Document	EPA Response to Comments from NOAA on Engineering Performance Standards – Public Review Copy Hudson River PCBs Superfund Site
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Reviewer	#	Comment	Topic	Response
NOAA	1	We are… skeptical that the dredging residual standard affords sufficient protection and permanence because it allows for capping of sediments with elevated PCBs, under some of the prescribed scenarios, without demonstrating that re-dredging will prove ineffective. EPA determined in the Hudson River Record of Decision (ROD) that sediment capping was not permanent, was subject to catastrophic events, would not reduce toxicity, and could restrict use of the river. However, capping has been integrated conceptually into the dredging residual standard.	**Residuals** Cap issues	Capping is allowed without re-dredging only where the design cut-lines have been achieved, the individual nodes comply with the PL action levels, and the average and median residual concentrations are less than 6 mg/kg Tri+ PCBs, thus documenting the removal of the PCB inventory. Given that the average of the 20-acre joint evaluation area must be at or below 1 mg/kg Tri+ PCBs, the objective of the ROD is achieved. Because a cap will be placed over residual sediment and not contaminated sediment inventory, residual capping is fundamentally different than the capping alternative evaluated in the 2000 Feasibility Study. Judicious use of capping will aid in achieving both the residual and productivity goals. As described in Section 4.0 of the Residuals Standard, USEPA will evaluate the use of non-dredging technologies following Phase 1.
NOAA	2	We believe that a performance standard or standards should be developed to assess the capping component of the dredging residual (see additional comments under Dredging Residual Standard). A performance standard or standards should also be considered for the natural	**Residuals** Cap issues	USEPA does not believe it is necessary to establish a performance standard for the capping component of the Residuals Standard. Caps that would potentially be installed during the remediation will need to

		attenuation component of the remedy and or such an assessment should be conducted as part of the long-term monitoring program (see comments directly below).		be designed during the Remedial Design (RD). USEPA will review the cap designs being prepared by General Electric Company, which are subject to Agency approval pursuant to the Administrative Order on Consent for Remedial Design. The long-term monitoring program that will be developed separately from the Engineering Performance Standards will provide the data necessary to evaluate the monitored natural attenuation component of USEPA's 2002 cleanup decision. USEPA believes that, while long-term monitoring will be required, there is no need for a performance standard for the long-term monitoring program due to the requirements for Quality Assurance Project Plans, which are standard for such monitoring programs.

NOAA	3	Monitoring is recommended prior to commencement of remediation to document baseline conditions and provide a starting point to assess the rate of change and evaluating effectiveness of the MNA component. Such pre-remediation data also provides a relative baseline to assess short-term impacts of the remedy, such as whether there were increases, decreases or no change in areas unremediated but in the vicinity of dredging activity. Insufficient information currently exists to provide baseline conditions for such an assessment. Either of these approaches should evaluate the trajectory of the recovery relative to the model projections and demonstrate that sediments, water column and biota are being remediated or protected by this component of the remedy. Page 81 of the ROD states "The No Action and MNA alternatives rely on natural attenuation processes such as burial by cleaner sediments, biodegradation, bioturbation and dilution to reduce concentrations of PCBs in sediments and surface water." Moreover, EPA states "The preponderance of data indicate that burial of contaminated sediment by cleaner materials is not universally or uniformly occurring." Results of the 2002 sediment sampling activities and analyses support those findings. Ninety-four percent of the sediment cores collected in 2002 and reported in the database exceed 3 ppm maximum total PCBs. Of these 890 cores, more than half (51.6 %) have maximum PCB concentrations in the top 2 inches and more than three-quarters (76.3%) have maximum concentrations in the top 12 inches. It is important to design a program that can test whether the hypothesis that MNA will naturally attenuate PCBs is reasonable. EPA's Dec 2002 draft Contaminated Sediment Remediation Guidance Document, cites the EPA Science Advisory Board (SAB) May 2001 report on Monitored Natural Attenuation and points to the need to	**Residuals** Baseline monitoring	Sediment, fish, and water quality data are being collected now to document pre-dredging conditions as part of the remedial design work. The issues in this comment are more appropriately raised when the long-term monitoring program is being developed. As indicated in the response to Comment No. 2, above, USEPA does not believe it is necessary to establish a performance standard for the long-term monitoring component of the remedy. The current sampling programs do not include a benthic invertebrate sampling component, as PCB concentrations in biota will be monitored using fish data collected as part of a post-dredging monitoring program. Biota recovery will be measured by monitoring PCB concentrations in fish collected under this program and compared with data obtained from the baseline monitoring program, as well as by direct observation of ecological communities, as discussed in the Habitat Delineation and Assessment Work Plan (GE, 2003). Benthic organism recovery will be measured indirectly through measurement of habitat suitability variables such as aquatic macrophyte shoot biomass, shoot density, percent cover, and plant species composition, and physical measurements including light availability, water depth, and current velocity. USEPA will consider habitat monitoring in unremediated areas to further document the recovery of these areas. As a part of this, USEPA could include some habitat reference stations from areas under the MNA alternative.

NOAA	6	Page ES-1, Para 3, " *"EPA required that performance standards…be established to address comments received by some of the public suggesting that the environmental dredging could 'do more harm than good'…"* This paragraph should also include a statement that other members of the public, including the natural resource trustees expressed concerns that the remedy would not achieve the rate or degree of "natural" recovery stated in the ROD.	**General** Rate/degree of recovery	The text will be modified to reflect both perspectives on the remediation.
NOAA	7	Setting the maximum total PCB load at 650 kg could potentially constrain the project if the volume of material to be dredged increased drastically.	**Resuspension** Total load standard	The 650 kg criterion is conservative with regard to the anticipated resuspension. Furthermore, it is an appropriate criterion to protect the Lower Hudson and fish tissue concentrations. Minor changes in the volume of the material to be dredged are not expected to require adjustment of this criterion. If the final estimate of the volume to be dredged is considerably revised during remedial design, this criterion will be reevaluated. See Section 2.0 of the Resuspension Standard for detailed technical justification of this criterion.
NOAA	8	The baseline conditions that will be used to determine net changes associated with dredging are based on the statistical treatment of monthly averages of historical data. These data will be updated by the additional monitoring that will be performed prior to the initiation of dredging. It is not clear why a more specific flow-dependent approach could not be used, or, better, the upstream data that are collected as part of the monitoring.	**Resuspension** Flow dependent approach should be used	The statistical treatment is necessary to determine true differences from baseline due to dredging. The upstream location is not used directly for baseline since it will also have variability. Thus far-field station conditions are compared to the 95th percentile for baseline, reflecting the variability in both baseline and downstream conditions. In this manner, additional monitoring is prompted at the lowest level

				only when conditions are truly above baseline. Meanwhile the response to higher levels, reflecting greater releases, will be relatively unaffected by this requirement. A flow-specific approach was not used since it provided only marginally improved estimates of baseline conditions in some months, while it added significantly to the complexity of the standard criteria.
NOAA	9	The statistical basis for the monitoring design is not discussed. Of concern is the consideration of the power of the monitoring, both routine and under non-compliant conditions, to ensure that the criteria are being met. For example, no variance analyses are proposed for the running averages to estimate the probability that the mean is below (or above) the criteria. Similarly, the 500 ng/l threshold is based only on the actual numerical average, not on the estimate of the probability that the threshold is being exceeded. Also, we did not find mention of how below-detection-limit (DL) concentrations would be handled for new data in the resuspension volume, only how they were handled for existing data and how they will be handled in the residual volume.	**Resuspension** Statistical Basis for Monitoring Plan	Attachment G of the Resuspension Standard discussed in detail the statistical basis for the monitoring design for both routine and non-compliant conditions, including assumptions regarding the expected level of variation. The text of the Resuspension Standard will be modified to note that the actual level of variance may be considered in evaluating the monitoring results after an initial period of data collection Half the detection limit will be substituted for non detect values in any formulas. This will be added to the text.
NOAA	10	Similar to the approach taken for dredging residuals, should the criteria include triggers based on "excessively high" concentrations in any single sample? This consideration would apply to both the PCB and suspended solids data.	**Resuspension** Add excessively high standard	USEPA does not believe such an approach is warranted for the Resuspension Standard. Due to baseline variations in the water column (which is expected to be more variable than variations in sediments) and the uncertainty associated with sampling and lab analysis there is not enough confidence

				in one sample to reliably require increased monitoring or engineering contingencies including temporarily halting operations,based on a single measurement.
NOAA	11	The probable effectiveness of feedback from the performance standards monitoring data on the dredging is unknown. The time lag for noting exceedances of the criteria seems to be so large, that in many instances, it will be arguable that activities at the dredge have already changed so the data do not apply.	**Resuspension** Time lag	There is no detrimental time lag as the monitoring plan is currently structured. The plan sets forth a reasonable sampling frequency and lab turnaround time. PCB data will be available within 24 hours and TSS/turbidity results will be available even sooner. When exceedences occur, the sampling frequency increases. The additional samples are necessary to assure that the exceedences are occurring and are not due to sampling or lab error. If the additional sampling confirms the exceedences it is likely that the cause of the exceedences are ongoing and require resolution. There is no alternate basis on which PCB conditions can be more rapidly known. However, part of the requirements for near-field monitoring are intended to provide near-immediate feedback to the dredge operator regarding the amount of sediments resuspended by the operation. It is this "loop" that has the greatest potential to directly reduce resuspension by the dredge operation. In addition, the time of travel necessary to move a parcel of water to the downstream water supplies should be considered. The time for the impacted water parcel to travel

				from the remedial area to the water intakes is greater than 24 hours for River Sections 1 and 2, except at the highest flow rates. However, it is unlikely that dredging will be conducted at high flow rates, because of safety concerns. Since the turn-around time for PCBs is 24 hours, this provides time for the operators of the public water intakes to take precautions if the concentration at the far-field stations is greater than the MCL. Contingencies for water supplies along with the warning procedures will be specified in the CHASP TSS or turbidity levels, depending on the ability to correlate them, will give near real-time indications of resuspension. Although TSS is not expected to have a one to one correlation with PCBs, it is anticipated that this information will provide an indication of excessive resuspension and elevated PCB levels. Such TSS/turbidity levels may then be used to prompt further PCB sampling downstream and notification of water supplies. Dredging in River Section 3 is not anticipated until later in the project, when many of the issues related to PCB release will be better understood. Due to the close proximity of the dredge operation to the water intakes, it may be necessary to implement other water supply contingencies during this period. This issue will be further addressed in the Remedial Design and

				CHASP.
NOAA	12	The report could include a discussion of potential concerns about dredging sediments with high organic content and low density. This sediment fluff layer could resuspend to a greater degree and stay in resuspension longer than more typical sediments. How important might this category of sediments be for Hudson River remediation and are contingencies being developed to minimize their resuspension and recontamination of remediated sediments?	**Resuspension** Fluff	The resuspension controls and contingencies for such areas will be developed by General Electric Company as part of the design documents that are subject to USEPA approval pursuant to the Administrative Order on Consent for Remedial Design. The remediation will be designed to comply with the performance standard while dredging areas containing sediments with high organic content and low density. The near-field transport model (TSS-Chem) used a settling velocity for both fine and coarse solids. The model indicated that while the coarse solids settled out quickly much of the fines remained in the water column after one mile. It was assumed that any solids that remained suspended at this distance according to the model would continue to stay in the water column. Beyond this distance the HUDTOX model did not settle out a significant amount of solids. During Phase 1, it will become evident if such solids have a significant impact on resuspension rates and PCB loadings. Any contingencies to minimize resuspension will be developed as part of the design phase.
NOAA	13	Some information is provided regarding the use of sampling approaches for collecting samples representative of the full river discharge, based on EDI	**Resuspension** Sampling equipment	This will be considered as part of the Remedial Design. The logistics of sampling and instrument deployment will be worked

		and EWI approaches; sampling handling for collecting PCB sample, e.g., filtering, etc. Specifics on the deployment of other instruments are not discussed.		out by the contractor and provided in work plans that will require approval by USEPA.
NOAA	14	Monitoring in the Lower Hudson is limited to once per month at Albany and Poughkeepsie. Sampling more frequently and further downstream is recommended if impacts from the dredging are detected at the Poughkeepsie station. Hence, additional stations should be identified and contingency sampling described in the subject document in case of such an event.	**Resuspension** Lower Hudson	Since the Lower Hudson has other sources of PCBs, it is unlikely that impacts to the water column concentration from the dredging operations in the Upper Hudson will be discernable. The sampling frequency is reasonable for the routine monitoring since there are lower PCB baseline concentrations in the Lower Hudson, settling will occur, and compliance with the action levels in the Upper Hudson will result in protective conditions for the Lower Hudson. As stated in Attachment G, the frequency of sampling in the Lower Hudson will be increased in response to greater loads and concentrations in the Upper Hudson, specifically, when Troy is expected to exceed 350 ng/L Total PCB in order to measure the concentration entering the public water intakes. The need for monitoring below Poughkeepsie, as suggested in the comment, is unclear even if dredging-related releases can be seen in the Lower Hudson. Tidal mixing, thermo-haline circulation and local sources will serve to confound any detection of PCB levels attributable to the dredging. Monitoring requirements for non-routine conditions will be specified in the CHASP.
NOAA	15	Sampling of suspended solids (SS) in the near field is set at a frequency of once per 3 hours. The use of these	**Resuspension** TSS Frequency	It is not practical to require TSS sampling at a higher frequency than once per three

		data are not clear in providing feed back, since the data are not available for 3 hours after collection. For example, the report includes the directive that SS will be collected once per hour for 2 hours after dredging ceases for the day (page 81, second paragraph) to ensure the release has stabilized before monitoring can end for the day. It is not clear why the frequency increases from once every 3 hours during dredging to once per hour upon cessation of dredging, nor is it clear that receiving the data 4 to 5 hours after dredging ceases will be meaningful in light of the apparent lack of corrective actions triggers.		hours. Real-time turbidity monitoring will be required even if there is no reliable semi-quantitative relationship between TSS and turbidity. In the absence of such a relationship, turbidity measurement will still provide some indication of resuspension to the dredge operator. It will be important to develop some semi-quantitative relationship between the TSS and a real-time turbidity measure if at all possible in order to reliably assess the water column conditions against the resuspension criteria. These data will provide additional information to modify or develop semi-quantitative relationships between TSS and turbidity. Sampling following the cessation of dredging is required primarily to determine if the TSS concentrations have stabilized, not for comparison to the standard. Two consecutive hourly TSS/turbidity samples at baseline levels are required after dredging has ended for the day before TSS/turbidity sampling can cease.
NOAA	16	In Section 3.1.1.1.1, what is the rationale for including the length of the dredging days (T_{d7}) as a parameter in the formula 3-1 for calculating the net far-field PCB load to the river? The data for far-field locations for PCBs are once-per-day measures; hence these are not particularly timed to ensure that any release is being captured. It would seem that the same formula without the dredging time correction would be better.	**Resuspension** Formulas	Even though the far-field PCB measures were not required to be timed, the samples are to be collected from dredging-impacted water that represents the dredging condition. Daily operation duration is an important factor to estimate the release of PCB during dredging based on the concentration. The daily operation hours could vary depending on operating conditions and other factors. By incorporating the period of operation in the

				calculation, the flux produced during the dredging period of each day is averaged to a 24 hour basis, the same as the criteria used in the standard.
NOAA	17	The report includes a caveat in a few places that the SS criteria can be waived if it results from tributary input associated with meteorological events. However, it appears that no tributary monitoring is proposed. Therefore, it is not clear how the tributary contributions will be determined. NOAA, commenting on the Remedial Design Work Plan recommended that baseline monitoring include direct measurements of tributary loading of SS to the Hudson.	**Resuspension** Tributary monitoring	Tributary monitoring is not prescribed because it is not deemed an essential component to implementation of the Resuspension Standard. If tributary input is identified as a potential concern during remedial design, however, USEPA would expect that the designers would provide for tributary sampling and/or meteorological data in the design.
NOAA	18	The near-field monitoring is designed to occur at set distances from the dredging operation, but the dredge should be moving. Will the buoys be repositioned frequently? Are there minimum and maximum distances for the monitoring locations? Also, as the dredge approaches a riverbank, is it not likely that one or more near-field station will be unavailable? If so, what are the contingencies to the plan? It would seem reasonable to simply not collect the data from that location since conceptually no resuspension could occur in that direction while the dredge is there.	**Resuspension** Monitoring placement	The monitoring equipment will be repositioned frequently unless the area is contained since the sampling would then be required downstream of the stationary containment. The distances provided are approximate. It is not expected that the locations will always be exactly 100 or 300 meters downstream but should be approximately those distances. It is not anticipated that any of the sampling locations will be unavailable. The three locations downstream are required to be within the plume. The upstream and channel side stations will always be available as well.

NOAA	19	The report indicates that, in addition to the discrete samples, PCBs will be measured with an integrating sampler. However, the type of sampler is left for the design phase to specify. The report also indicates that they would like to collect DOC, suspended OC, and SS with the integrated PCB sample. This requirement would seem to eliminate the use of semi-permeable membrane devices (SPMDs). Please clarify.	**Resuspension** Analyses	As noted, SPMDs do not meet all of the data quality objectives and additional grab samples would be required if these sampling devices were used. The solids, organic and PCB data will provide enough information to reliably estimate the PCB dissolved and particulate phase concentrations.
NOAA	20	Page 78, sentences in the second full paragraph from the bottom regarding Waterford station. The middle sentence appears to be missing something or to be a combination of multiple sentences. Similarly, the second full sentence at the top of page 79 appears to be missing a couple of words. Finally, the equation at the bottom of page 80 appears to be wrong.	**Resuspension** Text	The text is being revised to state that Stillwater and Waterford stations will be monitored to measure the PCB concentrations entering the Upper Hudson River public water treatment plants in Halfmoon and Waterford. The monitoring will also be used to confirm or adjust the basis for estimation of Total PCB concentrations at the Waterford station based on concentrations at upstream stations. The text is being revised to state that, for the Control Level and Resuspension Standard threshold, the samples will be collected four times a day, but will be composited from samples collected hourly over one 6-hour period (*i.e.,* four 6-hour composites per day). The equation is correct as shown on page 80. The equation is equivalent to C(FF) * Q(FF) = C(Troy) * Q(Troy) and assumes conservation of PCB mass with no other inputs.
NOAA	21	While the subject document does a good job of	**Residuals**	USEPA believes that the Residuals Standard

		describing the sampling contingencies and how the data will be compare to the acceptance criteria, NOAA's primary reservations focus on the complexity of the scenarios developed to address sediment residual PCBs and the allowance for backfill/cap over additional dredging. This is of particular concern because high Tri+ PCB residuals could remain in the river that would continue to pose a threat to ecological receptors. EPA should ensure that sediment inventory removal is the focus of the remedial action and that backfill/capping is utilized only to address sediments that cannot be remediated with available dredging equipment. The peer review panel should determine the appropriateness and effectiveness of using backfill and sub-aqueous caps to address residual contamination, especially focusing on what constitutes "residual" sediments and on the stability and permanence of these engineering controls in a dynamic river system. They should also opine on the need for performance standards specific to the sub-aqueous cap/backfill. This is especially important given the recent ice scour event evidenced on the Grasse River that eroded away the 12 inch 1:1 sand:topsoil cap and underlying PCB-contaminated sediments. Type, design specifications and erosion issues relative to backfill and sub-aqueous capping need to be fully evaluated, at least conceptually, to better understand the implications of the residual standard on remedial effectiveness.	Backfill Cap issues	is not unduly complex. Consistent with the 2002 ROD, USEPA will evaluate the data collected during Phase 1 to determine if changes are necessary to the standards or to the dredging operations in Phase 2. See the response to comment NOAA 1 regarding cap issues. The issues raised for consideration by the Peer Reviewers will be considered during the development of the charge for the panel.
NOAA	22	In the Executive Summary (Page ES-2, Footnote 2), PCB concentrations in fish are described in terms of Tri+PCBs but the ROD refers to them as PCBs, which would be constructed as total PCBs.	**General** Fish PCB concentration	The footnote defines the meaning of the term "negligible difference" when referring to the modeled results. The models predicted fish body burdens in terms of Tri+ PCBs because

				the historical Aroclor data provided an estimate of Tri+ PCBs and the PCBs detected in fish tissue are predominantly tri and higher homologues. The Tri+ PCB concentration in fish tissue represents 98 percent or more of the total PCB burden. This is because the bioaccumulation of PCBs results in a more chlorinated mixture of PCBs in fish tissue relative to the sediments and water to which they are exposed.
NOAA	23	Page ES-9, "*The "residual sediments" may consist of contaminated sediments that were disturbed but escaped capture by the dredge, resuspended sediments that were redeposited/ settled, or contaminated sediments remaining below the initial dredging cut elevations (e.g., due to uncertainties associated with interpolation between core nodes of the design sediment sampling program or insufficient core recovery).*": This description is too broad in the context of the Residuals Performance Standards because it allows for the potential for unnecessary contamination to be left behind in the river that would otherwise be removed. The "residual" description should explain these are the sediments that remain once the PCB inventory is removed. The text should also speak to how thick this layer may be and whether it can exceed the MPA. Residual sediments should be those sediments that cannot technically be removed from the river due to bottom type, obstructions, or equipment constraints and would therefore be addressed through capping or backfill. Failure to adequately characterize sediments	**Residuals** Definition of residual	The residual sediments as defined in the text are simply the contaminated sediment that is left once the design cut lines are met. The standard requires that the vertical extent of contamination be characterized prior to redredging, hence when the design depths are attained, the PCB inventory should be removed. Regardless of the source of the PCBs remaining in the sediments, the concentration levels must conform to the residuals performance standard criteria. The samples to be collected should provide sufficient evidence to indicate that deeper contamination does not lie below the depth of cut. If individual samples exceed specific thresholds then additional sampling of deeper sediments is required. If contamination is found below 6 inches, the next redredging attempt would not be counted as one of the residual redredging passes. In this way, the standard

		during the design phase or to initially capture sediments during the dredging process should not be sufficient grounds to shift the classification of the sediment from "contaminated" to a "residual". Nor should impacts on schedules.		differentiates between contamination at depth (inventory) and residual sediment that cannot be easily removed from the river bottom.
NOAA	24	The action levels and required responses for residual sediments allow Tri+ PCB concentrations up to 27 ppm to be left in place. This is of particular concern if the Tri+ PCBs under represent the total PCBs. While there is a provision for sub-aqueous capping of these sediments under certain conditions, the Hudson River ROD stated that "there is no reduction in the toxicity or volume of the PCBs under the cap" and emphasized the permanence of sediment removal compared to "the long-term operation and maintenance required by capping PCB-contaminated sediments" and the potential for the need to impose use restrictions to protect certain capped areas. What assurance is there that these areas do not exceed the MPA and will not continue to pose a threat to human health and the environment?	**Residuals** Cap issues	Where nodes approach the PL thresholds there will be areas of high concentration but low mass. The modeling conducted to determine the effectiveness of the selected remedy used the average concentration in large areas of the river (about 20 acres in River Section 1). If the average concentration is in compliance with the standard, the effectiveness of the remedy should not be compromise by smaller areas of elevated concentration. Capping is not permitted until the design cut lines have been met and the low median concentration (less than 6 ppm Tri+ PCBs) indicates that the PCB inventory has been removed. Therefore, the type of cap permitted by the standard is not the same as the remedial capping alternatives examined in the ROD, which isolated inventory. The caps permitted by the standard will isolate residual concentrations not inventory. Should these caps erode over time the impact to the river is not as pronounced, because of the lower mass and dilution with capping material.

NOAA	25	Analysis of sediments deeper than the top 6 inches is triggered when the average residual Tri+ PCB concentration exceeds 6 mg/kg. The spatial extent to which deeper sediments must be sampled is based on a median Tri+ PCB trigger. Page 54 and 55 of the ROD discusses the factors considered in delineating areas targeted for remediation and excluded areas where 12 inches or greater of relatively clean surface sediment exist. The 6 to 12 inch segment should be analyzed during the initial residual sampling round to ensure that the top 12 inches is "clean". Our proposed change to the sampling protocol would be more consistent with the intent of the ROD since it would confirm relatively clean surface sediment conditions for the top 12 inches of remediated areas.	**Residuals** Sampling for the residuals	Sampling only the 0-6 inch layer meets the intent of the ROD, assuming that the design cutline depths have been met and the concentrations are less than 6 ppm. The lower mean concentrations for 0-6 inch samples within a certification unit indicate that the dredge cut reached a horizon with minimal to non-detect PCB concentrations and there is little or no contamination remaining at depth.
NOAA	26	The subject document directs that sampling in certification units (CUs) of less than five acres be implemented at the same frequency, e.g., 40 samples, as a standard CU. While certainly providing substantial data, establishing a simple standard evaluation sample spacing of 80 feet would be adequate to characterize all areas. Information should be available to provide specific sampling location recommendations for the known areas proposed for dredging. Based on the mapping necessary for the design phase, the details could be refined prior to commencing work.	**Residuals** Number of samples per certification unit	The number of samples per certification unit (CU) was derived in the 2000 Feasibility Study. The derivation is for the number of samples (not a sampling "density") that are needed to have a level of certainty such that the central tendency of the data set is known. This derivation does not take the area of the CU into account. If fewer samples were used to characterize the smaller CUs, the estimate of the mean value would be more uncertain.
NOAA	27	The approach taken to address residual contamination still relies on the extensive analysis of the variance data from case studies to establish *a priori* thresholds to determine the likelihood of compliance with the 1mg/kg goal of the remediation. It is not clear why a more	**Residuals** Analysis for residual contamination compliance	Case study post-excavation data have been used to provide an estimate of the residual concentrations during the remediation including the expected confidence limits and prediction limits. No site-specific post-

		straight forward statistical evaluation of the mean of the collected data and the confidence bounds based on those data would not provide a better estimate of whether the project goals are being met. If a unit is not in compliance, the actual data could easily be ranked and tested to identify the stations that achieve compliance and earmark those that do not. A more specific example of our concern is the discussion at the start of the large paragraph in the middle of page 33. The subject document states that a unit with an arithmetic mean of less than 3 mg/kg Tri+ PCB, and meeting the 97.5% PL and the 99% PL, has 95% probability that the true mean is less than 3 mg/kg. This statement would seem to be true only if the variance in the samples from the unit is similar to the variance used to generate the criteria.		excavation data are available to conduct an analysis of variance and the impact on the statistics. Data collected during Phase 1 will be used to re-evaluate the action levels in the Residuals Standard. Alternative means of assessing compliance with the standard that could have been developed included means testing, but this is more complicated than a simple comparison to action levels and would result in areas where the average in the CU is greater than 1 ppm but still in compliance with the standard. In this case the standard is more rigorous. In addition, USEPA prefers to set simple rules for compliance and to avoid doing more involved statistical analyses during the remediation. The action levels were developed using the variance (Sy). As can be seen in Figure 2-6, the Sy values from the case studies did not vary greatly. It is reasonable to assume that the variance for the Upper Hudson River post-dredging sample results will be in this range.
NOAA	28	The subject document indicates that the PCB analyses would be for homologs. The cost to generate congener data would be similar and more useful.	**Residuals** PCB analysis	The specific analysis for PCB residuals will be determined during the RD. The text will be adjusted to not specify homolog analysis, because Aroclor analysis is more practical given cost and time constraints. The standard will require that the method have a

				sensitivity and accuracy greater than the analytical method used during the design support sediment sampling, since the anticipated working range of concentrations will be significantly lower than that of the design sampling. Additionally, the need to accurately assess mean concentrations in the vicinty of 1 ppm will require a substantially lower detection limit than that currently being used by GE.
NOAA	29	On page 34 of the subject document, the cost-effectiveness of re-dredging residuals compared to capping is discussed. It states: "The cost of construction and maintenance of a sub-aqueous cap should be considered and compared to the costs and schedule impacts of re-dredging when selecting this option." Capping requires life-long maintenance and monitoring to demonstrate cap stability, permanence, and effectiveness. These costs and those associated with potential cap failure should also be considered when comparing to the costs to re-dredge. Re-dredging areas eliminates future maintenance costs and should reduce long-term monitoring costs. This second paragraph also indicates that "[T[he sub-aqueous cap is not comparable to the capping remedial option evaluated in the FS and ROD, because it is not to be used to isolate contaminated sediment inventory." Yet, the purpose of the sub-aqueous cap is to isolate residual contamination that, as with the inventory, has the potential for biouptake, to flux to the water column, to erode, and to recontaminate remediated or MNA areas. The disadvantages of capping described in the	**Residuals** Cap issues	The long-term operation and maintenance costs will be added to the text as factors to be considered when weighing the decision to re-dredge or cap. It is possible that long-term maintenance will be guaranteed by requiring a bond, but this will be decided in a later stage of the remediation. The mass of PCBs will be greatly reduced by the removal. While the residuals may have elevated concentrations that could impact the environment if the cap eroded, the duration of the impact would be greatly reduced because of the lower mass and dilution of the residual concentrations by cap material. The breach of a cap that is used to isolate recalcitrant residuals would have a substantially smaller impact than the breach of a cap that was used to sequester PCB inventory, which was rejected in the ROD.

		ROD relative to dredging are the same for the residual standard, as made in our Points 1 and 5.		
NOAA	30	The subject document on page 40 raises the issue regarding the potential spread of contamination to nearby "non-targeted" areas, but only indicates that preventing such a problem is an issue for the dredging contractor via the "Construction Manager". If potential spread of contamination is a real issue, it would seem prudent to provide more guidance. For example, sampling should be routinely required in adjacent unremediated areas along with the residuals sampling to demonstrate that the spread has been minimal.	**Residuals** Sampling for the residuals	As was mentioned in Section 3.4 of the Resuspension Standard, sediment sampling may be required as a part of the remedial design to determine the impact to downstream non-target areas, especially if barriers are not proposed.
NOAA	31	Page 44, Bottom, Bullets: The third bullet on the bottom of page 44 is unclear. It appears that a CU that has already been backfilled/capped could be included in a 20-acre joint evaluation, using the concentrations of PCBs in the backfill/cap material. While it would be true that the concentrations in the residual sediments below the backfill/cap must have met the criteria, the use of the low backfill/cap concentrations would seem to substantially reduce the value of the 20-acre mean concentration. This approach does not seem to be consistent with the goal of reducing the PCB inventory. For example, the expected PCB concentration in the backfill/cap is no more than 0.25 mg/kg Tri+ PCB (or ½ DL if non-detect), compared to the allowable average concentration in the residual sediment of about 1 mg/kg. Conceivably, the backfill/cap concentration from three CUs could be compared in the running average with one unfilled CU, meaning the average in that CU could be 3 to 4 times greater than if the same comparison had been	**Residuals** Certification unit Average concentrations	The average concentration used to assess the joint evaluation area includes the capped area, substituting 0.25 mg/kg for the nodes in the capped area. Capping is not permitted until the PCB inventory has been removed, the design cut lines are met, and additional re-dredging attempts conducted if the median or average concentration is greater than 6 ppm Tri+ PCBs. The residual PCB mass should be much reduced from the pre-dredging condition. If the cap integrity is breached by some future event, the certification unit average would still be lower than estimated because of dilution/mixing with the capping material.

		made with the unfilled concentrations.		
NOAA	32	Under certain scenarios, two options are provided if average concentrations are above 1 mg/kg: construct an appropriately designed sub-aqueous cap or re-dredge. EPA should determine whether the area should be re-dredged. Preference should be given to re-dredging unless benefits from such an attempt are unlikely. What constitutes an appropriately designed sub-aqueous cap given the hydrodynamics of the river, the projected trajectory of recovery, the other components of the remedy, and the consequences of cap failure?	**Residuals** Redredging	If the design cut-lines have been achieved and the initial post-dredging sampling results indicate that the certification unit arithmetic average is between 3 and 6 mg/kg Tri+ PCBs, the Construction Manager may choose between re-dredging and immediate construction of a sub-aqueous cap. This decision was made to balance production and remediation goals, and represents an appropriate and protective approach for certification units with a mean that is within the 99% UCL of the ROD cleanup objective of 1 mg/kg Tri+ PCBs. Where appropriate, the standard allows a choice between re-dredging and capping for certain certification units, allowing the Construction Manager to balance feasibility, cost, and project schedule objectives. This option has been added to the standard because experience from the case studies indicates that it may be difficult to achieve the Residuals Standard in a small percentage of the remedial area, and the inventory removal objectives of the ROD will have been achieved prior to cap construction. It is important to recognize that capping has limited application because it puts restrictions on the use of these areas and requires long-term operation and maintenance efforts. USEPA plans to evaluate use of non-dredging technologies

				such as capping based on the Phase 1 data to determine if changes are necessary to the standard or to the dredging operations in Phase 2. During the remedial design, capping prototypes will be developed by General Electric Company that account for the general conditions of the river. These prototype designs will likely be based on guidance documents. The prototypes will be reviewed by USEPA and are subject to Agency approval. During the remediation, the prototype that is appropriate for the specific area requiring a cap will be modified and constructed for the specific river conditions. Potential failure of a sub-aqueous cap should not unduly hamper the success of the remedy because the residual standard requires the PCB inventory to be removed prior to cap construction.
NOAA	33	The last paragraph at the bottom of page 46 opens an interesting option in that it seems to negate the whole CU concept and allow the evaluation of each sample almost independently. Do two samples constitute a portion of a CU under that approach? The approach conceivably decreases the overall concentrations left in the river by decreasing the number of low concentration samples that could act to balance the impact of higher concentration samples. In addition, the contractor is required to provide a specific approval to, and receive permission from, EPA prior to invoking the option. However, it is still a concept that seems in conflict with	**Residuals** Certification unit	This option allows the contractor to close out portions of a CU prior to completing dredging in the entire area. This benefits both production and resuspension. The controls on the average Tri+ PCB concentration in the portion of the CU to be closed and the individual node restrictions are conceivably more restrictive than averaging 40 values. Portions of the CU on the scale of one acre might be appropriate, but USEPA is willing to consider other proposals from the Contractor.

		the approaches established in other parts of the document. For example, isn't the partial CU analogous to a less-than-5-acre CU? If so, shouldn't the sampling density be greater as per the requirements for the latter? As discussed in Point 6 above, the approach espoused here would indicate that the 80-ft sample spacing is adequate to characterize small, less than 5 acre, areas.		The samples in the closed out portion will be averaged with the remaining samples in the CU. Closing out portions would not alter the evaluation of the CUs for compliance with the Residuals Standard in any way.
NOAA	34	The discussion in Section 3.5.2 is intended to give guidance to determining what locations should be re-dredged, if that is required, to remove more highly contaminated residual sediments. This section would be better if it more specially addressed the three reasonable possibilities: that the high concentration sediments are contiguous; that they are not contiguous but proximate; and that no spatial relationship is apparent. The first situation is the only one that is specifically addressed and the discussion is specific only to a single point. Guidance would be useful regarding when a distribution requires a total re-dredging of the area and how to delineate/map smaller areas that can be removed to achieve compliance.	**Residuals** Redredging	The Residuals Standard facilitates adequate removal of contaminated sediment to meet the ROD objective. The determination of the non-compliant area is based on the nodes only, giving the Construction Manager flexibility in determining how to conduct the remediation, while ensuring that the areas having the highest concentrations are addressed. If the exceedences are not contiguous but proximate, the Construction Manager can decide if the area between should be re-dredged or not. If the areas are scattered, the Construction Manager can decide if the entire area should be re-dredged. In either case, the nodes that showed exceedences will be addressed.