CLU-IN Contaminated Site Clean-Up Information

Welcome to the CLU-IN Internet Seminar

US and EU Perspectives on Green and Sustainable Remediation Part 2

Delivered: March 15, 2011, 10:00 AM - 12:00 PM, EDT (14:00-16:00 GMT)

Presenters:

Carlos Pachon, U.S. EPA Office of Superfund Remediation and Technology Innovation, pachon.carlos@epa.gov, (703) 603-9904
Dietmar Müller, Environment Agency Austria, dietmar.mueller@umweltbundesamt.at, +43-(0)1-313 04/5913
Paul Bardos, r3 Environmental Technology Limited, p-bardos@r3-bardos.demon.co.uk, +44 (0)118 378 8164
Bonnie Arthur, U.S. EPA Region 9, Arthur.Bonnie@epa.gov, (415) 972-3030
Marc van Bemmel, Bioclear, bemmel@bioclear.nl, +31

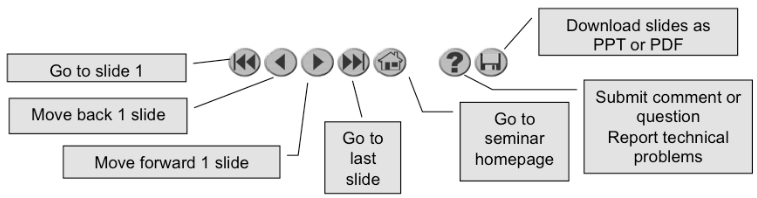
Moderators:

Carlos Pachon, U.S. EPA Office of Superfund Remediation and Technology Innovation, pachon.carlos@epa.gov, (703) 603-9904
Paul Bardos, r3 Environmental Technology Limited, p-bardos@r3-bardos.demon.co.uk, +44 (0)118 378 8164

Visit the Clean Up Information Network online at www.cluin.org 1

Housekeeping

- Please mute your phone lines, Do NOT put this call on hold
  - press *6 to mute #6 to unmute your lines at anytime
- Q&A
- Turn off any pop-up blockers
- Move through slides using # links on left or buttons



- This event is being recorded
- Archives accessed for free **http://cluin.org/live/archive/**

2

Although I’m sure that some of you have these rules memorized from previous CLU-IN events, let’s run through them quickly for our new participants.

Please mute your phone lines during the seminar to minimize disruption and background noise. If you do not have a mute button, press *6 to mute #6 to unmute your lines at anytime. Also, please do NOT put this call on hold as this may bring delightful, but unwanted background music over the lines and interupt the seminar.

You should note that throughout the seminar, we will ask for your feedback. You do not need to wait for Q&A breaks to ask questions or provide comments. To submit comments/questions and report technical problems, please use the ? Icon at the top of your screen. You can move forward/backward in the slides by using the single arrow buttons (left moves back 1 slide, right moves advances 1 slide). The double arrowed buttons will take you to 1st and last slides respectively. You may also advance to any slide using the numbered links that appear on the left side of your screen. The button with a house icon will take you back to main seminar page which displays our agenda, speaker information, links to the slides and additional resources. Lastly, the button with a computer disc can be used to download and save today’s presentation materials.

With that, please move to slide 3.

US and EU Perspectives on Green and Sustainable Remediation Part 2

Carlos Pachon
USEPA Office of Superfund Remediation and Technology Innovation

15 March, 2011

ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Chairs of EURODEMO+ and recent hosts of 2010 ConSoil

SuRF SUSTAINABLE REMEDIATION FORUM UK

3

Agenda

Introductions
Carlos Pachon, U.S. EPA Office of Superfund Remediation and Technology Innovation, Washington, DC (USA)

Consoil 2010: Summary of Findings – Concepts and Initiatives
Dietmar Müller, Environment Agency Austria, Vienna (A)

Frontier Fertilizer: US Case Study Presentation
Bonnie Arthur, U.S. EPA Region 9, San Francisco, CA (USA)

Ameland & The Hague: EU Case Study Presentations
Marc van Bemmel, Bioclear (NL)

Introduction to Discussion
Paul Bardos, r3 Environmental Technology Limited (UK)

Discussion Moderator
Carlos Pachon, U.S. EPA Office of Superfund Remediation and Technology Innovation

CLU-IN Internet Seminar • 15 March 2011 4

Who am I?

A bit about ConSoil, and Dietmar's role, the special sessions and pre-consoil material

Bonnies' bio and a highlight from her case study

Marc's bio and a highlight from his case study

Paul's bio, a summary of what he will cover/seek to achieve, and a mention of previous seminar participants on the call

- SuRF – Stephanie Fiorenza
- NICOLE – Olivier Maurer
- COMMON FORUM – Dominique Darmendrail (not available regarding "dry-run" March 10)
- SuRF UK – Nicola Harries (?)
- CABERNET – Paul Nathanail (not available regarding "dry-run" March 10)
- SuRF NL – Hans Slenders (not available regarding "dry-run" March 10)

Developments – United States

Important Developments (Policy and Technical):

- *Technical Primer on Green Remediation (2008)*
- *SuRF US White Paper on Sustainable Remediation (2009)*
- *EPA Superfund Green Remediation Strategy (2009)*
- *EPA Policy on Green Remediation (2009)*
- *Initial ASTM work on development of green cleanup standards (2010)*

Key US EPA Perspectives:

**** Greener cleanups are not an alternative approach to setting cleanup levels and selecting remedies.***

**** Cleaning up sites for reuse supports sustainable development.***

**** Reducing the environmental footprint of a cleanup does not justify changing the end point.***

Who am I?

A bit about ConSoil, and Dietmar's role, the special sessions and pre-consoil material

Bonnies' bio and a highlight from her case study

Marc's bio and a highlight from his case study

Paul's bio, a summary of what he will cover/seek to achieve, and a mention of previous seminar participants on the call

- SuRF – Stephanie Fiorenza
- NICOLE – Olivier Maurer
- COMMON FORUM – Dominique Darmendrail (not available regarding "dry-run" March 10)
- SuRF UK – Nicola Harries (?)
- CABERNET – Paul Nathanail (not available regarding "dry-run" March 10)
- SuRF NL – Hans Slenders (not available regarding "dry-run" March 10)

What is “Green Remediation”?

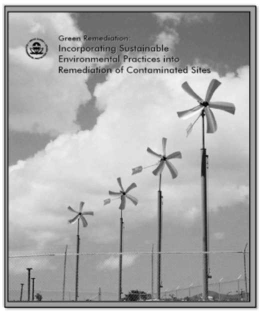
The practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprints of cleanup actions.

More Information from U.S. EPA

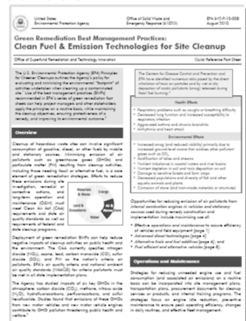
Green Remediation Focus

www.clu-in.org/greenremediation

- BMP Fact Sheets
- Policy References
- Technical Bulletins
- Case Studies
- Training Information
- Internet Resources



Aerojet-General Corporation	CA
Altus Air Force Base	OK
Apache Powder	AZ
Barksdale AF Base	LA
BP Casper	WY
BP Paulsboro	NJ
California Gulch	CO
Crozet Orchard	VA
De Sale Restoration Area	PA
Delfasco Forge	TX
Former Carswell Air Force Base	TX
Former Ferdula Landfill	NY
Former Nebraska Ordnance Plant	NE
Former St. Croix Alumina Plant	VI
Fort Carson	CO
Frontier Fertilizer Superfund Site	CA



or: ***www.epa.gov/superfund/greenremediation***

US and EU Perspectives on Green and Sustainable Remediation Part 2

Concepts, Initiatives and Information Exchange

Dietmar Müller
Environment Agency Austria (EAA)

15 March, 2011

ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Chairs of EURODEMO+ and recent hosts of 2010 ConSoil

SuRF SUSTAINABLE REMEDIATION FORUM UK

8

Outline

- ConSoil 2010 and how it started
- Green and Sustainable – more general
- Policies – US, European Union
- Initiatives – governmental, non-governmental
- Organizing further information exchange and discussions

International Fora for Information exchange and Discussion

- US: Sustainable Remediation Forum (2006)
- Europe: SuRF UK (2007) & NICOLE (2008)
- Green Remediation Conference (Copenhagen, 2009 ahead of UN Climate Change Conference COP15)
- U.S. EPA Webinar (July 2010)
  - ► ***paper summarizing international developments***
- CONSOIL 2010 (September 2010)
  - ► Special session 8A: international developments
  - ► Special session 8B: case studies

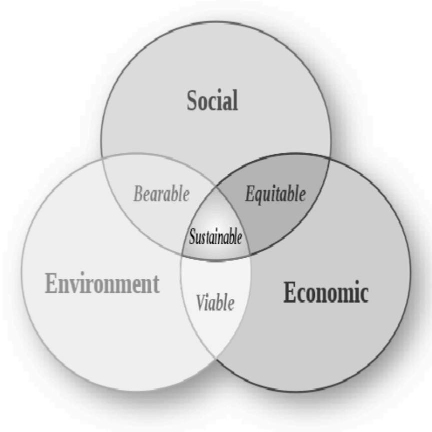
"Green Practices"

… are conducted in ways which minimize the environmental burdens imposed by an activity

"Green Remediation" (US EPA)

The practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprints of cleanup actions.

Sustainable Development



Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland report, 1987)

Sustainable remediation: broader concept of balancing economic growth, protection of the environment, and social responsibility, toward achievement of an improved quality of life for current and future generations

Green and sustainable remediation aim at …

- changing mindsets and practices
- integration to
  - decision-making, design,
  - implementation, and operational strategies of a site cleanup
- understanding impacts in comparing alternatives
- transparency
  - local community and other stakeholders
- "better solutions"

CONCEPTS, INITIATIVES AND INFORMATION EXCHANGE

USA: A Priority at Many Levels

OSWER Policy: Principles for Greener Cleanups

As a matter of policy, OSWER's goal is to evaluate cleanup actions comprehensively to ensure protection of human health and the environment and to reduce the environmental footprint of cleanup activities, to the maximum extent possible. (OSWER A.A. Mathy Stanislaus)

EPA Strategic Plan: Goal 5 Compliance and Environmental Stewardship

Stewards of the environment recycle wastes to the greatest extent possible, minimize or eliminate pollution at its source, conserve natural resources, and use energy efficiently to prevent harm to the environment or human health. By 2011, enhance public health and environmental protection and increase conservation of natural resources by promoting pollution prevention and the adoption of other stewardship practices by companies, communities, governmental organizations, and individuals. (EPA Administrator Steve Johnson)

EO 13514: Federal Leadership in Environmental, Energy, and Economic Performance

It is the policy of the United States that Federal agencies shall increase energy efficiency; measure, report, and reduce their greenhouse gas emissions from direct and indirect activities; conserve and protect water resources through efficiency, reuse, and stormwater management; eliminate waste, recycle, and prevent pollution (President Obama)

CLU-IN Internet Seminar • 15 March 2011 14

Sub-objective 5.2.1: Prevent Pollution and Promote Environmental Stewardship.

By 2011, reduce pollution, conserve natural resources, and improve other environmental stewardship practices while reducing costs through implementation of EPA's pollution prevention programs.

****

Goal 1: Clean Air and Global Climate Change

Protect and improve the air so it is healthy to breathe and risks to human health and the environment are reduced. Reduce greenhouse gas intensity by enhancing partnerships with businesses and other sectors.

Objective 1.3: Protect the Ozone Layer

Strategic Targets:

- By 2015, reduce U.S. consumption of Class II ozone-depleting substances to less than 1,520 tons per year of ozone depleting potential from the 2003 baseline of 9,900 tons per year.

Objective 1.5: Reduce Greenhouse Gas Emissions

Sub-objective 1.5.1: Buildings Sector.

By 2012, 46 MMT of carbon equivalent will be reduced in the buildings sector (compared to the 2002 level).

Sub-objective 1.5.2: Industry Sector. By 2012, 99 MMT of carbon equivalent will be reduced in the industry sector (compared to the 2002 level).

Sub-objective 1.5.3: Transportation Sector

By 2012, 15 MMT of carbon equivalent will be reduced in the transportation sector (compared to the 2002 level).

Environment Canada

Integration of policy frameworks:

•Federal Contaminated Sites Action Plan (2005)

•Treasury Board Policy on the Management of Real Property (2006):

– new policy to manage the land in a sustainable and financially-responsible manner throughout its lifecycle and perform the activities through efficient and cost-effective government programs.

➢Planning for a Sustainable Future: A Federal Sustainable Development Strategy for Canada (October 2010)

see http://www.ec.gc.ca

EUROPE: REMEDIATION AND WIDER POLICIES

EUROPEAN LEVEL

- *Soil Strategy*
- *6th Environment Action Programme & ETAP*
- *Strategy Sustainable Use of Natural Resources*
- *EU climate and energy targets (20-20-20)*

NATIONAL LEVEL, e.g. AUSTRIA

- *Sustainability Strategy (2002)*
- *Environmental Quality Objectives (2005)*
- *Key Objectives to CLM (2009):*
  - **Key Objective 5:** "Remediation measures need to enhance the environmental status of a site durable and in sustainable manner."

OSWER Green Remediation "Strategy"

- Principles for Greener Cleanups: Common policy position for all U.S. EPA cleanup programs
- Superfund Green Remediation Strategy: "Operationalizing" the Principles in the Superfund Cleanup Program
- Voluntary Green Cleanup Standards & Certification System: Robust tool for fostering greener cleanups in various cleanup programs
- RE-Powering America's Land: Renewable energy on contaminated lands
- Regional Initiatives:
  - Climate change strategies
  - Policy and guidance development, etc.

Key Action	Description
Policy and Guidance Development	
Key Action #1	Clarify the role of green remediation in remedy selection and implementation
Resource Development and Program Implementation	
Key Action #2	Develop a compendium of protocols and tools to help project and Program managers integrate green remediation practices
Key Action #3	Identify options that enable use of green remediation practices
Key Action #4	Address air pollutants and diesel emissions
Key Action #5	Develop pilot projects to evaluate and demonstrate green remediation applications
Key Action #6	Establish opportunities in contracts and assistance agreements to identify green remediation practices in selected remedies
Key Action #7	Communicate and share success stories and lessons learned among "implementers" across the Program and the public
Program Evaluation	
Key Action #8	Evaluate green remediation application at the site level
Key Action #9	Develop Program evaluation measures
Key Action #10	Evaluate the Superfund Green Remediation Strategy

Sustainable Remediation Forum (US)

several ongoing technical initiatives, including:

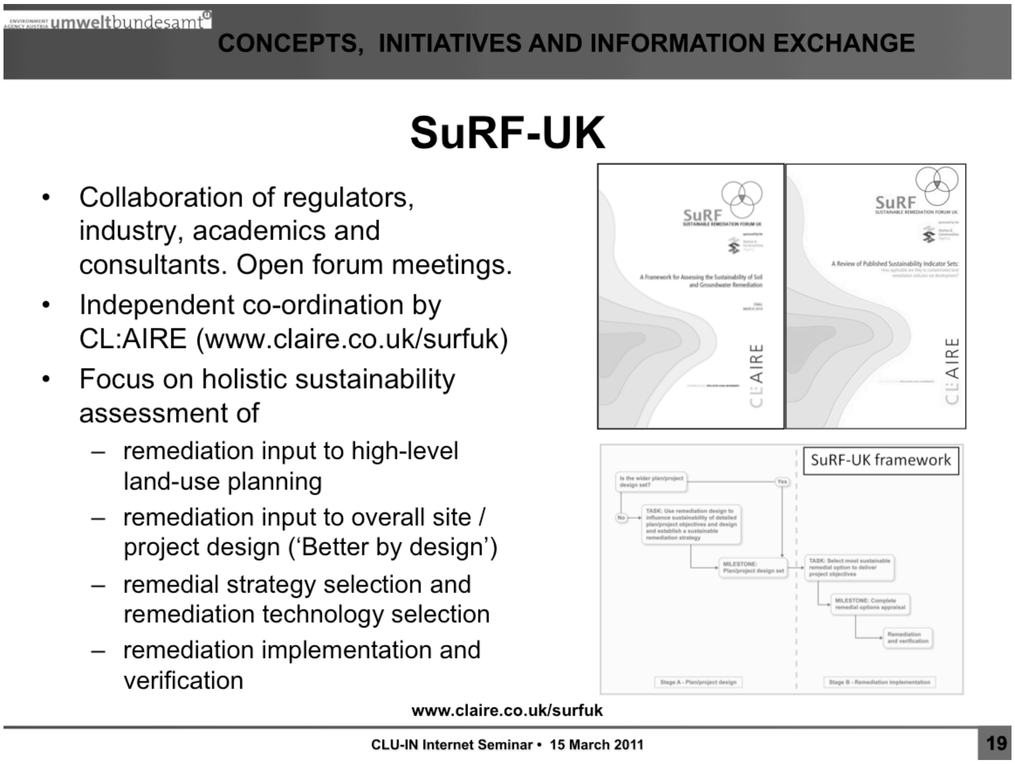
•Developing a consensus-based framework for sustainable remediation practices

•Fostering standardized sustainable remediation criteria and metrics

•Promoting consistency, transparency, and best practices for Life-Cycle Assessment (LCA)

➢"***Sustainable Remediation White Paper—Integrating Sustainable Principles, Practices, and Metrics Into Remediation Projects***"

see http://www.sustainableremediation.org/library



Set-up as a collaborative, voluntary project. HCA provided funding for CLAIRE to co-ordinate the project and for venue hire etc, but all other input was in-kind support.

Small steering group that did most of the drafting:

CLAIRE
Nicola Harries

Industry
Frank Evans, National Grid, Chair
Jonathan Smith, Royal Dutch Shell

Regulator
Brian Bone, Environment Agency

Government brownfield regeneration agency
Richard Boyle

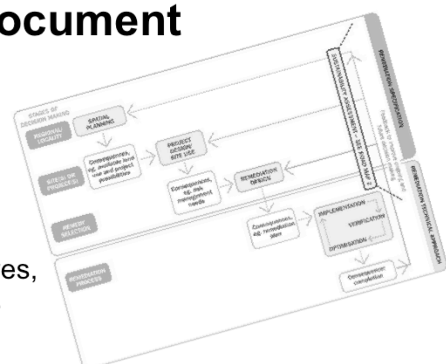
Consultant
Paul Bardos, r3 environmental

Liaising
Dave Ellis, Du Pont (SURF)
Peter Nadenbaum, SuRF-Australia

Guidance document

1. ROAD MAP

- 4-page booklet – Fall 2010
- links to full documentation



2. "Full" document

- Introduction, NICOLE's objectives, SRWG methodology, definition.
- Separate Chapters
  - Economics, check list of tools, guidance, references
  - Indicators, check list, guidance, references
  - Risk assessment
  - Illustrations with Case studies (web based, dynamic)
- Pilot testing (duration TBD).

- Factual
- Neutral
- Practical
- Simple

NICOLE

www.nicole.org

Common Forum on Contaminated Land in the European Union

- Network of contaminated land policy experts and advisors (since 1994)
  - Ministries and Environment agencies, 16 countries
  - Guests / research networks, Community Unions
- **Aiming at**: New concept for an efficient policy based on risk management and sustainable remediation at national and European levels

Common Forum

Further European initiatives

- ***EURODEMO+*** *together with regional and national demonstration platforms will promote and encourage the use of soil and groundwater remediation technologies through demonstration, with emphasis on the use of sustainable and cost-effective remediation practices.*
  - ***Focus: technologies & eco-efficiency***
- **CABERNET**: *The Network's aim is to enhance the rehabilitation of brownfield sites within the context of sustainable development, by sharing experiences from across Europe, providing new tools and management strategies and a framework for coordinated research activities*

Further international initiatives/activities

- SuRF Australia
- SuRF Brazil
- ISO/TC 190 “Soil quality”

Green and Sustainable Remediation Ambitions (ConSoil 2010)

- primary goal: protect human health and the environment
- optimizing benefits:
  - economically: e.g. increasing property values, jobs to local residents and businesses
  - general quality of life and healthier communities
- minimizing impacts – local, regional, global
  - Environmental footprint
  - "smart growth" – using/improving existing infrastructures

Green and Sustainable Remediation Questions (ConSoil 2010)

How to integrate/balance impacts …

- environmental, economic and social aspects
  - societal framing and "values" may change over time
  - time as a 4th dimension to sustainability
- at different scales ("system boundaries"?)
  - sites, regional, national, global
- interactions and trade-offs ("system boundaries"?)
  - in between different regions
  - in time

Organizing information exchange and discussion

TO SUSTAIN A "MEETING PLACE OF IDEAS"

- **1st GreenRemediation Conference (Copenhagen, 2009)**
- **CONSOIL 2010 *(Salzburg, 2010)***

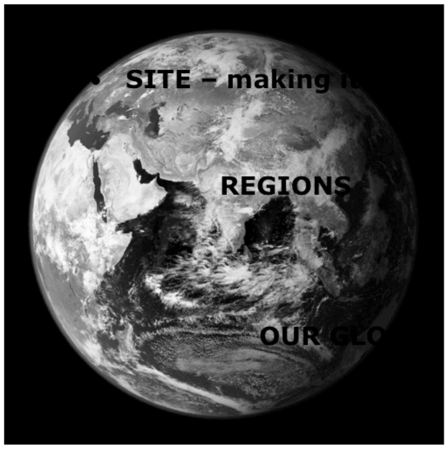
➔ Web-Seminars during 2011

➔ 2nd GreenRemediation Conference (2012?)

Future Lines of Discussion/Action

- International Discussion
- Integrating wider policies
- Conceptual Framework(s)
- Practical Tools & Metrics
- Greening Remediation
- Practicing Synergies
- Sustainable/Green Technologies

GREEN AND SUSTAINABLE REMEDIATION



understand natural and social systems

practice common responsibilty

management by objectives:
RISK-INFORMED! SUSTAINABLE!

US and EU Perspectives on Green and Sustainable Remediation Part 2

U.S. Case Study: Frontier Fertilizer Superfund Site

Bonnie Arthur
U.S. EPA Region 9

15 March, 2011

ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Chairs of EURODEMO+ and recent hosts of 2010 ConSoil

SuRF SUSTAINABLE REMEDIATION FORUM UK

Agenda

- Frontier Fertilizer Superfund Site Overview
- Groundwater Treatment Plant--Energy Efficiency Measures
- Two Solar Installations
- Treated Groundwater Reuse for Irrigation
- Source Area Thermal Treatment

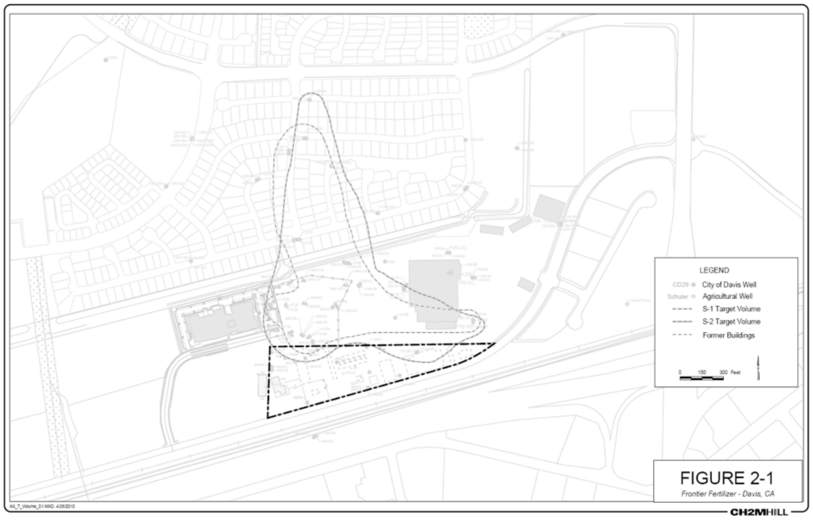
Frontier Fertilizer, Davis, CA

Davis has 78% Average Sunshine Days (defined as less than 30% cloud cover)

Site History

- 18-acre site near Davis, California
- Added to the U.S. National Priorities List (NPL) in 1994
- 1972 - 1983: Unused chemicals disposed into unlined ponds near the northwest corner of the site
- Chemicals of concern (COCs):
  - 1,2-dibromo-3-chloropropane (DBCP)
  - 1,2-dibromoethane (EDB)
  - 1,2-dichloropropane (1,2-DCP)
  - 1,2,3-trichloropropane (TCP)
  - carbon tetrachloride

Site Map
Groundwater Cleanup Target Zone



Groundwater Treatment Plant

- 16 extraction wells
- 2 pounds/month (2010 Average) of Chemicals of Concern (COCs)
- 2.4 million gallons/ month processed in plant
- 1,500 pounds of COCs treated (as of December 2010)

Groundwater Treatment Plant Energy Efficiency Measures

Combined measures reduced energy usage by 30%

- Installation of gravity fed pipe to City Sewer, 2004
  a) Capital Costs= $20,000
  b) Reduced annual electricity bill by $7,000; replaced 10 horse power pump
- Variable Frequency Drives in 16 extraction wells, 2006
  a) Capital Costs= $45,000
  b) Reduces wear on pumps by reducing start-stop cycles
  c) Stabilizes flow of water into the treatment plant

*Completed work under maintenance/upgrade contract tasks

Initial Photovoltaic (PV) System

- Roof-top PV installed in November 2007
- 5.7 kW DC system, 30 Evergreen (190 W) panels
- 8,000 kWh/ year
- Installed by local, small business

2007 PV System

- Capital Cost=$35,000
- $1,500/year electricity saving
- Reduce GHG by 4 metric tons/year
- Completed work under maintenance/ upgrade contract tasks; used “surplus” funds from contract transition

2010 PV System

- 336 Evergreen (205 W) PV Panels
- 68 kW DC; 101,125 kW-hrs/year
- Sized system based on 3 years of electricity bills
- Installed by local, small business

2010 PV System

- Capital Cost= $350,000; State Rebate – $100,000
- Annual electricity bill–$16,000
- Payoff timeframe: approximately14 years
- Reduce GHG by 50 metric tons/year
- Funds available because under-budget for contract; modified contract to complete work

Challenges:

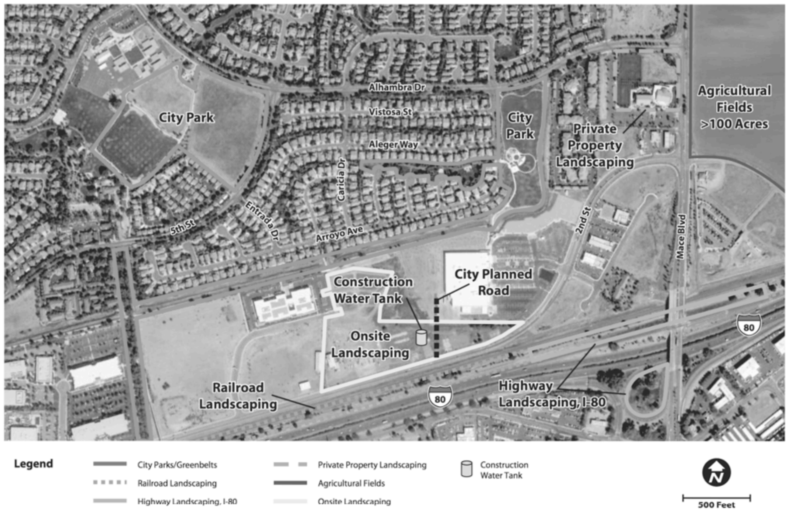
– 2009 American Recovery & Reinvestment Act—requires special reporting and material sourcing

Treated Groundwater Reuse for Irrigation

Issue: Increase beneficial use of treated groundwater

- Formed team with EPA, State agencies, EPA contractors;
- Prepared draft report for use in discharge permit--included chemical data from plant operations;
- Created map w/possible locations; started calling businesses, City of Davis, State and private businesses.

Treated Groundwater Reuse for Irrigation



Treated Groundwater Reuse for Irrigation

- Multiple planning meetings w/City Departments (Parks and Recreation, Public Works, City Managers Office);
- Partnership w/City hit recent hurdle due to budget issues. Understaffed and this budget climate prevents local communities from initiating new policies;
- Current efforts directed toward State transportation agency—Caltrans; Expect that City may hook up with us once we have system operating with another party first.

Challenges:

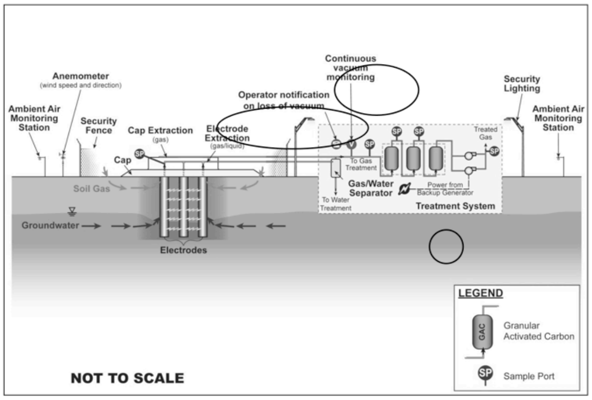
– Must be easy to operate for City use and eventual State management of the cleanup (2016);
– Avoid major intersections due to right-of-way complications;
– Limited budgets for Federal, State and local communities.

Source Area Thermal Treatment

Thermal Treatment selected as part of long-term cleanup;

- Pesticides still bound up in soils between 30-90 feet below ground-surface (bgs);
- Models predict Thermal Treatment will reduce time for groundwater treatment from hundreds of years to decades;
- Community & State desired active cleanup—they live nearby and did not want groundwater cleanup to be only cleanup.

Source Area Thermal Treatment
Electrical Resistive Heating



Thermal treatment uses 2.5 MW at peak of cleanup;
Proposed enrollment in Climate Smart Program
Increase in Cost by $0.00254 per kwh used

Renewable Energy for Thermal Heating

- Developed partnership with City of Davis to share PV (EPA use and pay for 1st 1.5 years) or fuel cells;
- Working group continued for 9 months with agreement to share cost of 1 MW solar system.

Challenges: land ownership complications

LESSONS LEARNED

- Teams should develop “to-do list” with focus on increasing sustainability of cleanups;
- Prioritize sustainability measures—this can be difficult to fit in with regular cleanup schedules;
- Reach out to local cities/villages/businesses to a) share renewable energy systems &/or b) reuse treated groundwater;
- Budget for renewable energy measures;
- Necessary to modify contracts.

US and EU Perspectives on Green and Sustainable Remediation Part 2

Sustainable Remediation – Two Green Cases

Marc van Bemmel
Bioclear, The Netherlands

15 March, 2011

ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Chairs of EURODEMO+ and recent hosts of 2010 ConSoil

SuRF SUSTAINABLE REMEDIATION FORUM UK

47

What is sustainability?

Brundtland 1987:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs

In remediation projects this means:

- Low energy use
- Low CO_2 emissions
- Use renewable resources
- Reuse of materials
- Minimal hindrance
- “remedy not worse than the disease”

Two examples of Green Remediation:

- Solar powered soil remediation
  - Ameland, The Netherlands
- Sustainability of Bio-augmentation
  - Full-scale TCE concept in The Hague
- Conclusions

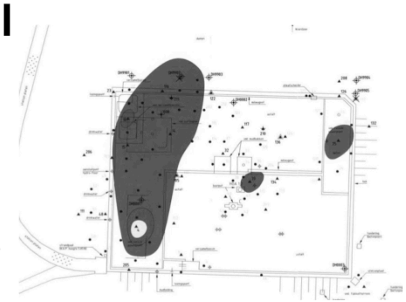
Wie zijn wij en wat ga ik deze presentatie bespreken in het kader van duurzaamheid.

Case 1. Ameland

- Former oil production site NAM
- Mineral oil contamination
- Isolated and vulnerable location

Locatie: op een eiland. Toegang: alleen met de auto via het strand. Geen elektriciteit of schoon water beschikbaar. Geen geluids- of visuele hinder was toegestaan. Het gebied ligt naast een drinking water source.

Goal



- Protect the environment
- Remediate contamination
- Protect drinkwater source

- Conditions:
  - Independent remediation system
  - No power/clean water available
  - Minimal noise and visual disturbance
  - Site acces only by car via the beach

Possible remediation strategies

- Natural attenuation
  - No actions
- Air injection
  - Stimulate biological degradation
- Pump and treat
  - Contain the contmination and clean the effluent

Er zijn verschillende afwegingen gemaakt, deze sheet laat je wat over de afwegingen vertellen
Afbraaktest: na natuurlijke afbraak is er nog steeds olie boven de interventie grens aanwezig
Solar panels veroorzaken geen overlast en kan onafhankelijk opereren.

Pump and Treat

- Low on energy demands
- Pump and treat design
  - 2 pumps
  - 6 solar panels
  - 2 batteries
  - Active coal filter
- Active fase: 5 years

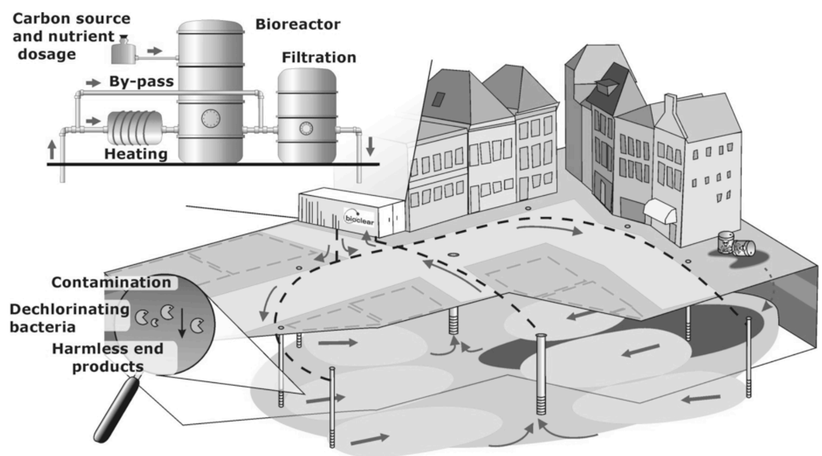
Voor het beheersen van de verspreiding van de grondwaterverontreiniging kan volstaan worden met een eenvoudig pump & treat systeem. Het systeem bestaat uit twee 12 Volts dompelpompen met een debiet van circa 0,5 m^3/uur elk, een actief koolfilter voor de zuivering van onttrokken grondwater, zes zonnepanelen en twee accu’s voor de stroomvoorziening en behuizing. Het doel van de TBM is het beheersen van de verspreiding van de grondwaterverontreiniging. Hiertoe worden de zones met de hoogste concentraties aan grondwaterverontreiniging gesaneerd. Rekening houdend met een doorspoelfactor en een overdimensionering met een factor 2 kan dit volume grondwater opgepompt worden met twee dompelpompen in een periode van circa 5 jaar. Na de periode van 5 jaar wordt de verontreiniging gemonitoord tot abandonment.

Progress

- Succesfull implementation in 2005
- Influent concentrations are diminishing
- Excellent treatment efficiency
- Decreasing groundwater concentrations near extraction wells

Case 2. The Hague

TCE concept (bio-augmentation)



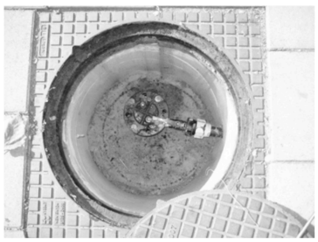
Design The Hague

- 80.000 m^3 > I-value
- Up to 1.000 µg/l
- 10 m-sl
- Densely populated area
- Medium-grained sand
- 5 Extraction wells
- 16 Infiltration wells
- Test K: 11 – 13 m/d
- Closed water balance
- Water table change < 42 cm
- 10 m^3/hour

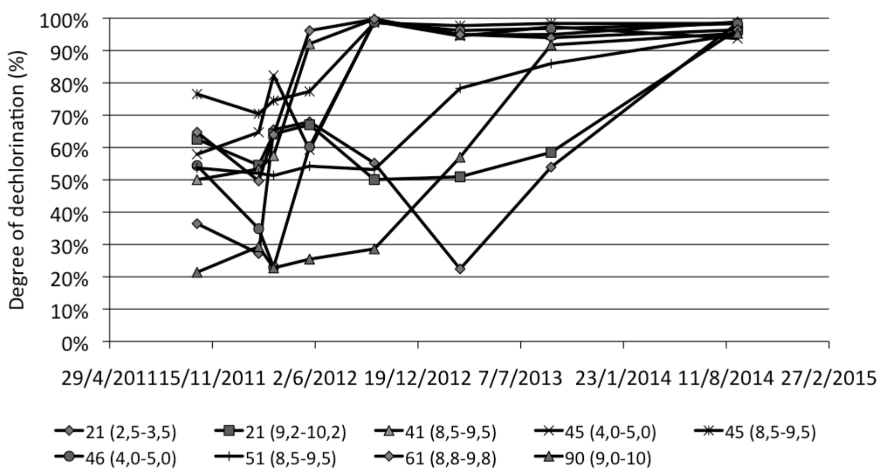
Remediation Phases

- **Active Phase**: Dec. 2007 – Sept. 2008
- **Passive Phase**: 2 Years, goal: < 0,5 (S+I)

(PCE=20 µg/l; TCE=262 µg/l; DCE=10 µg/l; VC=2,5 µg/l)



Results


Degree of dechlorination (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
29/4/2011
15/11/2011
2/6/2012
19/12/2012
7/7/2013
23/1/2014
11/8/2014
27/2/2015
21 (2,5-3,5)
21 (9,2-10,2)
41 (8,5-9,5)
45 (4,0-5,0)
45 (8,5-9,5)
46 (4,0-5,0)
51 (8,5-9,5)
61 (8,8-9,8)
90 (9,0-10)

Results

- After 1 year: 6 out of 9 wells < remediation target
- After 2 years: 8 out of 9 wells < rem. target
- Sept. 2010: Site closure
- In-situ treatment of TCE plume within 3 years
- 80.000 m^3 soil volume remediated
- Total actual costs € 441.000 (= 5,51 euro / m^3)

Sustainability Comparison

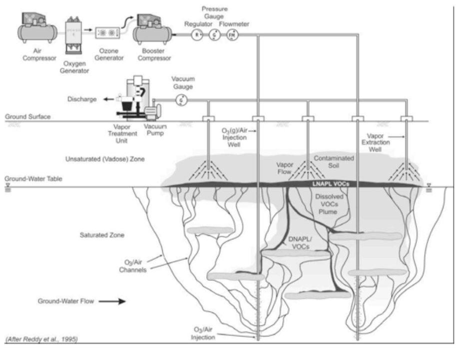
1. Bioremediation using the TCE concept (as performed)
2. Conventional Pump & Treat (hypothetical)
3. ISCO using Ozone (hypothetical)

Alternative 1. Pump & Treat

- 17 Infiltration wells
- 13 Extraction wells
- 10 m^3/hour
- Closed water balance
- Stripping system 8 KW
- Duration 10 years
- Costs est. € 900.000

Alternative 2. Ozone

- Ozone sparging
- Analogous to air-sparging
- NOD: 15 g O_3 / m^3 soil
- Sparging efficiency: 5 %
- 24.000 kg ozone
- PLI + SVE system 12 KW
- Duration 1 year
- Costs est. € 800.000



Method for comparison: MCA

SOCIAL EFFECTS
(smell, noise, hindrance, potential dangers, chance of calamities, chance of damage)

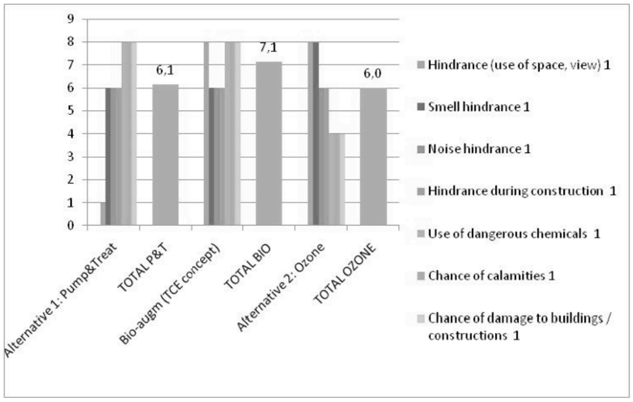
ENVIRONMENTAL EFFECTS
(air, soil, groundwater, ecology, waste production, residual contaminations)

RESOURCES AND MATERIALS
(use and reuse of water, groundwater, energy, fuels (transport), chemicals, materials)

CLIMATE EFFECTS
(Carbon dioxide & methane emissions)

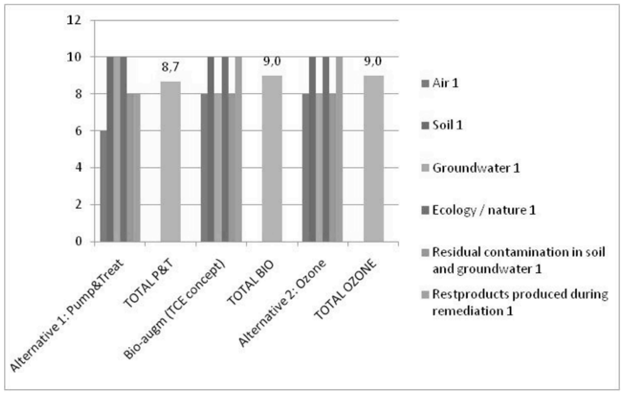
Compare remediation options on these 4 themes

Social Effects



- P & T : long term space use & deterioration of view
- Ozone : Use of a potentially dangerous chemical

Environmental Effects



Resources (Energy & Chemicals)

Parameter	P&T	TCE-concept	Ozone
Energy	700.000 KWH	**63.000 KWH**	600.000 KWH
Per m^3	8,8 KWH/M^3	0,8 KWH/M^3	7,9 KWH/M^3
Chemicals	NONE		
Lactic acid (80%)		24.000 KG	
Na-acetate ($3H_2O$)		32.000 KG	
Ozone			(24.000 KG)

Lactic Acid Lifecycle

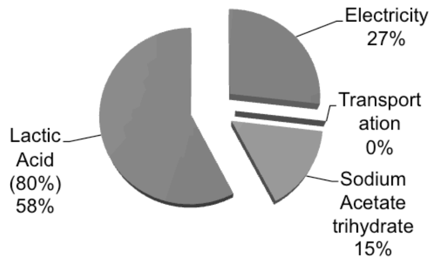
Corn → Dextrose → Lactic Acid (→ CH_4 → CO_2)

Production stage	Energy use (KWh/kg LA)	CO_2 emissions (kg CO_2/kg LA)
Corn	2,04	- 2,8
Dextrose	1,55	0,6
Lactic Acid	5,68	2,1
Total	9,06	-0,2

Lactic & acetic acid: renewable & CO_2-neutral

Energy & CO_2

Parameter	P&T	TCE-concept	Ozone
Energy	700.000 KWH	63.000 KWH	600.000 KWH
Per m^3	8,8 KWH/M^3	0,8 KWH/M^3	7,9 KWH/M^3
CO_2-total	397.000 KG	135.000 KG	361.000 KG
	5,0 KG/M3	1,7 KG/M3	4,5 KG/M3



Summary MCA results

	weight	Alternative 1: Pump&Treat score	Bio-augmentation (TCE concept) score	Alternative 2: Ozone score
Social effects	1	6,1	7,1	6,0
Environmental effects	1	8,7	9,0	9,0
Resources	1	8,0	9,5	8,0
Climate	1	6,0	9,0	6,0
Total		**7,2**	**8,7**	**7,3**

Conclusions

- Green remediation is possible in many cases
- MCA methods help in selecting sustainable remediation methods
- Bio-augmentation highly sustainable: low energy, low CO_2, low cost & very effective

Reactions or Questions:

Marc van Bemmel
bemmel@bioclear.nl
+31-50-5718455

US and EU Perspectives on Green and Sustainable Remediation Part 2

Language or Substance: Green and Sustainable Remediation Roundtable

Paul Bardos
Sustainable Remediation Forum – United Kingdom (SuRF)

15 March, 2011

ENVIRONMENT AGENCY AUSTRIA umweltbundesamt
Chairs of EURODEMO+ and recent hosts of 2010 ConSoil

SuRF SUSTAINABLE REMEDIATION FORUM UK

73

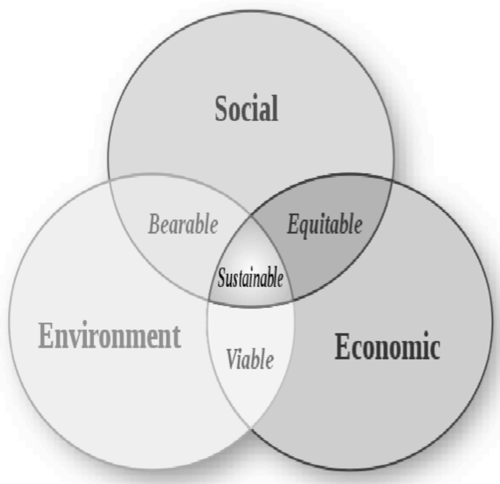
Contents

- Definitions
- How / Why are green and sustainable remediation different?
- Some questions for you

Definitions

- Green remediation is a term specifically defined by the US EPA
- Sustainable remediation is a term that has been described / defined by various initiatives
- Both terms have a colloquial use which can be confusing

Defining Sustainability…

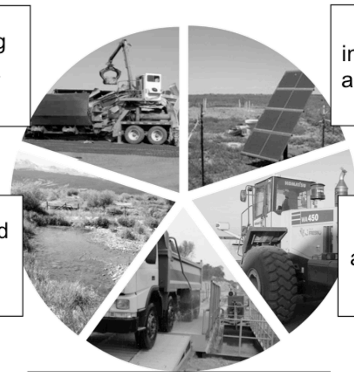


'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (1987, Brundtland)

Green Remediation – US EPA view

Managing and minimizing **material** use and **waste** generation

Reducing **energy** use, increasing energy efficiency, and using renewable energy sources



Conserving, protecting, and restoring **land and ecosystems**

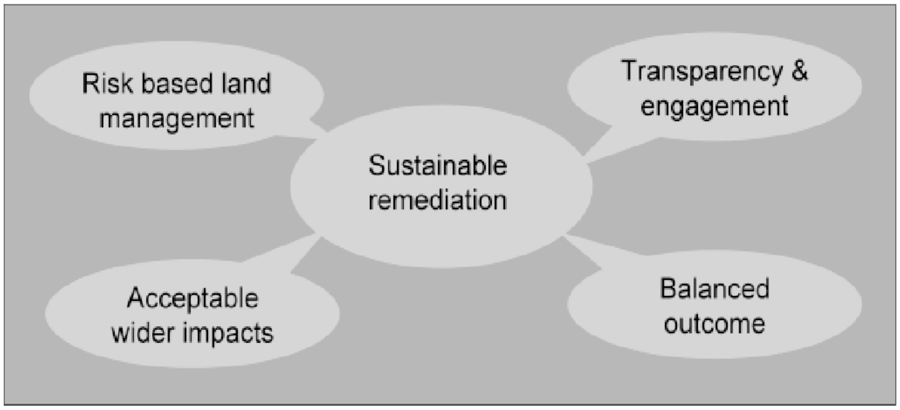
Protecting the quality of **air** and reducing emissions and greenhouse gases

Conserving **water** use and improving the overall quality of water

Green Remediation

- Green remediation integrates environmentally beneficial or neutral practices into decision-making, design, implementation, and operational strategies of a site cleanup
- It requires transparency of cleanup decision-making, planning and implementation activities for the local community and other stakeholders.

Sustainable remediation



Typical definition (SuRF-UK)

- '*the practice of demonstrating, in terms of* ***environmental, economic*** *and* ***social*** *indicators****,*** *that the benefit of undertaking remediation is greater than its impact and that the optimum remediation solution is selected through the use of a balanced decision-making process*'

- www.claire.co.uk/surfuk

- Definitions and descriptions also made in US (SURF), Australia, Europe (NICOLE) are not substantively different

In Common

- Wider environmental criteria than solely meeting remediation risk management objectives
- Transparency and engagement in decision-making

Different

- Range of environmental criteria
- Presence / absence of social and economic criteria
- Decision making boundary
  - Green remediation – strictly remediation process related
  - Sustainable remediation – remediation as a component of a wider land management set of decisions

Why?

- Legal constraints on organisational responsibilities
- Differences in contaminated land management policy and regulation
- Market “pull”

Confusions

- Green remediation is used colloquially by some people to mean sustainable remediation (or variants thereof)
- And *vice versa*
- Not everyone's "sustainable remediation" is exactly the same
  - Differences in scope, approach and criteria

Questions

1. Would you agree with this analysis?
2. Is it a problem to have “green” and “sustainable” remediation, or can they co-exist?
3. Can a green remediation making and a sustainable remediation context be applied in the same project?
   – Would this be helpful in some jurisdictions?
4. How helpful is it to consider green remediation a subset of sustainable remediation?
5. What in a practical sense is the added value of including economic and social criteria, compared with considering environmental criteria alone

Resources & Feedback

- To view a complete list of resources for this seminar, please visit the **Additional Resources**
- Please complete the **Feedback Form** to help ensure events like this are offered in the future

Need confirmation of your participation today?

Fill out the feedback form and check box for confirmation email.