Useful Technical Resources for Sustainable Environmental Remediation

Introduction

As a result of Executive Order 13423 and other initiatives, there is a growing recognition that Federal agencies can benefit from conducting activities in a sustainable manner that reduces the overall environmental "footprint" of a project. The term environmental footprint refers to the impacts on environmental media and society from performing a given activity. Minimizing the environmental footprint of a specific project might involve reducing toxic air and greenhouse gas emissions; promoting renewable energy over conventional sources; and reducing energy use, water consumption, or waste generation.

These same concepts also apply to the selection and implementation of remediation technologies for environmental restoration projects. Sustainable environmental remediation (SER) not only meets the traditional requirements of remediation (e.g. protection of human health and the environment and regulatory compliance), but also considers sustainable practices with a goal of minimizing the environmental "footprint" of the project. The purpose of this article is to summarize ongoing activities in this emerging area and to provide links to useful technical resources for understanding and implementing SER at cleanup sites.

Drivers for Sustainable Remediation Practices

Executive Order 13423-Strengthening Federal Environmental, Energy, and Transportation Management [January 2007]
Sets targets for sustainable practices for (i) energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction, (ii) renewable energy, including bioenergy, (iii) water conservation, (iv) acquisition, (v) pollution and waste prevention and recycling, and more.
http://www.ofee.gov/eo/EO_13423.pdf

Department of the Navy Environmental Strategy - Office of the Assistant Secretary of the Navy (Installations and Environment) [April 2008]
Promotes integration of environmental stewardship with Department of Navy operations, acquisitions, and installation management.
https://secnavportal.donhq.navy.mil/ie/environment

Groups Involved in SER Initiatives

Several Federal, State, and private groups are working to develop best practices for SER (also known as "green remediation") including the United States Environmental Protection Agency (US EPA), Department of Defense (DoD), Department of Energy (DOE), National Aeronautic and Space Administration (NASA), Interstate Technology Regulatory Council (ITRC), Sustainable Remediation Forum (SuRF), and others. A brief description of ongoing activities being conducted by these organizations is below, along with links to relevant web sites and documents.

U. S. Environmental Protection Agency

The U. S. EPA has taken several steps to develop best practices in the area of green remediation. A Green Remediation web site at *http://www.clu-in.org/greenremediation* has been established, which serves as the U. S. EPA's primary vehicle for sharing information on this topic. The web site hosts a "Green Remediation Toolbox" that contains key guidance documents on best management practices and provides a list of calculators and software models for potential use in quantifying the environmental footprint of site remediation projects. A searchable matrix of 20+ case studies is included that summarizes "real world" examples of how green remediation strategies were used for the design, construction, and operation of remedies.

The web site links to relevant U. S. EPA and Federal government policy and guidance documents. In April 2008, the U. S. EPA Office of Superfund Remediation and Technology Innovation (OSRTI) released a technology primer titled Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites (see link below). The primer discusses opportunities to increase sustainability throughout the investigation, design, construction, operation, and monitoring phases of site remediation. Profiles of site-specific implementation of green remediation strategies are also provided as examples in the document. Several other documents authored by U. S. EPA are applicable to the SER topic as listed below including guidance documents related to recycling, climate change, and energy efficiency.

U. S. Environmental Protection Agency Resources

U. S. EPA Green Remediation Web Site
http://www.clu-in.org/greenremediation/

U. S. EPA Green Remediation Case Studies
http://www.clu-in.org/greenremediation/tab_d.cfm

U. S. EPA Sustainability Web Site
http://www.epa.gov/sustainability/index.htm

U. S. EPA *Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites* [April 2008]
http://www.clu-in.org/download/remed/green-remediation-primer.pdf

U. S. EPA *Green Remediation: Best Management Practices for Excavation and Surface Restoration* [December 2008]
http://www.epa.gov/tio/download/remed/gr_quick_ref_fs_exc_rest.pdf

U. S. EPA *Recover Your Resources – Reduce, Reuse, and Recycle Construction and Demolition Materials at Land Revitalization Projects* [June 2008]
http://www.epa.gov/epaoswer/non-hw/debris-new/factsheet.htm

U. S. EPA *Cleaner Diesels: Low Cost Ways to Reduce Emissions from Construction Equipment* [March 2007]
http://www.epa.gov/sectors/pdf/emission_0307.pdf

U. S. EPA *Energy Consumption and Carbon Dioxide Emissions at Superfund Cleanups* [May 2008]
http://clu-in.org/greenremediation/docs/SF_Energy_Carbon_Footprint.pdf

U. S. EPA *Smart Energy Resources Guide* [March 2008]
http://www.epa.gov/nrmrl/pubs/600r08049/600r08049.pdf

U. S. EPA Climate Leaders Program Web Site
www.epa.gov/climateleaders

Department of Defense and Other Federal Organizations

The Department of Defense (DoD) is also increasingly focused on optimizing the efficiency of remedial actions at environmental restoration sites including taking into account more sustainable cleanup practices. The key organizations involved in SER from DoD's perspective include Naval Facilities Engineering Command's (NAVFAC's) Optimization Workgroup, the Air Force Center for Engineering and the Environment (AFCEE), and the U. S. Army Corps of Engineers (USACE). Links are listed below to SER resources from DoD and other Federal government organizations.

NAVFAC's Optimization Workgroup is taking the lead to engage Navy and Marine Corps Remedial Project Managers (RPMs) and Base Realignment and Closure (BRAC) Environmental Coordinators (BECs) in minimizing the environmental footprint of cleanups. SER will be used to complement current optimization approaches and will draw upon readily available and proven methodologies and technologies. The Optimization Workgroup is developing sustainability metrics, evaluating sustainability calculators/tools at Navy sites, and working to increase awareness of these concepts among the Navy and Marine Corps Environmental Restoration (ER) community. A SER Factsheet will be published in the Spring of 2009 by the NAVFAC Optimization Workgroup. This SER Factsheet will summarize key sustainability metrics for remediation sites and outline methodologies for environmental footprint assessment and reduction. NAVFAC will also present on SER at the Fall 2009 Remediation Innovative Technology Seminar (RITS). Several Navy sites have already implemented passive, low-impact remediation technologies such as monitored natural attenuation (MNA), passive biowalls, phytoremediation, and more. Soil excavation has been optimized at several Navy sites through the use of retrofitted equipment, clean and ultra-low sulfur diesel technologies, and rail transportation of excavated contaminated soils. The use of SER metrics in remedy selection and operations is expected to increase at Navy sites as a part of this initiative, which complements already ongoing efforts in remedial action optimization and long term management optimization.

AFCEE is working to help project managers incorporate sustainability concepts into their remedial decision-making process. AFCEE is developing a Sustainable Remediation Tool (SRT), which incorporates carbon emissions, energy consumption, worker safety, and resource service as metrics. It allows for site-specific evaluation of the environmental impact of remediation technologies such as soil excavation, soil vapor extraction, pump-and-treat, and enhanced bioremediation. AFCEE has also applied sustainable strategies to cleanup sites through use of wind turbines for on-site power generation, biowalls to replace pump-and-treat systems, and solar powered pumps.

USACE has incorporated sustainable practices into their remediation optimization evaluations in the form of cost reductions, risk reductions, site close-out time, equipment maintenance, and resource consumption. The Army is working to draft guidance and contract templates to include additional sustainability aspects, such as greenhouse gas emissions. The Army has used sources of renewable energy at remediation sites such as landfill gas, solar, and wind power.

Department of Defense and Other Federal Resources

NAVFAC Optimization Workgroup Web Site
https://portal.navfac.navy.mil/portal/page?_pageid=181,5707915&_dad=portal&_schema=PORTAL

AFCEE Sustainable Remediation Web Site http://www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremeditation/index.asp

AFCEE Sustainable Remediation Tool (Under Development)
http://www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremeditation/srt/index.asp

Federal Remediation Technologies Roundtable Green Remediation Meeting [December 2008]
http://www.frtr.gov/meetings1.htm

NASA Technology Evaluation for Environmental Risk Mitigation (TEERM) Center
http://acqp2.nasa.gov/overview.html

U. S. DOE National Renewable Energy Laboratory (NREL)
http://www.nrel.gov/science_technology/

U. S. DOE Pumping System Assessment Tool
http://www1.eere.energy.gov/industry/saveenergynow/pdfs/psat_webcast_slides.pdf

The Federal Remediation Technology Roundtable (FRTR), NASA, and U. S. DOE are also pursuing sustainability concepts for remediation. FRTR hosted a collaborative meeting in December 2008 to share experiences among Federal agencies and to provide lessons learned in advancing best practices (see link above). The FRTR has also established a Green Remediation Focus Group and NAVFAC is a participant. NASA has created a Technology Evaluation for Environmental Risk Mitigation (TEERM) Principal Center to validate sustainable pollution prevention technologies and to reduce energy costs for their long-term groundwater remedies. The U. S. DOE National Renewable Energy Laboratory (NREL) works to develop and advance renewable energy and energy-efficiency technologies through initial testing to field demonstration. U. S. DOE has also developed a Pumping System Assessment Tool to improve energy efficiency of pumping operations that could be applied to remediation systems.

State and Private Organizations

There are several State and private organizations involved in SER activities including various State Environmental Protection Agencies (EPA), the Association of State and Territorial Solid Waste Management Officials (ASTSWMO), the Interstate Technology Regulatory Council (ITRC), and the Sustainable Remediation Forum (SuRF). NAVFAC is actively participating as a member in the ITRC and SuRF activities. ITRC has established a Green/Sustainable Remediation (GSR) Team. The objectives of the GSR team for 2009 are to: 1) produce a technology overview document explaining what GSR is and how it is beginning to be implemented in new State and Federal programs; and 2) to survey ITRC States, partners, and stakeholders on their interest in this topic. Based on those results, the team may develop a GSR technical regulatory guidance document and associated internet training. SuRF is an organization facilitated by DuPont that is comprised of private industry, consultants, U. S. EPA, DoD, State agencies, academics and public stakeholders. Its goal is to establish a framework that incorporates sustainable concepts throughout the remedial action process. SuRF meets several times a year to discuss various issues surrounding sustainable remediation and the group is in the process of developing a white paper with the draft title *Integrating Sustainability Principles, Practices, and Metrics into Remediation Projects*. Links to resources from these organizations are provided below.

State and Private Resources

ITRC Green and Sustainable Remediation Team
http://www.itrcweb.org/teampublic_GSR.asp

Sustainable Remediation Forum
http://www.sustainableremediation.org

Association of State and Territorial Solid Waste Management Officials (ASTSWMO) Sustainability Resources Web Site
http://www.astswmo.org/resources_sustainability_greenercleanups.html

California Department of Toxic Substances Control Green Remediation Initiative [March 2008]
http://www.astswmo.org/documents/Scandura.pdf

Illinois Greener Cleanups Matrix – How to Maximize the Environmental Benefits of Site Remediation [February 2008]
http://www.epa.state.il.us/land/greener-cleanups/matrix.pdf

U. S. EPA Green Remediation Web Site – State Resources
http://www.clu-in.org/greenremediation/subtab_e2.cfm

Conclusion

Several organizations are engaged in the development of SER strategies and the overall interest in incorporating these strategies into remedial programs is growing. NAVFAC and Marine Corps RPMs and BECs are encouraged to become familiar with the SER concepts and the related literature presented here.

Point of Contact

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