DOI: 10.1002/rem.21700

COMMENTARY

WILEY

Sustainable remediation column

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1 | INTRODUCTION

In the Summer of 2009, *Remediation* included the first Sustainable Remediation Forum Column in question-and-answer format that addressed challenging issues facing sustainable remediation. As summarized in *Ten years later: The progress and future of integrating sustainable principles, practices, and metrics into remediation projects* (Favara et al., 2019) in the last decade, the large collection of published sustainable remediation literature has shifted from establishment of a practice to refinement and standardization. As an industry we are now looking forward to the new frontiers in sustainable and resilient remediation.

Just like the original series of the column, this column's purpose is to offer *Remediation* readers an opportunity to gain insights from environmental professionals who have been intimately involved with the concepts and implementation of sustainable and resilient remediation. The column touches on technical, social, and regulatory issues related to sustainable and resilient remediation and provides *Remediation's* readers with opinions from some of the most authoritative professionals involved with sustainable remediation.

In this first column, we have two active members of the U.S. Sustainable Remediation Forum (or "SURF") providing an opinion to the following two questions:

2 | WHAT IS THE BIGGEST CHANGE YOU HAVE SEEN IN SUSTAINABLE REMEDIATION IN THE LAST 10 YEARS?/ LOOKING FORWARD, WHERE DOES THE BIGGEST OPPORTUNITY LIE?

Maile Smith

In 2019, the U.S. SURF released an update (Favara et al., 2019) to its seminal 2009 White Paper (Ellis & Hadley, 2009) on sustainable remediation. In reflecting on the changes in sustainable remediation in the last decade, I am not surprised that we spent those intervening 10 years focused on quantifying the measurable inputs and outputs of the cleanup process. Sustainable remediation developed from a valiant attempt to shift the course of an industry that was originally driven by intense public concerns about high-profile contaminated sites in the era of Love Canal and Valley of the Drums and the incipient laws and regulations of the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act. With expertise in environmental engineering and geology, we largely relied on energy-intensive cleanup technologies that reduced big numbers to smaller numbers—of drums, mass of contaminants, lengths of plumes, and excess cancer risk—while at the same time improving our proficiency at investigating and characterizing contaminated sites. In those early days, we did not consider the feasibility of reaching numeric cleanup goals that were eventually proven to be unattainable, nor was there time or appetite to consider the environmental effects of the cleanup process itself.

With several decades in the rearview mirror, however, we had the time and experience to take a longer and a wider view. Between 2009 and 2019, SURF members and others explored environmental footprinting and life cycle assessment, assessed the relevancy and applicability of environmental, social, and economic metrics, and developed tools to quantify carbon dioxide emissions by which we could select the most "sustainable" remediation approach. Much like the energy and mining sectors, the remediation industry examined the highly consumptive nature of its extractive remedies, such as groundwater extraction and treatment and soil excavation and disposal. We counted kilowatt hours, air emissions, and gallons of water saved, reused, or reinjected. We examined capital and operating costs and used economic models to calculate the externalities—and benefits—of remediation projects. And we made enormous strides in developing and improving cleanup methodologies that take advantage of natural biologic or chemical processes to permanently transform or destroy contaminants, as opposed to moving them from one place or medium to another.

As we turn the corner into the next decade, we are progressing even further from dealing with those early, acute issues that we could relatively easily and quickly remedy. We are wrestling with the chronic and persistent remnants of environmental contamination, at the same time, awakening to the imminent danger of climate change. Feeling the pressure from both sides, some remediation practitioners are shifting focus from sustainability to resiliency. In basic engineering terms, resiliency is the ability of an object or system to return to its equilibrium state after experiencing a shock or a stress. In the fields of psychology ("Psychological Resilience", 2021) and public health (Allmark et al., 2014), resiliency is also used to describe the ability to adapt or cope with a crisis and then return to a precrisis state. In the remediation industry, resiliency is a term used when discussing climate change adaptation and planning for climate- and weather-related impacts to impaired properties (Maco et al., 2018). To understand a cleanup program's or site's resiliency, vulnerability assessments are useful to describe and assess long-term effectiveness (Maco et al., 2018) and ongoing remedy protectiveness (Thun, 2017). However, we must continue to make progress towards restoration, not just maintain that state of protectiveness (i.e., the precrisis state), even while acknowledging that the very premise of restoration as a state of "zero contamination" may be an impossible goal due to the physical, chemical, biological, and geologic constraints that can make complete remediation extremely difficult at many sites.

Our biggest challenges, and our biggest opportunities, therefore, remain largely where they started: protecting people from contaminated land, air, and water until it can be returned, with the least additional harm, to a pre- or less-contaminated state. In terms of scale, however, the larger human health threats are poverty, unemployment, and lack of political power, all of which result in an inequitable allocation of society's resources. Sustainable remediation remains a viable framework for tackling all of these challenges, and is well aligned with the United Nation's 17 global sustainable development goals (Sustainable Development, 2021). In the past decade, our industry's environmental engineers and scientists have engaged sociologists, social equity experts, and public policy developers, moving sustainable remediation and environmental justice more closely to each other (Harclerode et al., 2015). Some industry leaders not only consider the marginalized communities that are most impacted by their environmental projects, but are inviting them to the drawing board earlier and more often. And we continue to make significant progress in the development and understanding of in situ and passive remedies and mitigation measures, and how to transition from active to passive management at complex sites.

However, we must improve our industry's engagement with the communities where there is lasting contamination, mistrust, or cultural harm (Tsosie, 2015). We should assess data, communicate risk, and respectfully work with each other to keep properties productive and people protected while reducing our reliance on regulators and courts as referees. Rather than bringing the results of a feasibility study and a preselected remedy to the community, often via a perfunctory regulatory public participation process, we should invite community representatives to actively participate from the site characterization stage, or consider community-led approaches to facilitate ongoing operation of impaired properties that are responsible to the community and the environment in both the short- and long-term (Chelleri et al., 2015). We should bring more ideas, community values, and cultural and ancestral knowledge into risk communication and decision making, particularly for sites that have cleanup timeframes in the tens or hundreds of years. The future state of our industry should leverage our best scientific and engineering solutions for the management and monitoring of remediation sites while also providing true socioeconomic benefits to the impacted community. To achieve that state, our remediation industry will need to incorporate sustainability principles and a broader understanding of resilience that does not take us back to a precrisis state, but transitions us into a new state of coexistence with the environment, where social, ecological, and economic needs and resources are more equitably balanced.

Betsy Collins

In the last ten years the global landscape of sustainability has changed. One of the largest milestones in this change was the ratification of the United Nation Sustainable Development Goals (UN SDGs) as part of the 2030 Agenda for Sustainable Development in 2015. The adoption of the 2030 Agenda for Sustainable Development kicked off a 15-year journey to transform the world we live in "with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests."

What makes the UN SDGs different than previous efforts is the recognition that these goals will not be achieved without the support of the private sector. The UN Global Compact, committed to "delivering the SDGs through companies committed to responsible business practice and through ecosystems that enable positive change," has now partnered with more than 12,000 businesses and 3,000 non-businesses around the globe. In 2021, not only would you be hard pressed to find a company without a sustainability strategy – or at a minimum, a sustainability statement – many companies are aligning their corporate strategies with the UN SDGs.

What this provides, that did not exist a decade ago, is a common language and a cross-stakeholder commitment to sustainability with actionable targets we can collectively work towards. The challenge now is using this common language, this common goal, to work together to implement sustainable practices. Despite a decade of progress there is still work to be done. However, as sustainable remediation practitioners, if we align our goals with the UN SDGs, and subsequently with thousands of companies and governments around the globe, we will be better set-up for success and ultimately real change.

Resilient Remediation: Although inherently different, sustainable remediation and resilient remediation are intrinsically linked around impact. While sustainable remediation considers the impact of a remediation site on other systems (including the environment, society, and economy), resilient remediation considers the impact of an outside threat or hazard on the remediation system. However, as described in the 2021 Interstate Technology Regulatory Council's (ITRC's) *Sustainable Resilient Remediation (SRR) Guidance* (Interstate Technology & Regulatory Council [ITRC], 2021) the distinction is not always so simple in application: "For example, a remedy that is vulnerable to extreme weather—that is, not resilient when exposed to an extreme weather event—may fail to reach its design life, thereby causing significant adverse impacts to the surrounding environment. These environmental impacts, in turn, may have associated economic impacts (e.g., the cost to clean up a release caused by extreme weather and reestablish the remedy) and social impacts (e.g., the impacts to the community from the release caused by the extreme weather or the additional costs to reestablish the remedy at the expense of using those funds for another cleanup action)" (ITRC, 2021, Section 2.1.5). With the understanding that for remediation to be truly sustainable it must also be resilient the remediation community has begun to accept resilience as a 4th pillar of sustainability.

This acceptance is highlighted in recent guidance (such as the ITRC SRR Guidance [ITRC, 2021] and *ASTM E3249-21 Standard Guide for Remedial Action Resiliency to Climate Impacts* [ASTM International, Inc., 2021]) and white papers (such as *Resilient Remediation: Addressing Extreme Weather and Climate Change, Creating Community Value* [Maco et al., 2018] and *Ten Years Later: The Progress and Future of Integrating Sustainable Principles, Practices, and Metrics Into Remediation Projects* [Favara et al., 2019]). These guidance and publications offer important perspective on the challenges and opportunities that resilience provides, however, in general, they are singularly focused on resilience to climate change and extreme weather events.

Instead of limiting our scope to resilience to extreme weather events and climate change we should consider the ability of remediation sites, systems, and processes to survive, recover, adapt, and thrive from *any* chronic stressor or acute shocks. These shocks and stressors can be natural or human-made. They can occur individually or in combination. Vulnerabilities beyond those linked to climate change or extreme weather events include terrorism, cyber threats, aging infrastructure, infrastructure failure, and health epidemics. The COVID-19 pandemic offered a quintessential shared experience of a vulnerability that each and every one of our sites, systems, and processes were forced to respond to. We all experienced the supply chain disruptions, travel restrictions, and health implications associated with this catastrophic event. Evaluating a more inclusive set of vulnerabilities with the consideration of risk and probability allows a practitioner the ability to make informed decisions which would ultimately be expected to better ensure protectiveness, have lower long-term costs, and have less negative societal implications. For these reasons, a broader definition and application considering resilience to *any* vulnerability would benefit the SRR practice.

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Maile Smith, PG is an environmental scientist with 20+ year's of experience incorporating a wide range of environmental characterization, restoration, and risk management projects. Her practice area encompasses litigation support to full-scale restoration program design, with particular expertise in hydrogeologic and geochemical investigation, in situ groundwater remediation, Brownfields redevelopment, air quality and vapor intrusion evaluation, monitoring and remediation program optimization, and site closure strategies. She is at the forefront of the movement to implement smarter, greener, and more transparent environmental restoration projects, and was a founding Board member and past President of the U.S. SURF, a nonprofit organization working to incorporate sustainability principles into remediation practices. The opinions reflected here are her own, and not necessarily those of her employer.

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