UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
LAND AND EMERGENCY
MANAGEMENT

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MEMORANDUM

SUBJECT: CSTAG Recommendations on Operable Unit 4, the Lower Passaic River Study Area, 17 Mile Remedial Investigation/Feasibility Study, Interim Remedial Action – Draft Feasibility Study and Overall Cleanup Strategy

FROM: Karl Gustavson, Chair, Contaminated Sediments Technical Advisory Group (CSTAG), Office of Superfund Remediation and Technology Innovation (OSRTI)

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BACKGROUND

OSWER Directive 9285.6-08, Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites (February 12, 2002)[1], established the Contaminated Sediments Technical Advisory Group (CSTAG) to "*monitor the progress of and provide advice regarding a small number of large, complex, or controversial contaminated sediment Superfund sites*", which are known as "Tier 2" sites. CSTAG members are site managers, scientists, and engineers from EPA and the U.S. Army Corps of Engineers with expertise in Superfund sediment site characterization, remediation, and decision-making. One purpose of CSTAG is to guide site project managers to appropriately manage their sites throughout the Superfund process in accordance with the 11 risk management principles described in the 2002 OSWER Directive, the 2005 Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (EPA-540-R-05-012)[2], and the 2017 OLEM Directive on Remediating Contaminated Sediments (OLEM Directive 9200.1-130)[3]. The Diamond Alkali Superfund Site in Newark, New Jersey is a Tier 2 CSTAG site, and the contaminated sediment actions are subject to CSTAG review per CSTAG's policies and procedures.

[1] Available at: https://semspub.epa.gov/src/document/HQ/174512
[2] Available at: https://semspub.epa.gov/src/document/HQ/174471
[3] Available at: https://semspub.epa.gov/src/document/11/196834

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BRIEF DESCRIPTION OF THE SITE

The 17.7-mile Lower Passaic River Study Area (LPRSA) is Operable Unit (OU) 4 of the Diamond Alkali Superfund Site in Newark, New Jersey. The Lower Passaic River (LPR) flows through densely populated and industrialized areas and ultimately into Newark Bay. The Dundee Dam is just above the head of tide at River Mile (RM) 17.7 (utilizing the Feasibility Study [FS] river mile numbering system) and constitutes a hydraulic boundary. The three named tributaries to the LPR include the Saddle River, the Second River, and the Third River. Beginning in the early nineteenth century, the LPR watershed was a major center for industrial operations including cotton mills, manufactured gas plants, paper manufacturing and recycling facilities, and chemical manufacturing facilities. These facilities and adjacent municipalities discharged dioxins, petroleum hydrocarbons, polychlorinated biphenyls, pesticides, and metals to the LPR.

EPA's response at the LPRSA began at a former manufacturing facility located at 80-120 Lister Avenue in Newark, New Jersey, at RM 3.4. Manufacturing of DDT and other products began at this facility in the 1940s. In the 1950s and 1960s, the facility was operated by the Diamond Alkali Company (subsequently known as Diamond Shamrock Chemical Company and later purchased by and merged into Occidental Chemical Corporation). Between 1951 and 1969, the Diamond Alkali Company manufactured the chemical 2,4,5-trichlorophenol (2,4,5-TCP) and the herbicides 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), ingredients in the defoliant "Agent Orange." A by-product of the manufacturing was 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), the most toxic form of dioxin. These substances have all been found in LPR sediment and fish/crab tissue.

During the comprehensive investigation of the LPRSA, the sediments of the lower eight miles were found to be a major source of contamination to the approximately 17 miles of the LPR and to Newark Bay. EPA undertook a targeted remedial investigation (RI) and focused feasibility study (FFS) of the lower 8.3 miles. In March 2016, EPA selected a remedy, which includes the construction of an engineered cap over the river bottom of the lower 8.3 miles of the LPRSA, dredging of the river bottom from bank to bank prior to placement of the cap, and implementation of institutional controls designed to protect the engineered cap.

In Summer and Fall 2017, the Cooperating Parties Group (CPG), who are performing the remedial investigation/feasibility study (RI/FS) for the LPRSA, asked EPA to consider an interim remedy (IR) approach focusing on source control in the upper 9 miles of the LPR. In October 2018, EPA Region 2 directed the CPG to prepare and submit a draft FS, evaluating remedial alternatives for the interim remedy approach for source control in the upper 9 miles of the LPR. EPA Region 2 approved the CPG's Baseline Human Health Risk Assessment (BHHRA) and Baseline Ecological Risk Assessment (BERA) for the LPRSA, including a BERA for the discrete upper 9-mile reach, in July 2017 and June 2019, respectively. The final RI Report was submitted by the CPG in July 2019 and has been conditionally approved by EPA pending approval of the bioaccumulation model. The bioaccumulation model is an appendix to the RI that is still under development; the model is expected to be finalized and peer reviewed by approximately Fall 2021.

SITE REVIEW

In early 2018, CSTAG held a site meeting and on April 25, 2018 provided recommendations[4] on the IR proposal for the upper 9 miles of the LPRSA. The FS for the proposed IR is nearing completion. The draft FS materials and the overall cleanup strategy for the area are the subject of this CSTAG Review. CSTAG invited three National Remedy Review Board members to participate in the CSTAG review. In November 2019, the Region 2 LPRSA project team submitted the site information package to CSTAG describing how the eleven principles and sediment guidances are being considered in this phase of decision-making. On November 20-21, 2019, the Region presented those materials to CSTAG during an in-person meeting. The Community Advisory Group (CAG), the State of New Jersey, and the Cooperating Parties Group (CPG) also presented to CSTAG during the in-person meeting and provided written materials.

RECOMMENDATIONS

1. Remedial Action Objective (RAO) and Remedial Goal Development

a. CSTAG's April 2018 review of the draft IR proposal recommended the use of a contaminant exposure reduction goal in the interim action, in the form of a percent reduction in the SWAC (surface-weighted average concentration). The Region developed a RAO containing a SWAC goal of "not more than 85 ppt" 2,3,7,8-TCDD in RM 8.3 to 15. The 85 ppt SWAC is an estimated >90% reduction from current conditions, and the intent of the IR is to rapidly address higher concentration sediments to reduce SWACs, which is expected to immediately reduce risks and prevent source migration. Use of an interim action to reduce site risks quickly is consistent with EPA's 1999 ROD Guidance[5] on interim remedies and the 2017 Directive on Remediating Contaminated Sediments (recommendation 1). CSTAG appreciates that the interim action is substantial and that it focuses on high concentration, upstream areas of the 17-mile site, and that it uses remedial approaches that are reasonably anticipated to be consistent with a future final, protective remedy. The goal is risk-related (the SWAC represents a primary contaminant exposure term) and is measurable, albeit with challenges as described in comments 2 and 3.

b. RAO 1 of the interim action is to control "*sediment sources*" and "*sediment source areas containing elevated concentrations*". Achieving stakeholder consensus on the definition of source sediments, for the purposes of this action, has proven challenging, likely because of the impact on RAL selection. In the site information package (p. 4), the Region refers to source sediments as "*areas with elevated contaminant concentrations that represent significant exposure to the local biota, that contribute contamination to the water column and throughout the LPR through erosion and deposition, and that inhibit recovery of the system.*" In their submittal (p. 4), the CPG refers to source sediments as "*low-recovery potential sediments*" identified as being subject to net erosion or cyclical erosion/deposition and with

[4] CSTAG recommendations and Regional response are available at: https://semspub.epa.gov/src/document/02/534002
[5] OSWER Directive No. 9200.1-23P (July, 1999) A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents; Available at: https://www.epa.gov/sites/production/files/2015-02/documents/rod_guidance.pdf

concentrations higher than those on depositing water column particulates. Both appear to vary from EPA's definitions of sources or source material. For example, in the NCP (40 CFR 300.5), source control actions prevent continued release of hazardous substances, pollutants or contaminants into the environment. In the 2005 Sediment Guidance (p. 2-20), sources are "*the release of contaminants from direct and indirect continuing sources to the water body under investigation*". EPA's 1991 Guide to Principal Threat and Low Level Threat Wastes[6] (p. 1) refers to source material as "*material that includes...contaminants that act as a reservoir for migration of contamination to ground water, to surface water, to air, or acts as a source for direct exposure*." The latter description seems most closely aligned with an interim action intended to reduce SWACs (and therefore exposure and associated risks) as well as contaminant migration. CSTAG questions whether a site- and concentration-specific identification of "source" is necessary or helpful considering that RAO 1 describes material for remediation as those concentrations necessary to achieve the SWAC target. If the Region chooses to define source sediments for the purposes of the action, CSTAG recommends the decision documents explain how the approach to source is consistent with existing definitions and Guidance.

c. RAO 2 of the interim action is to "*Control subsurface sediments (sediments deeper than 6 inches below the sediment bed) from becoming sources of 2,3,7,8-TCDD and total PCBs by remediating sediments between RM 8.3 and RM 15 that have a demonstrated potential for erosion to expose subsurface concentrations above the defined subsurface RALs established for 2,3,7,8-TCDD and total PCBs.*" In the site information package (p. 15), the Region uses "*twice the surface RALs*" to delineate the subsurface materials for remediation. The 2-times RAL was based on a "*probability of continued erosion*". CSTAG recommends that the Regions develop a clearer explanation for how the "*probability of continued erosion*" influences the RAL of sediments with a "*demonstrated potential for erosion*", particularly since those concentrations would be remediated if they were exposed at the surface. The underlying goal of the subsurface RAO is to decrease likely future exposures and expedite natural recovery after the IR. However, the larger remedial footprint associated with applying RAO 2 also increases surety that the surface RAO 1 SWAC goal will be met, which could be considered during the selection of a preferred alternative.

As described, RAO 2 evaluates the RAL exceedances of sediments "*deeper than 6 inches below the sediment bed*" with "*a demonstrated potential for erosion*". The depths of erosion potential are unclear and CSTAG recommends the Region clarify this sampling and RAL evaluation strategy and document its basis.

d. Based on the information provided to CSTAG, the Region's preferred approach involves the use of SWACs, with RALs developed to attain the SWACs. To ensure transparency, provide clarity, and help facilitate meaningful public participation, CSTAG recommends that, consistent with the NCP and existing EPA CERCLA guidance (e.g., EPA's 1999 ROD Guidance and 1988 RI/FS Guidance[7]), the

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[6] OSWER Directive No. 9380.3-06FS (November 1991) A Guide to Principal Threat and Low Level Threat Wastes Available at: https://semspub.epa.gov/work/05/382007.pdf

[7] OSWER Directive No. 9355.3- 01 (October 1988) Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. Available at: https://semspub.epa.gov/work/06/901141.pdf

decision documents clarify how the preferred alternative was identified and how the RALs were evaluated.

2. SWAC Exposure Areas

a. The Region has indicated that the decision unit for this IR is RM 8.3 to 15. This is a large area to apply a SWAC calculation. The Data Quality Objectives Guidance (2006)[8] discusses the importance of appropriately matching the decision unit to the decision to be made or the area of exposure. Both RAOs address source areas of dioxins and PCBs within the river. Based on the maps of depositional and erosional areas, sediment grain size, contaminant concentrations, and proposed remedial footprints, contiguous in-river sediment sources are generally less than a mile in length. The IR is also expected to reduce exposures to the food web. While some receptors may transit throughout the site and beyond, others are likely exposed over smaller sections of river (indeed, the 2019/2020 biota sampling appears to divide the reach into two sampling areas with different target species). If SWACs are applied to areas much larger than discrete source or exposure areas, then the RAL/SWAC analysis may not delineate an IR footprint appropriate for targeting sources or reducing exposure and risk. In 2018, CSTAG advised (recommendation 4b) the Region to consider application of the SWAC across smaller areas of river. CSTAG reiterates this recommendation. Smaller decision units will permit better definition of source areas, exposures, and remedial footprints. These smaller decision units may be based on the size and location of source areas, habitat, salinity gradients, geomorphology, or other characteristics that are relevant to sources or exposures. For those receptors and decisions that are better matched to the entire upper 9 miles, the SWAC and upper confidence limit (UCL) from each smaller decision unit can be used to calculate a SWAC and UCL for the upper 9 miles.

Unlike a final action, an interim action isn't required to achieve final, protective levels for specified exposure pathways and areas. Rather the interim action "should not be inconsistent with, nor preclude implementation of, the expected final remedy" (NCP 40 CFR 300.430(a)(ii)(B). As a result, CSTAG acknowledges that a range of procedures and factors may be appropriate for determining the size and location of decision units and establishing the IR remediation areas. If a single decision unit is used, a stratified sample and analysis plan can still provide the benefits of smaller decision units. For example, if the upper 9 mile decision unit is divided (stratified) based on exposure or source area characteristics, the SWAC and UCL from these strata can be used to calculate the overall SWAC. In addition, identifying the number and location of strata that achieve or exceed SWAC goals may facilitate the alternatives analysis by differentiating alternative RALs or be useful in adaptive management by identifying areas for further evaluation.

b. In the site information package (p. 15), the Region explains "*The IR focuses on the stretch of the LPR from RM 8.3 to RM 15 because existing sediment data suggest the source areas to be targeted by the IR are located in this stretch... However, the [pre-design investigation] PDI will generate sediment data throughout the upper 9-mile reach, and if the sediment data collected during the PDI identify sediment source areas between RM 15 and Dundee Dam, these sediment source areas would also be addressed in the IR as necessary to achieve the RAOs.*" CSTAG supports applying the selected RALs to the stretch between RM 15 and the Dundee Dam, but recommends the approach should be restated. The clause "*as*

[8] EPA/240/B-06/001 (February 2006) Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4. Available at: https://www.epa.gov/sites/production/files/2015-06/documents/g4-final.pdf

necessary to achieve the RAOs" negates the need to remediate upstream of RM 15 because the RAOs are specific to achieving SWACs in RMs 8.3 to 15, not upstream to Dundee Dam.

3. IR Completion Strategy

a. The Region presented an evaluation framework for demonstrating completion of the IR based on several lines of evidence. Since RAO 1 is to achieve a post-IR SWAC, CSTAG recommends that the measured SWAC be used to evaluate RAO 1 achievement.

b. CSTAG recognizes that IR RAO achievement may be distinct from a determination of remedy completion, which could be evaluated using multiple lines of evidence if SWAC-based remedial goals are not met. The proposed weight of evidence (WOE) analysis of these additional lines of evidence (*e.g.*, bathymetry, high spatial density sediment sampling, geostatistical analysis of sediment data) could be useful for understanding the cause of non-attainment and evaluating whether construction is complete or whether additional monitoring or further remedial action is warranted. However, it was unclear to CSTAG how the Region would weigh the lines of evidence and apply this analysis. CSTAG recommends that, if a WOE framework is used, the performance metrics, endpoints, standards, and weighting be developed and agreed upon by stakeholders prior to post-IR confirmation sampling.

c. The Region presented a well-conceived plan for an empirical evaluation of the attainment of SWAC-based remedial goals using an unbiased sampling design with sample size estimates derived from considerations of SWAC certainty and the potential for false positives/negatives. Post-remediation sample data will be compared to the SWAC goal using a reverse null hypothesis test of equivalency. This statistical testing approach incentivizes robust sampling while recognizing and accommodating the uncertainties in SWAC estimates. The reverse null hypothesis tests the absence of a greater than allowable difference (the "Y-factor") from, in this case, a SWAC-based remedial goal. As presented to CSTAG, the Y-factor would generally be expected to range from 1.2 – 2, but the final value will be selected based on an analysis of the variance in the PDI data set. CSTAG recommends that the selected Y-factor should reflect the Region's tolerance of uncertainty in determining remedial success. In the decision documents, the Region should clearly describe the Y-factor, its statistical function, and their rationale for selecting a Y-factor value so that the definition of remedial success will be transparent to the public and other stakeholders.

d. As presented to CSTAG, post-remedy sampling to determine compliance with RAOs 1 and 2 will occur up to 2 years after the completion of IR construction. If these data indicate sediment concentrations remain above the RAL or discrete areas drive SWAC goal exceedances, the Region will not be in a position to remediate those areas without remobilizing equipment or initiating a new response action. CSTAG encourages the Region to conduct sampling before IR construction is completed. This process would inform remedial operations, support operational decisions on whether additional remediation would maximize the potential to reach the SWAC goals, and permit an earlier determination of remedy completion.

4. Alternative Development

The IR presents alternatives with one technological approach applied to different size areas of the upper 9 miles of the LPRSA. In the site information package (p. 12), the Region explains: "*The presumption of a dredging and capping approach for the IR originated during early consideration of the IR for the upper*

9-mile reach and the meetings between EPA Region 2, the NJDEP, and the CPG to discuss the IR and the IR FS. This approach is consistent with the RM 10.9 TCRA [time critical removal action] and OU2 remedy (i.e., capping with pre-dredging to prevent exacerbating flooding issues)."

a. CSTAG recommends the Region not describe technology selection as a "*presumption*". Rather, alternative development should be described in a manner consistent with EPA's 1988 FS Guidance on the development and screening of alternatives. The Region should also describe how remedial technologies are appropriate for the applied environment and the site's current and future uses (consistent with the 2005 Sediment Guidance and the 2017 Directive on Remediating Contaminated Sediments, recommendation 2) and are not inconsistent with nor preclude implementation of the expected final remedy (40 CFR 300.430(a)(ii)(B)).

b. The application of the dredge/cap approach is premised on its consistency with the river mile 10.9 TCRA and presumably the success and effectiveness of that action. As noted by CSTAG in its 2018 recommendations, an objective of the TCRA was to evaluate the effectiveness of sediment capping methods. Because performance monitoring data were not available (or described), CSTAG recommended that the performance monitoring data be compiled and analyzed to develop lessons learned so that an appropriate suite of alternatives could be developed and evaluated in the IR. In the 2019 site information package (p. 4), the Region again states that "*Dredging and capping at RM 10.9 were completed in 2014 and cap performance monitoring is ongoing*", but the outcome of these efforts and the potential effectiveness of the technology has yet to be documented (or presented). As such, CSTAG re-iterates its 2018 recommendation 5 to compile (or collect) remedy performance data on the RM 10.9 removal action to assess remedy performance and support the interim and final remedy evaluations.

c. In 2018, CSTAG recommended "*A broader range of alternatives should be considered in the FS, ...including an alternative that features dredging to clean sediments where feasible (e.g., areas with relatively shallow depths of contamination).*" CSTAG appreciates that the Region included this suggestion in their description of alternatives ("*[sediment removal] could incorporate dredging to a clean depth in areas where this may be practical; this will be considered in the IR design once the PDI data are available.*" [p. 15, site information package]), but it was unclear under what conditions "dredge to clean" would be implemented based on the sampling program and results. CSTAG recommends that the decision documents include a decision tree that articulates criteria for dredging to clean vs. dredging followed by capping, or at least document the principles for making those determinations based on collected data, including what constitutes "clean" in this context.

5. Adaptive Management

An adaptive management plan was provided to CSTAG for review. CSTAG recognizes the plan is "Draft" and appreciates the opportunity to provide input at an early stage. Adaptive management is used in decision making when the outcomes of potential management actions are highly uncertain. The fundamental uncertainty in the upper 9 miles of the LPRSA (and many large, complex contaminated sediment sites) relates to the degree of remediation necessary to achieve contaminant exposure levels protective of human health and the environment. In the upper 9 miles of the LPRSA, the IR is proposed to significantly reduce SWACs, with anticipated associated reductions in exposure and risk. An adaptive management process accompanies and follows the IR to monitor the progress toward and attainment of final RAOs (the subject of a future final ROD) and evaluate whether additional remedial action is needed to achieve the final RAOs.

a. In EPA's 2017 Directive on Remediating Contaminated Sediment Guidance (recommendation 8) and other references on using adaptive management in remediation (e.g., NRC 2003[9]), the first step in developing an adaptive management plan is to establish a measurable objective of the management action. The current LPRSA adaptive management plan does not establish this type of objective. While CSTAG is concerned that a final remedial goal isn't included with the approach, it is recognized that the site's timing doesn't currently support remedial goal development, nor is the IR design contingent on the final remedial goal. According to the Region, "*risk-based sediment PRGs for the Upper 9 miles of the LPR will be derived in conjunction with the IR design*". As such, the remedial goal should be available prior to needing it in the post-IR phase when data from the monitoring program will be used to assess progress towards and attainment of the final remedy RAOs and associated remedial goals. CSTAG recommends the Region prioritize the development and communication of the media and associated contaminant levels used to signify attainment of final remedy RAOs so that the long-term objective is understood, and the IR's risk reduction can be placed in the context of a final remedial goal. Because remediation and assessment are planned to occur over decades, CSTAG also recommends that interim goals for fish tissue or fish meals be developed to communicate risk reduction expectations and progress.

b. The foundation of an adaptive management plan is a monitoring program that is sufficient to identify the response and trends in parameters associated with progress toward and attainment of RAOs while providing a better understanding of the drivers of or impediments to attaining the objectives. The materials presented envision physical, chemical, and biological attributes in multiple sampling media, including sediment, biota, and water, and bathymetry measurements, with some parameters (water and biota) collected annually and others (sediment and bathymetry) periodically to support long-term monitoring and to diagnose why certain outcomes have or have not been achieved. CSTAG commends the robust and comprehensive monitoring plan developed to date and support the plan's objectives to evaluate contaminant exposure and risk to receptors over time and indicate drivers of the results. The evaluations will be supported by the 2019/2020 current (pre-remedy, baseline) conditions monitoring of sediment, biota, water column, and bathymetry and the post-remedy SWAC verification sampling. CSTAG recognizes the value of the baseline and SWAC verification program for improving the conceptual site model, deriving remedial goals, supporting remedial design, and providing a baseline for the long-term monitoring and adaptive management program.

c. The long-term monitoring will likely include annual monitoring of contaminants in fish/crab tissue and surface water, and periodic monitoring of sediment contaminant concentrations. CSTAG recommends that the Region consider the use of passive sampling in the water column as part of their long-term monitoring. Passive sampling measures the freely dissolved concentrations of COCs in the surface water, which for certain chemicals may be strongly correlated to tissue concentrations in benthic and pelagic organisms at multiple trophic levels. It also provides a time-weighted sample with lower detection limits

[9] NRC (National Research Council). 2003. Environmental Cleanup at Navy Facilities. Adaptive Site Management. The National Academies Press. Washington DC. Available at: https://www.nap.edu/catalog/10599/environmental-cleanup-at-navy-facilities-adaptive-site-management.

than the proposed water sampling methods that could prove valuable in the long-term assessment of trends and in evaluating the feasibility of attaining the water quality ARAR.

d. The LPRSA is one of the first large, contaminated sediment sites to develop a more formalized adaptive management approach. The draft adaptive management plan reviewed by CSTAG established three "adaptive elements" related to developing remedial goals, evaluating the performance of numerical models, and evaluating attainment of remedial goals. This represents a much broader view of adaptive management than is embodied in the 2017 Directive on Remediating Contaminated Sediments (recommendation 8) that focuses on setting objectives, implementing actions, monitoring, and using the information to determine what actions are necessary, if any, to achieve the objectives. The "adaptive element" of developing PRGs in the RI/FS into remedial goals in the ROD is already a Superfund remedial process and, post-ROD, the five-year reviews routinely re-evaluate whether cleanup levels (and RAOs) remain valid. These procedures do not require adaptive management. However, data collected during the adaptive management program will likely support the five-year review determinations. Similarly, if the Region continues to rely on complex, linked numerical models at the site, their ongoing calibration and verification would be an expectation, not a process requiring adaptive management. These two "adaptive elements" add additional, unnecessary complexity and layers of process that obscure the primary intent of adaptive management in sediment remediation (assessing progress toward remedial goals and, identifying whether additional remedial actions are needed to achieve those goals). CSTAG re-iterates recommendations from the 2018 review, specifically that adaptive management should focus on comparing empirical, site-specific data to criteria related to the goal of protection of human health and the environment to determine the need for additional remedial actions. This recommendation does not negate the need for periodic evaluation of the validity of cleanup levels based on site-specific analyses or other factors. CSTAG emphasizes the importance of the five-year review for making those determinations. CSTAG recommends the Region enhance the rigor of those reviews by being clear about the inputs, evaluations, and criteria that would support the ongoing re-evaluations of the validity of the remedial goals.

e. The most important decision point in the adaptive management process will be determining if additional remediation is warranted after the IR and period of assessment to achieve RAOs and remedial goals. The decision tree on the attainment of remedial goals (fig 5-2) asks "*is recovery progressing toward protective levels in a reasonable timeframe*." The Region states that after a "post-IR monitoring period on the order of 10 years" they "*will evaluate whether recovery trends support attainment of risk-based goals in a reasonable timeframe*". This language is ambiguous in meaning and timing. For example, the phrase "*is recovery progressing... in a reasonable timeframe*" suggests that recovery rates, not risk-based goals are the metric. It's also unclear whether 10 years is the reasonable timeframe for attainment of risk-based goals, or 10 years is just when an assessment of an unstated, future reasonable timeframe for goal attainment will occur. CSTAG recommends that the Region's adaptive management plan unambiguously state when decisions will be made and on what basis. EPA's 2005 Sediment Guidance (p. 4-12) emphasizes that managers consider the "*extent and likelihood of human exposure to contaminants during the recovery period*", among other factors, in their determination of "reasonable". While the timeframe will be informed by long-term monitoring data and trends, stakeholder (including community) input and communication will be critical for this determination.