

EPA'S GREEN REMEDIATION, PRINCIPLES AND FIELD CASES

NEW TRENDS IN RESTORATION OF DEGRADED SOILS III: TRACE ELEMENTS, ORGANIC POLLUTANTS, AND CONSTRUCTED WETLANDS

VITORIA, SPAIN OCTOBER 9, 2018

CARLOS S PACHON

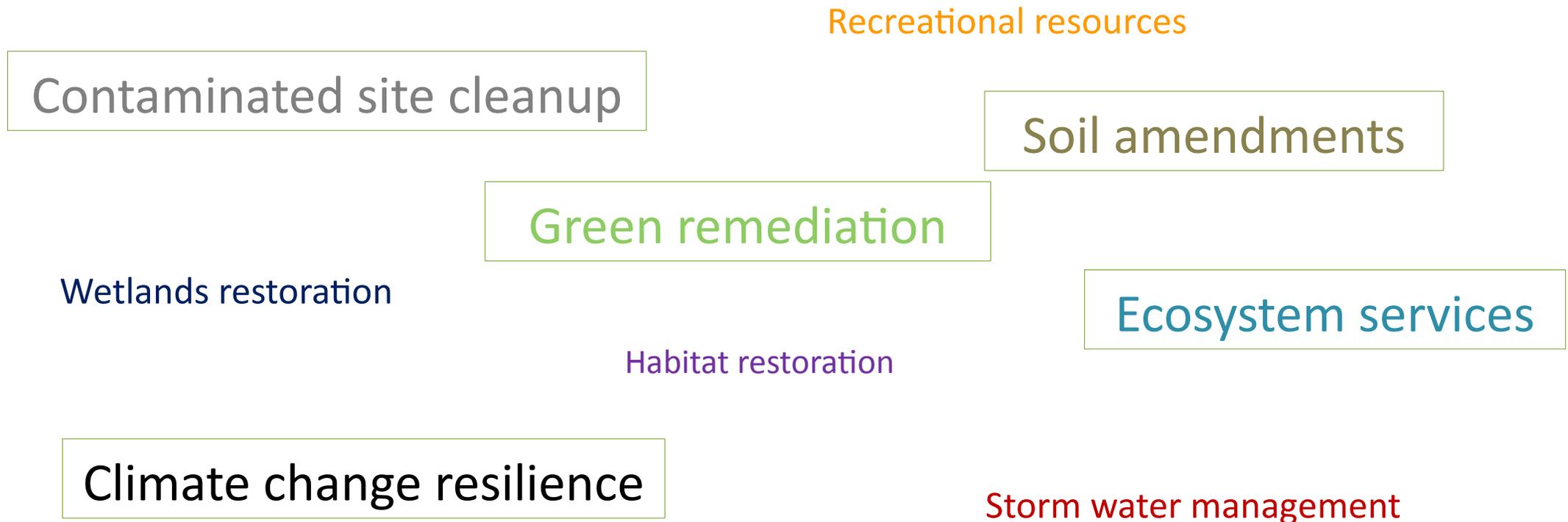
TEAM LEAD, GREENER CLEANUPS

US EPA SUPERFUND

WASHINGTON, DC



Interconnected Themes

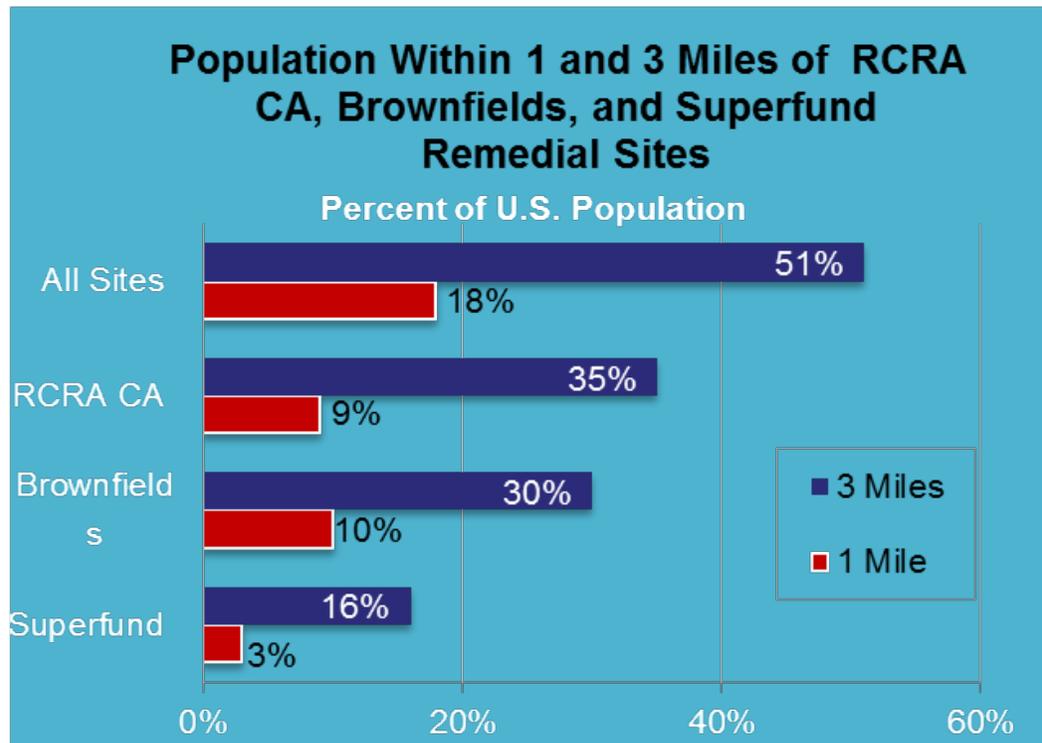


Why Greener Cleanups?

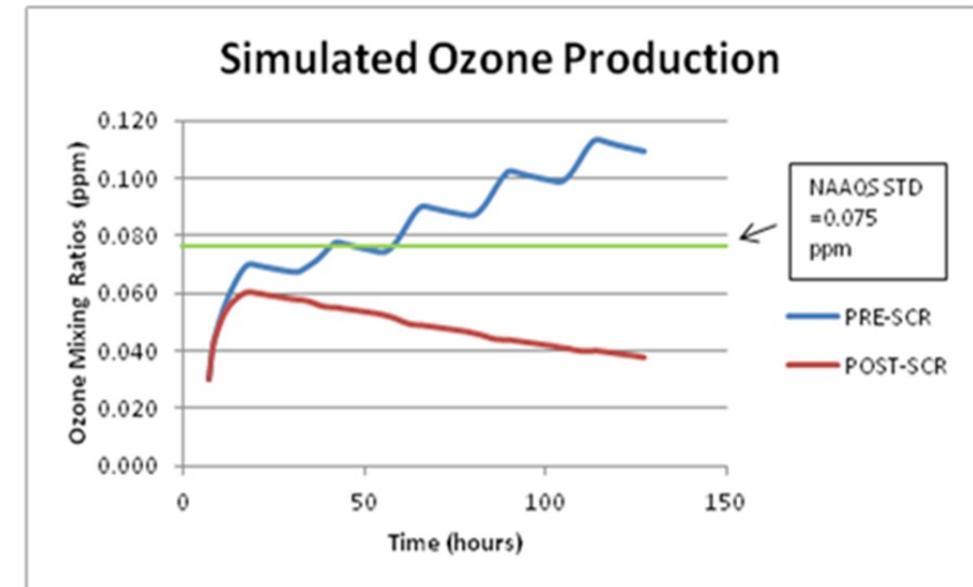
Greener cleanups build sustainable practices into our core mission: protect human health and the environment



EPA Cleanup Programs Address Contamination at Sites Near 51% of the U.S. Population



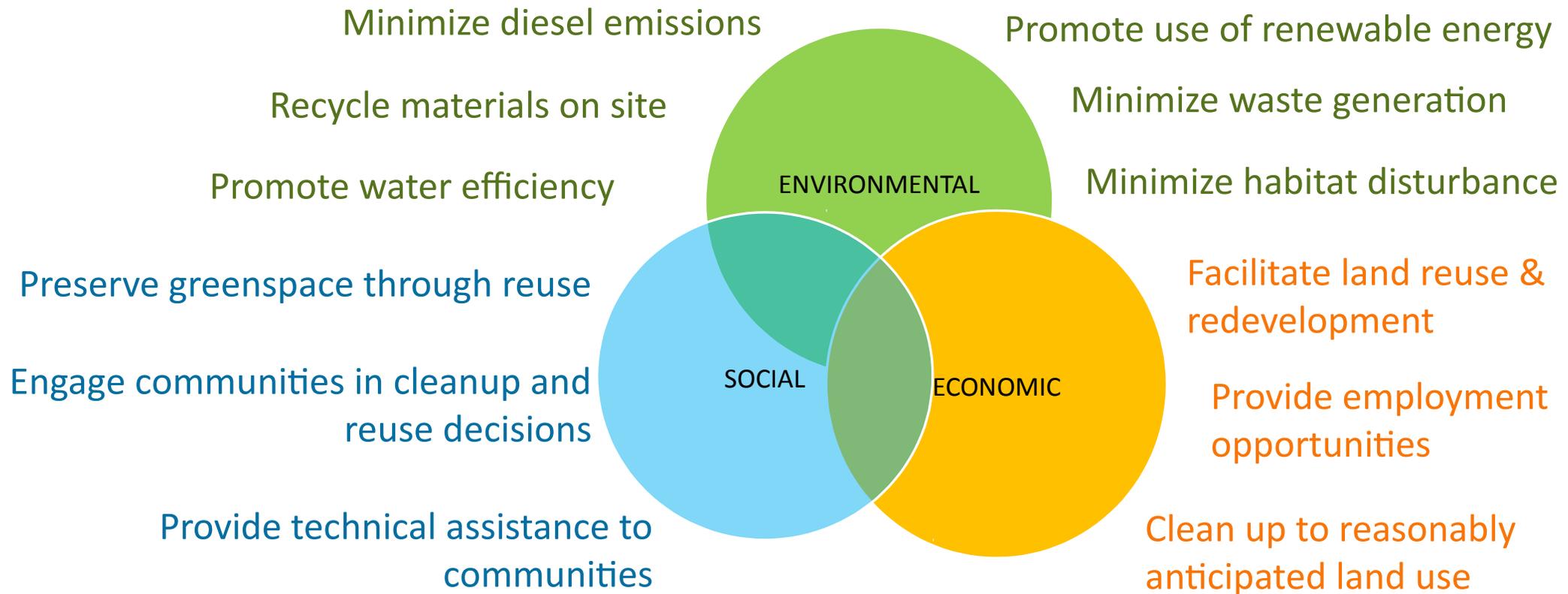
Example of a local impact on air quality



Source: <https://clu-in.org/s.focus/c/pub/i/2545/>

Source: <https://www3.epa.gov/osweraccomplishments/story.html>
<https://clu-in.org/s.focus/c/pub/i/2545/>

Sustainability Principles in Cleanup Programs Now and in the Future...



Green Remediation: Fields Cases I

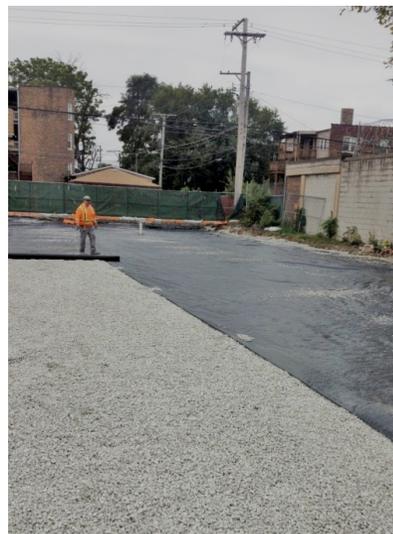


Cleaner Air

A new generation of clean diesel technology for off-road engines and equipment (Tier 4) is making its way onto remediation job sites across the country, such as the [Elizabeth Mine NPL site](#) in Vermont (Region 1). *More on Tier 4 at: http://www.aem.org/PDF/DTF_Tier4WP_FIN.pdf*

Water Resource Protection

More permanent solutions are used to manage stormwater at urban sites. A subsurface geotextile-lined stormwater basin was installed during remedy construction at the Whitney Young Branch Library brownfield site in Chicago (Region 5) to complement future site reuse and the city's developing green infrastructure. Winner of 2015 IL *Governor's Sustainability Award*



Renewable Energy

Off-grid renewable energy systems are increasingly used at remote sites. A mobile 25-kW SolaRover Mojave 3 hybrid system supported Superfund removal action at the [Pennsylvania Mine](#) near Keystone, CO (Region 8); the system's generator recharged portable tools and sampling devices and powered communication equipment and EPA's mobile lab.

Green Remediation: Fields Cases II



Ecosystem Considerations

Increased attention is given to accelerating restoration of damaged ecosystems and increasing ecosystem services. At the Pharmacia-Upjohn site in North Haven Connecticut (Region 1), RCRA Corrective Action included restoring ecosystems along portions of the Quinnipiac River and creating a new upland meadow providing habitat for pollinators, songbirds, reptiles and other wildlife.



Waste Reuse

Industrial by-products frequently substitute for virgin resources or processed materials. Through a state-voluntary partnership, coal ash from a local power plant and spent mushroom compost from a nearby agricultural producer are used to treat acid mine drainage in the De Sale Restoration Area of western Pennsylvania (Region 3).

Sustainable Materials

Greater efforts are made to choose greener products.

Removal and remedial actions at the Lawrence Aviation Industries NPL site in Port Jefferson Station, NY, (Region 2) involved building groundwater treatment facilities made of certified green lumber,

low-toxicity siding and insulation, and products containing recycled or rapidly-renewable materials.



Strong USEPA Support for Greener Cleanups

- ◆ Policy: Encouraging Greener Cleanup Practices through Use of ASTM International's Standard Guide for Greener Cleanups (12/2013)
- ◆ Tools: ASTM Standard Guide for Greener Cleanups E2893 (2013)
- ◆ Guidance: Consideration of Greener Cleanup Activities throughout the CERCLA Process (8/2016)
- ◆ Contracts: Superfund Remedial Acquisition Framework (+ \$1,000M) (2018)

Green Remediation: A Growing Practice

Examples of companies with green remediation on corporate websites*



* Based on query conducted April 2017. Not exhaustive, inclusion does not imply an endorsement..

Ecosystem Services Approaches and Tools for Contaminated Site Cleanup

Ecosystem services are nature's contributions to human well-being.



Material Derived from Presentation by Jewel Lipps, Biology graduate student at Georgetown University and former EPA ORISE Research Participant at the Office of Superfund Remediation and Technology Innovation el785@Georgetown.edu

The Classic Ecosystem Services Example: New York City's Long-Term Watershed Protection for Clean Water Supply

“A filtration plant large enough to clean the City's water supply would cost approximately \$6 billion to build and another \$250 million annually to maintain. Preserving the watershed, conversely, was estimated at \$1.5 billion, just over a dime invested on ecological preservation for every dollar that would have been spent on a filtration plant.”
– Alice Kenny, The Ecosystem Marketplace

<http://www.ecosystemmarketplace.com/articles/ecosystem-services-in-the-new-york-city-watershed-1969-12-31/>



Bureau of Land Management

An Ecosystem Services Approach to Sage-Grouse Conservation: Upper Green River Conservation Exchange Program (2014)



VIEW PDF



Describes a collaborative effort to protect habitat for sage-grouse in advance of the species' potential listing by the Fish and Wildlife Service under the Endangered Species Act.

U.S. Department of Agriculture

Assessing Pollinator Habitat Services to Optimize Conservation Programs



VIEW PDF



Describes how pollination services have received increased attention over the past several years, and protecting foraging area is beginning to be reflected in conservation policy. Includes prospects for doing so in a more analytically rigorous manner, by quantifying the pollination services for sites being considered for ecological restoration.

U.S. Forest Service

Integrating Ecosystem Services Into National Forest Service Policy and Operations (2017)



VIEW PDF



Describes Forest Service efforts to integrate ecosystem services in planning, performance and partnerships.

National Oceanic and Atmospheric Administration

Operationalizing and Leveraging an Ecosystem Services Framework for Habitat Conservation: Coastal Blue Carbon (2014)



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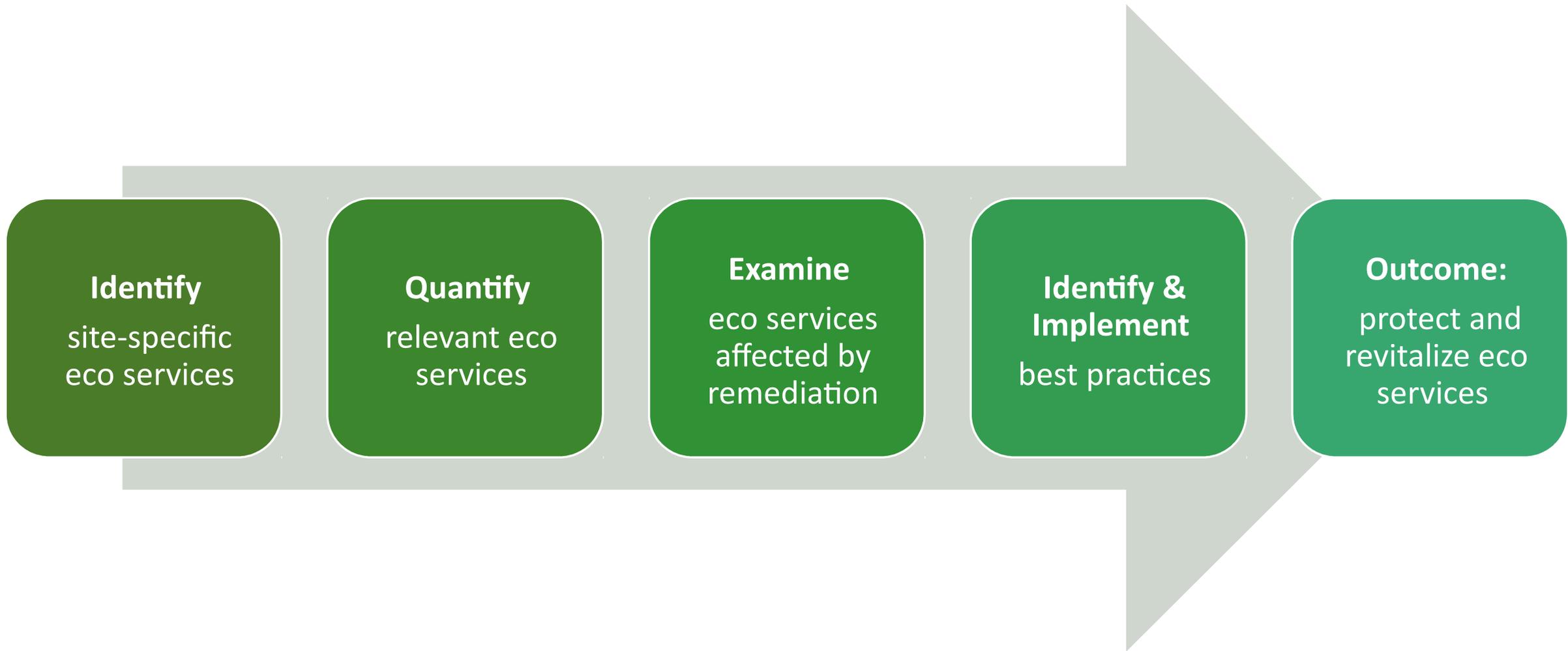
Describes NOAA's efforts to support the scientific, policy, and economic framework needed to increase use of information on coastal wetland's carbon sequestration potential in coastal management.

Why evaluate ecosystem services at Superfund sites?



How do we know which ecosystem services are affected by cleanup activities?

And... what can we do about it during cleanup?



Evaluation Framework

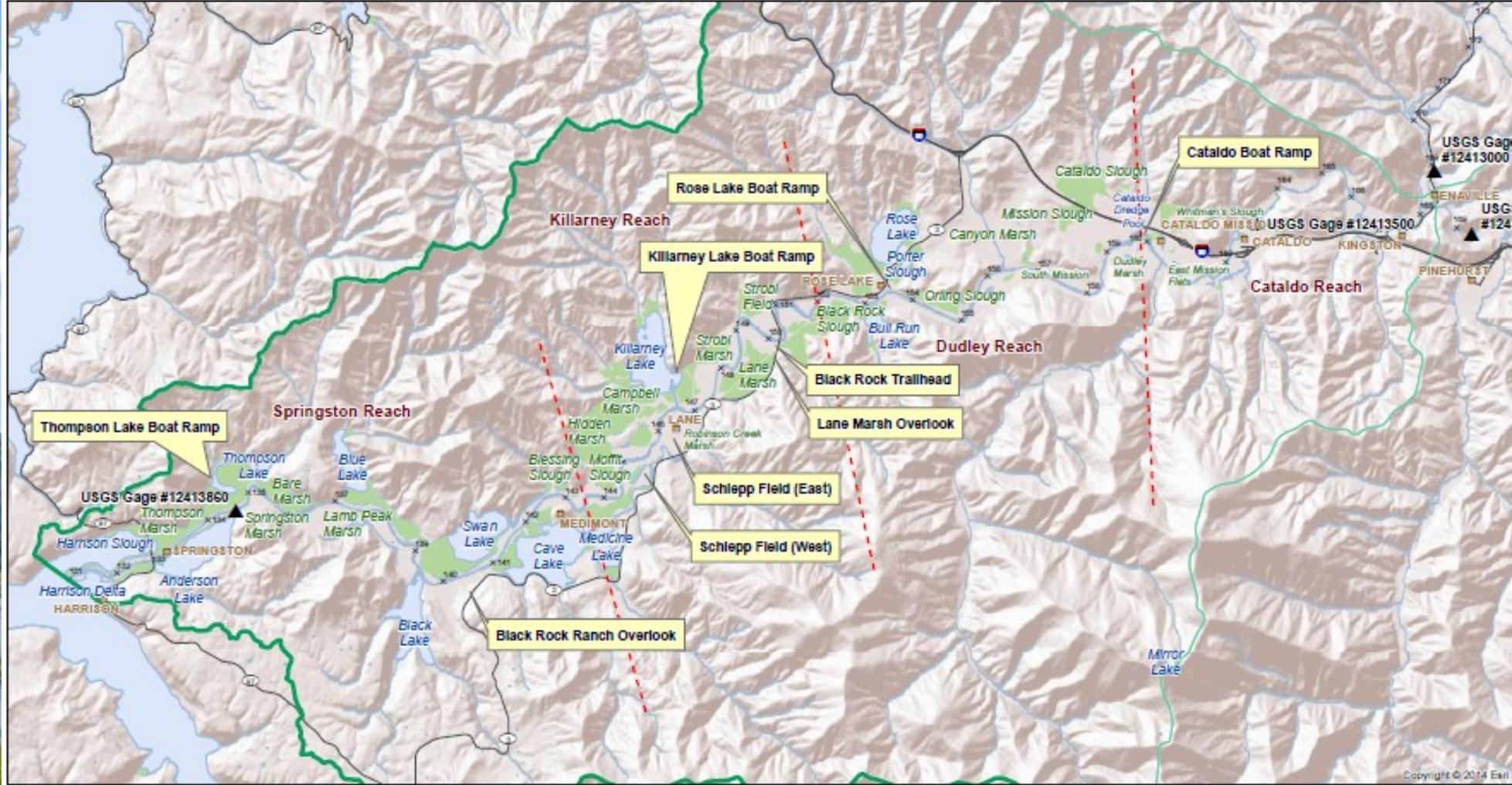
Pilot Study of Evaluations and Tools Conducted at Two Superfund Sites

Lower Darby Creek Area, Philadelphia, PA

- A site set in an urban-suburban area

Bunker Hill Mine Complex, Coeur d'Alene, ID

- A very large historic mining site



Bunker Hill Mine Complex, Coeur d'Alene, ID

Rural location, watershed scale

In Summary

- Ecosystem services approach can help site teams optimize remedy design and communicate the positive cleanup outcomes.
- Free evaluation tools provide several options for quantification of ecosystem services.
 - Different tools for different needs or “niches”
 - Challenges remain in standardizing classification and quantification approaches
- Learn more about the concepts and find more tool options in the Superfund Engineering Forum issue paper, <https://www.epa.gov/remedytech/ecosystem-services-contaminated-site-cleanups>
- Ecosystem Services Approaches and Tools for Contaminated Site Cleanup (Oct 24, 2017)
- https://clu-in.org/conf/tio/EcosystemServices_102417/

Engineering Forum Issue Paper



Agriculture-to-wetland project at the Lower Basin of Coeur d'Alene River Superfund site in northern Idaho. Photo Credit: Jewel Lipps

Ecosystem Services at Contaminated Site Cleanups

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1. Purpose
 2. Ecosystem Services
 3. Considerations During Cleanup
 4. Community Involvement
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 6. Best Management Practices for Ecosystem Services
 7. Summary
 8. Acknowledgements
 9. Notice and Disclaimer
 10. Selected Resources
 11. Cited References
- Appendix A. Ecosystem Services Evaluation Tools

The Technical Support Project (TSP) Engineering Forum issue papers provide information on remediation technologies or technical issues of interest. The information is not guidance or policy.

"Ecosystem goods and services are the many life-sustaining benefits we receive from nature — clean air and water, fertile soil for crop production, pollination, and flood control."

- U.S. Environmental Protection Agency, 2017
www.epa.gov/eco-research/ecosystems-services

1. Purpose

The U.S. Environmental Protection Agency (EPA) developed this issue paper to provide cleanup site teams with information about ecosystem services. These concepts and tools are useful in communicating the positive results of cleanup in addition to achieving the goals of cleanup. Information about ecosystem services may be considered in characterization of future land use options or design of a cleanup that is consistent with anticipated ecological reuse, depending on the regulatory authority of the cleanup program. This document does not provide guidance on how ecosystem services may or may not be factored into specific cleanup programs.

Soil Amendments: Cleanup to Ecological Restoration

What are Soil Amendments?

Residuals from other processes that:

- Have beneficial properties
- Reduce exposure by limiting the exposure pathways and immobilizing contaminants
- Restore soil quality
- Enable site remediation, revegetation and revitalization, and reuse

Benefits to the Site & Community

Benefits of Amendments

- Restore soil health and structure allowing establishment of vegetation
- Recreate ecological function of soils
- Decrease bioavailability of toxic pollutants
- Decrease leachability and mobility of contaminants
- Decrease erosion and improve soil drainage
- Reduce costs compared to traditional remediation techniques
- May abate acid mine drainage



Benefits of Revitalized Land

- Provides wildlife habitat
- Provides improved water quality in receiving streams
- Sequesters carbon
- Reuses of devoid and damaged lands
- Improves property values
- Reduces wind- and water-borne contaminants leaving the site
- Increases evapotranspiration
- Reduces the amount of possibly contaminated water recharging local aquifers

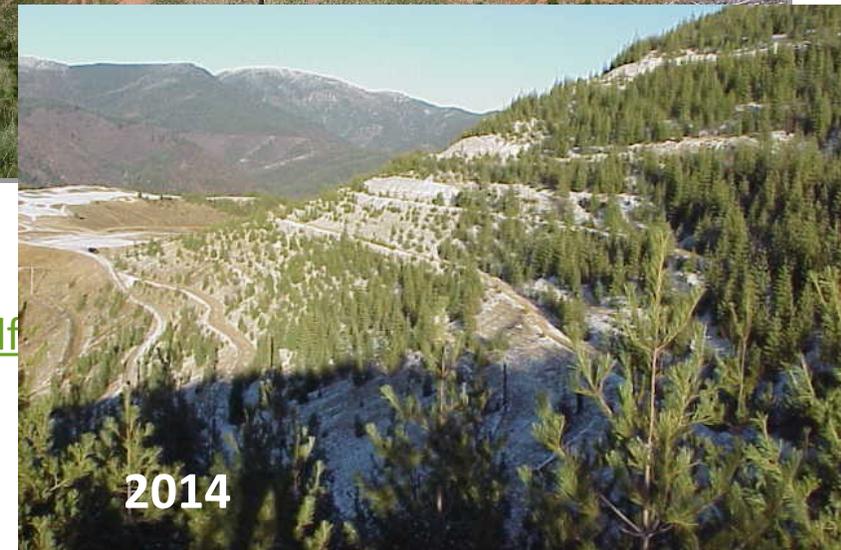
Problems Addressed by Soil Amendments

- Contaminant Bioavailability & Phytoavailability
 - Toxicity (organic & inorganic)
 - Contaminant mobility
- pH
- Excess Sodium
- Excess Salts
- Soil Physical Properties
 - Density, aggregation and texture
- Nutrient Deficiencies
 - Micronutrients (Zinc and Manganese)

**E-Pond Solid Waste Management
Unit Site in Ohio**



Restoring Hillsides at the Bunker Hill Mining and Metallurgical Superfund Site, Coeur d'Alene, Idaho



https://clu-in.org/conf/tio/sri2_042115/

https://clu-in.org/ecotools/downloads/bunker_hill_eco_case_study_final_feb2015.pdf

<https://www.youtube.com/watch?v=ZBITaxahAcw>

Related Published and Online Tools

- Ecological Revitalization
- Urban Gardening
 - Series of fact sheets
 - Workshops
- EcoTools Web site
 - <http://www.cluin.org/ecotools>
- Future Published and Online Tools
 - Soil Amendments Paper as a web-based tool Resource Center
- Cluin.org/mining



Superfund Approach to Remedy Resilience

- 1) Evaluate site-specific vulnerability of a remedy through:
 - Exposure assessment
 - Sensitivity assessment

➤ **Evaluate where past conditions differ from future climate scenarios**

- 2) Implement adaptation measures, where warranted, to increase resilience of the remedy
 - Identification of options
 - Selection of suitable adaptation measures

➤ **Integrate measures into remedy designs and required five-year reviews**

- 3) Monitor all cleanup projects and periodically re-evaluate the need to modify existing measures or take additional measures



Field Case 1: American Cyanamid Superfund Site

Bridgewater, New Jersey

Primary Hazard: Floods

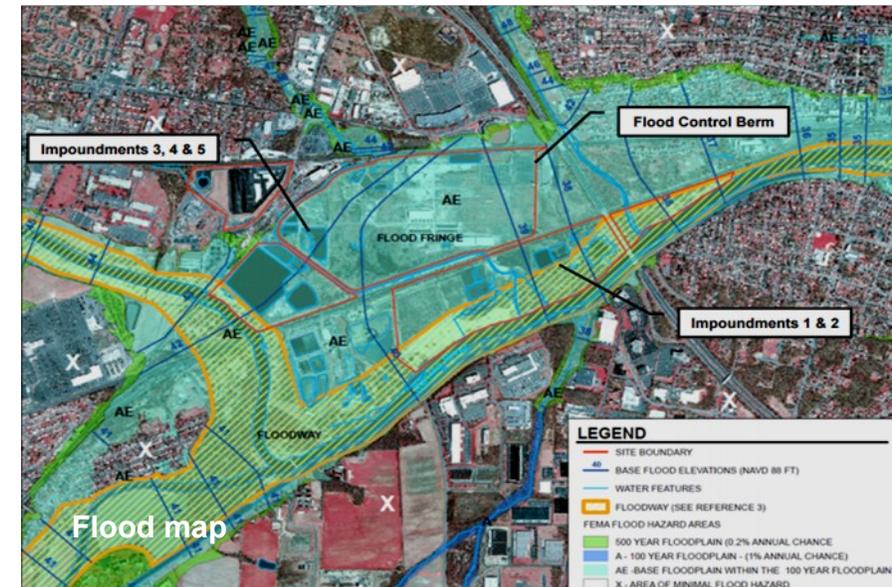
Rationale: This 435-acre site located along the Raritan River experienced significant flooding in 2011 due to Hurricane Irene

Adaptation Measures:

- Elevated critical electrical instrumentation 5 feet higher than Hurricane Irene flood waters
- Installed submersible pumps in bedrock wells to maintain hydraulic control during future floods
- Reinforced earthen berms surrounding two highly contaminated waste impoundments
- Requiring future capping systems to be designed to withstand a 500-year flood event



Elevated electrical controls



Field Case 2: Grasse River Superfund Site

Massena, New York

Primary Hazard: Severe ice jam events

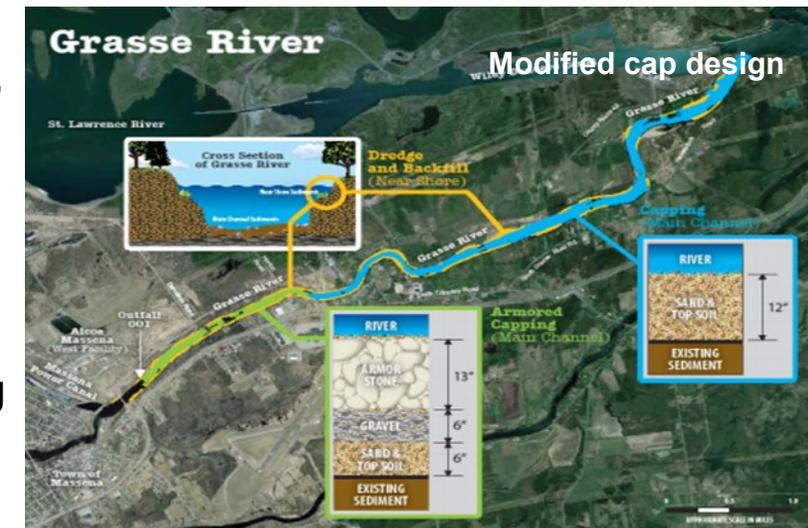
Rationale: The 7.2-mile stretch of the lower Grasse River, a tributary to the St. Lawrence River, is contaminated with PCBs; the uppermost two miles of the site sediment is vulnerable to scouring during severe ice jam events

Adaptation Measures:

- Modified design and construction specifications for a full-scale contaminated sediment cap to be installed; in the ice-jam vulnerable area, the modified design includes:
 - A 6-inch layer of sand and top soil
 - A 6-inch layer of gravel
 - A 13-inch layer of stone to armor the sand/topsoil cap
- Performing mechanical ice breaking along the 7.2-mile river stretch during periodic ice jams



Severe ice jam in 2003



Recommended Resource

<https://www.epa.gov/superfund/superfund-climate-change-adaptation>

- Planning and implementation tools
- Links to resources for evaluating site-specific vulnerabilities
- Technical fact sheets on the most vulnerable types of remediation systems, such as groundwater extraction and treatment
- Examples of adaptation measures taken at Superfund sites

The image shows two overlapping screenshots from the EPA website. The top screenshot is the 'Superfund Climate Change Adaptation' page, which includes a navigation menu on the left and a main content area with the title 'Climate Change Adaptation'. The bottom screenshot is a 'Climate Change Adaptation Technical Fact Sheet: Groundwater Remediation Systems', which includes a table of climate change impacts and associated information resources.

Climate Change Impacts					Information Resources and Type of Information Available (▶) for Applicable Impact (◆)
Temperature	Precipitation	Wind	Sea Level Rise	Wildfires	
◆	◆		◆		EPA Climate Change Indicators in the United States website ▶ Information on "weather and climate" indicators relating to temperatures, precipitation as well as extreme oceanic, snowfall and ice scenarios
	◆				Federal Emergency Management Agency (FEMA) Map Service Center website ▶ Floodplain maps

In Summary

- ◆ Greener Cleanups practices are gaining traction across cleanup programs in the United States
- ◆ Advances in technical tools are improving our capacity to consider protection and restoration of ecosystem services
- ◆ Soil Amendments make valuable contributions to contaminated site cleanup and ecological restoration, particularly at mine scarred lands
- ◆ Remedy climate change resiliency is often connected to broader resilience efforts where it is located
- ◆ Green remediation, ecosystem services and mine land revitalization are often in a “continuum”, both in approach and outcome