



## **Evaluation of PCB Concentrations Measured in the Hudson River near Waterford, New York**

May 31, 2010

### **Summary of Findings**

An analysis of PCB measurements collected in the water column of the Hudson River in the vicinity of Waterford, New York suggests that there is no recent appreciable natural attenuation, or decline in PCB concentrations, occurring. The finding of no recent natural attenuation is consistent with a conclusion reached by EPA in March 2010, but inconsistent with a conclusion reached by EPA in April 2010. This information is important for purposes of developing future predictions of PCB loadings from the Upper Hudson River to the NY/NJ Harbor Estuary.

### **Need for the Analysis**

The ongoing release of PCBs from the Upper Hudson River to the NY/NJ Harbor is responsible for much of the PCBs measured in broad areas of the NY/NJ Harbor. Work performed by the Contamination Assessment and Reduction Project (CARP) has quantified the impact of Upper Hudson River PCB releases on measured and modeled PCB levels throughout the NY/NJ Harbor. Future loadings of PCBs from the Upper Hudson River to the Harbor are of interest to EPA and a broader NY/NJ Harbor stakeholder community for purposes of PCB TMDL development, dredged material management, and natural resources damage assessments.

The EPA had previously projected reductions to the PCB loading to the lower Hudson River at Albany in the future as a result of the completion of the Upper Hudson River Superfund related dredging. These projected changes include a 98% drop over sixty-nine years in annual PCBs delivered from the Upper Hudson River at Albany according to the column labeled "R20RS (REM 3/10/Select - w/0.13%resuspension) - 6 yr dredge" in Table 363150-7, Tri+ PCB Load Over Federal Dam, on page 70 of *Responsiveness Summary Hudson River PCBs Site Record of Decision*, web available at [http://www.epa.gov/hudson/Resp\\_Summ\\_Files/rsbk3-02.pdf](http://www.epa.gov/hudson/Resp_Summ_Files/rsbk3-02.pdf). Since March 2010, there have been several indications from EPA that anticipated future loadings of PCBs from the Upper Hudson River to the NY/NJ Harbor Estuary previously presented in the Record of Decision (ROD) may no longer be accurate.

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Prediction of future PCB loadings to the Harbor involves understanding:

- natural attenuation of PCBs that may occur in the Upper Hudson River above the confluence with the Mohawk River (i.e., Waterford/Pleasantdale vicinity)
- mobilization of PCBs from the upstream bed as a direct result of dredging activities
- reductions in water column concentrations of PCBs as a result of the sediment bed inventory removed by dredging

In Appendix I-G of EPA's March 2010 Phase I Evaluation Report prepared by the Louis Berger Group, EPA reported that estimates of total PCB (TPCB) loads at Waterford based on USGS and GE data for the period 1995 to 2008 show no statistically significant decline, with "half life" of 99 years. In April 2010, the Louis Berger Group prepared an addendum to the EPA Phase I Evaluation Report. In Topic 4-A of the addendum, EPA presents a reanalysis of the projected future PCB loadings to the Harbor. In the reanalysis, PCB concentration data instead of loading estimates were considered to evaluate attenuation. The concentration data used in the attenuation calculation however were developed by normalizing annual load estimates by total flow. The reanalysis discarded data from 1999 and 2000 from the estimate of attenuation rate. EPA's reanalysis considered tri+ PCB concentrations on a flow-weighted basis and estimated an exponential decay function of PCB concentration. For 1995, the decay function suggests tri+ PCB concentrations of 34 ng/L. For 2008, the decay function suggests tri+ PCB concentrations of 14 ng/L. This rate of decay corresponds to a half life of less than 13 years.

This variable information for the Upper Hudson River PCB "half life" reported by EPA, 99 years vs. less than 13 years makes prediction of the rate of natural attenuation of PCBs to consider in future loading estimates to the Harbor dubious. The analysis presented below attempts to independently understand the natural attenuation rate of PCBs in the Upper Hudson River before blending with the Mohawk River and release to the NY/NJ Harbor.

### **Description of the Analysis**

For the independent analysis, the following data were considered:

- Total PCBs in the water column rather than tri+ PCBs
- Data from 1990 onward rather than 1995 onward
- Discrete measurements of concentration rather than concentrations derived from annual loading estimates normalized by annual flow volume
- Suspended sediment measurements coincident with PCB measurements
- Data collected by USGS, General Electric, CARP, and NYS DOH

Total PCBs rather than tri+ PCB homologs were considered in the analysis. The reason for considering total PCBs is that the mono-CB and di-CB homologs, not included in tri+ PCBs, comprise a large portion of the PCB contamination in the Upper Hudson River and the loading ultimately delivered to the NY/NJ Harbor estuary. Also, water column measurements rather than sediment bed measurements were considered since the water

column measurements represent the loading that will eventually flow over the Federal Dam to the Harbor after mixing with the Mohwak River plume. Total PCB water column measurements were available from the USGS, CARP, General Electric, and the New York State Department of Health. Simon Litten (formerly of NYSDEC), Kevin Farrar (NYSDEC), Gary Wall (USGS), and Ed Garvey and Julianna Atmajda (Louis Berger Group) are gratefully acknowledged for transmitting data.

For the period 1975 to 1994, the USGS simultaneously measured total PCBs and several PCB Aroclors. The coincident measurements of Aroclors and total PCBs for 1990 to 1994 were examined. A good correspondence between the Aroclor sums and the total PCB measurements was found. The correspondence is shown on Figure 1. For the period between 1995 and 2002 when the USGS measured Aroclors only, the Aroclor sum was used as a surrogate for total PCBs. The Aroclors measured by USGS and included in the sum are 1016, 1242, 1254, and 1260. Aroclors 1016 and 1242 in particular include the mono-CB and di-CB homologs.

Data from 1990 onward, rather than 1995 onward, were considered simply to broaden the perspective. The concept that the most recent data should be considered for calculating rates of attenuation to be used in future projections, as EPA did, is technically correct and is not being challenged.

Figure 2 displays the discrete PCB measurements collected since 1990 and prior to the initiation of dredging in 2009. The discrete measurements do not show a declining trend over time. Two attempts were made to eliminate variability in the data and reveal any potential underlying trend. The first attempt was to look at the data on a “per gram of solids” basis to eliminate variations in the PCB measurements due to variations in suspended sediment. This was possible for the USGS, CARP, and General Electric data, but not for the NYSDOH data. Figure 3 displays the PCB data on a “per gram of solids” basis. On a solids normalized basis, there doesn’t appear to be a rate of decline of PCB concentrations over time. The second attempt was to “bin” the discrete measurements by year. The “binned” PCB data are shown of Figure 4. There doesn’t appear to be a declining trend in the binned data either.

It is interesting to note on Figure 4 that while there is some decline between 1998 and 2002 concentrations, 2004 to 2006 concentrations are similar to those of 1998. There is also an indication of a decreasing trend between 2006 and 2009. It is not clear that concentrations would continue to decrease in the future if dredging hadn’t been initiated. Considering the 1990’s and 2000’s data together, a declining trend is not apparent.

### **Findings of the Analysis**

The conclusion drawn from the analysis is that there doesn’t appear to be an ongoing rate of decline in PCB concentrations near Waterford as shown by Figures 2, 3, and 4. It is noted that over a longer period, from 1975 onward, there has been a notable decline in PCB concentrations. The decline since 1975, however, is likely attributable to the halt of PCB production/use and remedial activities along the Upper Hudson River rather than just natural attenuation. Figure 5 displays PCB concentrations since 1975.

The conclusion is consistent with Appendix I-G of EPA's March 2010 Phase I Evaluation Report prepared by the Louis Berger Group. EPA reported that estimates of total PCB (TPCB) annual loads at Waterford based on USGS and GE data for the period 1995 to 2008 show no statistically significant decline, with "half life" of 99 years.

The conclusion is inconsistent with the April 2010 addendum to the EPA Phase I Evaluation Report. In Topic 4-A of the addendum, EPA presents a reanalysis of the projected future PCB loadings to the Harbor. In the reanalysis, PCB concentration data instead of loading estimates were considered to evaluate attenuation. The concentration data used in the attenuation calculation however were developed by normalizing annual load estimates by total flow. The reanalysis discarded data from 1999 and 2000 from the estimate of attenuation rate. EPA's reanalysis considered tri+ PCB concentrations on a flow-weighted basis and estimated an exponential decay function of implied PCB concentration. For 1995, the decay function suggests PCB concentrations of 34 ng/L. For 2008, the decay function suggests PCB concentrations of 14 ng/L. This rate of decay corresponds to a half life of less than 13 years.

It is difficult to pinpoint the exact reasons why the findings of the analysis are in contradiction with the addendum findings. Some of the possible explanations include:

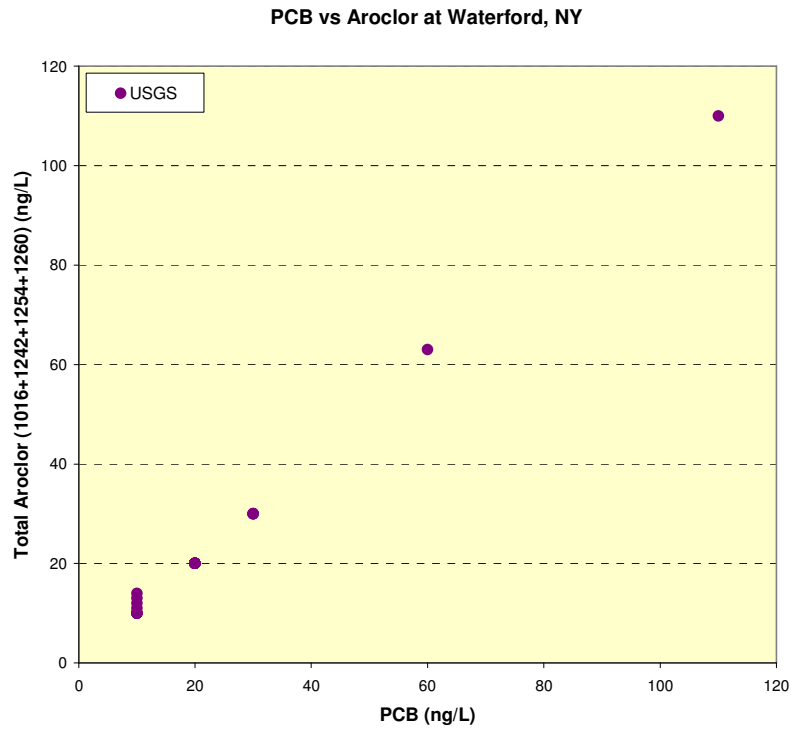
- Tri + PCB rather than total PCBs were considered.
- USGS 1999 and 2000 data were discarded.
- CARP and NYSDOH data weren't considered.
- Estimating annual loadings and then dividing them by total annual flow volumes to produce annual concentration estimates may not be necessary for evaluating concentration trends and may be imposing a flow related, rather than PCB related, trend in the analysis.

It is noted that there isn't a clear reason to reject the addendum findings. The addendum represents an alternate approach.

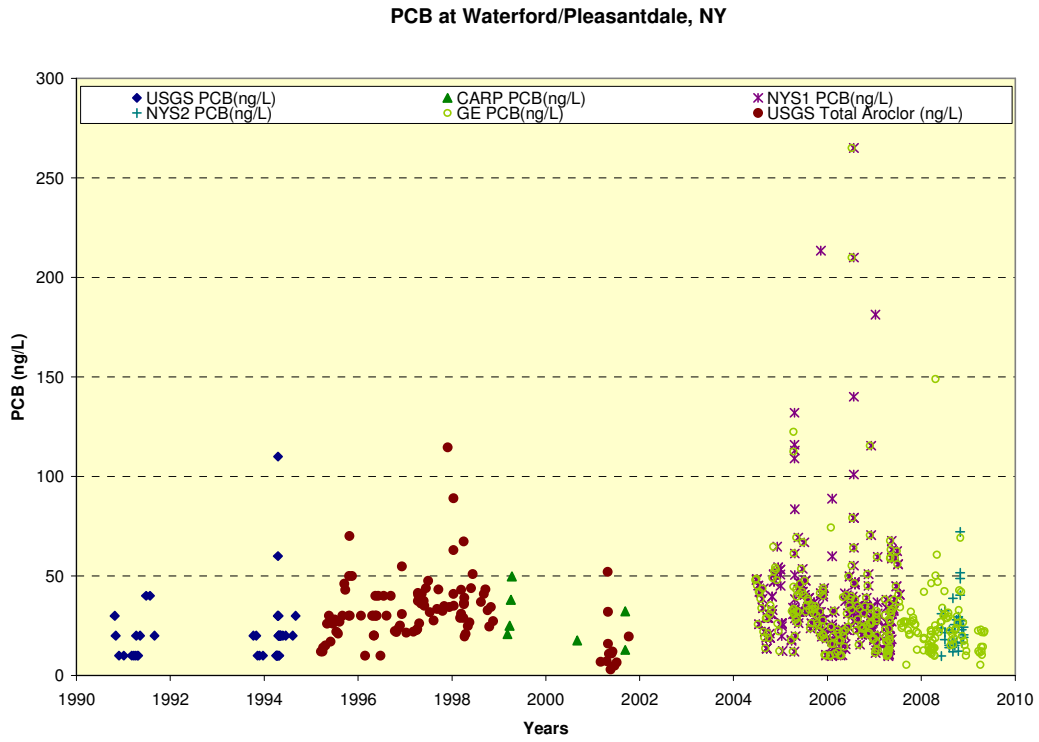
Given that there are three different analyses, this report, the EPA March 2010 Phase I Evaluation Report, and the EPA April 2010 addendum, and that only one of the analyses suggests an ongoing decline in PCB concentrations (i.e., there isn't a consensus of results across methods), it is not prudent for Harbor managers to rely upon a natural attenuation factor in future loading projections. Further, the decline that was indicated in the EPA April 2010 Addendum is for tri+ PCBs. It is not clear that this decline also applies to total PCBs. Ratios of total PCBs to tri+ PCBs have been observed in the 1.4 to 1.9 range based on water column concentration measurements near Waterford (i.e. CARP data and 2005 to 2008 General Electric data).

CARP had performed two projection scenarios which considered the Upper Hudson River PCB loadings. In one case, future Harbor water quality was projected with the continuation of 1998 to 2002 PCB loadings. In another case, future Harbor water

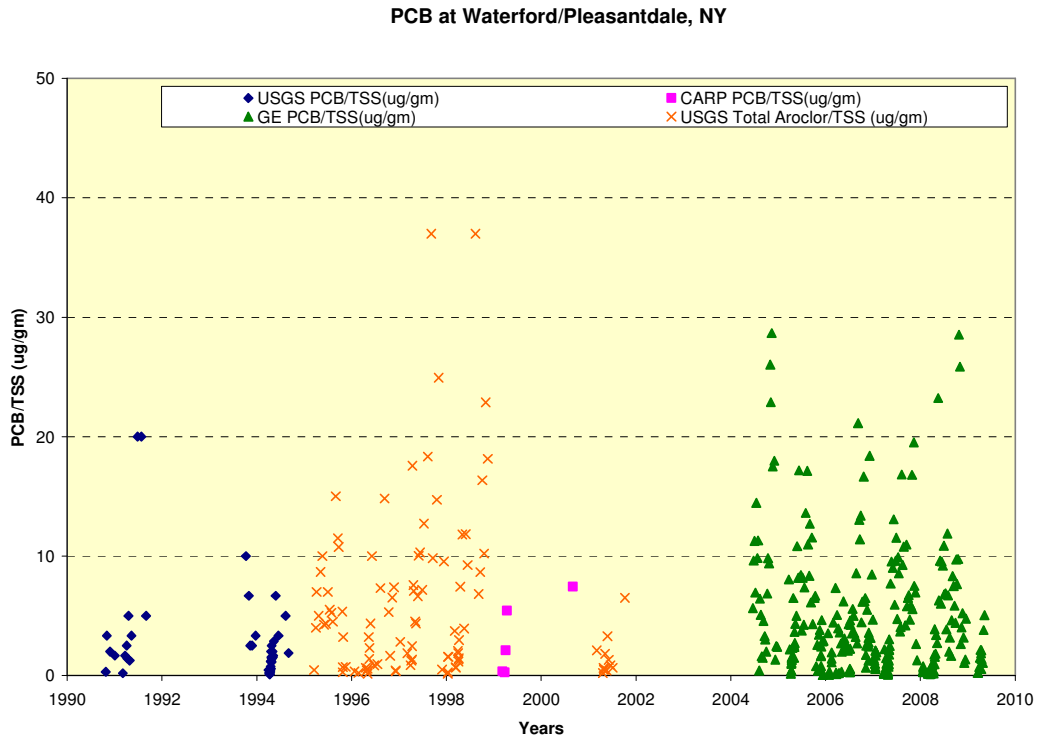
quality was projected with the EPA PCB ROD. Given the current status of information, the CARP projection case including the ROD should not be used for management purposes. The CARP case that considered the continuation of 1998 to 2002 PCB loadings still represents a reasonable, conservative estimate of the future PCB loading to the Harbor from the Upper Hudson River without remediation dredging. The CARP projection did not include any attenuation of the Upper Hudson River PCB loading. Once decisions related to the continued dredging of the Upper Hudson River are finalized between EPA and General Electric, the CARP projection loadings, future with 1998-2002 loadings and no attenuation, could be modified to reflect the expected changes to loadings during and after dredging for Harbor TMDL and other purposes. At that point a new CARP model simulation could be performed to forecast future Harbor PCB levels.



**Figure 1. The sum of Aroclors 1016, 1242, 1254, and 1260 USGS measurements in the Hudson River near Waterford for 1990 -1994 are in good agreement with coincident USGS measures of total PCBs.**

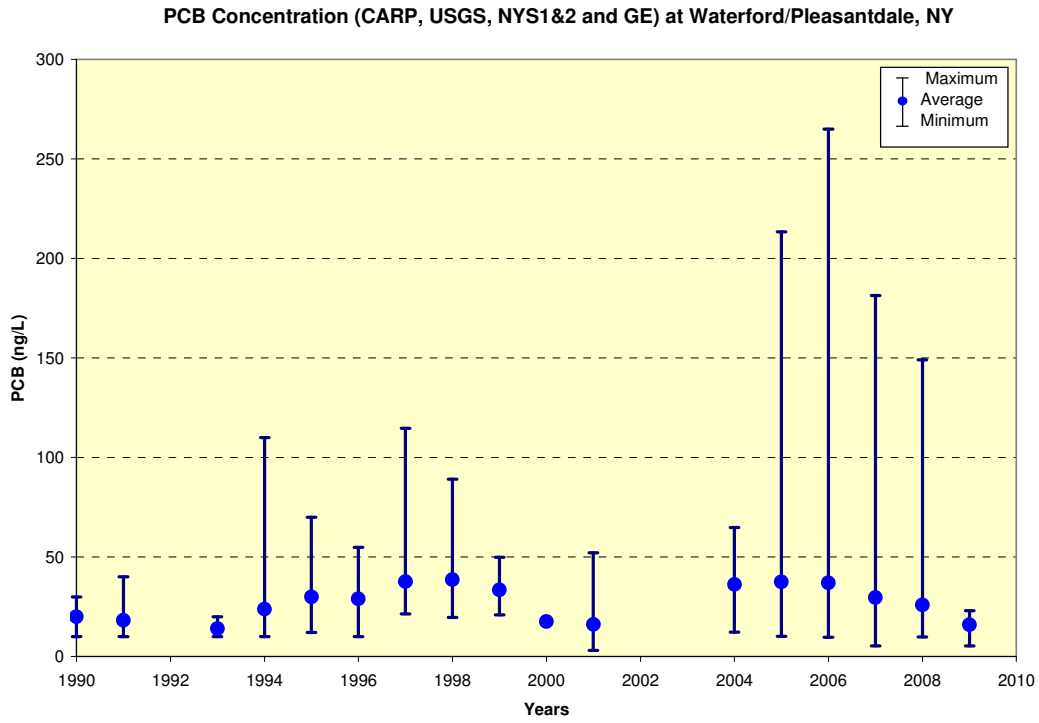


**Figure 2. Hudson River PCB measurements near Waterford**

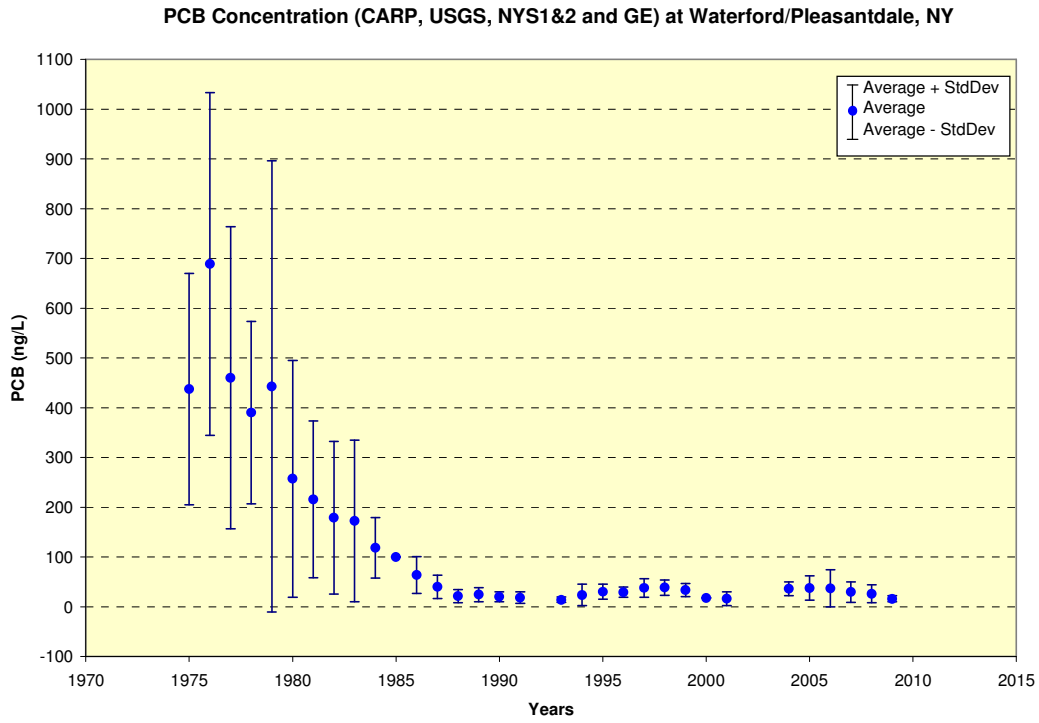


**Figure 3. PCB measurements expressed as per gram of suspended sediments**





**Figure 4. PCB measurements summarized on a per year basis**



**Figure 5. Summary of PCB measurements from 1975**