs; 3) comparison of modeled total PCB egg concentrations to TRVs; 4) comparison of modeled TEQ egg concentrations to TRVs; 5) comparison of modeled water column concentrations of PCBs to criteria; and 6) field-based observations. The tree swallow was selected to represent insectivorous bird species.

Collectively, the evidence indicates that future PCB exposures (predicted from 1993 to 2018) are not expected to be of a sufficient magnitude to prevent reproduction or recruitment of common insectivorous bird species in the Lower Hudson River Valley. TQs are all below one for all locations for the entire forecast period (1993 to 2018). However, given that U.S. Fish and Wildlife Service field studies suggest PCBs may cause abnormal nest construction of Upper Hudson River tree swallows, it is possible that future exposure to PCBs in the Lower Hudson River may reduce or impair the reproductive capability of tree swallows, particularly in the upper reaches of the Lower Hudson River.

There is a moderate degree of uncertainty in the calculated modeled concentrations of PCBs in tree swallow diets and the concentrations of PCBs in eggs. There is a low degree of uncertainty associated with tree swallow TRVs, which were derived from field studies of Hudson River tree swallows.

Modeled concentrations of PCBs in river water in the Lower Hudson River show exceedances of criteria developed for the protection of wildlife through the duration of the forecast period (1993-2018).

Waterfowl

Risks to local waterfowl populations were examined using six lines of evidence. These lines of evidence are: 1) comparison of modeled total PCB dietary doses to TRVs; 2) comparison of modeled TEQ dietary doses to TRVs; 3) comparison of modeled total PCB egg concentrations to TRVs; 4) comparison of modeled TEQ egg concentrations to TRVs; 5) comparison of modeled water column concentrations of PCBs to criteria; and 6) field-based observations. The mallard was selected to represent waterfowl.

Collectively, the evidence indicates that future PCB exposures (predicted from 1993 to 2018) are not expected to be of a sufficient magnitude to prevent reproduction or recruitment of common waterfowl in the Lower Hudson River Valley. However, based upon toxicity quotients, future exposure to PCBs may reduce or impair the survival, growth, and reproductive capability of some waterfowl, particularly in the upper reaches of the lower river.

Calculated dietary doses of PCBs and concentrations of PCBs in eggs typically exceed their respective TRVs throughout the modeling period. Toxicity quotients for the TEQ-based (*i.e.*, dioxin-like) PCBs consistently show greater exceedances than for total (Tri+) PCBs. There is a moderate degree of uncertainty in the dietary dose and egg concentration estimates. Given the magnitude of the TEQ-based TQs, they would have to decrease by an order of magnitude or more to fall below one for waterfowl in the Lower Hudson River.

Modeled concentrations of PCBs in river water in the Lower Hudson River show exceedances of criteria developed for the protection of wildlife through the duration of the forecast period (1993-2018).

Piscivorous Birds

Risks to local semi-piscivorous/piscivorous bird populations were examined using six lines of evidence. These lines of evidence are: 1) comparison of modeled total PCB dietary doses to TRVs; 2) comparison of modeled TEQ dietary doses to TRVs; 3) comparison of modeled total PCB egg concentrations to TRVs; 4) comparison of modeled TEQ egg concentrations to TRVs; 5) comparison of modeled water column concentrations of PCBs to criteria; and 6) field-based observations. The belted kingfisher, great blue heron, and bald eagle were selected to represent piscivorous birds.

Collectively, the evidence indicates that future PCB exposures (predicted from 1993 to 2018) are not expected to be of a sufficient magnitude to prevent reproduction or recruitment of these piscivorous species. However, based upon toxicity quotients, future exposure to PCBs may reduce or impair the survival, growth, and reproductive capability of some piscivorous birds, particularly in the upper reaches of the Lower Hudson Rver. Calculated dietary doses of PCBs and concentrations of PCBs in eggs exceed all TRVs (*i.e.*, NOAELs and LOAELs) for the belted kingfisher and bald eagle throughout the modeling period, and exceed NOAELs for the great blue heron. Toxicity quotients for egg concentrations are generally higher than body burden TQs.

There is a moderate degree of uncertainty in the dietary dose and egg concentration estimates. Given the magnitude of the TQs, they would have to decrease by an order of magnitude or more to fall below one for piscivorous birds in the Lower Hudson River. In particular, the bald eagle TQs exceeded one by up to three orders of magnitude. Therefore, even if the factor of 2.5 to adjust from largemouth bass fillets to whole body burden and the subchronic-to-chronic uncertainty factor of 10 used for the body burden TRV are removed, the TQs would remain well over one. These results coupled with the lack of breeding success in Lower Hudson River bald eagles (USGS, 1999) indicate that reproductive effects may be present.

Modeled concentrations of PCBs in river water in the Lower Hudson River show exceedances of criteria developed for the protection of wildlife through the duration of the forecast period (1993-2018).

Insectivorous Mammals

Risks to local insectivorous mammal populations were examined using four lines of evidence. These lines of evidence are: 1) comparison of modeled total PCB dietary doses to TRVs;

2) comparison of modeled TEQ dietary doses to TRVs; 3) comparison of modeled water column concentrations of PCBs to criteria; and 4) field-based observations. The little brown bat was selected to represent insectivorous mammals.

Collectively, the evidence indicates that future PCB exposures (predicted from 1993 to 2018) are not expected to be of a sufficient magnitude to prevent reproduction or recruitment of common insectivorous mammals in the Lower Hudson River Valley. However, exposure to PCBs may reduce or impair the survival, growth, or reproductive capability of insectivorous mammals in the Lower Hudson River. Modeled dietary doses for the little brown bat exceed TRVs by up to two orders of magnitude at all locations modeled. There is a moderate degree of uncertainty in the calculated dietary doses.

Modeled concentrations of PCBs in river water in the Lower Hudson River show exceedances of criteria developed for the protection of wildlife through the duration of the forecast period (1993-2018).

<u>Omnivorous Mammals</u>

Risks to local omnivorous mammal populations were examined using four lines of evidence. These lines of evidence are: 1) comparison of modeled total PCB dietary doses to TRVs; 2) comparison of modeled TEQ dietary doses to TRVs; 3) comparison of modeled water column concentrations of PCBs to criteria; and 4) field-based observations. The raccoon was selected to represent omnivorous mammals.

Collectively, the evidence indicates that future PCB exposures (predicted from 1993 to 2018) are not expected to be of a sufficient magnitude to prevent reproduction or recruitment of common omnivorous mammals in the Lower Hudson River Valley. However, exposure to PCBs may reduce or impair the survival, growth, or reproductive capability of omnivorous mammals in the Lower Hudson River. Modeled dietary doses for the raccoon exceed dietary dose NOAELs on a total PCB (Tri+) basis and all TRVs on a TEQ-basis. There is a moderate degree of uncertainty in the calculated dietary doses.

Modeled concentrations of PCBs in river water in the Lower Hudson River show exceedances of criteria developed for the protection of wildlife through the duration of the forecast period (1993 - 2018).

<u>Piscivorous Mammals</u>

Risks to local semi-piscivorous/piscivorous mammal populations were examined using four lines of evidence. These lines of evidence are: 1) comparison of modeled total PCB dietary doses to TRVs; 2) comparison of modeled TEQ dietary doses to TRVs; 3) comparison of modeled water column concentrations of PCBs to criteria; and 4) field-based observations. The mink and river otter were selected to represent piscivorous mammals.

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Collectively, the evidence indicates that future PCB exposures (predicted from 1993 to 2018) are not expected to be of a sufficient magnitude to prevent reproduction or recruitment of these piscivorous species. However, based upon toxicity quotients, future exposure to PCBs may reduce or impair the survival, growth, and reproductive capability of piscivorous mammals, particularly in the upper reaches of the Lower Hudson River. Calculated dietary doses of PCBs exceed the NOAEL on a total PCB basis for both the mink and river otter and exceed all TEQ-based TRVs by up to three orders of magnitude.

There is a moderate degree of uncertainty in the dietary dose estimates. However, given the magnitude of the TQs, they would have to decrease at least an order of magnitude to fall below one. In particular, the river otter TQs exceeded one by up to three orders of magnitude. Therefore, even if the factor of 2.5 to adjust from largemouth bass fillets to whole body burden is removed, the TQs would remain well over one.

Modeled concentrations of PCBs in river water in the Lower Hudson River show exceedances of criteria developed for the protection of wildlife through the duration of the forecast period (1993-2018). In addition, preliminary results from a NYSDEC study indicate that PCBs may have an adverse effect on the litter size and possibly kit survival of river otter in the Hudson River (Mayack, 1999b).

Threatened and Endangered Species

Risks to threatened and endangered species were examined using five lines of evidence. These lines of evidence are: 1) comparison of modeled total PCB dietary doses/egg concentrations to TRVs; 2) comparison of modeled TEQ dietary doses/egg concentrations to TRVs; 3) comparison of predicted modeled water column concentrations of PCBs to criteria; 4) comparison of modeled sediment concentrations of PCBs to guidelines; and 5) field-based observations. The shortnose sturgeon and bald eagle were selected to represent threatened and endangered species.

Collectively, the evidence indicates that future PCB exposures (predicted from 1993 to 2018) are not expected to be of a sufficient magnitude to prevent reproduction or recruitment of threatened or endangered species. However, using the TEQ-based toxicity quotients, potential for adverse reproductive effects in shortnose sturgeon exists, particularly when considering the long life expectancy of the sturgeon. Almost all TQs calculated for the bald eagle (across all locations) exceeded one, in some instances by more than three orders of magnitude. Both the dietary dose and egg-based results were consistent in this regard. Other threatened or endangered raptors, such as the peregrine falcon, osprey, northern harrier, and red-shouldered hawk may experience similar exposures.

There is a moderate degree of uncertainty in the dietary dose estimates. However, the bald eagle TQs exceeded one by up to three orders of magnitude. Therefore, even if the factor of 2.5 to adjust from largemouth bass fillets to whole body burden and the subchronic-to-chronic uncertainty factor of 10 used for the body burden TRV are removed, the TQs would remain well over one.

These results coupled with the lack of breeding success in Lower Hudson River bald eagles (USGS, 1999) indicate that reproductive effects may be present.

Modeled concentrations of PCBs in river water and sediment in the Lower Hudson River show exceedances of the majority of their respective criteria and guidelines through the duration of the forecast period (1993-2018).

Significant Habitats

Risks to significant habitats were examined using four lines of evidence. These lines of evidence are: 1) toxicity quotients calculated for receptors in this assessment; 2) comparison of modeled water column concentrations of PCBs to criteria; 3) comparison of modeled sediment concentrations of PCBs to guidelines; and 4) field-based observations.

Based on the toxicity quotients for receptors of concern, future PCB concentrations modeled for the Lower Hudson River exceed toxicity reference values for some fish, avian, and mammalian receptors. These comparisons indicate that animals feeding on Hudson River-based prey may be affected by the concentrations of PCBs found in the river on both a total PCB and TEQ basis. In addition, based on the ratios obtained in this evaluation, other taxononic groups not directly addressed in this evaluation (*e.g.*, amphibians and reptiles) may also be affected by PCBs in the Lower Hudson River. Many year-round and migrant species use the significant habitats along the Lower Hudson River for breeding or rearing their young. Therefore, exposure to PCBs may occur at a sensitive time in the life cycle (i.e., reproductive and development) and have a greater effect on populations than at other times of the year.

Modeled concentrations of PCBs in river water and sediment in the Lower Hudson River show exceedances of the majority of their respective criteria and guidelines through the duration of the forecast period (1993-2018).

Major Findings of the ERA Addendum

The results of the risk assessment indicate that receptors in close contact with the Lower Hudson River are at an increased ecological risk as a result of future exposure to PCBs in sediments, water, and/or prey. This conclusion is based on a TQ approach, in which modeled body burdens, dietary doses, and egg concentrations of PCBs were compared to TRVs, and on field observations. On the basis of these comparisons, all receptors of concern except the tree swallow are at risk. In summary, the major findings of the report are:

- Fish in the Lower Hudson River are at risk from future exposure to PCBs. Fish that eat other fish (*i.e.*, which are higher on the food chain), such as the largemouth bass and striped bass, are especially at risk. PCBs may adversely affect fish survival, growth, and reproduction.

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- Mammals that feed on insects with an aquatic stage spent in the Lower Hudson River, such as the little brown bat, are at risk from future PCB exposure. PCBs may adversely affect the survival, growth, and reproduction of these species.

- Birds that feed on insects with an aquatic stage spent in the Lower Hudson, such as the tree swallow, are not expected to be at risk from future exposure to PCBs.

- Waterfowl feeding on animals and plants in the Lower Hudson River are at risk from PCB exposure. Future concentrations of PCBs may adversely affect avian survival, growth, and reproduction.

- Birds and mammals that eat PCB-contaminated fish from the Lower Hudson River, such as the bald eagle, belted kingfisher, great blue heron, mink, and river otter, are at risk. Future concentrations of PCBs may adversely affect the survival, growth, and reproduction of these species.

- Omnivorous animals, such as the raccoon, that derive some of their food from the Lower Hudson River are at risk from PCB exposure. Future concentrations of PCBs may adversely affect the survival, growth, and reproduction of these species.

- Fragile populations of threatened and endangered species in the Lower Hudson River, represented by the bald eagle and shortnose sturgeon, are particularly susceptible to adverse effects from future PCB exposure.

- Modeled PCB concentrations in water and sediments in the Lower Hudson River generally exceed standards, criteria and guidelines established to be protective of the environment. Animals that use areas along the Lower Hudson designated as significant habitats may be adversely affected by the PCBs.

- The future risks to fish and wildlife are greatest in the upper reaches of the Lower Hudson River and decrease in relation to decreasing PCB concentrations down river. Based on modeled PCB concentrations, many species are expected to be at risk through 2018 (the entire forecast period).

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Mid-Hudson River Human Health Risk Assessment

Hudson River PCBs Reassessment

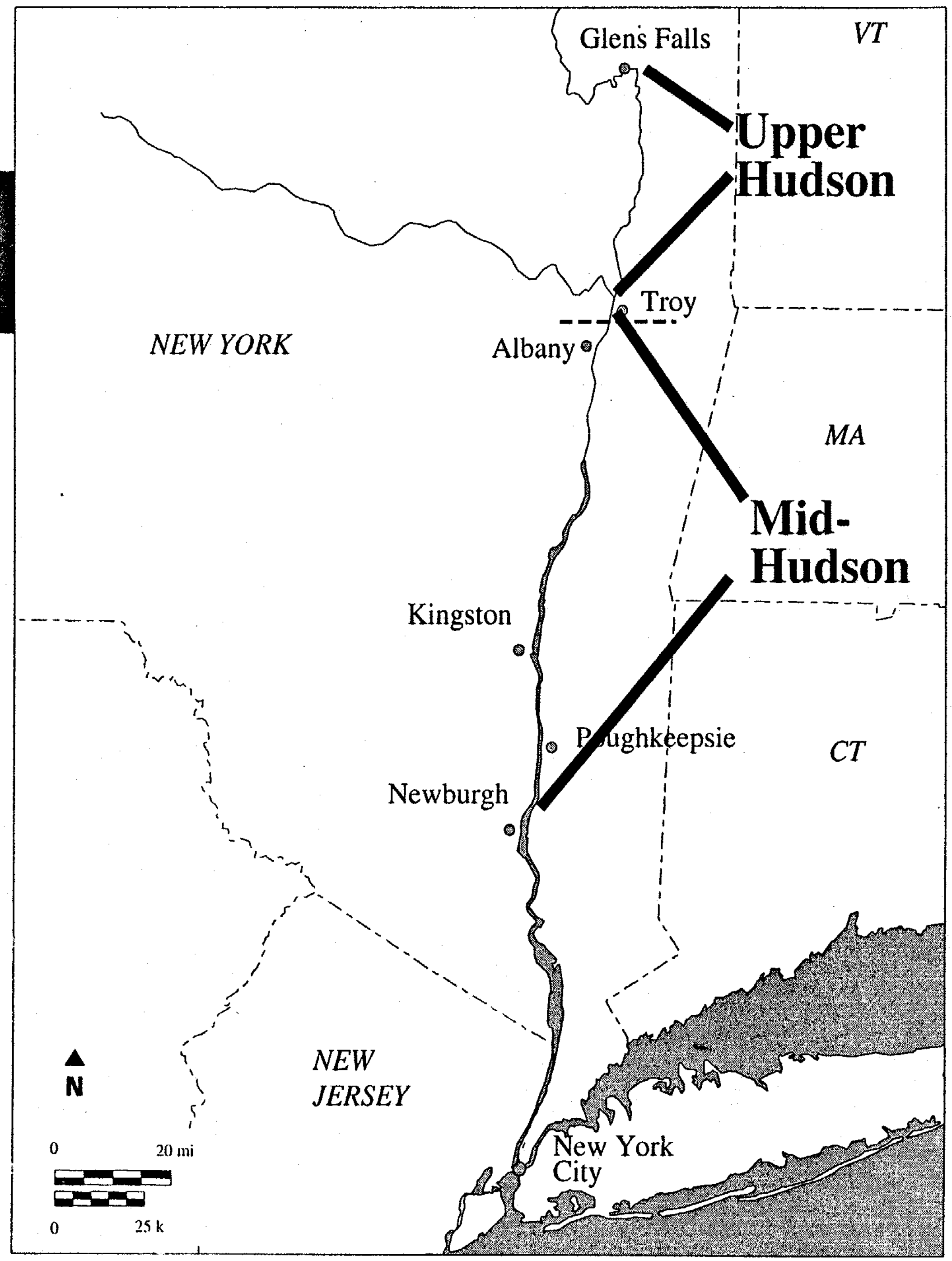
January 11, 2000

ATTACHMENT 2
1-10

What Does this Mid-Hudson Risk Assessment Address?

- What are the risks from various activities in the river now and in the future?
- What activities have the highest risks or exceed EPA's risk range?
- Are risks for children or adolescents higher than those for adults?
- How do Mid-Hudson risks compare with Upper Hudson risks?

Scope of Human Health Risk Assessments



Finding #1 -- Consuming Fish is the Highest Risk Pathway

- Adults who eat 1 half-pound fish meal per week:
  - There is a risk of 4 additional cancers per 10,000 people exposed.
  - The level of exposure to PCBs is 30 times higher than EPA's level of concern for non-cancer hazards.
- For adults who eat 1 half-pound fish meal every two months:
  - There is a risk of 6 additional cancers per 1,000,000 people exposed.
  - The level of exposure to PCBs is 3 times higher than EPA's level of concern for non-cancer hazards.
- Risks and hazards for children eating fish from the Mid-Hudson River are approximately 1/3 that of adults.

Finding #2 -- PCBs in Water, Sediment and Air

- Drinking water from the Mid-Hudson does not pose a human health risk, and is well below the MCL.

- Risks from skin contact, and incidental ingestion of sediment and water were shown to be below EPA's levels of concern.

- Risks from air inhalation do not raise health concerns.

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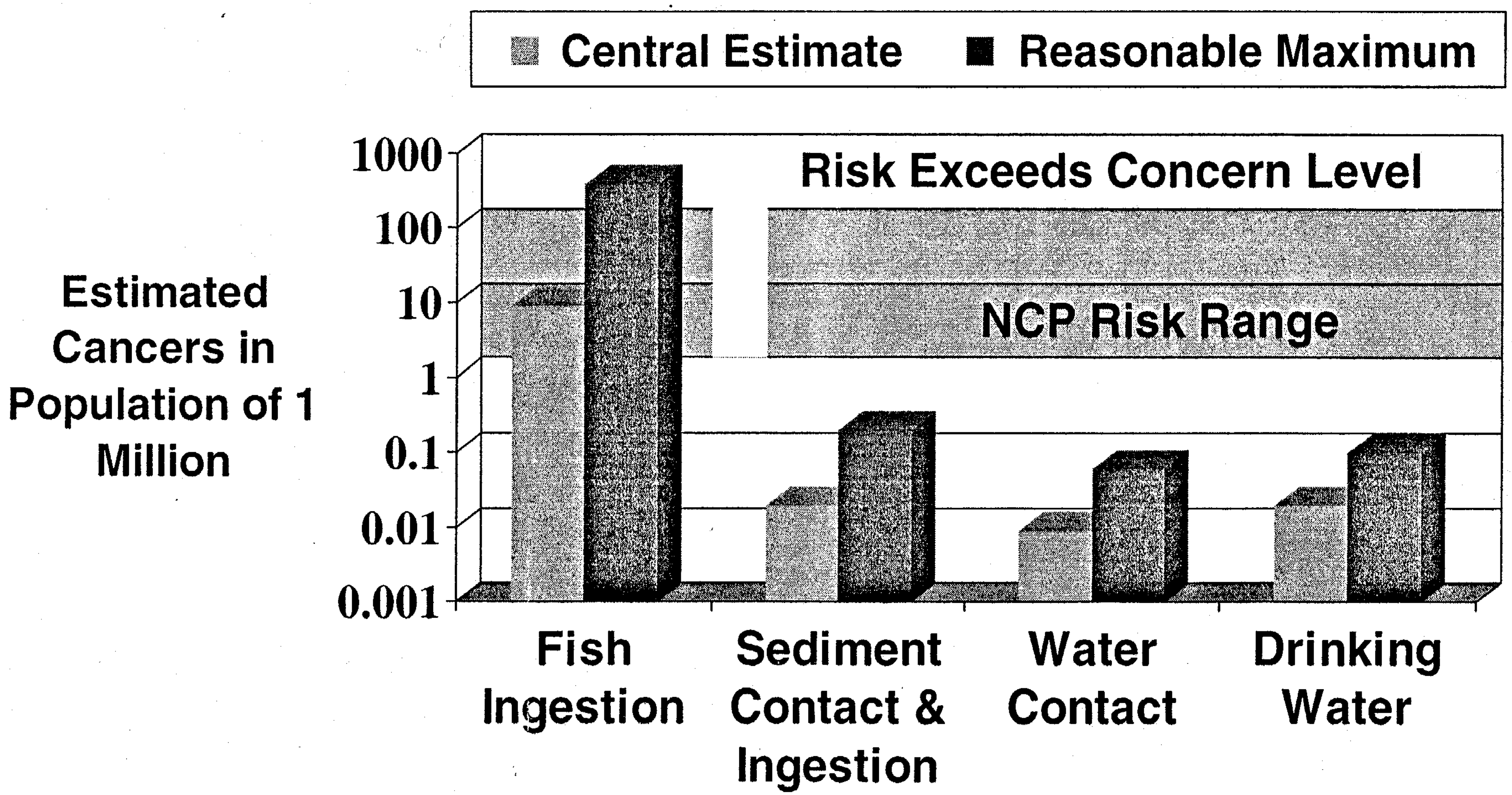
Cancer Risks from Fish Ingestion Exceed Levels of Concern



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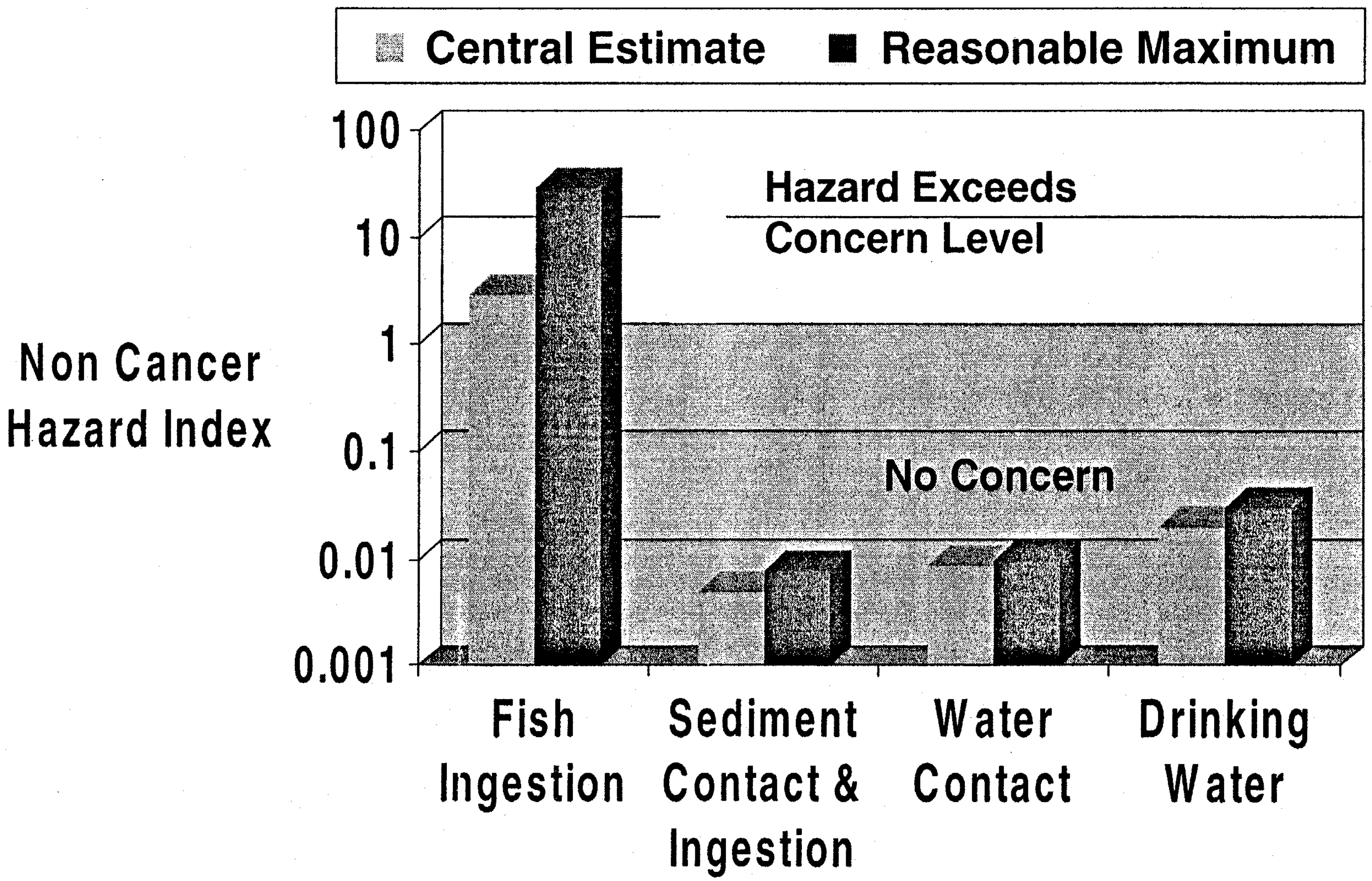
Non-Cancer Hazards for Fish Ingestion Exceed Levels of Concern



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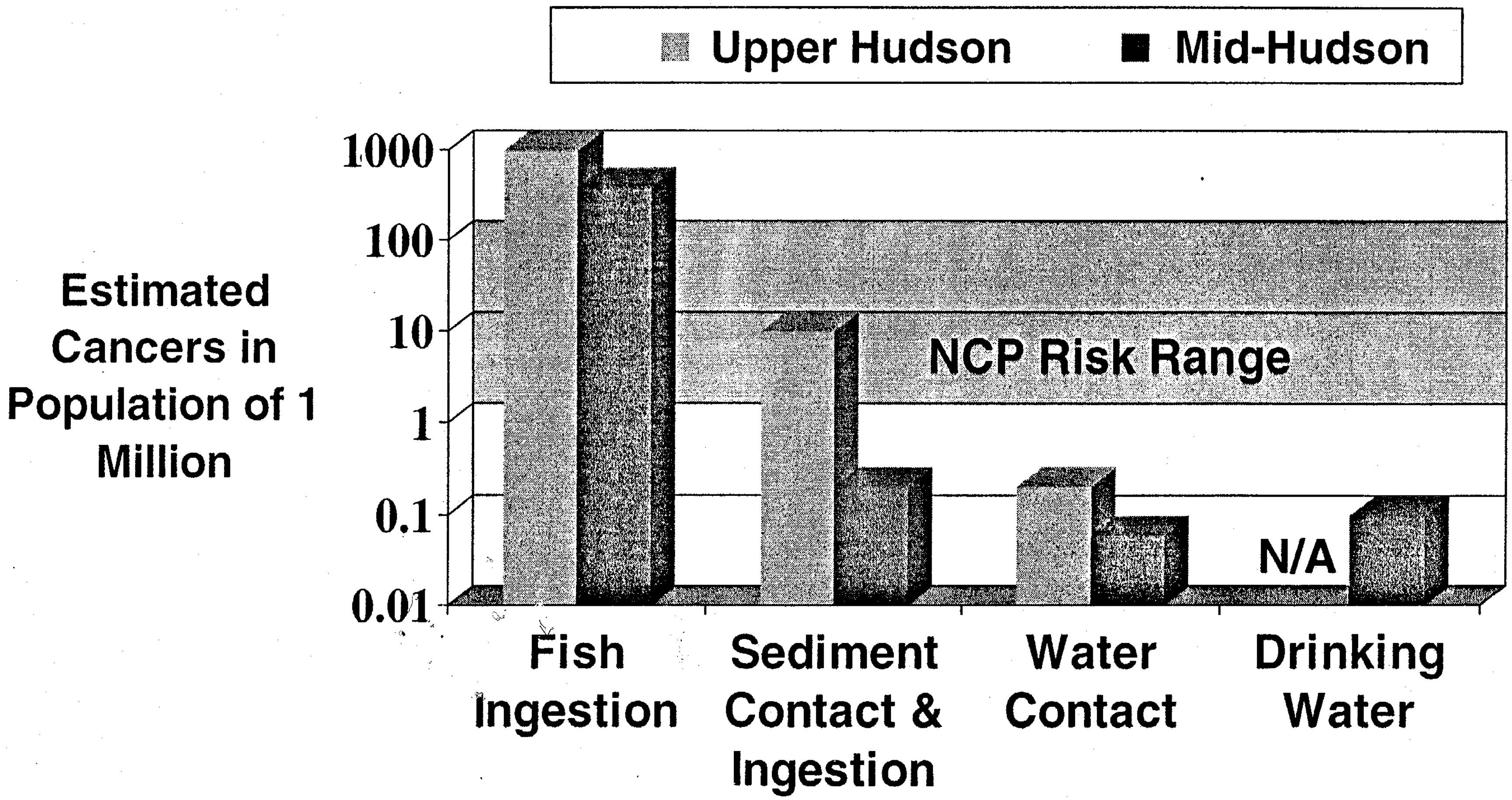
Cancer: Reasonable Maximum Estimate



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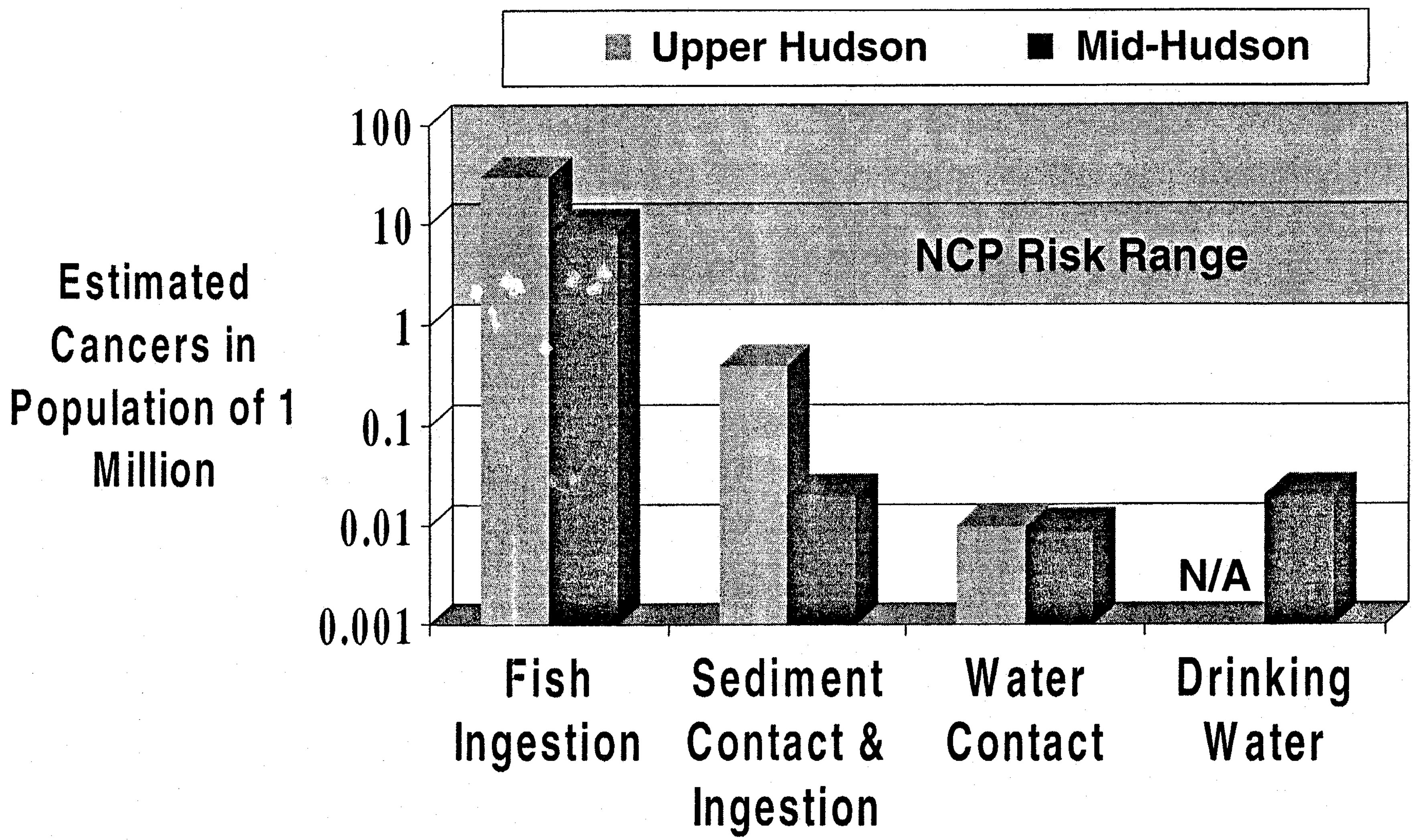
Cancer: Central Estimate (Average)



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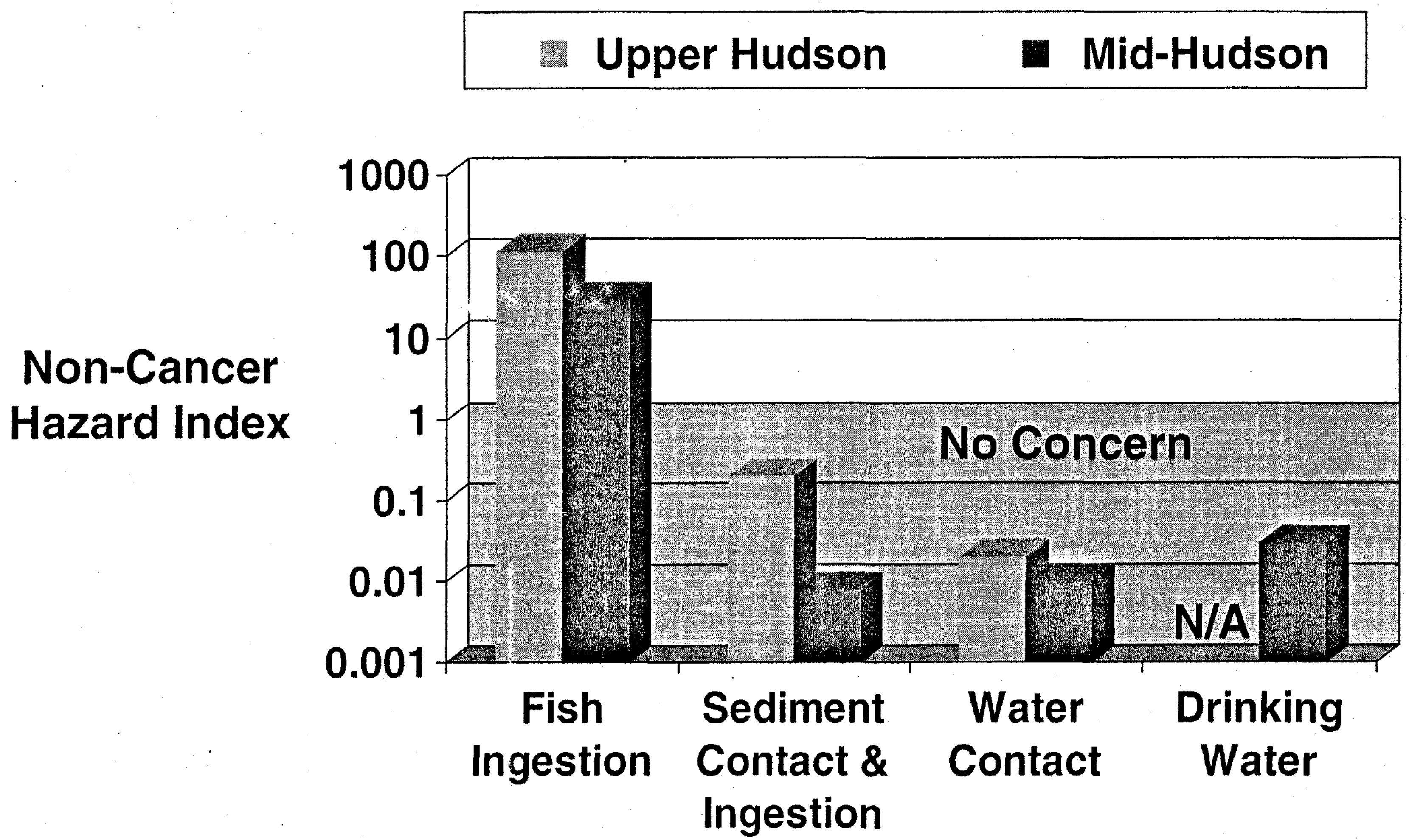
Non-Cancer: Reasonable Maximum Estimate



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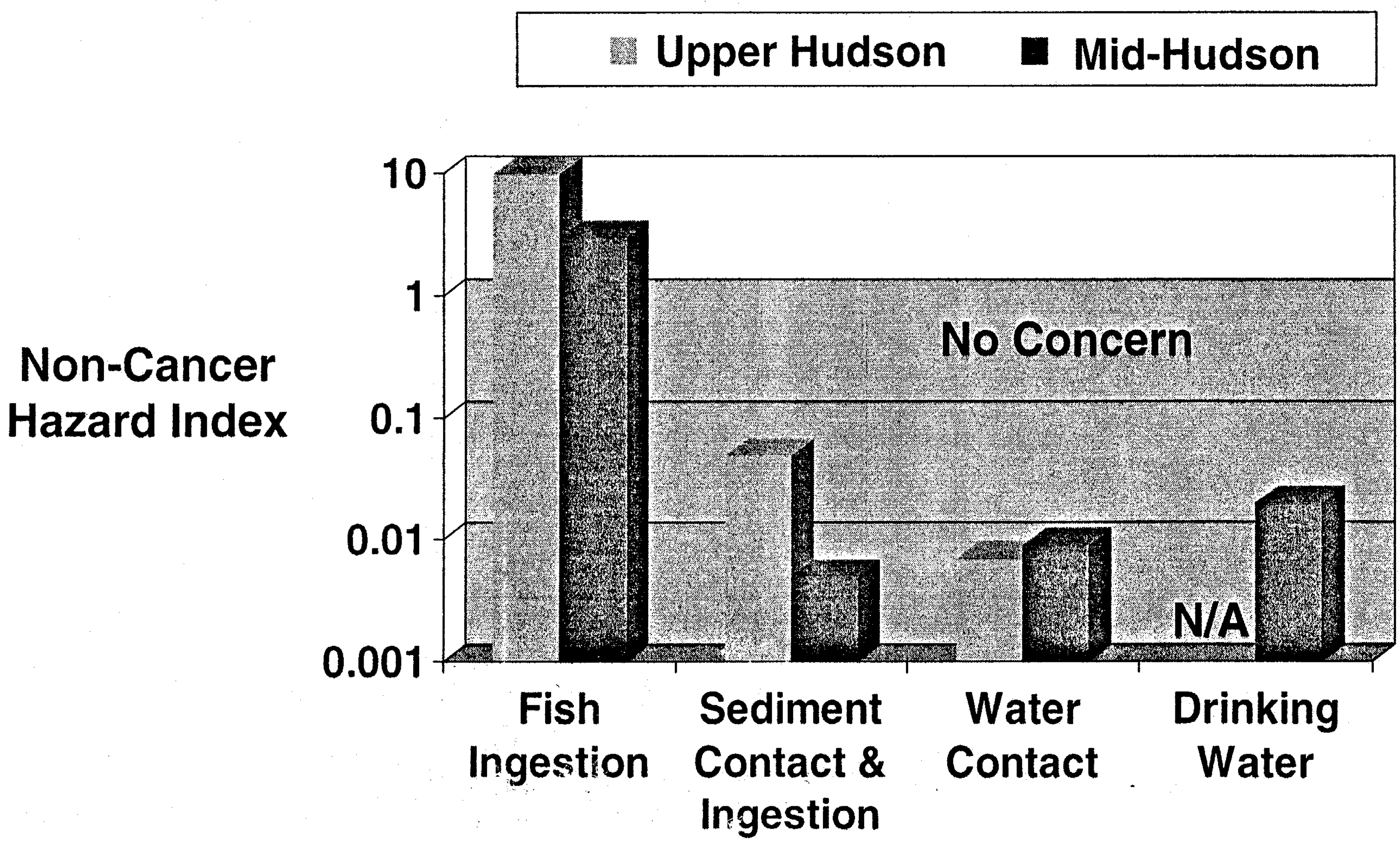
Non-Cancer: Central Estimate (Average)



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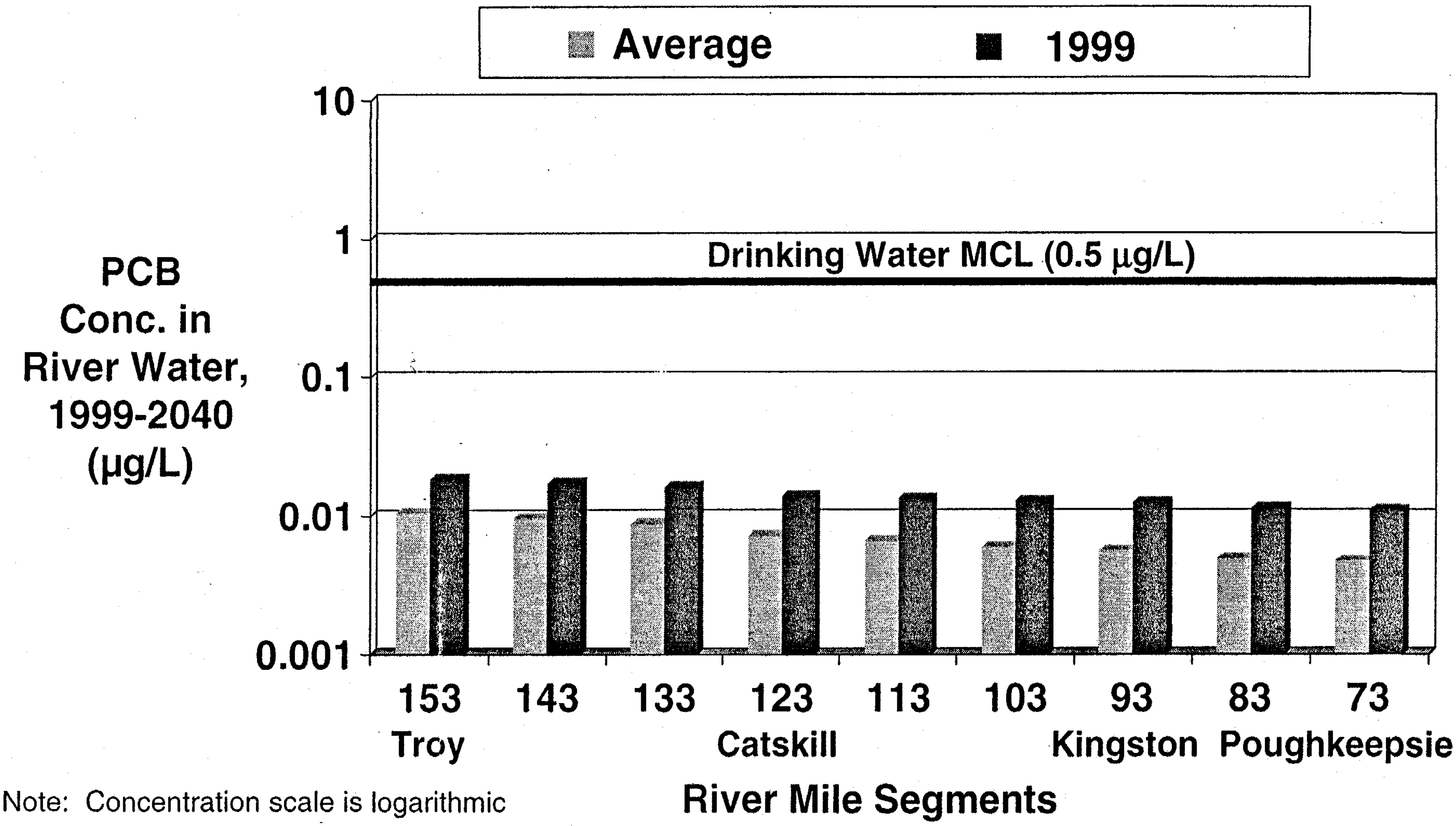
PCB Concentration in River Water is Below Federal Maximum Contaminant Level for Drinking Water



Note: Concentration scale is logarithmic

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Risk Assessment - Basic Components

Risk is a function of:

Exposure

Chemicals in food, sediment, water, air and their contact with and entry into the human body

Toxicity

The ability of a chemical to cause adverse health effects

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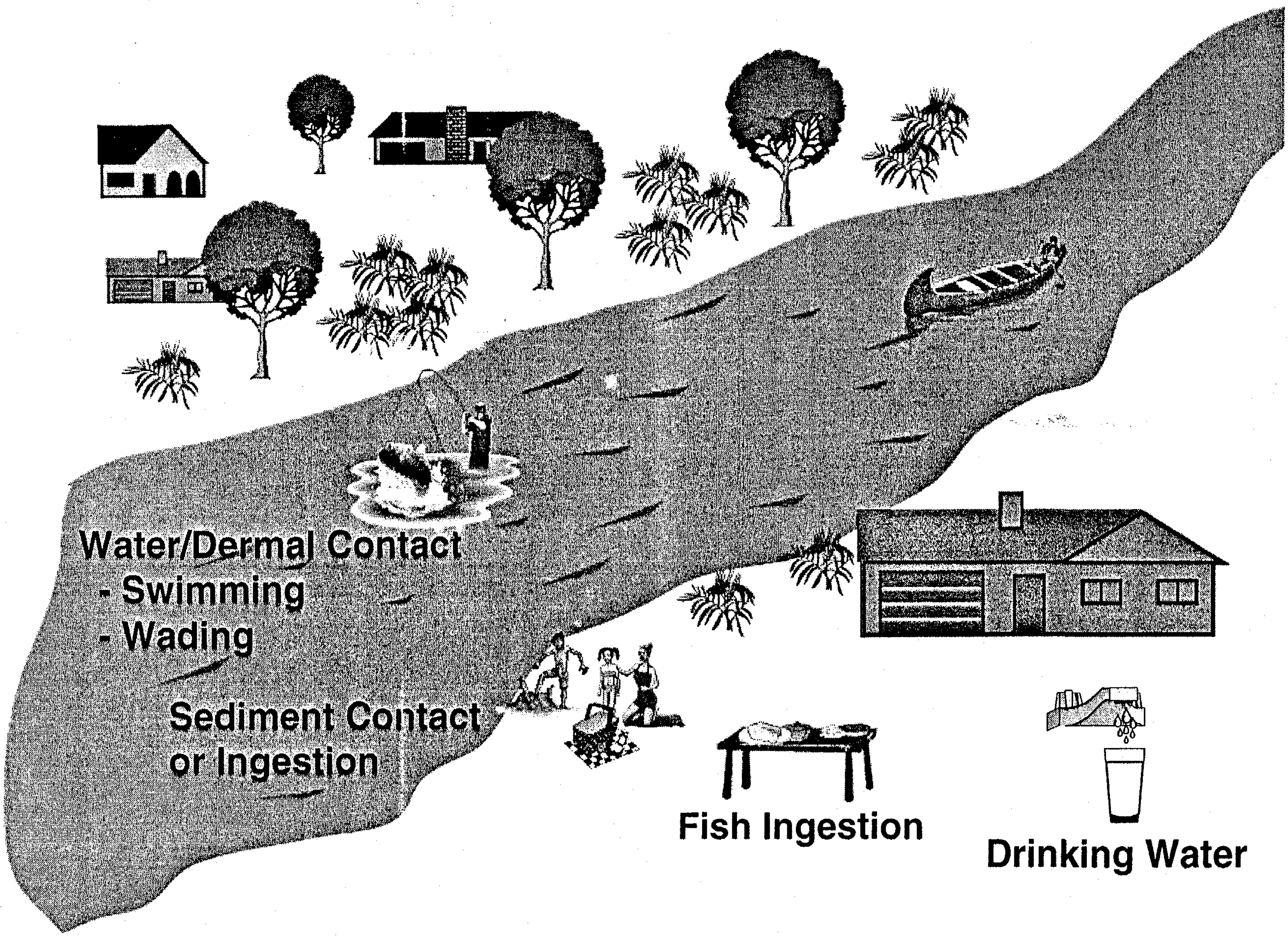
Exposure Pathways to PCBs



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Summary of Important Exposure Factors

Exposure Factor	Central Estimate	Reasonable Maximum (RME)
Fish Ingestion		
Consumption (meals/year)	≈6	≈50
Exposure Duration (years)	12	40
PCBs Lost in Cooking	20%	0%
Exposure to Water/Sediment		
Adult/Child Recreation (Summer)	50% of RME	1 day per week
Adolescent Recreation (Summer)	50% of RME	3 days per week
Residence Duration (years)	11	41
Drinking Water		
Residence Duration (years)	11	41
Adult/Adolescent Consumption (L/d)	1.4	2.3
Child Consumption (L/d)	0.9	1.5

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Cancer Toxicity of PCBs from USEPA Integrated Risk Information System

- Classified as probable human carcinogen
  - Evidence from occupational studies is inadequate but suggestive
- Sufficient evidence from animal laboratory studies
  - Rats exposed to Aroclors 1260, 1254, 1242 and 1016 exhibited liver tumors (1996 study)
  - Males had increased numbers of thyroid tumors for all Aroclors
  - Commercial Arcolor mixtures cover range of congeners found in environment

Non-Cancer Toxicity Factors from IRIS

- Reference Dose (RfD): *chemical intake likely to be without an appreciable risk of adverse effects to humans during a lifetime.*
- RfD is based on feeding studies with rhesus monkeys
- Example adverse effects in animals:
  - Reduced birthweight (1016)
  - immune system impairment (1254)
  - eye toxicity (1254)
- RfD for PCBs is among the lowest (high toxicity) in IRIS

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Risk Characterization

- Two point estimates of risk were examined:
  - reasonable maximum exposure (RME)
  - central tendency (average)
- Probability methods (Monte Carlo Analyses) not included in Mid-Hudson because of lower risks compared to Upper Hudson

Summary

- Eating fish from the Mid-Hudson River is the highest risk pathway.
- Individuals who eat 1 half-pound fish meal per week:
  - There is a risk of 4 additional cancers per 10,000 people exposed.
  - The level of exposure to PCBs is 30 times higher than EPA's level of concern for non-cancer hazards.
- Risks and hazards for children eating fish from the Mid-Hudson River are approximately 1/3 that of adults.
- Exposure to PCBs in water, sediment, and air are below EPA's levels of concern.