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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Re: Hudson River PCB Reassessment RI/FS

COMMENTS OF THE GENERAL ELECTRIC COMPANY ON THE TAMS SCOPE OF WORK

The General Electric Company submits these comments on the draft Scope of Work for the Hudson River PCB Reassessment Remedial Investigation/Feasibility Study (RI/FS) prepared for the U.S. Environmental Protection Agency (EPA) by TAMS Consultants, Inc.

The attached figures present the results of various analyses recently conducted regarding data about PCBs in the Hudson River. They show that conditions in the upper Hudson are dynamic and that PCB conditions in the upper River have substantially changed since the late 1970s and early 1980s, when existing measurements were taken. In particular, the riverbed is changing, PCBs are biodegrading, and the PCB load in the River is decreasing. Moreover, the figures present evidence that conditions in the lower River are different from those in the upper River in important ways.

General Electric believes that the changes in the upper Hudson and the new information about the lower Hudson will have a dramatic effect on the Scope of Work required for an accurate reassessment of the Hudson River. EPA has proposed a 3-phase Scope of Work for its Hudson River PCB

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Reassessment RI/FS. During the first phase, EPA plans to use existing data to characterize the site and to model the anticipated effects of various remedial alternatives. The second phase will involve the gathering of additional data to refine the model and to perform more accurate risk assessments of various remedial alternatives. Finally, the third phase is a feasibility study of the various remedial alternatives, based on remedial response objectives and risk assessment results.

To obtain public and scientific consensus on the most appropriate remedial action, however, EPA must assure itself that the facts upon which it bases its decision are accurate, complete, and thoroughly analyzed. Recent and detailed sampling indicates that nearly all areas of the existing data base -- including PCB concentration , PCB compositions, sediment depths, and sediment locations -- do not reflect current conditions in the River. The first phase should therefore be limited to the evaluation of existing data for the purpose of identifying which data are still relevant today and what field work must be performed to replace outdated data or to fill data gaps. It should not include any modeling or risk assessment based on information that is no longer accurate. Any conclusions derived from extensive analysis of outdated or unreliable data are worthless at best and misleading at worst ("garbage in-garbage out"). Indeed, extensive modeling or risk assessment in advance of adequate data could prejudice the entire RRI/FS process.

1. <u>Thompson Island Pool</u>

Figure 1 shows a portion of the upper Hudson River just south of the Village of Fort Edward, an area known as the Thompson Island Pool. The grey shaded areas represent areas of the riverbed that the New York State Department of Environmental Conservation ("NYSDEC") found in 1979 to contain PCB concentrations of over 50 parts per million ("ppm"). The darker areas indicate portions of the riverbed that meet the same criterion, based on data gathered in 1984. Although the data may have been subject to inappropriate statistical analyses, even assuming the data to be reliable, the change from 1979 to 1984 is significant and apparent: Based on NYSDEC's own data, about 80 percent of the "hot spots" identified in 1979 were no longer present in 1984. Moreover, given the dramatic changes from 1979 to 1984, one can reasonably expect that additional changes have occurred from 1984 to the present. These changes not only highlight the dynamic nature of PCBs in the River, but also underscore the necessity of basing any decision on information that is both current and reliable.

2. <u>1990 GE Sediment Survey</u>

Figures 2 and 3 present another aspect of the changing nature of the riverbed. Samples of the riverbed taken at these locations in 1984 apparently indicated that these locations were primarily sediment. Recent sampling at the same locations shows a greater variety of material and much less of the sediment that was previously thought to exist. These changes, moreover, are not confined to a few of the locations, but rather appear to be widespread. The changes may be explained either by errors in the old sampling data or by actual changes in the sediment profile of the riverbed (or by both). In either case, the need for reliance on current and reliable information is apparent.

3. <u>Sediment Depth and PCB Concentrations at GE Site H-7</u>

Figure 4 shows the results of a recent analysis of the riverbed at a particular site in the upper River. Each bar represents a sample taken from a high-resolution grid (12 ft by 12 ft). The height of the bar represents the sediment depth (see the scale on the left). Note that although sediment depth was previously thought to be about 4 or 5 ft, none of the samples in this recent study contained over 18 inches of sediment. In addition, the numbers in each bar indicate the PCB concentration at the particular grid-location and depth, and they reveal great variability in PCB concentrations. Only a very few of the grid-locations (*e.g.*, B7, B8, and B9) show high PCB concentrations -- most of the samples have less than 5 ppm total PCBs. Note also that the PCB concentrations at any particular site are highly variable at different depths. This figure therefore shows not only that sediment depth has changed over time, but also that, because of the variability in PCB concentrations over space, one must be very cautious in drawing conclusions regarding total PCB mass from insufficient sampling.

4. Cross-Section Changes

Figures 5 and 6 show changes in the cross-section of the riverbed at two locations: mile 188.96 and mile 189.20. The solid lines represent the river bottom as it existed in 1977; the dashed lines represent the river bottom as it existed in 1982. The areas marked "F" indicate areas that have been filled from 1977 to 1982; the areas marked "E" indicate areas that have eroded from 1977 to 1982. These bathymetry results graphically and independently confirm the large changes in the riverbed from 1977 to 1982 and suggest that further changes have likely occurred since 1982.

5. PCB Water Concentrations

Figure 7 compares the relationship of three variables -- river flow (in cubic feet of water per second ("cfs")); suspended solids concentration (in milligrams of solids per liter of water); and PCB water concentration (in micrograms of PCB per liter of water ("µg/L")) -- as a function of time, based on U.S. Geological Service data from 1975 to the present. From 1977 to 1982, one can see that during periods of high flow, suspended solids concentration increased and PCB concentration increased as well. From 1987 to 1989, however, increases in flow still led to increases in suspended solids concentration (as expected), but did not result in comparable increases in PCB water concentration in the River. This figure therefore dramatically shows not only that PCB water concentrations are decreasing over time, but also that they are less "flow-sensitive" -- that is, PCB concentrations in the water remain low even during periods of high flow. A similar pattern exists at other locations in the upper River.

6. PCB Loading

Figure 8 presents the same type of information as in Figure 7, but in a different form (and at a different site in the River). The graph plots PCB load (in lbs of PCB per day ("lb/d")) as a function of river flow (in cfs). The upward sloping lines shows that PCB load increases, as expected, at high flow rates. The sig ificance of this graph is that it shows that at all relevant flow rates, the PCB load has decreased an order-of-magnitude over the last 10 years. Thus, for example, at a flow rate of about 10,000 cfs, the 1977-79 data show a PCB load of about 10 lb/d; by 1987-87, PCB load under the same conditions was about 1 lb/d. Likewise, at very high flows (about 40,000 cfs), the PCB load in 1977-79 was about 100 lb/d; in 1987-89 it was about 10 lb/d.

7. PCB Concentration - Time Trend

Figure 9 confirms the significant decrease in PCB concentration in the upper River over time. Based on data provided by the U.S. Geological Service, the average PCB concentration in the River (from mile posts 194 to 160), during the summer average flow periods, decreased from about 0.5 µg/L in the late 1970s to about 0.03 µg/L in the late 1980s. Indeed, although year-to-year variations exist, the general trend is a 50 percent reduction in total PCB loading every three years. A similar trend is observed during high flow events.

8. PCB Physical/Chemical Processes

Figure 10 summarizes the physical and chemical processes that occur to PCBs in the river. Starting from the left of the figure and moving generally to the right, note that PCBs may enter any given portion of the River from upstream ("streamflow in") or from other sources ("inputs"). In the water, the PCBs may settle on the riverbed, dissolve in the water, or become volatilized into the atmosphere. Once in the riverbed, the PCBs may diffuse to different parts of the bed, biodegrade, or "scour" back into the water. The PCBs may also be transferred from the water to the bed, or vice versa, due to changes in bed elevation. Finally, PCBs in the water may also exit the water column ("streamflow out") into the next water column. Multiple potential causes for the observed decreases in PCB concentration over time therefore exist.

9. Biodegradation in the Upper Hudson

Figure 11 shows the widespread biodegradation of PCBs that is taking place in the upper Hudson River. Based on samples taken by NYSDEC in 1984, the cross-hatches ("+") on the map of the upper Hudson and in the enlarged area indicate locations where samples contained 10 or more ppm PCBs. An examination of the types of PCBs at these locations in 1984, however, shows that these PCBs are much less highly chlorinated than those originally discharged into the River. (This conclusion derives from an analysis of the gas chromatograph peaks recorded for the samples.) The presence of reduced chlorine content is evidence of biodegradation activity (anaerobic dechlorination). The areas where significant dechlorination has occurred are indicated on the maps by circled samples: This figure shows that over 70 percent of the samples had exhibited natural biodegradation by 1984. This result is significant not only because it can help explain the observed decrease in PCB concentrations over time, but also because the less highly chlorinated PCBs are thought to pose much less of a risk than the more highly chlorinated PCBs.

10. Biodegradation in the Upper Hudson

In the course of searching for an appropriate site for a field test of PCB biodegradation, General Electric sought to verify the biodegradation activity suggested by NYSDEC's 1984 data. In 1990, General Electric researchers took 60 sediment samples at various locations in the upper River, searching for a site that was not highly dechlorinated (that is, a site that remained highly chlorinated) so that the researchers could test the possibilities for enhanced biodegradation. Sites were chosen based upon earlier sampling indicating less extensive dechlorination. What the researchers confirmed -- as Figure 12 indicates -- is that extensive natural dechlorination has taken place throughout the upper Hudson: Whereas Aroclor 1242 contains (on average) about 3.5 chlorine atoms per biphenyl, the 1990 samples indicate that significant portions of the PCBs that remain have been dechlorinated to (on average) about 2.0 to 2.5 chlorines per biphenyl. These samples were analyzed by high-resolution capillary gas chromatograms, a much more detailed method of analysis than that used for the 1984 samples. In addition, the specific chlorine atoms removed are now known to be the outer chlorines, the removal of which greatly reduces the risk associated with the substance.

11. Average Chlorine Level at GE Site H-7

General Electric researchers then selected a potential site for the 1991 field test ("Site H-7") and took additional sediment samples -- this time using a high-resolution (12 ft by 12 ft) coring grid. These samples, as noted before, revealed changes in sediment depth and PCB concentrations. Moreover, as Figure 13 indicates, analysis of the samples (again by high-resolution capillary gas chromatography) shows that the dechlorination is spatially widespread and occurs over a wide range of PCB concentrations.

Mean chlorine-to-biphenyl ratios of 2.0 to 2.5 are considered to be very low.

12. Homolog Distribution Shifts in Hudson

Figure 14 shows the shift to more highly chlorinated PCBs in the lower Hudson. The graph at the top shows the distribution of PCB homologs at the H-7 site in the upper Hudson. As the prior slide indicated, the samples at this site exhibited very low chlorine-to-biphenyl ratios. The bottom three graphs show this same information at three downstream sites -- the Tidal Hudson, New York Harbor, and Long Island Sound. At these sites, the average chlorine levels increases (to as much as 5.0 chlorines-per-biphenyl in Long Island Sound). In addition, sediment samples of more highly chlorinated PCBs not used in GE plants (e.g., Aroclor 1260) are found in the lower Hudson. These results indicate that, consistent with the 1989 study by Thomann, et al., the upper River is not a significant source of PCBs found in the lower River. Moreover, the shift in homolog distribution (to more highly chlorinated PCBs in the lower Hudson) suggests that other local point sources of PCBs may be present in the lower Hudson.

13. PCB Trends in Surficial Sediments - Tidal Hudson River

Figure 15 examines the possibility that other PCB sources may be present in the lower Hudson. It shows the changes in PCB concentration from Albany (at the right side of the graph) downstream to New York City (at the left side of the graph). Based on information gathered in 1979 and in 1988-89, the graph shows that higher PCB concentrations tend to be found near metropolitan areas. Although further study must be done on this issue, this result -- combined with the fact that more highly chlorinated PCB mixtures are found in the lower Hudson -- is consistent with the possibility that local point sources of PCBs exist in the lower Hudson.

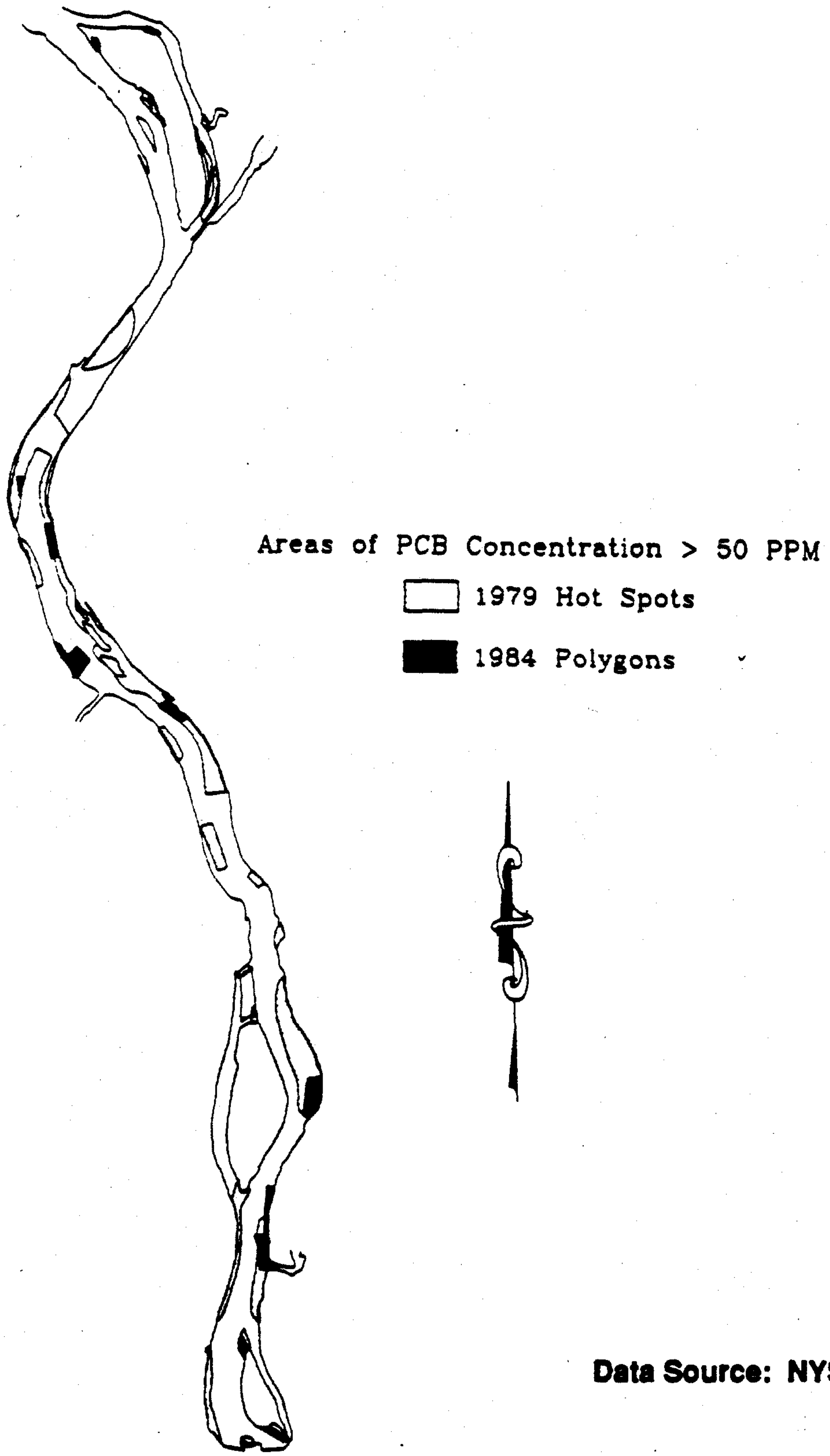
14. Conclusions from Data

In summary, recent information gathered and analyzed by General Electric reveals that existing data on PCB conditions in the upper Hudson River are no longer accurate. In particular: (1) the riverbed has changed from 1977 to present, PCBs have been subject to natural biodegradation during this time, and the PCB load in the river has decreased by an order of magnitude over the last ten years, and (2) homolog and sediment distributions suggest the possibility of other PCB sources in the lower River.

These conclusions indicate that the data contained in the Record compiled for the 1984 ROD and the data (most of which was collected shortly thereafter by New York State and its contractors) apparently considered by EPA in deciding to reopen the ROD neither represent present conditions in the River nor are adequate to identify PCB sources or predict PCB fate and transport. Therefore, any use of this information in modeling or risk assessment, prior to a thorough sorting of the existing body of information to discard outdated data and followed by a comprehensive in-river data collection program to fill significant data gaps, is likely to waste time and resources, lead to erroneous conclusions, and prejudice the scientific integrity of the RRI/FS process.

The first phase of the Scope of Work should therefore be modified to be limited to data sorting, and all modeling and risk assessment should be deferred until after the new data collection tasks have been completed.

January 21, 1991



Data Source: NYSDEC

- Many 1979 Hot Spots No Longer Present in 1984
- <u>Issue</u>: Further Changes Since 1984?

FIGURE 1

1990 GE Sediment Survey

Location	River Mile	Water Depth	Sample Type	1990 Description
Sta. 1 C	194.0	12'	Grab	Coarse sand
Sta. 1 E	194.0	10'	Grab	Fine gravel, coarse sand
Sta. 1 W	194.0	8'	Grab	Medium sand, little organic matter
Sta. 3 C	192.7	10'	Grab sand	Gravel, shale fragments, some
Sta. 3 E	192.7	15'	Grab	Fine gravel, shale fragments, some sand
Sta. 3 W	192.7	5'	Core	Fine sand, black organic matter
Sta. 6 C	190.7	15'	Grab	Medium sand
Sta. 6 E	190.7	5'	Grab	Sand, some black organic matter
Sta. 6 W	190.7	3'	Core	Fine sand, black organic matter
Sta. 9 C	189.0	18'	Grab	Gravel
Sta. 9 E	189.0	10'	Core	Fine sand, black organic matter
Sta. 9 W	189.0	3'	Grab	Medium sand
Sta. 11 C	184.4	15'	Grab	Coarse sand, wood chips
Sta. 11E	184.4	6'	Core	Dark brown silt/organic matter
Sta. 11 W	184.4	5'	Core	Fine sand, gray silty clay

FIG 2

1990 GE Sediment Survey (Cont.)

Location	River Mile	Water Depth	Sample Type	1990 Description
Sta. 13 C	175.8	22'	Grab	Coarse sand
Sta. 13 E	175.8	5'	Core	Fine sand
Sta. 13 W	175.8	5'	Grab	Fine sand (thin layer over gravel)
Sta. 15 C	166.3	15'	Grab	Coarse brown sand
Sta. 15 E	166.3	4'	Grab	Fine sand (thin layer over gravel)
Sta. 15 W	166.3	8'	Grab	Organic matter (thin) over gravel
Sta. 16 C	164.1	6'	Grab	Coarse gravel
Sta. 16 E	164.1	6'	Grab	Shale fragments, little fine sand
Sta. 16 W	164.1	5'	Core	Black organic matter, fine sand, over gray clay
Sta. 19 C	154.3	20'	Grab	Coarse sand
Sta. 19 E	154.3	10'	Grab	Gravel
Sta. 19 W	154.3	8'	Grab gravel	Thin layer organic matter over

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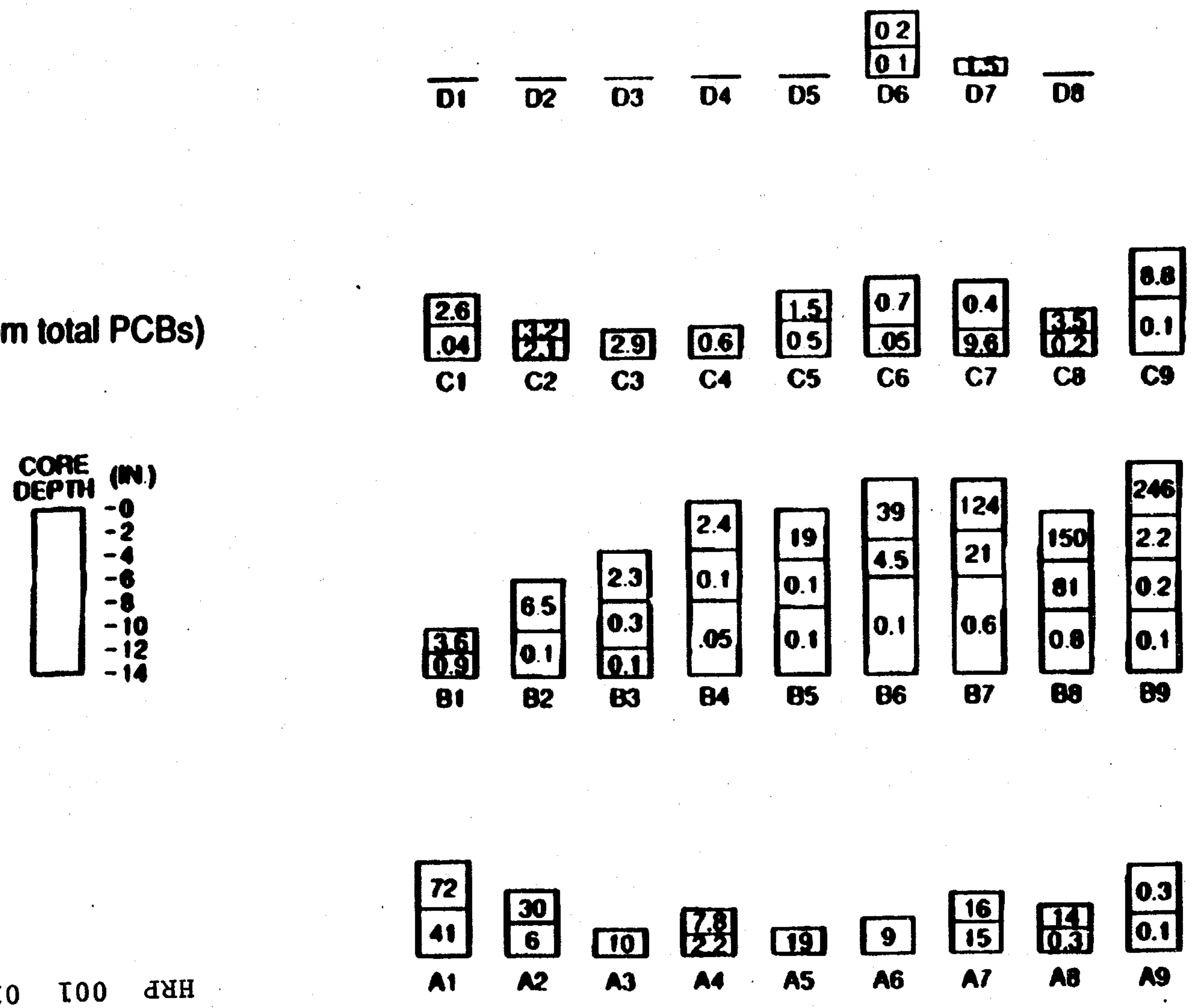
- **Sediment Not Found Where Expected**
- **Changes Are Widespread**

FIGURE 3

Sediment Depth and PCB Concentrations At GE Site H-7 (1990)



- Changes In Sediment Dep[illegible] Confirmed By Detailed Sampling
- Great Variability In PCB C[illegible]centrations Also Observed

FIGUR[illegible] 4

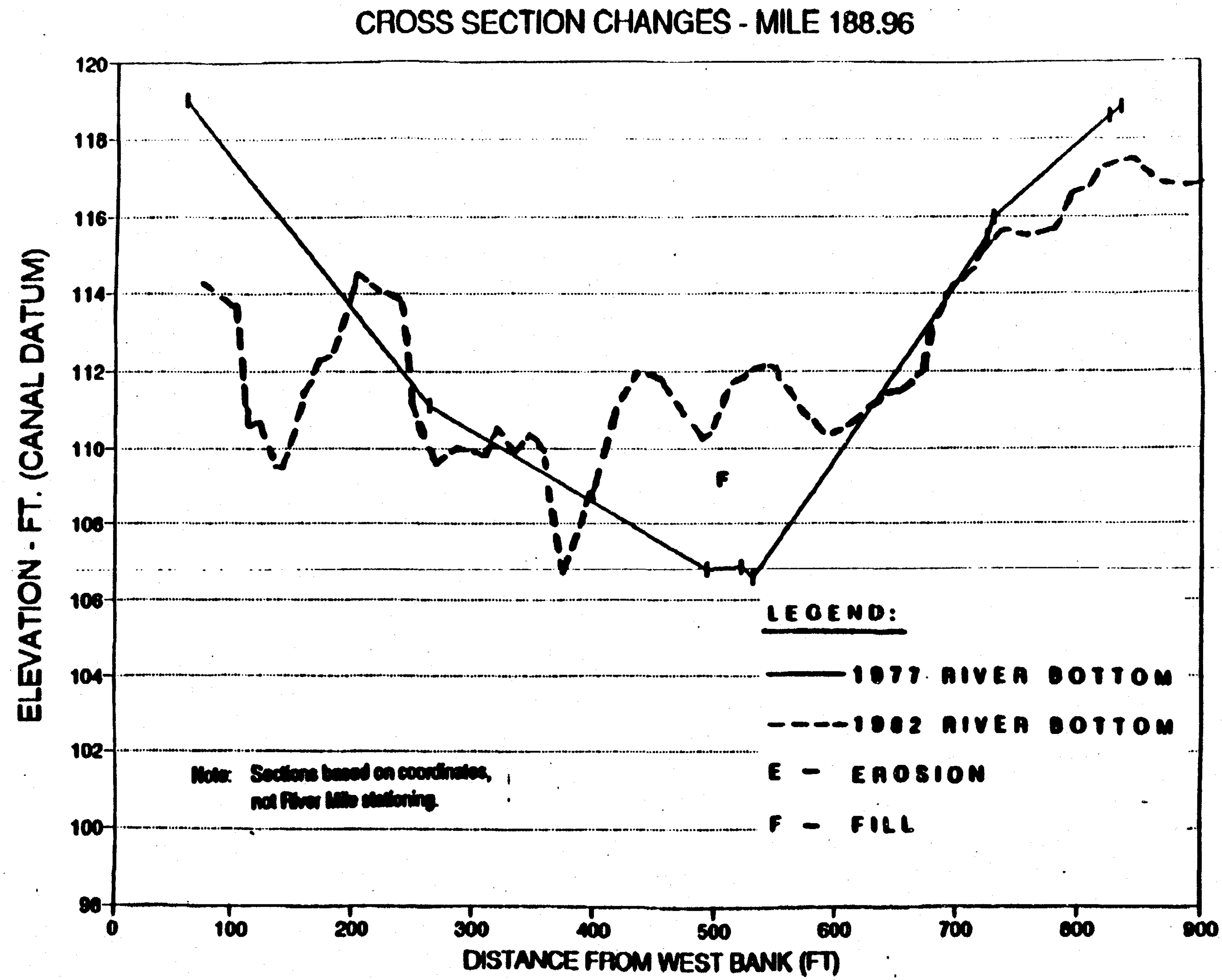


FIGURE 5

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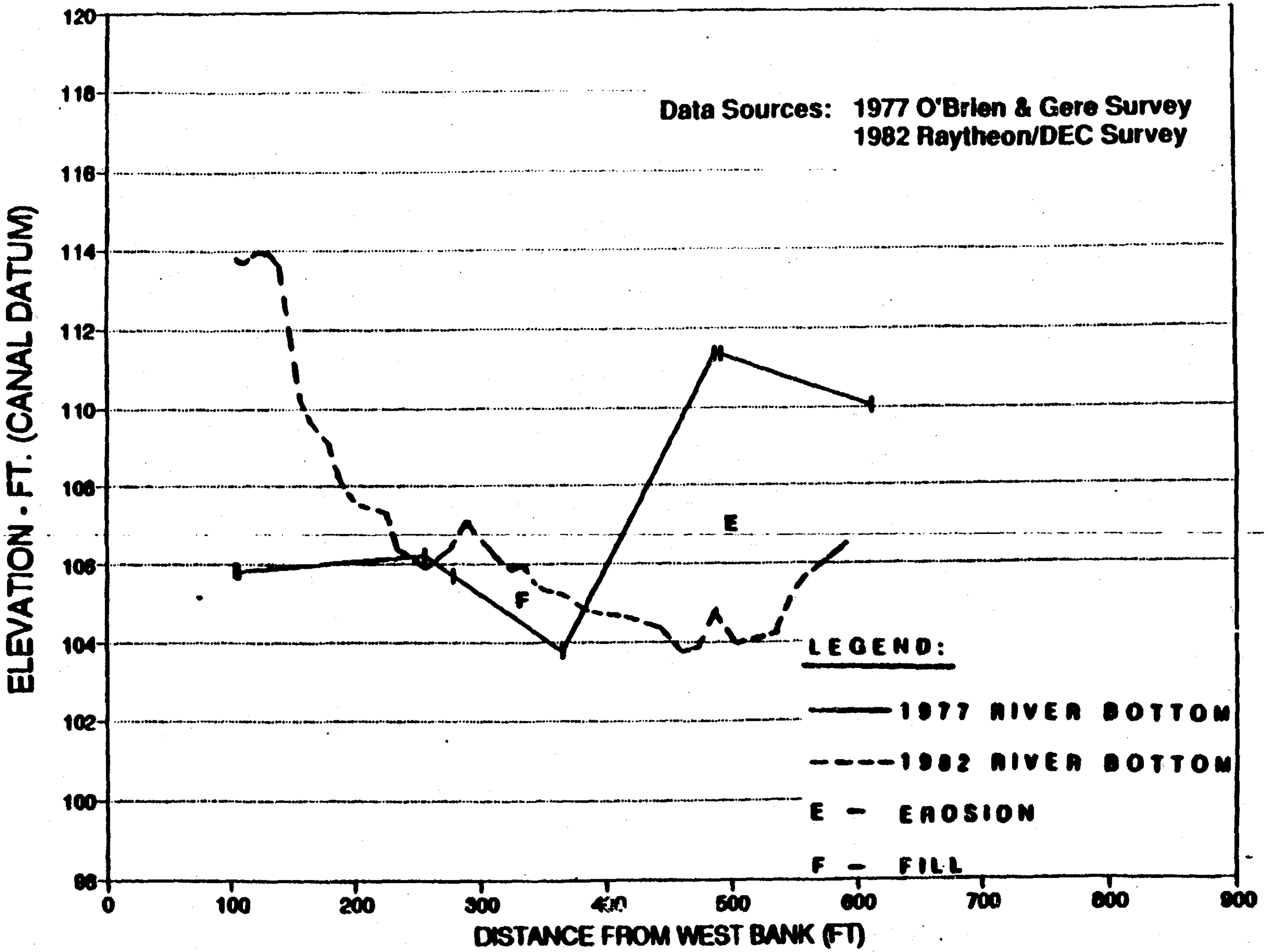
CROSS SECTION CHANGES - MILE 189.20



- Bathymetry Data Independently Confirms Changes In The River Bed
- <u>Issues</u>: Degree Of Changes Between 1977-82; Changes Since 1982?

FIGURE 6

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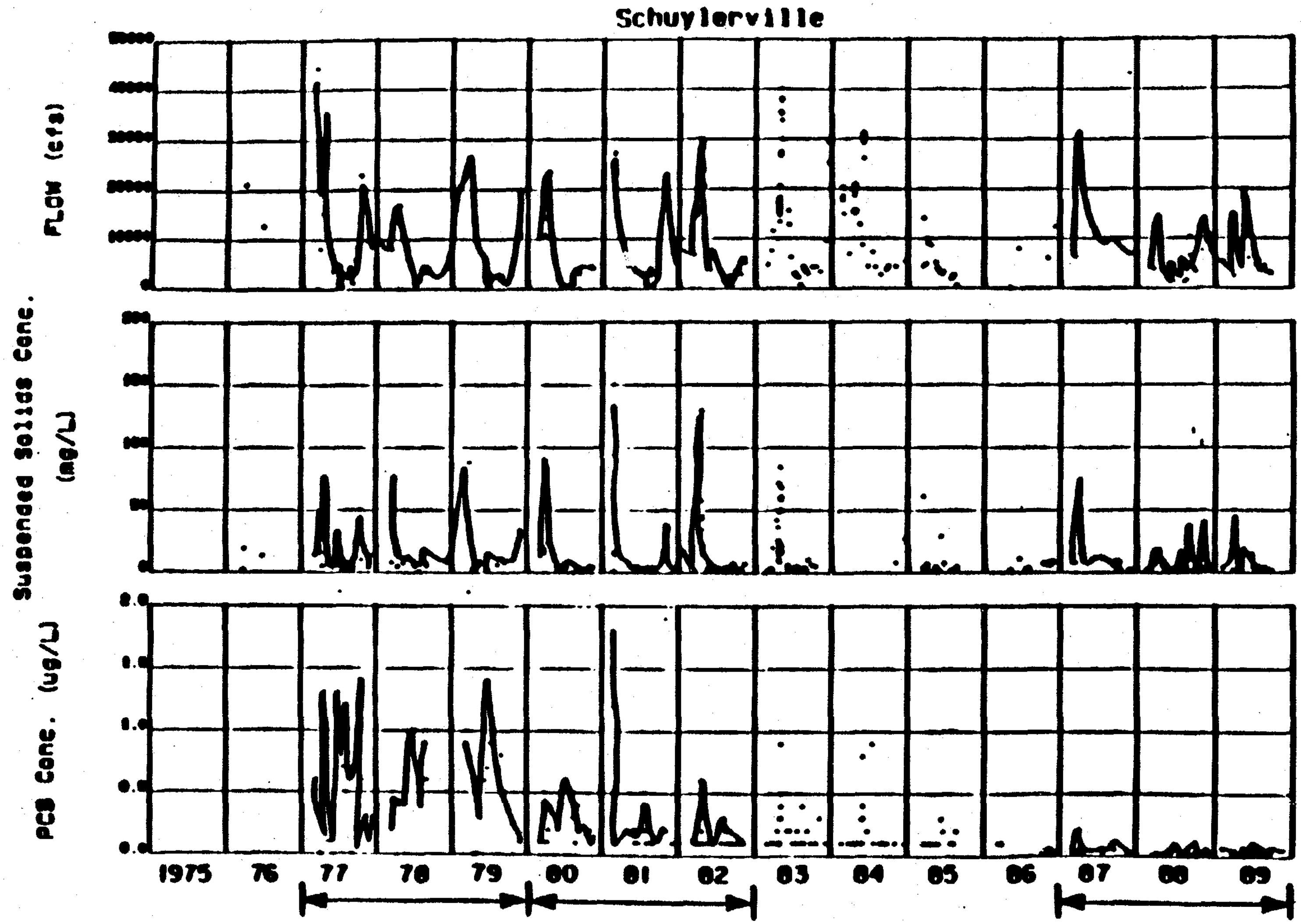
PCB Water Concentrations

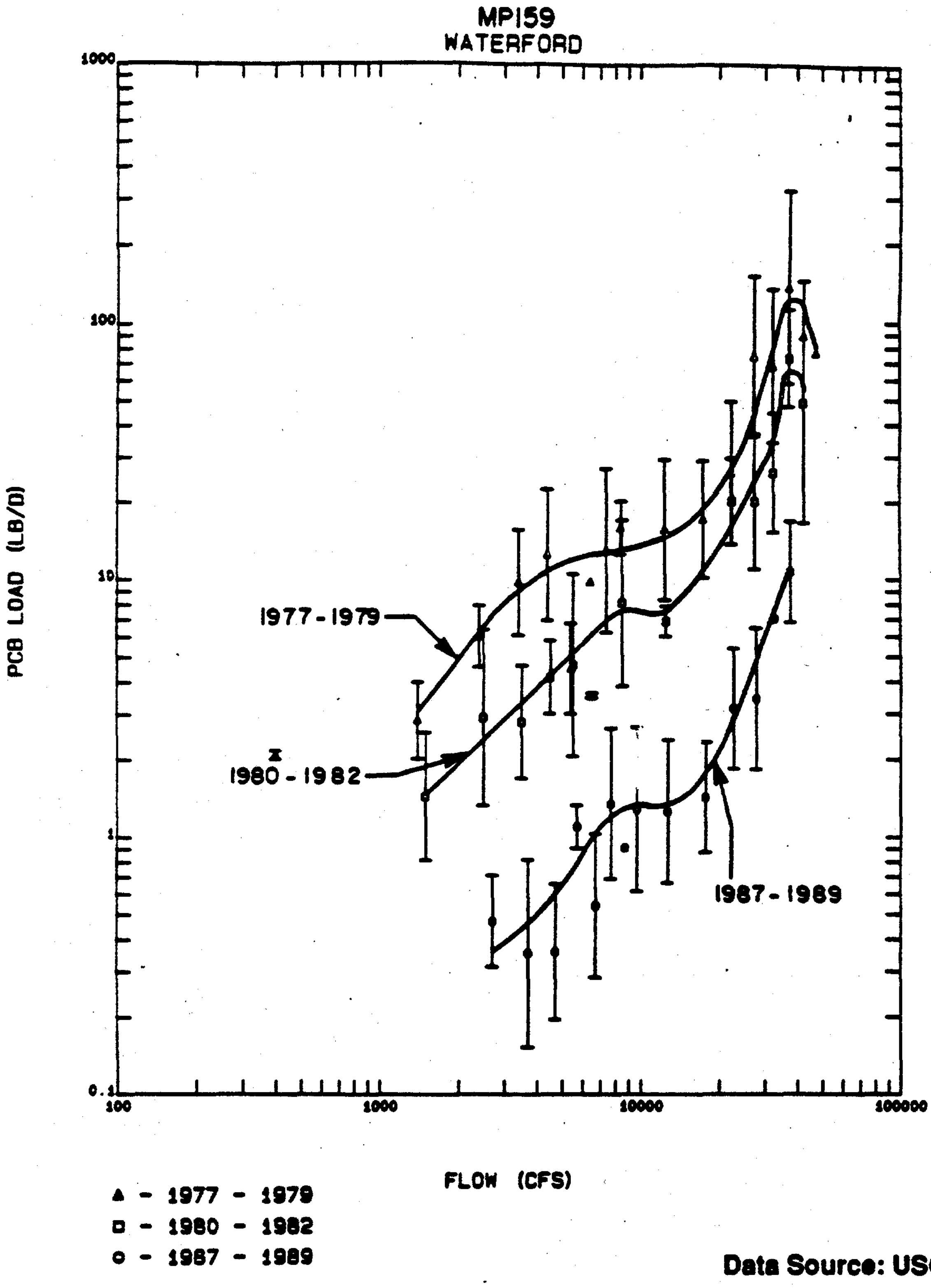


Data Source: USGS

- PCB Water Concentrations Decreasing
- Changes Since 1984 Dramatic; Transport Less Flow Sensitive
- Similar Pattern At All Locations

FIGURE 7

PCB Loading



Data Source: USGS

- Order Of Magnitude Decreases In PCB Load In Last 10 Years
- Same Trend At All Flow Rates And At Other Locations

FIGURE 8

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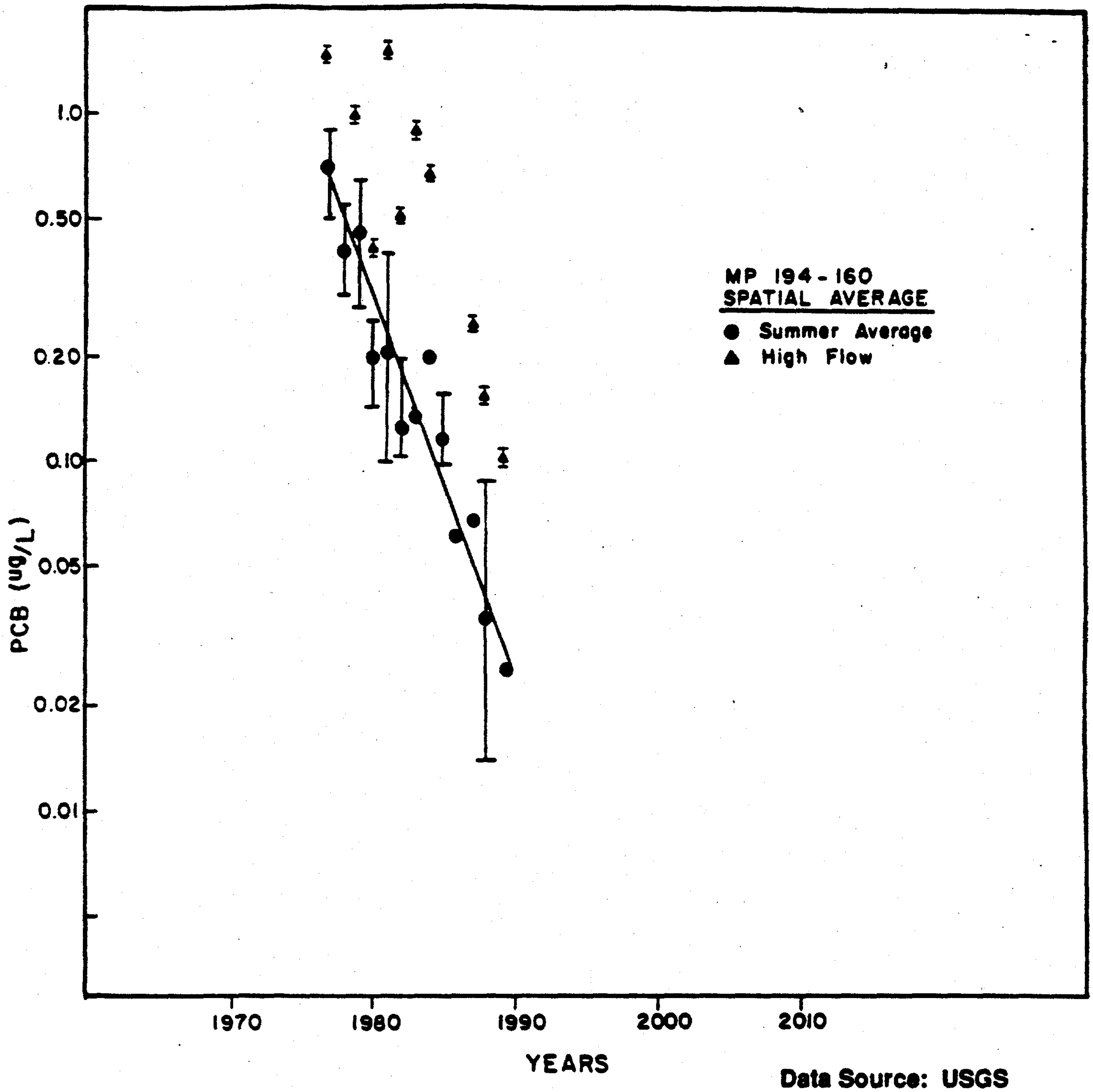
Upper Hudson River



Data Source: USGS

- **PCB Concentration Decreasing For All Flows**
- **Year-To-Year Variations But Trend Is 50% Decrease Every 3 Years**

FIGURE 9

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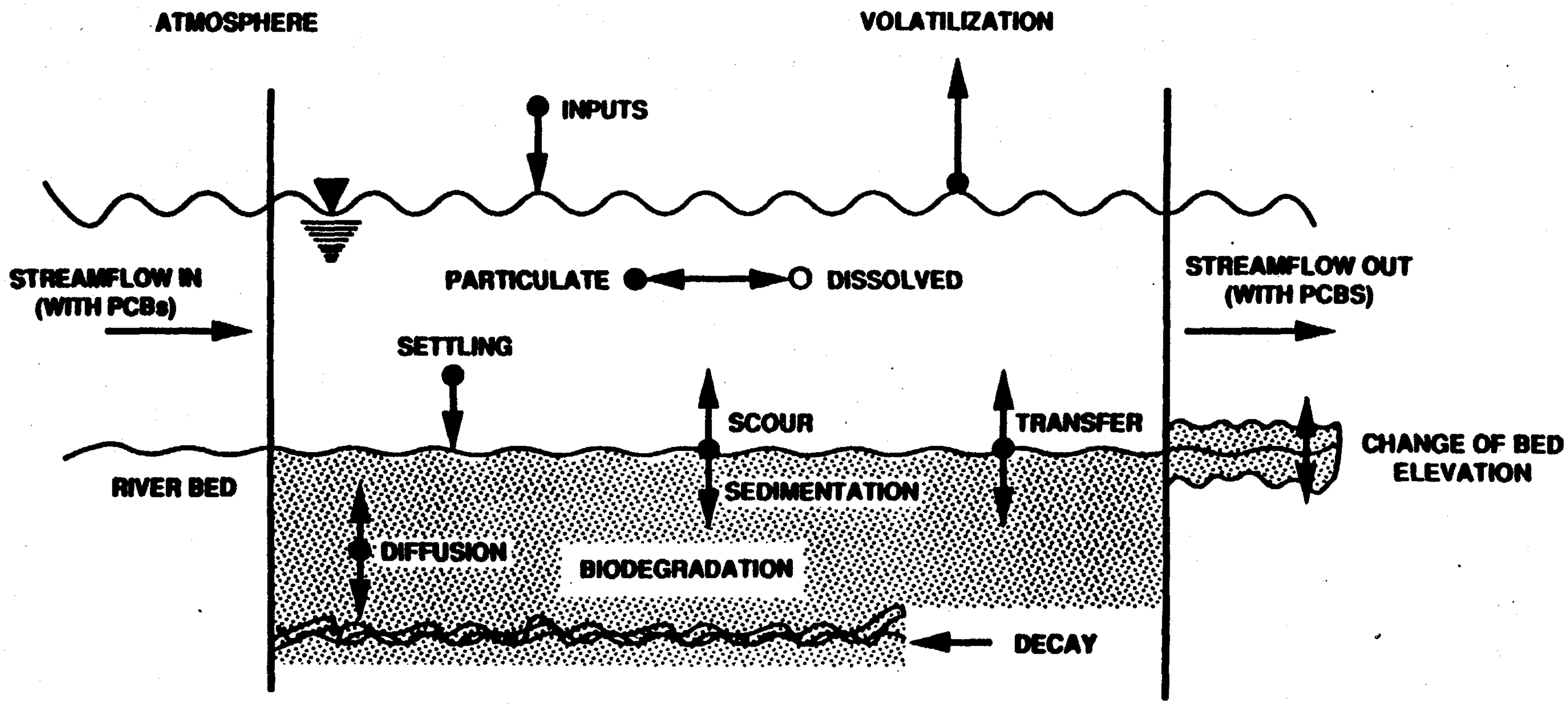
PCB Physical/Chemical Processes



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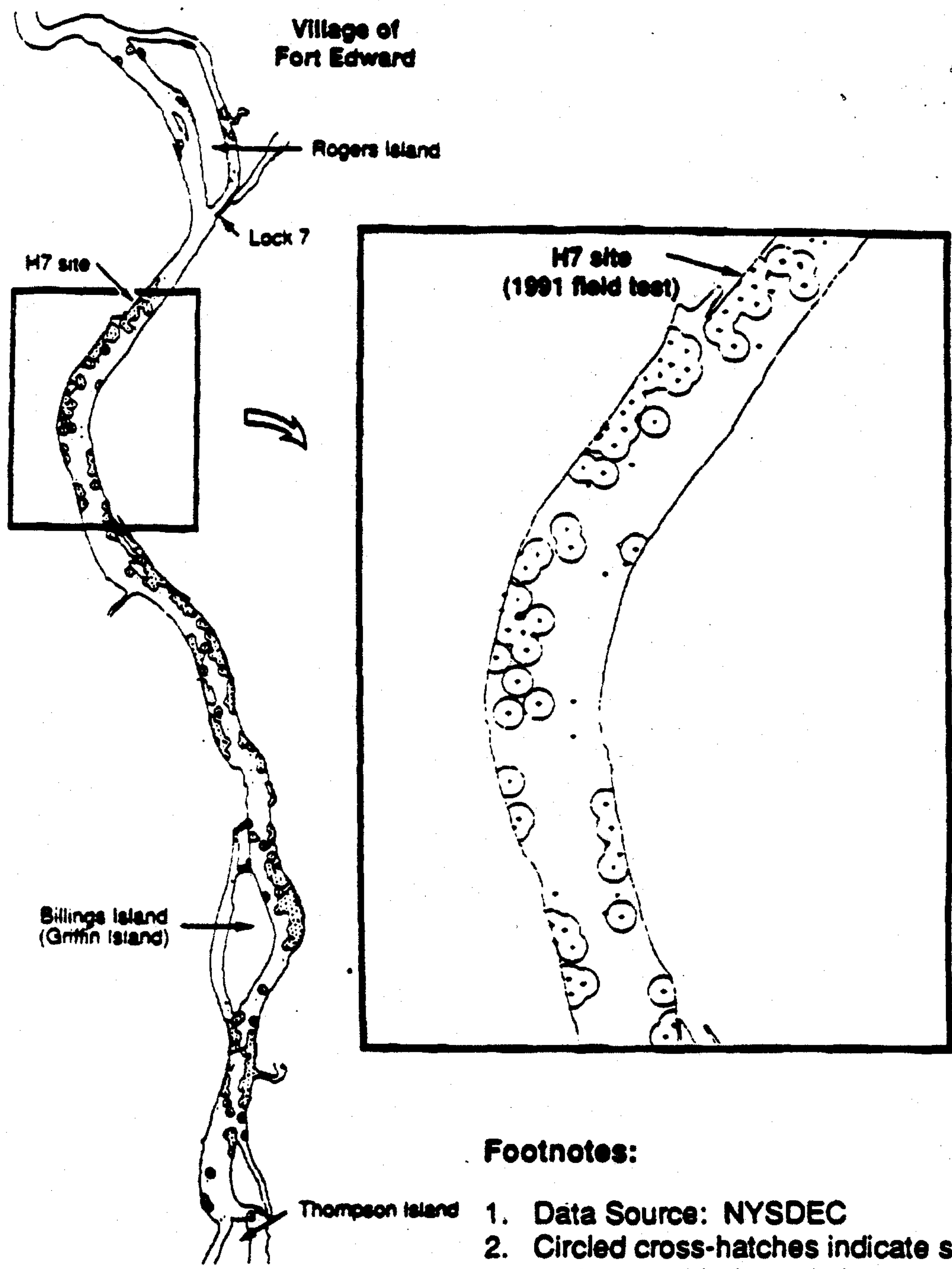
Multiple Potential Causes For Decreases In PCB Concentration:
• Diffusion, Vol-·ilization, Biodegradation

FIG··RE 10

Biodegradation In The Upper Hudson



Footnotes:

1. Data Source: NYSDEC
2. Circled cross-hatches indicate sites that have undergone biodegradation
3. Biodegradation activity determined by comparison of chromatogram peaks

- **Widespread Biodegradation By 1984**
- **70% Of Samples Significantly Altered**
- **Issue: Reduced Chlorine Content = Reduced Toxicity = Reduced Risk?**

FIGURE 11

Biodegradation In The Upper Hudson

Site No.	Mean Cl/Biphenyl Ratio (3 samples)		
1	--	--	--
2	--	--	--
3	--	--	--
4	2.3	2.4	2.9
5	2.2	2.2	2.3
6	2.1	2.3	2.3
7	2.4	2.3	2.9
8	2.4	2.3	--
9	2.8	3.1	2.9
10	3.0	3.1	3.2
11	3.3	3.5	3.3
12	2.3	2.7	3.2
13	2.7	2.8	2.8
14	2.8	--	--
15	--	--	--
16	--	--	--
17	2.4	--	--
18	2.8	--	--

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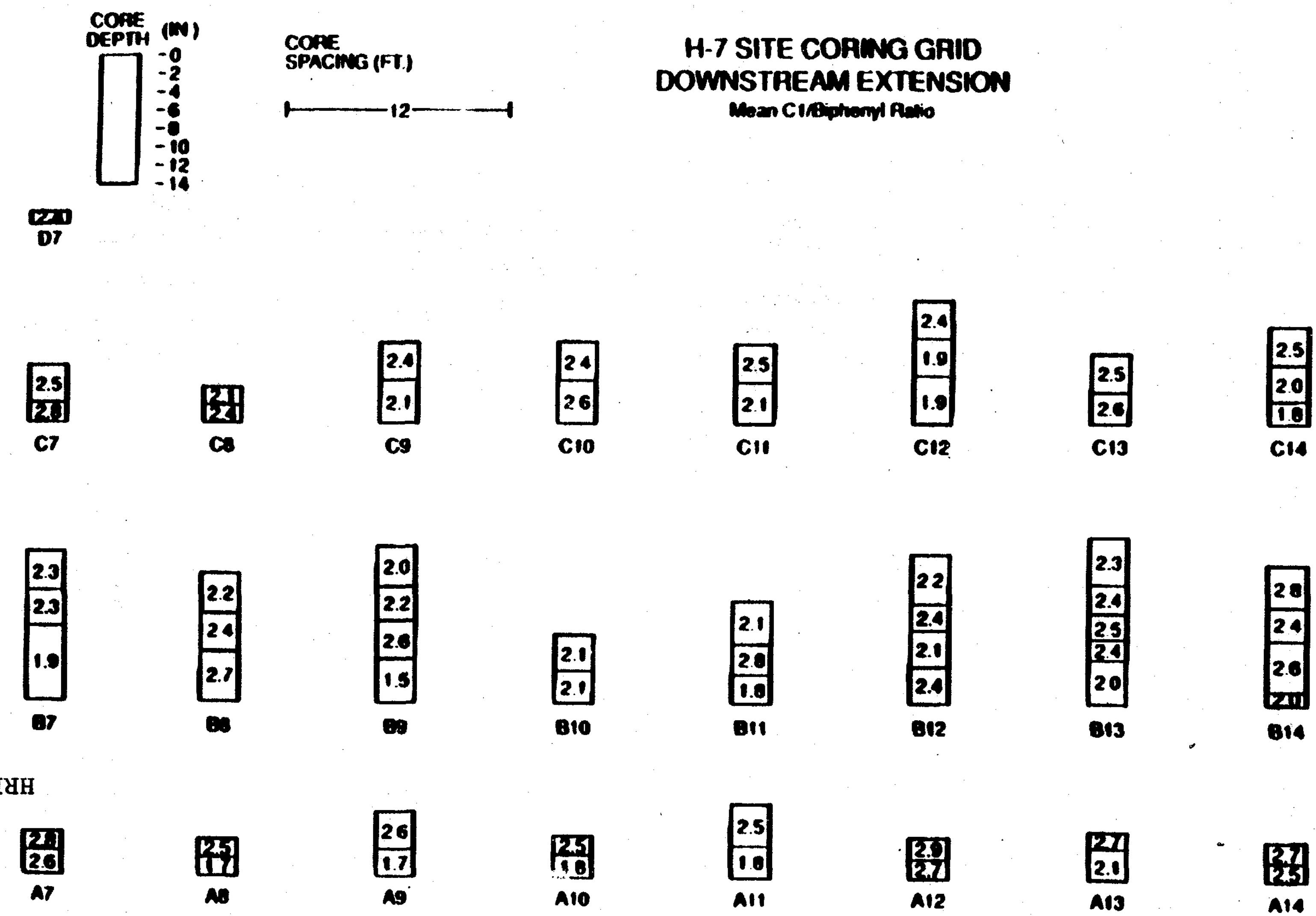
Footnotes:

1. Data Source: 1990 GE search for 1991 test site
2. Aroclor 1242 ratio: 3.5

- **Dechlorination Confirmed By Recent Sampling**
- **Natural Biodegradation Activity Is Pervasive**

FIGURE

Average Chlorine Level At GE Site H-7



Footnotes:

1. Aroclor 1242 ratio: 3.5

- **Dechlorination Also Confirmed By High Resolution Sampling**

FIGURE 13

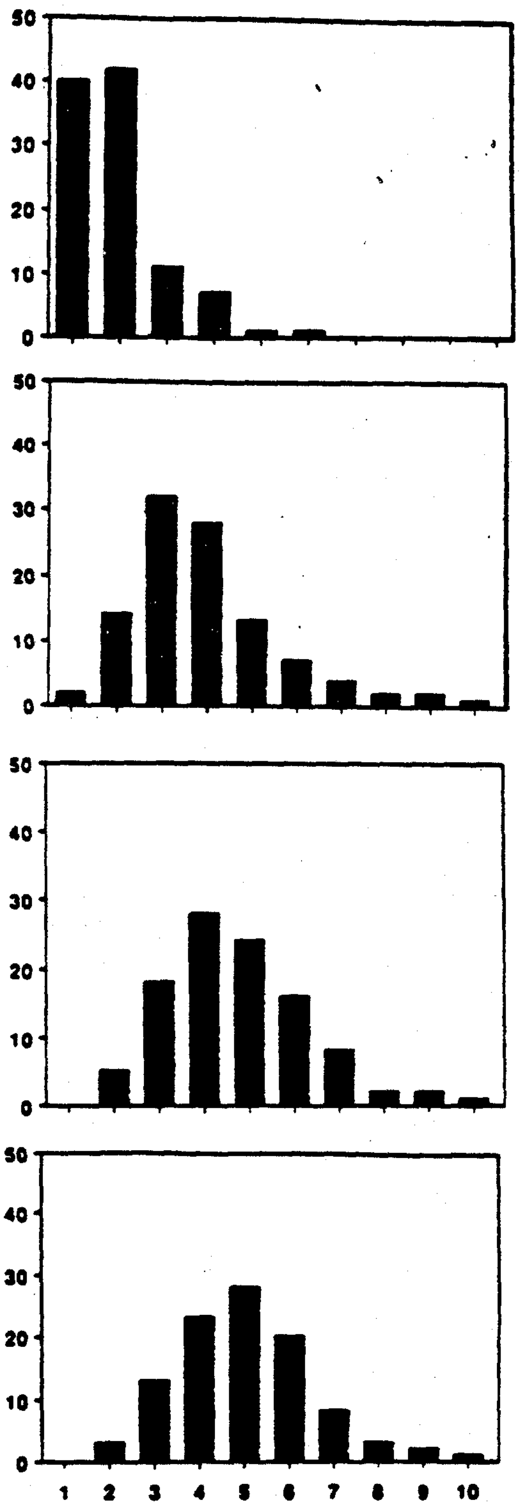
Homolog Distribution Shifts In Hudson

Upper Hudson (H7)

Tidal Hudson River

New York Harbor

Long Island Sound



Data Source: 1989 GE Sediment Survey

- Significant Shift To Higher Chlorinated PCBs In Lower River With Evidence of Aroclor 1254, 1260
- Consistent With Thomann Report, Upper River Cannot Be A Significant Source For The Lower River
- Issue: Identification Of Lower River Sources

FIGURE 14

PCB Trends in Surficial Sediments
Tidal Hudson River

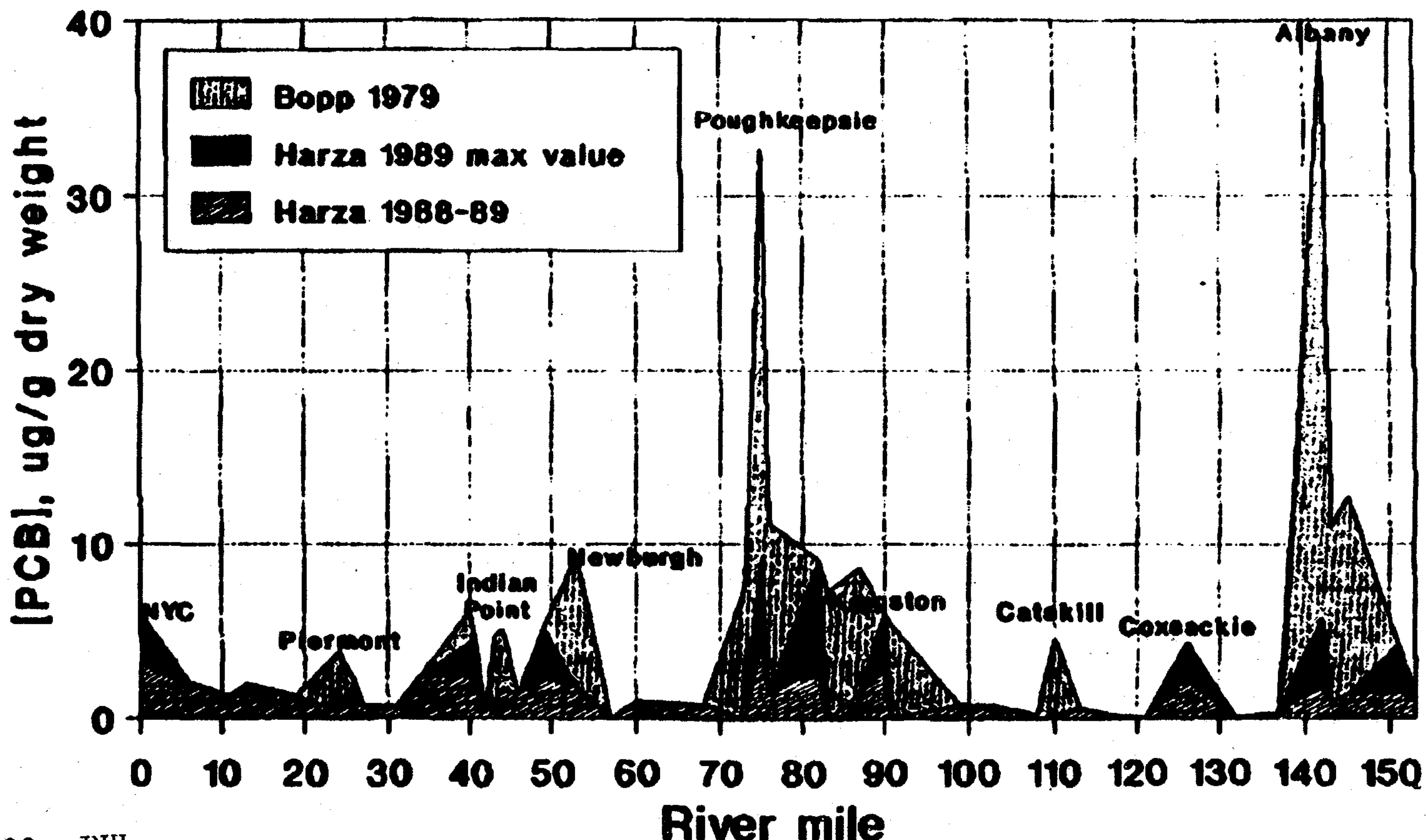


FIGURE 15