Sediment Site Recontamination: Leveraging National Policies and Cross-Program Coordination Strategies

ASTSWMO Sediments Focus Group

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Introduction

This paper expands upon two previous works of the ASTSWMO Sediments Focus Group addressing the issue of sediment cleanups and recontamination of bedded sediments from on-going or new sources. In *Sediment Remedy Effectiveness and Recontamination: Selected Case Studies,* the Sediments Focus Group introduced the issue of sediment recontamination and presented case studies where remediated sediment was recontaminated after remedy efforts commenced or were completed (ASTSWMO 2013). In those case studies, most recontamination was found to be caused by uninvestigated pathways, inadequate source control or some combination of these issues. Examples include: incomplete contaminant removal or discovery of unknown upstream sediment contamination, which became redistributed over remediated areas; undiscovered adjacent bank contamination, which eroded onto remediated in-stream sediment; uninvestigated groundwater sources promoting advection to clean surfaces from deeper residual contamination; and uncontrolled combined sewer overflows or unaddressed legacy sediment laden stormwater pipe discharges led to sediment recontamination. The Focus Group's follow-up paper, "*The Clean Water Act and Sediment Remediation, Using the Data Quality Objective Process to Help Assure that Remediated Sediment Sites are not Recontaminated*," focused on coordination between on-going discharges and water pollution reduction programs of the Clean Water Act (CWA) and sediment remediation under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). A familiar remediation process tool, Data Quality Objectives (DQOs), is suggested as a unifying planning method to help identify possible sources of pollutants that could prevent a site from reaching remedial cleanup levels and objectives and/or from being recontaminated following cleanup (ASTSWMO 2016).

Objective

The purpose of this document is to evaluate efforts coordinated across CERCLA and CWA authorities that were, or could have been better, aimed at preventing sediment recontamination. We approach this by presenting several case studies of CERCLA sites that involve a component of sediment remediation through which to explore application of collaborative recommendations jointly developed by several EPA offices.

Background

ASTSWMO is an organization that supports State and Territorial (States) environmental agencies' programs in hazardous, municipal and industrial waste, recycling, remediation at both State and federal facilities and underground storage tanks. The association's mission is "to enhance and promote effective State programs and to affect relevant national policies for waste and materials management, environmentally sustainable practices, and environmental restoration" (ASTSWMO 2017).

The Sediments Focus Group is part of ASTSWMO's CERCLA and Brownfields Research Center Subcommittee. The Focus Group's mission is to promote opportunities for State-to-State information exchange and the development of new sediment remediation approaches as well as to influence national sediment cleanup guidance and policy.

The CERCLA program, also known as Superfund, provides a framework whereby EPA and its partner States can identify and assess sites where the soil, groundwater, surface water, sediments, or air has been contaminated with hazardous substances derived from historical or ongoing sources. Where such contamination is determined to pose unacceptable risk to human and ecological health, CERCLA further provides authorities and, when there are no viable responsible parties, federal funds for the cleanup of such sites. To compel responsible parties to conduct and pay for cleanup, CERCLA includes an enforcement program.

The CWA provides the structure under which the chemical, physical and biological integrity of the nation's waters are restored and maintained. The foundation of this structure is the identification and classification of each State's waters according to their primary uses. The CWA requires States to establish water quality criteria to preserve each water's use classification, to maintain a list of waters not meeting these criteria, and to develop strategies for improving water quality to restore uses. Each State maintains a CWA Section 303(d) list of impaired waters. Impairment occurs when the water does not meet its water quality criteria and thus, its use classification. For most impairments, States are required to develop a Total Maximum Daily Load (TMDL), a calculation of the maximum contaminant loading a waterbody can assimilate and still meet its water quality criteria. This water column loading is allocated along the waterbody across the existing permitted point source discharges, with reserve capacity for future permitted and nonpoint source discharges. Section 402 of the CWA, also known as the National Pollutant Discharge Elimination System (NPDES), prohibits the discharge of pollutants to waters of the U.S. except by permits with effluent limits and other requirements designed to implement each State's water quality criteria.

As the Sediments Focus Group's previous papers identified, disconnects can occur between the objectives of the CERCLA and CWA programs that can adversely impact the success of sediment cleanup projects. State water quality criteria focus on current water column chemistry related to ecological and human exposure, direct consumption or organism consumption. In contrast, CERCLA's focus at contaminated sediment sites is primarily on past contaminant releases that impact sediment and remediating them to human and ecological risk-based concentrations, with secondary consideration for other media, like surface water or air. Only one State, Washington, has promulgated State water quality standards that address sediment. An important gap between these foci is the absence of standardized and accepted methods for accurately estimating contaminant loads to and from bedded sediment. Contaminants in on-going discharges to the water column can settle onto sediment and contaminants in sediment can partition into the water column. Effective methods for evaluating both these load potentials are needed to better understand whether one or both must be addressed to protect a sediment remedy from recontamination and how the remedy can assist in attainment of water column toxics goals.

Other obstacles to converging CERCLA and CWA include barriers to communication between the programs, implementation schedule disparities, lack of clarity on overlapping language and application of common regulatory tools, as well as fundamentally different authority structures. The CWA delegates to States the obligation for developing water quality criteria and

implementing programs to reach compliance, as summarized above. In contrast, CERCLA is strictly a federal program implemented by EPA where States are involved only in a support capacity.

Recognizing the existence of obstacles, EPA developed guidance entitled *Integrating Water and Waste Programs to Restore Watersheds: A Guide for Federal and State Project Managers*, published in 2007. Developed jointly by EPA Office of Water (OW) and Office of Solid Waste and Emergency Response (OSWER)[1], the manual was intended to enhance coordination across federal, State and local water and waste programs for more efficient implementation of watershed cleanup projects with streamlined requirements that satisfy multiple objectives, tap a variety of funding sources, and show measurable results (EPA 2007). The guide approaches coordination from the broad watershed scale, primarily around inventorying, prioritizing and funding cleanup and restoration projects toward efficient watershed scale improvements. The guide does not offer project scale collaborative recommendations and does not address the chief barriers to collaboration, which include differing authorities between federal and State programs, data collection disparities and widely varying implementation schedules. The guide includes a valuable flow chart (as Figure 2-1) that presents the potential crossover opportunities between the process chains of a number of waste and water programs.

More recently, EPA issued a directive to remedial project managers in December 2013 entitled *Sediment Assessment and Monitoring Sheet (SAMS) #4: A Primer for Remedial Project Managers on Water Quality Standards and the Regulation of Combined Sewage Overflows under the Clean Water Act*, and a memorandum to Regional Administrators dated February 12, 2015 entitled *Promoting Water, Superfund and Enforcement Collaboration on Contaminated Sediments*. The 2013 directive was issued by EPA OSWER to provide cross-program information on aspects of the CWA that have the potential to overlap with CERCLA, particularly in regard to recontamination of sediment sites, and concluded with recommendations for coordination improvement involving inclusion of Superfund contaminants into NPDES permit monitoring and prioritizing TMDLs in waters with sediment Superfund sites. The 2015 memo was issued collaboratively by the Assistant Administrators of EPA's Office of Enforcement and Compliance Assurance (OECA), EPA OLEM and the Deputy Assistant Administrator of OW and outlines three coordination activities that should be done as a matter of course and six more activities at the program or site level intended to promote effective and lasting cleanups of federal contaminated sediment sites. The nine recommendations from the 2015 memo include:

1. Sharing monitoring data as well as electronic data management and mapping capabilities among EPA programs, States, tribes and localities;
2. Coordinating actions and schedules under different legal authorities to address sources of contaminants within a watershed;
3. Engaging the EPA, State, tribal and local entities early in the process, and over the long-term, to help facilitate collaborative solutions;

[1] Since 2015, OSWER is referred to as Office of Land and Emergency Management or OLEM.

4. Aligning Superfund cleanups, local and State decision-making on water infrastructure improvements, State or federal TMDL development and implementation, and NPDES permit actions, when feasible, to facilitate more coordinated progress that leads to reduced recontamination potential and improved watershed restoration;
5. Sharing knowledge of upland or upstream sources and/or background contamination;
6. Developing appropriate site remediation plans in accordance with CERCLA and the National Contingency Plan (NCP) that may also serve to reduce the site load to impaired waters to facilitate attainment of water quality standards;
7. Identifying appropriate terms and conditions in NPDES permits that address contaminants of concern at Superfund sites with or adjacent to the water body;
8. Developing TMDLs that reflect cleanup reductions from remediation of contaminated sediments and any ongoing sources that would recontaminate remediated sediments; and
9. Developing settlements or enforcement orders that address multi-program issues.

(EPA, 2015)

As with EPA's 2007 Guide for Integrating Water and Waste Programs, all of these recommendations are most effective at a regional, watershed or programmatic scale. Of course successful integration of broad scale, multi-program recommendations requires long-term planning and visioning by State and federal staff, with focused communication and continuing support and guidance by State and federal management. In addition to broad scale recommendations, a few of the 2013 and 2015 recommendations can be applied at the project scale, which may be more readily implementable as they require less cross-programmatic visioning effort.

In this paper, the Focus Group identified sediment sites across all regions of the U.S. where any of the 2015 memo recommended activities were or could be applied. The goal was to evaluate the methods and results of these coordination efforts across CWA and CERCLA for potential application by EPA and the States at on-going sites. A secondary goal was highlighting recommendations that need additional clarification, including guidance development, in order to be effectively applied.

To simplify the analysis, recommendations that had similarity or overlap were combined. Specifically, recommendations 1 and 5 were combined, as were recommendations 2 and 4, resulting in seven total recommendations. Each of the seven recommendations is discussed in its own section, along with sediment sites identified by evaluators where the recommendation was exemplified.

Compilation of sediment site case studies began with the list of case studies the ASTSWMO Sediment Focus Group identified as having been recontaminated in the 2013 paper entitled *Sediment Remedy Effectiveness and Recontamination: Selected Case Studies.* Focus Group members then looked for additional sites within the Regions they represented to ensure national, though not comprehensive, coverage. Varying levels of information were available on the process at these sites, which are at varying levels of completion. In all, 18 potential case studies that

included sediment remediation under CERCLA were evaluated, as summarized in Table 1. Nine sites were selected for more in depth discussion as to application of one or more of the recommendations.

Information is highlighted in blue at seven sites used as examples of relatively positive application of one or more of the recommendations. The three sites with orange highlight represent examples where application of one or more recommendations could be improved.

CERCLA and CWA Recommendations and Evaluation of Their Application

Recommendation 1/5 – Sharing Data and Knowledge: 1) Sharing monitoring data as well as electronic data management and mapping capabilities among EPA programs, States, tribes and localities; and 5) Sharing knowledge of upland or upstream sources and/or background contamination.

Interpretation of Recommendation – With the awareness that various entities maintain differing perspectives and information chains regarding the same location, this recommendation encourages sharing of all manner of data, information and knowledge of a particular location in order to develop the broadest possible understanding of the locality within the watershed and to leverage capabilities across all stakeholders. Somewhat inherent in this recommendation is application on a regional or watershed scale, but it is also applicable on a more site-specific scale that includes upstream areas that likely lie outside of the study area boundaries.

EPA's 2007 Guide for Integrating Water and Waste Programs and ASTSWMO's 2016 Data Quality Objectives paper advocate information sharing between sediment cleanup proponents and water quality TMDL developers. These approaches acknowledge the potential for contaminants to partition between sediment and water and the reality that watershed-wide inputs have the potential to continue impacting sediment sites after remediation. Sharing information on contaminant loading in sediment and waterway maximizes understanding of the whole system, so the most efficient cleanup targets and methods can be selected to improve sediment remedy success and sustainability. This begins with comprehensive identification of all the potential entities with information to contribute and developing a process for coordinated information sharing. Development of a comprehensive data repository commensurate with the scope of the project or watershed is a critical piece of the information sharing process. Mapping capabilities that make use of the compiled data can be greatly beneficial, particularly for immediate visualization to identify action areas related to the various media under investigation, understand potential crossover opportunities and provide early focus on recontamination prevention.

Case Studies

Rose Hill Landfill - South Kingstown, RI (Region 1) – First added to the National Priorities List (NPL) in 1989, this former municipal landfill presented unacceptable risk from multiple contaminants in groundwater, stormwater, air, leachate, soil, and visual impact to an unnamed tributary, Mitchell Brook and Saugatucket River. Surface water detections of aluminum, copper, iron, lead and manganese above relevant water quality levels and visual confirmation of heavy iron fouling

led to coordination with State water quality programs. Discussions between CERCLA and water program staff began early in the process with the aim of collaborating on monitoring and information sharing to meet goals across the various cleanup and water programs. Cross-program collaboration continued throughout the process and a Record of Decision (ROD) was issued in 1999 that addressed the overlapping issues of minimizing releases, collecting data to assess source control remedies, and assisting the State with TMDL predictions. In 2003, the EPA and Rhode Island (water and CERCLA/waste sections) worked together to develop Project Action Limits (PALs) for TMDL purposes. Remedy construction in 2005 to 2007 entailed excavation of 160,000 tons from a bulky waste storage area, which was interred under the main landfill area and capped. Following post-remedy monitoring, the PALs were lowered for most contaminants, in alignment with the State water quality criteria, to address State concerns regarding protectiveness. Unfortunately, the bulky waste storage area appears not to be the source of metals to the streams because two five-year reviews so far do not show improvement for stream water quality in response to the remedy. While there was continued coordination between water and cleanup programs, a lack of adequate investigation in both programs led to invalidated assumptions and as yet unmet TMDL goals. The effect of this disconnect on recontamination potential is not yet understood.

Vertac Site – Jacksonville, AR (Region 6) – Added to the NPL in 1983, this site presented unacceptable risk in groundwater and Rocky Branch Creek streambanks due to elevated concentrations of dioxin, silver, 2-4 D and other contaminants. A ROD for Operable Unit (OU) 3 was issued in 1996 which required that treated groundwater meet TMDL requirements for dioxin, silver and 2-4 D prior to discharge. Removal of contaminated streambank soil was completed in 1997, leaving concentrations of dioxin up to 1 mg/kg. Construction of a French drain to recover groundwater for treatment prior to discharge to Rocky Branch Creek was completed in 1998. The fourth 5-year review was signed in 2014 and shows water quality and ecological goals are being met through treatment of collected groundwater, but reassessment of dioxin was required due to changing human health remedial levels. While some coordination on TMDLs occurred during the remediation process, it is not clear that program overlaps with regard to recontamination assessment and prevention were identified or leveraged. Vertac is an example of a site, among many, that could have benefited from a shared electronic data repository, to better coordinate overlapping interests between CERCLA and CWA. EPA and Arkansas Departments of Health and Environmental Quality all received hard copies of data from the other entities, which was used to establish background concentrations of chlorides and total dissolved solids. However, an electronic repository of the data was not established, which may have allowed for evaluation and mapping of additional data sets across the various impacted media and perhaps allowed for recontamination potential evaluation.

<u>Conclusions on Recommendation 1/5</u>

The very process of information sharing requires improved attention to communication across programs, within EPA and State program silos, between EPA and States and among tribal groups and other local, State and federal agencies that bring information to bear on sites and watersheds.

Identifying, integrating and improving these lines of communication will improve the implementation potential of this information sharing recommendation on both the regional/watershed and more site-specific scales. Specifically, EPA and States must bridge the silos of their various cleanup (CERCLA/RCRA/TSCA) and water programs (not only TMDL, but also Standards, Assessment, NPDES and Nonpoint Source), in an effort to identify barriers and find workable solutions for effective data and information sharing across cleanup and water programs. In addition to this internal coordination, it should be noted that EPA coordination with the States, across both cleanup and water programs, is an essential element in more effectively achieving environmental goals, which is the ultimate objective of the EPA memo. This federal-State coordination is critical for finding alignments between the differing authority structures (recall that States are delegated authority to implement the CWA programs, whereas EPA implements CERCLA). Also importantly, State coordination as to Applicable or Relevant and Appropriate Requirements (ARAR), State-led source control and eventually State concurrence with the remedy are critical components of the CERCLA process. Finally, effective sharing of data and information across EPA CERCLA and EPA and State water programs can aid in development of site-specific recontamination assessment and prevention strategies. Neither of the case studies we looked at focused on recontamination potential.

As the Rose Hill example illustrates, caution should be applied in coordinating across programs, to avoid making simplified assumptions without adequate investigation. While coordination between the cleanup and TMDL program was collaborative, assumptions were made regarding the source of metals contamination to the surface waters. Had the collected data been available electronically, remediation and water programs could have evaluated and mapped it to suit their individual program needs and more effectively discussed the environmental indications and gaps. These discussions may have allowed a mutual understanding of the evaluative process for TMDL load allocation, aiding the CERCLA investigation and monitoring for effectiveness of contaminant load reduction, meeting the objectives of both programs.

A key challenge to implementing this data and information sharing recommendation is that data collection and evaluation methods are different for different purposes and this makes for data compatibility issues. This challenge applies to application of this recommendation on both the regional/watershed and more site-specific scales. An initial CERCLA data gathering effort is aimed at understanding the extent and magnitude of risk due to a sediment contamination problem and additional CERCLA data collection evaluates effectiveness of an implemented remedy. CERCLA sediment site work is focused on sediment data for targeted contaminants in a discrete area within a waterbody, supplemented by data on pore water, surface water, groundwater and possibly discrete discharges, all with varying aims and weight within the evaluation. In contrast, surface water quality assessments are undertaken on a broad waterbody-wide scale and rarely include sediment data. Instead the focus is on a suite of conventional water column pollutants (e.g., pH, dissolved oxygen, temperature, bacteria) along with some toxic contaminants that may or may not intersect with the CERCLA-focus contaminants. Further, when the TMDL process determines water column assimilative capacity of pollutants to establish allocations of loads for conventional and toxic water column pollutants, the important context of partitioning to and from contaminated sediment is not typically evaluated. This is a missing link between sediment

contamination and water column pollution, without which assumptions about permitted discharges recontaminating sediment or contaminated sediment impairing water columns cannot be validated.

While the data-sharing recommendation makes sense, known barriers such as data incompatibility, added costs and unfunded capacity considerations, must be acknowledged and addressed in order to effectively implement this recommendation.

Recommendation 2/4 – Cross-Program Watershed Coordination: 2) Coordinating actions and schedules under different legal authorities to address sources of contaminants within a watershed; and 4) Aligning Superfund cleanups, local and State decision-making on water infrastructure improvements, State or federal TMDL development and implementation, and NPDES permit actions, when feasible, to facilitate more coordinated progress that leads to reduced recontamination potential and improved watershed restoration.

Interpretation of Recommendation – The driving purpose of this recommendation is to broaden the CERCLA sediment remediation project understanding to acknowledge other actions within the watershed that are likely to impact sediment remediation, either positively or negatively. This recommendation acknowledges that efforts outside of the CERCLA process are underway and that understanding how and when these efforts can impact a sediment cleanup is critical to the success and sustainability of the remedy. These efforts are undertaken through the State-led CWA programs like NPDES permitting, TMDL development and implementation and combined sewer overflow amelioration supported by Statewide Revolving Loans. These State-led efforts also include restoration projects, both within and outside CWA programs, like 319 grants. These efforts are driven by program-specific timelines, funding mechanisms and regulations, all of which can be opportunities or constraints in regard to coordination with CERCLA processes. This recommendation goes hand-in-hand with Recommendation 1/5 on sharing data and information.

Case Study

Montrose & Del Amo - Los Angeles, CA (Region 9) – Added to the NPL in 1989, Montrose & Del Amo posed unacceptable risk in soil, groundwater, air, surface water and sediment due to elevated concentrations of dichlorodiphenyltrichloroethane (DDT), chlorobenzene and benzene hexachloride. Although the site is located approximately seven miles from the Los Angeles Harbor, contaminated surface water flowed off the property along the Kenwood stormwater drainage and sanitary sewer system into the Dominguez Channel and Los Angeles Harbor, which are impaired waterways. The DDT manufacturing and distribution plant was disassembled in 1982 and the property was paved to prevent dispersion of DDT in soils via wind and stormwater. A ROD was issued in 1999 and groundwater remedial design was completed in 2012. Data sharing was notable during the process for this site, in that CERCLA-derived water and fish tissue data were considered in 303(d) listing evaluations and in development of TMDLs for a number of pollutants, including DDT. EPA CERCLA review of the draft TMDLs helped both the Water and Superfund programs understand the concerns of the other and addressed errors and inaccuracies within the TMDLs, which helped avoid future disputes between EPA, the State and public. Following up on future 5-year reviews and TMDL attainment measures is needed to understand

if these coordination efforts have resulted in reduced recontamination potential and improved watershed restoration.

Conclusions on Recommendation 2/4 – An initial observation on this recommendation is that it seems to be limited to CERCLA sediment cleanup as the driver, to find alignment of authorities and implementation in collaboration with State and local water programs. This is understandable, given the specific offices authoring the memo and SAMS paper. However, as highlighted in the 2007 Guide for Integrating Waste and Water Programs, consideration of RCRA coordination may also be appropriate. In addition, development of model coordination strategies between CERCLA cleanups and water programs would benefit both CERCLA and State-led sediment cleanups. Indeed, States may already be leading the way on watershed-wide coordination, as exemplified by the examples provided below.

As advocated in both the EPA guide for integrating waste and water programs (EPA 2007) and the ASTSWMO DQO paper (ASTSWMO 2016), early coordination on the broader watershed goals, including data, information and map sharing advocated in Recommendation 1/5 above, is recommended for leveraging improved outcomes for sediment remediation and recontamination prevention. Benefits to water programs can also be realized through these coordination efforts. The Montrose & Del Amo example demonstrates how benefits to both programs can be realized when timing of TMDL development aligns with CERCLA efforts and opportunities for inter-program reviews and integration of feedback are meaningfully actualized. Agencies must identify and institutionalize routine, deliberate and systematic collaboration practices and strategies for CERCLA/Cleanup and CWA staff at sediment remediation sites and on a watershed level. This includes incorporating metrics for these collaboration efforts within a defined process and sensitivity to the resource constraints each program feels in accomplishing their own tasks and goals.

Recommendation 3 – Stakeholder Engagement: Engaging the EPA, State, tribal and local entities early in the process, and over the long-term, to help facilitate collaborative solutions.

Interpretation of Recommendation – Collaborative engagement with all potential stakeholders allows for group understanding of sometimes disparate interests, such that a collaborative solution can be crafted that satisfactorily addresses those interests. Unfortunately, even the best intended engagement often fails to include some critical stakeholders or occurs too late in the process to allow all the perspectives to feel their interests have been considered. This recommendation can be applied broadly on the regional/watershed scale, but also very effectively on the project or issue-specific scale. The intention of broad engagement is to identify and utilize information that might not otherwise be available or recognized within the silo of CERCLA, so that all tools for recontamination prevention and improved environmental outcomes are efficiently brought to bear and broad buy-in is attained.

Case Studies

Portland Harbor - Portland, OR (Region 10) – Listed on the NPL in 2000, this mega-site includes approximately 10 urban river miles of sediment contaminated by historical dumping of PCBs,

DDT, metals, PAHs and dioxins/furans, among others, which impacts wildlife and restricts consumption of resident fish. A Memorandum of Understanding (MOU) was signed in 2001 between EPA, the State of Oregon, six tribes and State and federal natural resource agencies, which codifies the early and on-going engagement opportunities between these signatories. The MOU assigns EPA to lead in-river sediment cleanup, with input from Oregon Department of Environmental Quality (ODEQ) and the other partners, and puts ODEQ in the lead for upland source control, with input from EPA and partners. EPA and ODEQ collaborated on the 2005 Portland Harbor Joint Source Control Strategy. This strategy includes collaborative opportunity on remediation of riverbank areas where responsibilities overlap and offers a framework for future collaboration on recontamination prevention. While the MOU and JSCS have allowed ample coordination opportunities on investigations over the 16 years since the site was listed, the most frequent participants are EPA and ODEQ. Some of the tribes participate on a less frequent basis, but note that lack of funding keeps them from participating as fully and consistently as they would prefer. In addition, the Portland Harbor Community Advisory Group formed soon after the listing of the site, meeting monthly over the past 15 years, serving as an engaging force between the community and the agencies and taking advantage of EPA technical assistance grants to facilitate expert assistance in interpreting and commenting on technical information about the site. Effectiveness of the sediment remedy and prevention of recontamination are chief concerns of the CAG, the tribes and the public. EPA released their Proposed Plan in June 2016. After receiving over 5,300 comments, EPA released the ROD in January 2017, with a more aggressive remedy in response to comments.

Tri-State Mining District - KS, MO, OK (Regions 6 & 7) – This large district spanning parts of three States includes four sites that were added to the NPL beginning in 1983, in recognition that historical mining activities contaminated surface water, groundwater and stream sediments with heavy metals, such as cadmium, lead, and zinc in the Neosho River and Spring River basins. The sites are exceptionally complicated due to wide-spread impacts in multiple media and within areas of two EPA Regions, three States and regular use by multiple tribes. Each site was divided into OU's, some of which are residential areas, and require on-going coordination across the various programs in all three States for phased remediation, completion of which varies by OU. Early and intensive coordination occurred between various State, federal, and tribal environmental entities and natural resource trustees. In particular, there was a coordinated effort to provide information to risk managers to determine potential aquatic ecological receptors and contaminant exposure risks, as well as to evaluate the need for additional source control measures and establish candidate cleanup goals. This information coordination also extended to natural resources trustees for identification of restoration goals and to water programs for assurance that TMDL limits could be attained and cleanup goals and actions aligned with the intent of NPDES permits. Tribal entities in Region 6 made plans to implement watershed wide monitoring within the Tar Creek basin, located both in Kansas and Oklahoma, which would provide early indications of remedy success or recontamination in several of the OUs. Unfortunately, CWA funding the tribes planned to use for this monitoring was reduced, so this aspect of the coordination efforts will not be realized.

Lower Passaic River - Newark, NJ (Region 2) – Associated with the former Diamond Alkali facility, which was listed on the NPL in 1984, an order on consent to perform a remedial investigation and feasibility study for the lowest six miles of the Passaic River was issued in 1994. In 2002, the site was expanded to encompass the entire 17 mile tidal portion of the river, from Dundee Dam to Newark Bay, with a focused feasibility study on the lowest eight miles. Passaic River sediment is impacted by numerous contaminants, with 2,3,7,8-TCCD, a by-product of Agent Orange manufacturing conducted at the Diamond Alkali site, as the main risk driver. Through the 2016 ROD for OU2, the lower eight miles of the river will be addressed by two-foot-deep bank to bank dredging and capping, in consideration of ongoing commercial navigation needs and cap-induced flooding. Additional remedial actions are planned for the lower river and Newark Bay Site contaminants include 2,3,7,8-TCDD and other dioxin/furan congeners, PCBs, mercury and DDT, which are attributed to various historical sources and in some limited cases, on-going discharge over the Dundee Dam. No tribes were identified for engagement regarding this site, but EPA engaged and shared information with the municipal governments and the Passaic Valley Sewage Commission and regular meetings have been held with the public. Three citizens' groups, the New York/New Jersey Baykeeper, the Passaic River Coalition, and the Ironbound Community Corporation, are active in the communities and at the public meetings, including the Passaic River Community Advisory Group meetings. Coordination meeting between federal CERCLA and State CWA programs is occurring. While large amounts of data exist for the sediment, the data are not easily accessible in a manner useful to the CWA program and only minimal CWA data above the Dundee Dam exists, which does not include the major contaminants of concern in the Lower Passaic River sediment. As yet, the coordination between EPA, the State and the citizens' groups has not found a path toward resolution of the potential recontamination threat to the lower river from ongoing discharges above the Dundee Dam.

Conclusions on Recommendation 3 – Work at complex sediment sites, especially those that cover large geographic areas and cross multiple programs, is technically challenging and inherently difficult to manage. In addition to broad technical skills, the issues involved with stakeholder engagement require skills around communication and collaboration involving parties with different goals, priorities and authorities. Ensuring that staff with both technical and community collaboration skills lead sediment remediation projects is an important aspect of productively engaging stakeholders to better address recontamination threats.

The Portland Harbor and Tri-State Mining cases highlight funding, as one of the most significant barriers to meaningful collaboration with stakeholders, who may be outside of the regulatory structure. Though structures for stakeholder involvement have been in place since the beginning of the Portland Harbor project, lack of funding prevents some of the meaningful tribal involvement. Loss of funding to support tribal water programs equated to a loss of stakeholder involvement in tracking recontamination potential at the Tri-State Mining site. EPA's Technical Assistance Grant (TAG) and Technical Assistance Services for Communities programs can help communities participate in CERCLA cleanup decision-making. However, TAG funding generally only provides for community groups to contract their own technical advisor and TASC contracts provide scientists, engineers and other professionals, at no cost to the community, to review and

explain technical information to communities. Funding sources for truly collaborative projects may be intermittent, year-to-year and subject to priorities of other programs.

The Lower Passaic case underlines the importance of Recommendations 1/5 and the need to coordinate data gathering and sharing in formats usable by multiple programs. Collaboration is best achieved when the collaborating parties can share information seamlessly. Developing a mutual understanding of data indications and gaps to meet the aims of both remediation and water program stakeholders can be focused around the joint goal of recontamination prevention.

Recommendation 6 – Remediate to Also Address Water Quality: Developing appropriate site remediation plans in accordance with CERCLA and the NCP that may also serve to reduce the site load to impaired waters to facilitate attainment of water quality standards.

Interpretation of Recommendation – While the primary attention for remediating sediment sites is rightly on sediment, the propensity for contaminants to partition between sediment and water needs consideration. Where remedial alternatives can be relied on or intentionally designed to also address water column impairments, preference for this additional benefit should be given. This is a site-specific recommendation, but is also anticipated to have broader watershed responses.

Case Studies

Portland Harbor - Portland, OR (Region 10) – Expanding on the Portland Harbor site summary above in Recommendation 3, remediation of sediment contamination is anticipated to improve water column impairments for the majority of contaminants driving the cleanup. This is because sediment was contaminated by historical dumping of high volumes and concentrations of contaminants, which no longer occurs. Water column impairments for chlordane, cyanide, hexachlorobenzene, manganese, pentachlorophenol, PAHs and potentially PCBs only occur in the lower river and are known to be associated with sources in the Superfund reach. Therefore, even without a water impairment component of the remedy, it is likely that sediment remediation will also address these contaminants in the water column, allowing for de-listing following successful completion of the remedy. This is supported by the example of the sediment remedy for the McCormick and Baxter Superfund site (which occurs within the Portland Harbor reach) having been completed and monitored for ten years, leading ODEQ to petition EPA in 2013 through the existing CWA process to re-categorize this listing for pentachlorophenol toward de-listing. It should be noted that, prior to remedy selection and design, a substantial amount of upland source remediation and control has been completed at approximately 100 sites and in all areas draining to Portland Harbor. These comprehensive actions include removal or capping of contaminated upland and bank soils, cut-off and treatment of several groundwater plumes, removal of legacy stormline solids, treatment or control of stormwater from sites, and basin-wide control of Combined Sewer Overflows (CSO) in 2000 to 2011 and separation or diversion of industrial stormwater. Absent control of these frequent culprits of recontamination, confidence in a sediment remedy also addressing water quality impairments may not be realistic.

Passaic River - Newark, NJ (Region 2) – This section expands on the Passaic River site summary above in Recommendation 3. EPA conducted sediment transport modeling as part of the CERCLA

remedial investigation. The model results contributed to the conclusion that the tributaries, combined sewer overflows and stormwater outfalls are not significant contributors of contaminants of concern to the Lower Passaic River. The context for this conclusion is comparison to the sediment itself, which, due to decades of historical discharges, is considered to be the major contaminant source. EPA's study considered State CSO investigation work, but did not initially coordinate with New Jersey water programs as to how water impacts may be improved through implementation of the sediment remediation in the Lower Passaic River. Subsequent modeling indicates that water-borne particles coming over the Dundee Dam are likely to lead to some degree of sediment recontamination, mainly from PCBs, following sediment remediation in the Lower Passaic River. State work identified only one sewage treatment plant above the Dundee Dam that would be regulated under New Jersey's PCB rule, but it is not a significant source or located within a waterway designated on the State 303(d) list as impaired for PCBs. Therefore, this sewage treatment plant and other minor discharges above the Dundee Dam may not be addressed with regard to PCBs under State CWA programs. State cleanup program actions are addressing numerous known contaminated sites on and along the Upper Passaic River. Coordination of these other remedial projects with the CERCLA project presents significant challenges. Importantly, timing of their completion may not align with remedial design completion and implementation in the Lower Passaic River and Newark Bay. Although additional control of upstream sources may be warranted, it would be consistent with EPA 2005 Contaminated Sediment Remediation Guidance for Hazardous Waste Sites to proceed with sediment remedial work if cleanup actions will result in significant benefits to human health or the environment despite the risk of recontamination associated with on-going upland sources.

Conclusions on Recommendation 6 – Depending on the level and quality of source investigation and control, as well as other site-specific considerations, evaluating and planning for CERCLA sediment remedy elements to also address water quality impairment may be possible. While the CWA Category 4b process for delisting from the 303(d) list as a result of water column benefits realized through implementation of a sediment cleanup exists, clarification of affirmation and cross-program education between EPA CERCLA project managers and Office of Water staff would be helpful in correctly aiming the coordinated approach. As demonstrated by the case of the Passaic River and other sediment sites evaluated for this paper, determining the proper amount of reliance on a sediment remedy to improve water quality and how significant on-going, low concentration discharges are as an impediment to sediment remedy success remains a challenge requiring improved coordination between CERCLA and CWA programs. Making assumptions without an understanding of the realistic potential for discharges to pose a threat of sediment recontamination may present CERCLA project managers with a conundrum of scope creep in trying to implement this recommendation. As multiple EPA guidance documents acknowledge, CERCLA actions must be confined to a limited study area and specific media and broader waterway issues are best addressed by the CWA authorities and programs (EPA 1998, 2005, 2015b).

The key to this recommendation is ensuring that source control and remedial investigation and response actions are thorough and coordinated with water program information and actions. While source control is an important facet of sediment remedy implementation, frequently in

the cases evaluated for this paper, responsibility for source control rests with the State. Given that States are expected to have better comprehensive information on nearby State-led remedial actions and water program implementation that affect their watersheds, States leading source control seems like a good fit. As EPA will continue to rely on State source control efforts as part of the success of CERCLA sediment remedies, improved coordination between EPA and States on source control may be needed, as well as improved coordination between CERCLA/Cleanup and water programs at both the federal and State levels. As discussed in several recommendation sections in this paper, it would also be helpful to develop a methodology for determining whether discharges constitute "sources" that could impact sediment as opposed to acknowledging that low-level, diffuse pollutants exist, but don't add up to a load that threatens sediment recontamination and would therefore be best addressed by a TMDL or other water program.

Recommendation 7 – Use NPDES to Also Address CERCLA Contaminants: Identifying appropriate terms and conditions in NPDES permits that address contaminants of concern at Superfund sites with or adjacent to the water body.

Interpretation of Recommendation – To implement this recommendation, it is necessary that recommendations 1/5 and 2/4 are first implemented. While this recommendation can be applied both site-specifically and in a broader watershed context, sharing of data and information must first occur, as well as examination of the potential constraints around NPDES regulation, timing, funding and implementation. If water-borne sources of pollutants align with contaminants of concern in CERCLA sediment sites and adequate information exists or can be developed to confirm that water-borne discharges either contribute to the sediment issues needing remediation or present a threat of recontamination following sediment cleanup, regulating CERCLA contaminants using NPDES permits can be effective. Coordination between EPA CERCLA and EPA Water programs is essential however, because in most cases EPA Water approves various aspects of State CWA programs, which are then implemented by the States.

Case Studies

Portland Harbor - Portland, OR (Region 10) – Expanding on the site summary in Recommendation 3 and additional information provided in Recommendation 6, the Portland Harbor CERCLA process has also benefitted from alignment of the NPDES permitting program. This is mainly because contaminants of concern in site sediment also impair the waterway in the Superfund reach and monitoring of all 303(d) listed pollutants for each waterway or reach has been required under the NPDES 1200Z Industrial Stormwater general permit since 2012. While discharge of pollutants and heavy loads of solids can result in water column impairments and sediment contamination, bedded sediment contaminants can also partition to the water column, resulting in ambient impairments. Although sufficient information has not been developed to show that water-borne pollutants are a recontamination threat to Portland Harbor, nearly all of the contaminants of concern to Portland Harbor sediment are monitored in discharges covered under the general and individual NPDES waste water and stormwater permits and this data is shared with Oregon's cleanup/source control program. In addition, individual permits are issued to sites with groundwater or stormwater treatment systems in place as a result of source control actions in the uplands surrounding Portland Harbor, which include strict limits on contaminants

of concern targeted by the treatments. As a result, the State of Oregon has been building a data set of concentrations of pollutants in about 75-100 monitored discharges in Portland Harbor to help effectuate source control within the Portland Harbor study area. Pre-remediation evaluations of this data include whether or not there are any significant on-going discharges, potential pollutant loads to the water column, and the potential threat of recontamination permitted discharges may or may not pose. Post-remediation, NPDES permits can continue to be a tool to address any potential on-going sources, recontamination prevention and any residual water column impairment not addressed as anticipated by the sediment remediation.

Ten Mile Drain site - St Clair Shores, MI (Region 5) – While not initially listed on the NPL, PCBs were discovered in the Ten Mile Drain in 2001 and EPA conducted a time-critical removal action during 2002-2004. Included in the site is a portion of the Ten Mile drain storm sewer system (concrete sewer pipes and soil in a utility corridor 15 feet below ground surface), and the Lange and Revere Street canals, which all connect to Lake St. Clair. Release of PCBs may have historically entered the storm sewer system from surficial spills or illegal dumping activities. In response, the removal action targeted high concentrations of PCB-contaminated sediments from the storm sewer system and sediment in several interconnecting canal segments. Subsequent monitoring revealed PCB recontamination of the Ten Mile Drain and canal sediments. This prompted several investigations and mitigation actions by Michigan Department of Environmental Quality, Macomb County and EPA between 2004 to 2008. The site was added to the NPL in 2010. Interim remedial actions were initiated in 2011 for monthly monitoring and clean out of sediments trapped behind weirs placed in the storm lines. Interim actions continued in 2015 to remove pooled PCB oil and associated soils and replace the vaults and connecting piping. EPA conducted a site-wide remedial investigation during 2012-2013 that identified a former factory as the potential source of PCBs in the drain system. EPA's final site remedy is planned in two phases: the contaminated soils in residential and commercial areas will be addressed next; and the storm drain corridor and canal sediments will be addressed last. Ultimately, the lack of site-wide source control investigation and implementation led to failure of the removal action through recontamination by unidentified sources. However, critical coordination with the NPDES program was also missed, which could have been used to monitor discharges for earlier detection of the potential threat to recontamination and to assist with source tracing and control of pollutants in the stormwater system.

Conclusions on Recommendation 7 – This recommendation seems to be a straightforward and fruitful coordination, site by site, between CERCLA source control and a specific CWA program. However, we did not find many examples of this coordination, which must be preceded by the coordination described by Recommendations 1/5 and 2/4, occurring at CERCLA sediment sites. Indeed, the Ten Mile Drain example offers a critical lesson about the value of water program information and authority, which could have been used to monitor and identify sources for better cleanup outcomes up to a decade earlier.

As also discussed above in the sections on Recommendations 1/5 and 6, there is a crucial piece that would allow improved implementation of these three recommendations. This is developing a better understanding of the significance of partitioning of contaminants between sediment and the water column. High concentrations or volumes of contaminants associated with particulates

discharged to waterways should be considered a source of potential sediment recontamination and should be addressed through source control actions. What is less clear is the potential for low concentrations of contaminants in on-going and diffuse discharges throughout potentially large watersheds to add up to cumulative impacts to sediment within a CERCLA study area. Also poorly understood, is the impact to the water column within and downstream of CERCLA sediment sites from sediment contamination partitioning to the water column at concentrations that result in impairment, as determined by the CWA programs. Standardized approaches are needed to fill these gaps in understanding. This could efficiently reduce uncertainty for multiple programs and interests, including recontamination prevention, sediment remedy success, whether additional controls are needed in discharge permits and affirming processes for delisting water column impairments related to sediment contamination.

Recommendation 8 – TMDLs Reflective of Remediation and Recontamination Prevention: Developing TMDLs that reflect cleanup reductions from remediation of contaminated sediments and any ongoing sources that would recontaminate remediated sediments.

Interpretation of Recommendation –This recommendation acknowledges that sediment contamination can contribute partitioned contaminants to water columns, which causes impairments, and that CERCLA-driven remediation of those sediments can also address those water column impairments. As such, data and information sharing, per Recommendation 1/5, is required to implement this recommendation. Further, the TMDL becomes the tool for designing remediation to also address water column impairments, per Recommendation 6. The recommendation goes on to say that any ongoing sources of contamination through discharges should be identified and addressed via the TMDL, to prevent sediment recontamination, which is a narrower reprisal of Recommendation 2/4. Given the nature of TMDL development being on a waterway or watershed-wide scale, this recommendation is also applied on a waterway or watershed scale.

Case Studies

Peck Iron & Metal - Portsmouth, VA (Region 3) – Placed on the NPL in 2009, the remedial investigation began in 2011 to evaluate PCB contamination in groundwater, surface water and sediment, including in an on-site creek and wetlands. Studies were suspended in 2014 with discovery of radioactive material on the site, so that radiation related planning could be incorporated. Completion of the Remedial Investigation using water, clam and sediment data is anticipated in Spring 2017. Coordination between the EPA CERCLA process and State of Virginia 303(d) list and TMDL development processes included agreement as to use of PCB congener analysis and development of estimates of the site's PCB load contribution in TMDL development.

Rose Hill Landfill - South Kingstown, RI (Region 1) – As discussed in the site summary in Recommendation 1/5, data gathered at the site for CERCLA purposes were used in TMDL development for the waterway. Although, it now appears that source assumptions were incorrect and TMDL goals were not able to be advanced through implementation of the remedy.

Conclusions on Recommendation 8 – As worded, this recommendation seems to be a straightforward coordination between the source control aspects of CERCLA and TMDL development and implementation. This amounts to a narrowed aspect of the coordination specified by Recommendations 1/5 and 2/4. As with those recommendations, an improved understanding is needed of cross-media behavior of contaminants, relevant concentrations and volumes of discharges adding up to loads of concern or not, and appropriate tools within the compendiums of CWA programs and CERCLA processes that should be relied upon in consideration of site-specific circumstances.

The State of Virginia has embarked on a Statewide process for identifying and controlling sources of PCBs across all media. As such, lessons have been learned in linking together cross-media data analyses, from which EPA could benefit. Through the Peck Iron coordination and Statewide PCB strategy, Virginia DEQ called for EPA to reevaluate PCB clean-up levels for remediation programs with consideration of protection of human consumption of contaminated fish. Virginia DEQ also encouraged EPA to promulgate Method 1668, the PCB congener analysis used for TMDL purposes, and to issue clear guidance for its use across environmental programs. This could help to actualize cross-program coordination, ensure consistent and effective cleanups and predict or prevent recontamination.

Recommendation 9 – Enforcement Coordination: Developing settlements or enforcement orders that address multi-program issues.

Interpretation of Recommendation

Ideally, enforceable instruments capture all enforceable requirements, which are narrowly defined, such that violation determinations cite back to the instrument with clear direction and authority to act. Development of effective instruments to address both remediation and water program issues, then requires an intimate understanding of the rules, laws and statutes that govern both and the ability to merge timeframes and compliance requirements toward achieving broad, overarching goals that must be succinctly stated. The nature of enforcement instruments being narrow, by definition, confines this recommendation to a site by site scale. For this recommendation to apply to recontamination prevention, the comprehensive enforcement instrument would need to be developed and implemented prior to indications of remedy failure.

Case Study

We were unable to find any examples of enforcement instruments that combined CERCLA and CWA violations, timeframes and compliance requirements. However, a few examples exist of consent agreements which include CERCLA ROD development inclusive of TMDL obligations. Another avenue that emerged as a need was coordination across CERCLA and RCRA enforcement processes.

Eastern Michaud Flats/Simplot - Pocatello, ID (Region 10) – While not considered a sediment site, contaminated groundwater discharges from this site contributed to water quality exceedances of phosphorus in the Portneuf River, exemplifying a need for coordination between CERCLA and CWA programs for satisfactory resolution. Remediation work at this site began with an Order on

Consent for the remedial investigation/feasibility study in 1991, which led to a 1998 ROD to address contaminant migration from a phosphoric acid plant and adjacent phosphate plant, though phosphoric acid was not recognized as a contaminant of concern. Unfortunately, phosphorus concentrations from site groundwater discharging to the Portneuf River were 40 times higher than the water quality target for the entire waterway, which became an inequitable problem for TMDL development considering other uses, like the municipal wastewater treatment plant discharges. Tribal, State and local interest led to exploration of making a finding under RCRA of "imminent and substantial endangerment," which resulted in the responsible party signing a CERCLA Consent Decree in 2010, in which they agreed to stop the orthophosphate releases from groundwater to the Portneuf River. As the State of Idaho proceeded with phosphorus TMDL development, an interim ROD amendment was finalized in 2012, which added phosphoric acid as a contaminant with a cleanup level consistent with TMDL load allocations.

Conclusions on Recommendation 9

As the situation at the Eastern Michaud/Simplot site progressed, the aligning of the CERCLA enforcement action with the water quality goal involved achievement of Recommendations 1/5, 2/4, 3, 6 and 8. While CERCLA tools were used here to help meet water column goals, it is not clear that there was a recontamination threat from phosphorus-laden groundwater discharges or that this process addressed any recontamination potential. Recommendation 9, while difficult to find concrete examples of, seems to be a powerful tool toward getting improved coordination on multiple fronts, though the potential impact of enforcement coordination on recontamination is difficult to gage.

Recommendations Drawn from Summary of Conclusions

ASTSWMO supports the efforts of EPA's Assistant Administrators from OECA, OLEM and OW in recognizing the need for improved cross-program coordination around contaminated sediment and taking action by issuing the 2015 memo with recommendations. The memo was a good start. As the evaluation presented in this paper demonstrates, additional action is needed in order to wholly and more meaningfully implement these recommendations to prevent sediment recontamination. ASTSWMO appreciates EPA's recognition in the memo of ASTSWMO's engagement with this issue, as well as that of our sister organization, the Association of Clean Water Administrators (ACWA). ASTSWMO recommends partnering with these and other federal, State, local and tribal organizations with a focus on the specific tasks listed below to overcome challenges, maximize benefits to each program and allow cross-program coordination to become effective and sustainable. We have included *italicized* text within the three categories of tasks below to highlight necessary action items.

Improving Communication, Coordination and Collaboration

One approach toward bridging the entrenched isolation between sediment remediation and water programs, which exist at both the federal and State level (as well as between EPA and the States), is to *unify under the overarching goal of recontamination prevention*. Using this joint goal, the required tasks of each program can be elucidated, overlaps and commonality within tasks can be identified and collaboration can be incentivized. This approach often requires a "champion" with skills across both programs who will take the lead in organizing each program's

tasks along with gathering support and buy-in from the programs. It may also *require accountability for both staff and management* built into performance reviews, in order for this unified approach to be meaningfully actualized.

For cross-program and cross-agency collaboration to be successful and sustained, *coordination must become routine, deliberate and systematic*. As an example of this, Delaware recently implemented a Watershed Approach to Toxics Assessment and Restoration to coordinate the actions of the State-led remediation and CWA programs (DNREC 2013). This approach attempts to address sources and sinks (sediment sites) within a watershed as a coordinated effort of programs with different legal authority and with the vision of eliminating sediment recontamination. Key elements of the work plan include compilation and assessment of high-resolution toxics data throughout watersheds to develop TMDLs while, more importantly, prioritizing site remediation to remove loading of toxic contaminants to the waterway prior to conducting in-waterway remediation and restoration.

Another productive example of sustained cross-program coordination is found in Virginia's Statewide PCB Strategy (VDEQ 2005). This effort induced collaboration between water, cleanup and other regulatory programs, aimed at addressing a single, ubiquitous contaminant. The Virginia water program used organism tissue and sediment data to develop a PCB TMDL, which applied to many impaired waterbodies. A variety of source tracing methodologies were applied and State-led cleanup of upland and in-water sediment were prioritized in order to implement the TMDL and effect removal of fish consumption advisories.

Also noteworthy is the recontamination prevention approach to upland source control being implemented by ODEQ on the Portland Harbor site. In addition to the bank and groundwater pathways, since 2005, a liaison between the cleanup and water programs coordinates development and implementation of a stormwater source control strategy across programs and with EPA Region 10. ODEQ developed guidance used at 150 sites and within public conveyance systems draining to 10 river miles to evaluate and control legacy and on-going sources of contamination in stormwater and prevent recontamination. In addition, ODEQ developed a Portland Harbor-specific section in the Statewide NPDES industrial stormwater general permit to ensure that on-going discharges will not recontaminate the sediment following remediation.
EPA Region 5 developed a draft *action plan for implementing the cross-program recommendations*. Elements of the plan include: identifying and mapping all sediment Superfund sites in the region; collaborating with regional water staff to populate GIS layers with water quality impairments, permitted discharges, waterbodies with TMDLs, CSOs, etc.; and having program to program discussions about aligning goals, tools and timing toward cross-program remedy benefits (EPA 2016a). *Having each EPA Region undertake these initial steps* would go a long way toward bridging silos within EPA and pave the way for inviting the States, tribes and municipalities to deepen the coordination further. ASTSWMO understands that EPA is currently developing *a MOU template that could be helpful in memorializing this needed coordination between both federal and State programs*.

Importantly, the cross-program coordination successes in Delaware, Virginia, Oregon and EPA Region 5, all have an element of cross-training or a liaison position. Having skills across multiple programs is essential to facilitating a shared vocabulary and leveraging of overlap opportunities. To enhance coordination toward a united goal of pollution reduction in multiple media, *opportunities for cross-training CERCLA staff and water staff or creating liaison positions between the programs should be identified, funded and actualized.* These examples demonstrate the power of deliberate cross-program planning and routine implementation. Once deliberately established and made routine, collaborative efforts may be expanded to RCRA and other programs that may also benefit.

Converging of Data Collection, Management and Evaluation Protocols

Meaningful implementation of Recommendations 1/5, 2/4, 6, 7 and 8 can be improved with use of *protocols for sharing and managing data and for standardized approaches for understanding partitioning of contamination between different media.* Options include identifying and promoting existing approaches or developing new protocols. Sharing existing data without a mutual understanding of the context around the data collection and how disparate data sources may fit together to inform the various program decisions, can lead to misunderstandings. Merging of differently designed and collected data that already exists between CERCLA and CWA programs needs careful consideration. ASTSWMO members discussed many instances of personal experience with failed efforts at sustainable multi-purpose database design and management by various entities in recent years, such that we recognize the complexity of the issues involved in solving this problem. We acknowledge that it might not be possible to design a one-size-fits-all process for data rules and database management between differently purposed information that already exists. Tremendous value may be gained for evaluations going forward, however, by *creating rules and protocols for CERCLA sediment site data and WQ program data* that has yet to be developed. In this focused way, *overarching objectives can likely be aligned, some data collection can be effectively synchronized, agreements can be forged around qualitative interpretation of some data and model databases with robust management and validation protocols can be created.*

One likely approach is to *convene a forum of experts in data and analysis from both water and sediment remediation programs to try to unify data collection design and evaluative methodologies across programs*. This will involve delving into hard questions, teasing out overlaps and aligning seemingly disparate outcomes to pioneer approaches that satisfy the aims of both programs. A *focus on recontamination prevention* may be helpful as a unifying approach. A logical starting place is in contrasting the CERCLA processes for assessing human and ecological risk from sediment contamination with the TMDL water column loading and allocation process. Linkages and gaps may become evident, related both to direct exposures and organism consumption, as well as improved understanding of "background" conditions. Another important focus is *developing a better understanding of the significance of partitioning of contaminants between sediment and the water column*. *Expert guidance is needed on how to determine what magnitude of contaminants associated with particulates discharged to waterways should be considered a source of potential sediment recontamination, what risks are posed by low concentrations of contaminants in on-going and diffuse discharges throughout a watershed and*

what magnitude of sediment contamination partitioning to the water column results in impairment. It may be worthwhile to look into how PCB loading estimates were determined at the Peck Iron site, in developing standardized approaches to understanding partitioning of contamination between different media.

Sustained Funding

As noted in the case studies described in Recommendations 1/5, 2/4 and 3 above, lack of funding directly prevented realization of well-intended coordination efforts and leveraging of stakeholder participation. Importantly, data management and sharing cannot be meaningfully implemented by States toward improved data-driven implementation and effectiveness tracking because a majority of States, including those represented on the ASTSWMO Sediment Focus Group, report having limited technological capacity that is chronically underfunded (personal communications, NEIWPCC 2015). *Additional funding to support State or joint work on locating, assessing, prioritizing and mitigating water-borne sources for CERCLA purposes, in line with or in addition to work planned through water program implementation*, would also be helpful in implementing Recommendations 6, 7 and 8. Finally, *increased and sustained funding is necessary to undertake the needed work of bridging silos and converging data collection, management and evaluation recommended herein* to improve implementation of EPA's cross-program recommendations for improving outcomes at sediment sites.

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TABLE 1: Sediment Sites Evaluated on Application of CERCLA/CWA Coordination to Prevent Recontamination

	1/5	2/4	3	6	7	8	9
Recommendation →	Sharing data and knowledge among stakeholders	Coordinating actions & schedules under different legal authorities	Early engagement of all stakeholders; maintain collaboration over the long-term	Considering remediation plans under CERCLA that also serve to reduce site load to impaired waters	Develop NPDES permits that also address COCs at adjacent Superfund sites	Develop TMDLs that meet WQS, reflect remediation and prevent recontamination	Develop settlements or enforcement orders that address multi-program issues
Case Study Site ↓							
Rose Hill Landfill - South Kingstown, RI - Region 1	EPA CERCLA and state water staff shared monitoring data and collaborated on monitoring efforts on surface water contaminants. The 1999 ROD addressed overlapping issues and Project Action Limits to address water quality were developed by EPA/state prior to remedy construction.					Data gathered under CERCLA were used in TMDL development and the 1999 ROD included CERCLA assistance to the state with TMDL predictions.	
Pine Street Canal (&Maltex Pond EA) - Burlington, VT - Region 1	No initial data sharing at this site between EPA and state. Ineffective remedy performance led to more coordination and data sharing started to take place.		Stakeholders were not engaged initially, but after the public rejected the Proposed Plan and remedy was performing inadequately, the state, local governments, and the public became more involved in the project.	Stormwater drains addressed under CERCLA were a benefit to CWA group.		TMDL and remediation coordination did not occur. Storm drains were addressed under CERCLA, but this did not completely resolve contamination sources.	
New Bedford Harbor - Fairhaven, MA - Region 1	Data sharing occurred between the EPA, state government, and local governments.	CSOs were on-going sources. In the 1980s sediment was removed from lines, interceptor abandoned, CSOs relocated, municipal discharges were monitored for PCBs from upgraded treatment plant prior to dredging.	Engagement of state and public occurred early on, but public reversed support for incineration for hot spot remedy. Extensive, mediated stakeholder engagement for Harbor-wide remedy continued through RD and RA.	Some CSO relocations and upgrades required through the CERCLA process, but loads were not reduced.			Settlements/orders addressed CERCLA issues only.
Peterson/Puritan - Cumberland & Lincoln, RI - Region 1	CERCLA data was used by state to identify PCBs as an impairment for the river; CERCLA Sediment and fish tissue data from upstream indicated a regional problem and was shared with state health & environment programs.	Exchange of information helped further define remedial investigation and program studies along the river.	EPA CERCLA worked closely with Region 1 Office of Ecosystem Protection and partnered w/others to address issues of the larger watershed locally & regionally. State Health Dept. used data to determine fish consumption restriction areas. Public interest & local community groups raised awareness on these issues as well.			Data used to determine potential impacts, which led to defining needs for TMDL determinations for the river.	
Gowanus Canal - Brooklyn, NY - Region 2	Data sharing did not occur between EPA, state & PRPs early on, but increased in 2017.	CERCLA and state water program efforts coordinated per 2013 ROD. CSO tanks determined unnecessary by state, but required by ROD.	EPA/state coordination story is rocky, but improved in 2017		Industrial uses now limited, so few NPDES permits.	TMDLs not planned	
Onondoga Lake - Syracuse, NY - Region 2	NY, EPA & RP coordinated on remediation pilot study activities and decisions. This sharing of data and knowledge resulted in anESD that called for nitrate addition instead of oxygenation.	Amended consent judgment required elimination or treatment of 70 CSOs by 2018, for a 95% reduction. 35 were completed in 2010 with an 85% reduction.					
Passaic River - Newark, NJ - Region 2			Engagement of state Cleanup program, municipal governments, the public, and citizens' groups was ongoing over the course of the project. State CWA program was not engaged.	To assess site loads to the waterway, EPA CERCLA conducted sediment transport modeling that concluded that CSOs, tributaries, and stormwater outfalls are not significant sources of CoCs when compared to impacted sediment. The CERCLA remedy does not address on-going discharges that NJ determined are a potential for sediment recontamination.			

TABLE 1: Sediment Sites Evaluated on Application of CERCLA/CWA Coordination to Prevent Recontamination

	1/5	2/4	3	6	7	8	9
Recommendation →	Sharing data and knowledge among stakeholders	Coordinating actions & schedules under different legal authorities	Early engagement of all stakeholders; maintain collaboration over the long-term	Considering remediation plans under CERCLA that also serve to reduce site load to impaired waters	Develop NPDES permits that also address COCs at adjacent Superfund sites	Develop TMDLs that meet WQS, reflect remediation and prevent recontamination	Develop settlements or enforcement orders that address multi-program issues
Case Study Site ↓							
Peck Iron & Metal - Portsmouth, VA - Region 3						The EPA and state of VA worked together to agree that PCB cogener analysis to be used for the project, as well as to develop estimates of the site's PCB load contribution for use in TMDL development	
Solutia/(Monsanto), Anniston PCB Site - Anniston, AL - Region 4						TMDL relied on RCRA cleanup and did not memorialized NPDES conditions/process as only remaining on-going source	Site is not on NPL (Alternative site). EPA partial Consent Decree w/Solutia covered residential, waterways and site landfills. State involvement was subsequently scaled back.
Allied Paper Inc/Portage Creek/Kalamazoo River Allegan and Kalamazoo Counties, MI - Region 5	Water quality and fish tissue data collected by the state was shared with EPA, and state provided input on PRGs which were incorporated into the ROD RAOs.		No early engagement at this site, but collaboration between EPA, State, NOAA, USFWS, and the public was reported.				Some collaboration between EPA and the state on settlement for Area 1 at site.
Ten Mile Drain Site - St. Clair Shores, MI - Region 5					Unidentified PCB source was discharged through a storm system, leading to failure of the sediment removal action by recontamination. Coordination with NPDES programs early-on and throughout the investigation process may have helped to identify these PCB sources and monitor discharges earlier, eliminating the likelihood of sediment recontamination.		
Vertac Site - Jacksonville, AR - Region 6	There is no electronic repository for the data, but AR DEQ, EPA and AR Dept. of Health all received hard copies of data which was beneficial in establishing background concentrations of some constituents. An electronic repository would have allowed for evaluation and mapping of additional data sets across all media.			A ROD for OU3 was issued in 1996 which required that treated groundwater meet TMDL requirements for dioxin, silver and 2-4 D prior to discharge.			
Tri-State Mining District - KS, MO, OK - Region 7	Information provided to risk managers to determine potential aquatic ecological receptors and exposure risk, as well as to evaluate source control. Information sharing with natural resource trustees and water programs to identify restoration goals and assure that TMDL limits could be attained and that cleanup actions aligned with NPDES permits.		Site extends to 2 EPA regions, 3 states, and multiple Tribes. Partnership between state, EPA, and tribal environmental groups, as well as natural resource trustees to develop and complete the study.				

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Case Study Site ↓							
Silver Bow Creek/Butte Area - Butte, MT - Region 8	State-led site with EPA oversight, so greater opportunities for information and data sharing between the various state groups involved.			Controlling contaminated stormwater source to Silver Bow Creek is a critical element of the selected remedy for the Butte Priority Soils OU.		Superfund program was involved in the TMDL development process, and contributed to internal TMDL document reviews.	
Montrose & Del Amo - Los Angeles, CA - Region 9	Data sharing was notable during the project: CERCLA-derived water and tissue data were considered in 303(d) listing evaluations and TMDL development.	TMDL development and CERCLA efforts occurred concurrently, which allowed for inter-program reviews of TMDL documents and incorporation of feedback. Aligning of schedules helped both programs to understand the goals/concerns of the other, which helped to avoid potential future disputes.					
Eastern Michaud Flats - Pocatello, ID - Region 10 (NOT A SEDIMENT SITE)			The ROD was revised to include phosphoric acid in order to stop contaminating groundwater and reduce pollution to a level that supported the TMDLs, which involved collaboration over the course of the project.			TMDLs influenced the cleanup decisions instead of the reverse. The ROD supported the TMDLs.	Although not a sediment site, a CERCLA Consent Degree was signed by the responsible party in an agreement to eliminate orthophosphate groundwater releases to the river. The ROD was then amended to add phosphoric acid to the contaminant list with a cleanup level that was consistent with TMDL load allocations for the waterway.
Portland Harbor - Portland, OR - Region 10			A Memorandum of Understanding was signed in 2001 between EPA, OR, 6 Tribes, and state and federal natural resource agencies which codifies the early and on-going engagement opportunities among stakeholders.	Water quality impairments in the lower river are associated with the Superfund site. The proposed sediment remediation will address water quality impairment and may potentially allow for de-listing from 303(d) once the remedy has been completed.	Nearly all of the CoCs under CERCLA in Portland Harbor are monitored in discharges covered under general and individual NPDES wastewater and stormwater permits. Individual permits with strict limits on CoCs are issued to sites with GW or stormwater treatment systems where discharges may impact Portland Harbor sediment. Such NPDES permits will also be used as a tool to prevent recontamination and ongoing sources post-remedy.		
North Boeing Field/Georgetown Steam Plant/Slip 4 (part of Lower Duwamish) - Seattle, WA - Region 10	Sharing of knowledge and information to identify North Boeing Field as the primary contribution of PCB impacts to Slip 4.	Coordinated contaminated sediment cleanup (at local level) with a source control action (at federal level); Instead of waiting for the in-water cleanup to be complete, coordination with EPA to require short-term stormwater treatment until the long-term treatment facility was installed, enabled the City & County to begin sediment removal without concern for recontamination.		Both short and long term plans were taken into account at a major source area to prevent recontamination before the removal action/cleanup was implemented.			EPA required Boeing to treat stormwater if PCB discharges to Slip 4 were not eliminated by accelerated source control measures, which facilitated the local entities conducting sediment removal action.
					Unhighlighted cases were not evaluated further in the paper.	Examples where application of recommendations could be improved highlighted in orange.	Examples of positive application of recommendations highlighted in blue.