Brief Communication

Coordinating Ecological Risk Assessment with Natural Resource Damage Assessment: A Panel Discussion

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ABSTRACT</ABH>
Contaminated sites in the United States undergo remediation and restoration through regulatory programs that lead the 2 processes through independent but often parallel pathways with different objectives. The objective of remediation is to reduce risk to human health and the environment, whereas that of restoration is to restore injured resources and compensate the public for lost use of the services that natural resources provide. More complex sites, such as those associated with large river systems and urban waterways, have resulted in increasingly

larger-scale ecological risk assessments (ERAs) and natural resource damage assessment (NRDAs) that take many years and involve diverse practitioners including scientists, economists, and engineers. Substantial levels of effort are now frequently required, creating a need for more efficient and cost-effective approaches to data collection, analyses, and assessments. Because there are commonalities in the data needs between ERAs and NRDAs, coordination of the design and implementation of site-specific studies that meet the needs of both programs could result in increased efficiency and lower costs. The Association for Environmental Health and Sciences Foundation convened a panel of environmental practitioners from industry, consulting, and regulatory bodies to examine the benefits and challenges associated with coordinating ERA and NRDA activities in the context of a broad range of regulatory programs. This brief communication presents the opinions and conclusions of the panelists on these issues and reports 2 case studies for which coordinated ERA and NRDA activities produced a positive outcome. *Integr Environ Assess Manag* 2016;X:000–000. ©2016 SETAC</ABS>

Keywords: Coordinated approach, Ecological risk assessment, Natural resource damage assessment</KWG>

INTRODUCTION</H1>

In the United States, the remediation of legacy contaminated sites and restoration of lost resources take place under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and proceed down 2 independent but often parallel pathways: 1) cleanup and remediation of the site to reduce risk to human health and the environment, and 2) assessment of injury to natural resources and restoration of the lost services they provide, through the natural resource damage assessment (NRDA) process. The Oil Pollution Act (OPA) and a number of other legislative acts, as well as state statutes and regulations, have similar provisions.

In recent years, the more complex sites such as those associated with large river systems and urban waterways have resulted in increasingly larger-scale ecological risk assessments (ERAs) and NRDAs that take multiple years and involve diverse practitioners including scientists, economists, and engineers. Substantial levels of effort are now frequently required, creating a

need for more efficient and cost-effective approaches to data collection, analyses, and assessments. It has been suggested that because there are overlaps in the data needs between ERAs and NRDAs, coordination in the design and implementation of site investigations and the organization and analysis of resulting data could result in increased efficiency and lower costs (Barnthouse and Stahl 2002).

A series of articles published from a Society of Environmental Toxicology and Chemistry (SETAC) technical workshop titled "The Nexus between Ecological Risk Assessment and Natural Resource Damage Assessment under CERCLA: Understanding and Improving the Common Scientific Underpinnings" addresses this issue in depth (Gala et al. 2009; Gouget et al. 2009; Munns et al. 2009; Stahl et al. 2009). The workshop looked at the ways in which ERAs and NRDAs are practiced under CERCLA and evaluated similarities and differences between the 2 types of assessments. It further went on to discuss the extent to which coordination of design, data collection, and interpretation might reduce effort and cost. It was concluded that although there are some opportunities for coordination, a totally integrated methodology is not practical because of the different objectives and regulatory requirements.

This article summarizes discussions in an Association for Environmental Health and Sciences (AEHS) Foundation panel comprising practitioners offering both trustee (agencies responsible for restoring injured resources) and potentially responsible party (PRP) perspectives (Ammann and Sanders 2014). Although generally in agreement with the SETAC workshop's conclusions, the AEHS panel explored the extent to which a case-by-case framework might be developed that can allow for greater coordination between data gathering and analysis for ERAs and NRDAs. This article describes 2 case studies in which the ERA and NRDA were closely coordinated and discusses the benefits of this enhanced coordination.

FRAMEWORK FOR THE PANEL</H1>

The organizing committee for this panel identified key elements for an overarching framework that takes into account the different objectives of remediation and NRDA. The cleanup or remedial process is expected to minimize risks to human health and the environment, whereas

the NRDA process determines and scales lost services provided by the natural resources and implements restoration alternatives that return the site to baseline conditions and compensates the public for lost use of those services. This framework is intended to provide a common structure for the gathering of data that, where possible, can be used for both remedial decision-making and evaluation of natural resource damages and subsequent scaling of restoration. Such a coordinated approach can be more efficient, informative, and cost-effective than approaches that rely on independent assessments for remediation and NRDAs. Furthermore, the committee suggested that the framework be iterative, so that it can be refined with a better understanding of each site (e.g., sources, fate and transport processes, habitat, receptor species, and other factors that will support both remedial and injury and/or restoration<zaq;5> decisions).

The premise is that a well-focused framework would 1) clearly define the different goals of the 2 programs, 2) identify the specific data needed to achieve those goals, and 3) provide opportunities to gather those data sets in a coordinated and efficient process that supports the 2 different programs. Furthermore, the committee suggested that this coordinated approach would

Result in a study plan with clearly stated data quality objectives that documents what to measure, how to measure, and how to use data to resolve both remediation and NRDA requirements in a coordinated fashion</B1>
Allow a more efficient assessment of potential ecological risk and/or injury to natural resources than evaluating ERA and NRDA processes independently</B1>
Provide information to support the general goals for remediation and restoration and allow for iterative refinement of the likely type and extent of restoration</B1>
Assist NRDA practitioners in developing a common understanding of past and present site conditions</B1></BL>

The AEHS panel moderators were Mike Ammann and Brenda Sanders. The panel included Mark Huston, Kenneth Jenkins, Karen Pelto, Todd Rettig, and Anne Wagner. Each panelist brought decades of experience in the design and implementation of ERAs and NRDAs from an industry, consulting, or regulatory perspective. The goal for the panel session was to discuss the proposed framework, determine where variations of the framework have been used successfully, and

identify challenges in implementing this coordinated approach.

After individual responses from the panel and a discussion that included members of the audience, 3 presentations provided examples in which industry, trustees, and consultants have worked together to coordinate the remedial and NRDA pathways. The presenters were asked to evaluate the extent to which coordination reduced the level of effort for the ERA and NRDA, resulting in cost reductions. The first presentation addressed coordination from a programmatic perspective at the state level in Massachusetts. This was followed by case studies of 2 contaminated sites—one of which was the result of a product spill and the other a result of activities that took place over the course of decades. The 3 presentations were as follows

Restoration Planning Opportunities and Obstacles: Lessons Learned from Massachusetts. Presented by Karen Pelto, Massachusetts Department of Environmental Protection (MassDEP)</B1>
Whatcom Creek, Bellingham, WA, Product Spill and NRDA: Assessing Injury and Remedy. Presented by Tony Palagyi, Cardno; and Dan Doty, Washington Department of Fish and Wildlife</B1>
The Lower Duwamish River Natural Resource Damages Settlement: Coordinating Remediation, NRDA, and On-Site Restoration in an Urban Area. Presented by Rebecca Hoff, National Oceanic and Atmospheric Administration (NOAA), Seattle, WA.</B1></BL>

DISCUSSION AND CASE STUDIES</H1>

Panel members were asked to offer their opinions on the use of a framework for coordinating ERA and NRDA activities and to specifically address the strengths and weaknesses of the approach based on their own experiences. There was general agreement among the panel members supporting coordination of such activities, in concept. They also agreed that the use of a common framework could increase efficiency and reduce the costs and level of effort required for both assessments. Commonalities of the 2 processes were noted, including the collection of overlapping environmental data for the evaluation of risk and natural resource injury, and the design and implementation of remediation and restoration strategies. Differences were also

considered. Figure 1 illustrates the specific steps in the ERA and NRDA processes. The early steps have the greatest potential for using common data sets that might entail collection of contaminant concentrations in the environment, or evaluation of exposure and impacts of those contaminants on organisms. The later steps diverge as a consequence of differences in purpose of the 2 assessments.

Building consensus regarding objectives</H2>

Karen Pelto (MassDEP) emphasized that from a program and process perspective, the most important step is to agree on objectives up front, particularly when dealing with larger spills or legacy sites where there are often perceived differences in objectives and data needs between federal and state regulators involved with both remediation and restoration, as well as the PRPs. By developing agreement on objectives from the start, the various parties can also overcome perceived (or real) conflicts and build trust with one another. Further regular and ongoing coordination between remedial agencies and trustees to develop relationships and a common understanding can facilitate agreement of objectives. Ideally, building relationships before working together on a specific case can ultimately reduce transaction costs and provide value. Early engagement with PRPs can also facilitate this process. However, Ms. Pelto acknowledged that funding constraints in government agencies may preclude meetings outside of specific matters.

Right from the start, the parties also need to prioritize each type of data relative to their use in the evaluation of remedial and resource injury and agree on a common framework that meets their needs. Based on his experience as a practitioner and from a policy standpoint, Mark Huston (US Department of the Interior [DOI]) agreed. He cited a particularly successful experience at one large site contaminated with PCBs, in which the PRPs, practitioners, agency staff, and trustees met at the beginning of the process and reached agreement on the media, biota, and endpoints that would be needed for both the ERA to support the remedial actions and the NRDA to support the injury assessment, and the scaling and restoration of injured resources.

The challenges of coordinated data collection</H2>

Up-front agreement on goals, data needs, and ranking is crucial for data collection coordination, strengthening both assessments. Yet the biggest challenge of using ERA data in the NRDA process is that risk in the remedial pathway may not equate directly to injury to a natural resource, which is the criterion for an NRDA (Figure 1). For example, fish tissue might be collected to determine body burden for the ERA, whereas the NRDA might evaluate fish reproduction and population data to evaluate injury to that resource. Asked how they would deal with situations in which media data collected for an ERA did not correlate with ecological effects, Mr. Huston pointed out that these situations are common (e.g., a situation where hazard quotients do not agree with biological, field-collected data). As in other situations, one needs to evaluate the strengths and limitations of the various lines of evidence on a case-by-case basis to determine which of the 2 data sets best reflect conditions at the site and the data needs of each program.

Providing the PRPs' perspective, Anne Wagner (Chevron Energy Technology Company) pointed out that using a common framework allows for an open dialogue that facilitates getting to the end game for both the ERA and the NRDA. From an NRDA perspective, what really matters is determining what resources were injured and how they can be restored or compensated for. The PRPs want an efficient process that is fair, transparent, and quickly progresses to restoration. Dr. Wagner pointed out that once we engage in the restoration conversation, it becomes easier to see the path to a settlement. Kenneth Jenkins (Integral Consulting) echoed this sentiment, stating that in his experience, once the parties can agree on the bounds of the uncertainty of the NRDA, the group can redirect its attention to restoration planning, which opens up opportunities not previously apparent.

Given the broad support for coordinating data collection for both ERAs and NRDAs, the panel was asked why a more coordinated approach is not used more often. Several panelists pointed out that decision-making groups working on larger sites can themselves become large and unwieldy, due to the sheer complexity of the sites. The process tends to go much more smoothly if there are mutual trust and respect within the group and an explicit understanding of the different programmatic requirements. However, the larger the group the more difficult it becomes to reach consensus. For example, if we consider just the list of potential trustees for a

large urban waterway, the group can include NOAA, DOI (including the US Fish and Wildlife Service and any of the land management bureaus), one or more states (each of which can be trustees alone or each state may have multiple natural resource trustees depending on the injured resource), and tribes, each of which may approach the process differently. Consequently, sites where coordination has been most successful tend to be in the mid-size range, where a smaller number of trustees and PRPs are involved and the potential liability more discrete. The panel suggested that taking lessons learned from cooperative settlements at mid-size sites and applying them to the larger sites could facilitate coordination of objectives and data collection.

Todd Rettig (Illinois Department of Natural Resources) noted that another obstacle to coordination is that the remedial program under CERCLA tends to take precedence over the NRDA process. This can give the remedial side a sense of primacy that can be difficult to overcome. Furthermore, there is a tendency to not begin the NRDA process until the remedy has been identified and often completed. Ms. Pelto pointed out that in Massachusetts it was rare for the ERA and NRDA to take place at the same time. For sites in states that have gone through both, in the majority of cases, the NRDA was initiated after remediation, resulting in lost opportunities for coordination and settlement.

Several panelists mentioned that in practice, agreement on a common approach may be easier in the case of an oil spill where there is a clear starting point and a sense of urgency, rather than in the case of a legacy site where contamination occurred years earlier, there are multiple PRPs, the parties have entered at different stages, and the opportunity to develop a common framework has been lost. The Whatcom Creek pipeline explosion, one of our case studies, proved to be a good example of how a number of these factors (a discrete event with a clear starting point, a sense of urgency, community involvement, and a cooperative team made up of trustees and PRPs who had a working relationship before the incident occurred) coincided to foster a rapid, very cooperative cleanup and restoration process.

Case study 1: Olympic pipeline explosion</H2>

On June 10, 1999, a 16-inch pipeline owned by Olympic Pipeline Company (OPL) ruptured in

Bellingham, Washington. The rupture caused 277 200 gallons of gasoline to spill into Hanna Creek and Whatcom Creek, which flows through downtown Bellingham and into Bellingham Bay. The gasoline vapors exploded, creating a river of fire from the spill site at the Whatcom Falls Treatment Station, downstream a mile and a half. Tragically, the explosion led to the deaths of a fisherman and 2 young boys.

Olympic Pipeline Company responded to the spill along with NOAA, the US Fish and Wildlife Service, and the Washington State Department of Ecology, acting as the federal and state NRDA trustees, and the US Environmental Protection Agency (USEPA) to assess the contamination and cleanup needs.

Fortunately, staff for Shell Oil (one of the owners of OPL) and the trustees had participated for several years on the West Coast Joint Assessment Team for NRDA. The relationships formed during those meetings and several spill drills contributed to reaching quick agreement on the response action and a rapid injury assessment through a cooperative agreement. The response included developing operational areas, sparge testing to address submerged hydrocarbons, sediment remediation, and free product seep control using a horizontal extraction well.

An emergency restoration plan was developed that was closely coordinated with remediation activities. The cooperative NRDA team proposed that heavy equipment being used at the site for the remediation could also be brought online to implement the emergency restoration plan, which included reconstruction of the impacted creek, addition of pool and riffle complexes, placement of large woody debris to facilitate salmon spawning, and planting for erosion control and other projects. The biggest challenge for the cooperative NRDA team was to complete the cleanup and emergency restoration in time for returning Chinook salmon, a threatened and endangered species, to spawn in the restored creek. The team worked together so that the majority of the cleanup and restoration activities were completed in just 3 months, and salmon were allowed back into the creek.

As a result of the spill, approximately 26 acres of habitat were burned, killing numerous fish, aquatic invertebrates, amphibians, mammals, and birds. In addition, 16 acres of parkland were

closed to the public for weeks, and fisheries were closed for 120 days (NOAA 2015). A settlement was finalized in 2004 that included $3.5 million for additional restoration and transfer of 13.5 acres of land to the City of Bellingham to expand the park. Three projects were completed that restored freshwater marsh and vegetation, high-water refuge for fish, and the creek channel and pools, all critical for salmon and other injured resources. A 10-y review showed recovering aquatic and terrestrial ecosystems, a recovering salmon population, and healthy riparian habitat (R2 Resource Consultants 2009). The review concluded that the highly efficient exchange of ideas, negotiation of scope, and a high level of trust among the trustees and the PRPs within the cooperative process were essential for the success of the creek restoration.

Case study 2: The Lower Duwamish River</H2>

The Lower Duwamish River case study presented by Rebecca Hoff (NOAA) provided an excellent example of the up-front coordination of remedial, NRDA, and restoration planning to encourage data sharing. This case study provides a specific example of how remediation and restoration activities can be coordinated at a large, complex site where multiple parties are involved. In 2001, the Lower Duwamish Waterway was listed as a Superfund site. This 7-mile stretch of river is highly urbanized, with multiple industrial uses including aerospace, shipping, shipbuilding and ship repair, iron working, and cement manufacturing, all of which contributed to the numerous contaminants of concern (e.g., PCBs, polycyclic aromatic hydrocarbons, metals, dioxin, furans). Ecological resources within the river habitat include threatened chinook salmon, bull trout and steelhead, as well as other marine fish, mammals, and birds.

The Elliott Bay Trustee Council for the NRDA is comprised of NOAA, DOI, the State of Washington, and the Suquamish and Muckleshoot tribes. Negotiations between The Boeing Company (Boeing) and the trustee council began in the 1990s. Early on, Boeing combined its remedial cleanup under USEPA (under the Resource Conservation and Recovery Act [RCRA]) with construction of restoration projects on its properties (for the NRDA) into a single Boeing team. The restoration design and implementation were closely coordinated and implemented with both the trustees and USEPA. Where possible, data collected as part of the USEPA Superfund remedial investigation were also used for the NRDA and restoration. In addition, the

trustees relied on state source control investigations to determine historical sources. Furthermore, cleanup activities were coordinated in sequence with the restoration so that newly created restoration projects would not be contaminated by later cleanups. For the NRDA effort, planning included the use of sediment data from the remedial investigation in the habitat equivalency analysis to scale injuries and facilitate early settlement.

As part of a 2010 NRDA settlement, Boeing undertook the largest restoration on the Lower Duwamish River, creating nearly 5 acres of habitat and a half linear mile of restored riverfront. Boeing also agreed to pay the trustees for past costs, cover maintenance and monitoring for 30 years, and pay into a fund for long-term stewardship of the project. The remedial investigation and feasibility study is complete and the record of decision was issued in November 2014. Early-action cleanups are currently underway at some sites by the state (uplands) and USEPA (sediments).

Ms. Hoff and Boeing staff attribute the project's success to the common internal vision and leadership provided by the Boeing team, USEPA, and the trustees as they worked together from the start to combine projects and find efficiencies in activities associated with demolition, remediation under RCRA, and NRDA restoration. Ongoing communication and coordination among the groups and their collaboration toward common restoration goals were also cited as important success factors that set a positive example for other PRPs.

SUMMARY AND CONCLUSIONS</H1>

In summary, the panelists concluded that ERAs and NRDAs share common data needs that, if coordinated, can be structured to reduce both effort and cost relative to sites where the 2 assessments are conducted independently. However, to facilitate such coordination, the parties must work closely together to identify up front what data will be needed and how the data will be used for each assessment. This enhanced coordination

Facilitates an open dialogue for the completion of both the ERA and the NRDA</B1>
Allows for a more thorough understanding of historical and current conditions at the site, and

allows each assessment to inform the other relative to sample collection and identification of data gaps</B1>
Involves frequent and greater communication, especially for large, complex sites, given the sheer number of parties involved with difference perspectives, goals, and time frames</B1>
Requires positive working relationships and a commitment to coordinating remedial and restoration activities</B1></BL>

The 2 case studies presented—the OPL explosion and the Lower Duwamish River contamination—demonstrate that when all parties are committed to coordinating remedial and restoration activities, both processes benefit from sharing data, resources, and knowledge to better understand the history and current conditions at the site. Further coordination can facilitate agreement regarding the bounds of uncertainty, which enables the groups to redirect their attention to restoration planning and can open up opportunities that were not previously apparent.

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Disclaimer—Although authors of this article include employees of government agencies and the private sector, the ideas and opinions described herein do not necessarily reflect the policies of the agencies or companies with which the authors are affiliated, and no official endorsement should be inferred.

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<abstract type="short">Key Points<zaq;1>
Ecological risk assessment and natural resource damage assessment share common data needs that, if coordinated, can be structured to reduce both effort and cost relative to sites where the 2 assessments are conducted independently.</B1>
To facilitate such coordination, the parties must work closely together to identify up front what data will be needed and how the data will be used for each assessment.</B1>

When all parties are committed to coordinating remedial and restoration activities, both processes benefit from sharing data, resources, and knowledge to better understand the history and current conditions at the site.</B1>
Further coordination can facilitate agreement regarding the bounds of uncertainty, which enables the groups to redirect their attention to restoration planning and can open up opportunities that were not previously apparent.</B1></BL></abstract>

Figure 1. A comparison of the key steps and objectives for assessing and reducing risk to the environment as part of a remedial action (ERA) and assessing injury and implementing restoration alternatives that restore natural resources to baseline conditions and compensate the public for lost use (NRDA).

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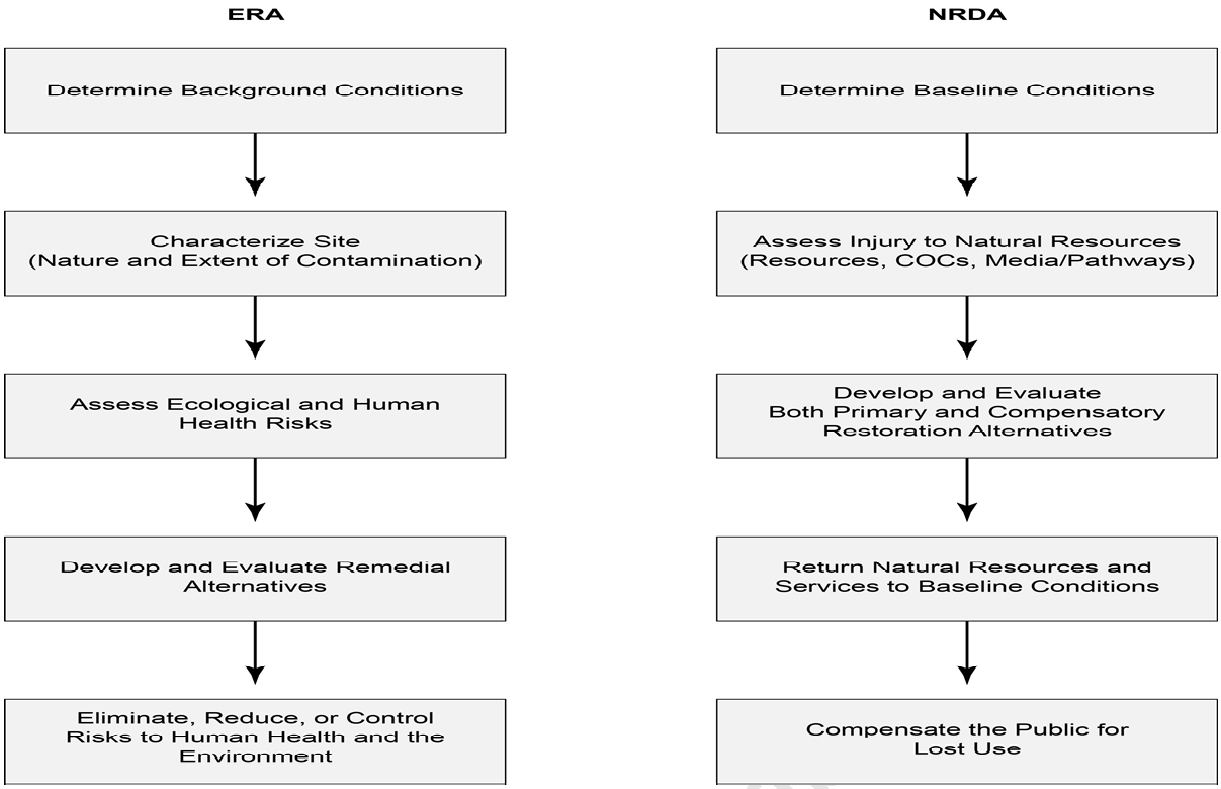

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