Sustainable Remediation Forum (SURF) 4 Meeting
August 22-23, 2007
Newark, NJ

Meeting Attendees

Dave Ellis (SURF Chair, meeting sponsor), DuPont
Dan Watts (meeting host), New Jersey Institute of Technology (NJIT)
Mike Rominger (meeting facilitator), DuPont
Maria Hunt (meeting recorder), URS Corporation

The remaining attendees are listed in Attachment 1.

Meeting Opening

This meeting marked the fourth time that various stakeholders in remediation—industry, government agencies, environmental groups, consultants, and academia—came together to develop the ability to use sustainability concepts in remedial decision making.

The meeting began with Dan Watts (NJIT) introducing Don Sebastian (Vice President for Research and Development at NJIT). Don welcomed everyone to the NJIT campus and gave a brief introduction to the university's history, current academic opportunities and path, and NJIT's interest in working with SURF.

Mike Rominger (DuPont meeting facilitator) welcomed everyone to SURF and thanked Dan, Don, and the meeting's design team (the team is indicated in Attachment 1). Mike reviewed the anti-trust statement and mission statement, discussed meeting logistics, and reviewed the meeting guidance as follows:

> *There is a clear expectation that attendees will be active participants whether attending by phone or in person. They will show respect for others, appreciate and encourage divergent opinions, and refrain from marketing. New participants are expected to be familiar with the notes from past meetings so that the meeting can focus on new information.*

Mike noted that the SURF discussions and information seemed to comply with Export Control regulations. Introductions were then made, and the notes from prior meetings (November 13, 2006, February 8, 2007, and May 10, 2007) were available in hard copy for those participants attending the meeting in person.

News Briefs

Dave Ellis (DuPont) led the discussion for news briefs. He mentioned the June 18, 2007 UK Sustainable Remediation Meeting, sponsored by Contaminated Land: Applications in Real Environments (CL:AIRE) and held in London. Deb Goldblum from the U.S.

Environmental Protection Agency (EPA) Region 3, gave a quick update on the status of the EPA Region 3 pilot project, first discussed at the May 10 meeting.

CL:AIRE Sustainable Remediation Meeting

Nicola Harries (CL:AIRE) updated everyone on the June 18 London meeting (see Attachment 2). The purpose of the June meeting was to bring together stakeholders in the remediation industry to develop the concepts of sustainable remediation decision making. Moving forward, the group will develop work packages that address the path for developing the sustainability remediation framework. After the presentation, one attendee noted that it seemed like a formal process and asked if there was any discussion about going informal. Nicola responded that there was no direction to go formal, but it seemed the best approach for getting buy-in from regulators. However, since the initial development of this process would be industry led, the final process would be more flexible. When asked if Europe's effort is comparable to the UK efforts, Nicola mentioned a sharing of ideas with Hans Van Duijne from Holland and that the UK is committed to sharing the effort with the European network. Dave Ellis also mentioned his continuing effort in working with CL:AIRE.

Update on EPA Region 3/DuPont Martinsville Pilot Program

Deb Goldblum (EPA Region 3) explained the pilot project and described the current status (see Attachment 3). The purpose of the pilot is to test how to use sustainability as one of the balancing criteria in the Resource Conservation and Recovery Act (RCRA) Corrective Action framework. Potential remedial measures for soil and groundwater have been identified and evaluated using the sustainability assessment tool. The team began by applying debits (e.g., emits carbon dioxide) and credits (e.g., reduces carbon dioxide emissions) to the technologies based on their operation. Then, they categorized the information into four steps: project data, remedial options, calculation modules, and sustainability factors. Each step in the process was evaluated, including the CO_2 generated from the truck's route to and from the site. Using a tiered approach, the team first examined the greenhouse gas and energy, then focused on the site-specific issues.

History of New Technologies and How It Can Help SURF

As a way of putting perspective on acceptance of sustainability metrics, Gil Meyer (DuPont) presented a history of human reactions to new technologies (see Attachment 4). Gil's main message was that the road to acceptance of new technology is slow and can be hindered or helped through our understanding of how current society deals with these technologies. He recommended managing risk and resistance to change by not over promising, doing each step well, and making sure the steps are small because moving too quickly can backfire.

Metrics Presentations

Seven presentations were designed to answer the following question: How Might We Better Understand the Use of Metrics in Making Better Sustainable Remediation Decisions?

Ecosystems Evaluations

Charles Iceland presented World Resources Institute's corporate ecosystem services (see Attachment 5). As regulatory and legal issues drive opportunities, businesses need to prepare and respond to these services. Charles presented the steps to conducting an ecosystem-services review and the activities involved as well as the risks and opportunities associated with these services. When asked about the relationship between low regulations in 3rd world countries and the effect on adequate resources for ecosystems needs, Charles pointed out that even highly regulated 1st world countries are vulnerable to climate changes (e.g., Canada's lack-of-water issues). He concluded his presentation with industry case studies.

The Longevity of CO_2 in the Atmosphere

Dan Watts presented facts, assumptions, and uncertainties of atmospheric persistence of carbon dioxide (see Attachment 6). Although it's a simple question—"how long does CO_2 released to the atmosphere, stay in the atmosphere?"—the answer is complex because we know little about the CO_2 removal rates when conditions change.

As Dan explained, a portion of CO_2 is absorbed by the ocean, residing on the bottom of the ocean. Whether it re-emerges at some point or stays in the sediment is unknown. Once it is absorbed in the atmosphere, there's no certain way of knowing how long it remains. Based on the Intergovernmental Panel on Climate Change, past CO_2 atmospheric additions (starting with the industrial revolution) appear to be mostly still present. The approach is not get back to pre-industrial levels but to stabilize emissions versus stabilizing concentrations of CO_2. Dan closed by saying that even though if CO_2 emissions have a century-life-span, we shouldn't stop thinking about reducing CO_2 and its effect on future generations.

National Grid Sustainability Calculation Tools

Frank Evans (National Grid Property) discussed National Grid's use of metrics in making better sustainable remediation decisions (see Attachment 7). He explained the National Grid Perspective from the role of landowner and the plan for tackling climate change. This plan involves incorporating sustainable remediation factors within the environment, social progress, and economic factors and determining whether adding sustainable remediation can be expressed in monetary units.

Frank described the cost benefit analysis, which is a part of the UK toolbox and for which there is guidance available, with sustainable remediation included. While gathering the information, Frank focused on six remediation techniques that represented the most projects in the program and contributed to the current targets. Even narrowing the discussion to the six presents challenges for balancing company objectives (maximize re-use, minimize impact to climate, maximize land value, minimize costs, and keep safety performance high). Frank discussed the plan for continued development of the metric through refining and validating the model, adding further aspects and remediation techniques, evaluating internal decision making as a consequence, and engaging U.S. counterparts.

Superfund Remedial Program Energy and Carbon Footprint: Initial Analytical Approach for Site Cleanup Treatment Technologies

Carlos Pachon from EPA Office of Superfund Remediation & Technology Innovation (OSWER) presented the initial analytical approach to site-cleanup treatment technologies (see Attachment 8). He defined "green remediation" as the practice of considering the environmental effects of a remediation strategy early in the process and incorporating options to maximize the next environmental benefit in the cleanup action.

Carlos focused on identifying opportunities for improvements in the cleanup action. Historically, groundwater remedies consisted of pump-and-treat (P&T) systems. Using the energy and carbon footprint flash analysis findings, P&T are compared to four other remedies. When asked about the continued use of P&T systems, Carlos responded that they still fill a need and will continue to be a part of the analysis. Carlos then presented research performed by Amanda Dellons, NEEMS Fellow at EPA (as stated on slide 12, the final results are expected to be published in October 2007 on http://cluin.org).

Metrics from Cherokee

Holly Fling (Cherokee Investment Services, Inc.) shared copies of the Cherokee model for the sustainability guidelines as they apply to economic, social, and environmental factors (see Attachment 9 for the one-page matrix).

Metrics from a Variety of DuPont Sites

Dave Ellis examined the use of metrics at three DuPont sites: East Chicago, Reichhold, and Brevard (see Attachment 10):

- At East Chicago, DuPont installed a permeable reactive barrier (PRB) instead of a traditional P&T system. Filling the PRB with slag instead of iron was initially based on the fact that slag is more effective than iron. The sustainability assessment showed that the use of slag instead of iron substantially reduced the greenhouse impacts of the PRB.
- Riechhold, a former chemical site near downtown Chicago, is a redeveloped brownfield with department stores. The assessment showed the use of crushed concrete as clean fill, although cheap and available, was not the best sustainable choice because recycling the concrete would have saved a lot of CO_2.
- The DuPont Brevard, North Carolina site includes an industrial landfill containing off-spec PET films. The recovery and recycling of the landfill material was shown to yield 80-million pounds of re-usable PET. The sustainability estimates were quite complete, going from excavation and sorting through truck and boat transportation from Brevard to Shanghai, China. This recycling action avoids the emission of up to 106,000 tons of CO_2. If CO_2 credits were available for the avoided CO_2, they would be worth at least $425,000 and potentially much more if

the price of CO_2 credits increases. It's clear that resource recovery and recycling efforts can have a significant impact on lowering greenhouse gas emissions.

Metrics at a BP Site

Stephanie Fiorenza (BP) and Dick Raymond (Terra Systems) presented sustainability of sludge pit remediation (see Attachment 11). Using a simplified approach, BP modified the DuPont/URS model by showing pre-construction activities under one task, focusing on CO_2 through each task, and using a yes/no qualifier.

Site-Specific Activity Presentations

Perspective from a Brownfield Redeveloper

Jim Poling (Delaware Department of Natural Resources and Environmental Control) presented Delaware's brownfield development program (see Attachment 12). The brownfield program began as part of a Livable Delaware Task Force, whose goal was to protect the potential purchaser who would not cause or contribute to contamination and would be willing to take as a risk. There is a constant balancing act between re-using the space and improving the surrounding community. Without proper planning (addressing the needs of the poor in the surrounding community with affordable housing and integrating new communities with existing ones) and without adequate infrastructure in place (new/improved roadways, adequate sewer systems, etc.), new development can become future brownfields. Some attendees commented on the importance of incentives for new developments and of addressing the needs of the community work force (e.g., keeping an industrial site as such so that the working class has jobs close by).

Somersworth Landfill Post Mortem

Dave Major (GeoSyntec Consultants) presented a sustainability post-mortem analysis of the Somersworth Landfill in Somersworth, New Hampshire (see Attachment 13). The initial goal was to find a more cost-effective alternative to attain risk and regulatory compliance objectives as outlined in the Record of Decision (ROD). The team selected a PRB remedy instead of the EPA recommended P&T system. The project did have the right sustainability end point, but at the time, decisions were based on costs.

Summary of Open Discussions

The group consensus was that the concept of sustainability metrics is helpful and valuable. The group expressed a wide variety of opinions about whether sustainability estimates should be qualitative or quantitative. It seemed likely that companies and regulators will feel a need to customize sustainability considerations. A broad consensus on the need for—and the use of—sustainability estimates and metrics would be very helpful. Some participants believed that certain metrics (for example global warming) are likely to be useful at all sites. Others believe that every site needs a customized set of metrics based on stakeholder desires, location, and details of its contaminants.

Several participants believe that detailed calculations of sustainability parameters are necessary to understand project impacts. Their position was that only a detailed estimation process can discover which parts of a project have significant impacts and which can be omitted without changing conclusions. Others felt that detailed estimates may be too complex for many sites, especially small ones and favored qualitative assessments.

No consensus was reached on whether sustainability assessments should be required in remedial actions. Regulatory representatives expressed concern that all responsible parties or consultants may not have the capability to conduct sustainability assessments. Creating a wide knowledge base or a "sustainability light" approach may be necessary to achieve broad acceptance of sustainability as a requirement in cleanup decisions.

Feedback

At the end of each day's session, a question was posed to the attendees to gage progress and to provide guidance for future gatherings (see Attachment 14 for the participant responses):

- ❑ Question #1 was "What metrics issue causes you the most concern?" The following issues appeared most often among the responses: the number of metrics, the process to evaluate/weight those metrics, the lack of common understanding of the metrics, and uncertainty about how much detail was necessary in calculating a specific metric.
- ❑ Question #2 was "Is there any barrier preventing a full discussion of sustainability in a hypothetical meeting of key stakeholders on a particular remediation situation?" The lack of a common definition and understanding of "sustainability" among all participants was the most frequently noted issue.

Path Forward

The following path forward items were identified at the meeting:

- ❑ The volunteers for the SURF 5 Meeting Design Team are as follows: Dave Ellis (DuPont), Dave Woodward (Earth Tech), Dick Raymond (Terra Systems), Jane Anderson (Chevron), Nick Lagos (LFR), Paul Favara (CH2M Hill), Paul Hadley (CA DTSC), and Mike Rominger (DuPont). Additional members are welcome.
- ❑ The next meeting will be held on November 28 and 29, 2007. It will be located at the California DTSC Sacramento Regional Office, 8800 Cal Center Drive, Sacramento, CA 95826-3268. A draft agenda will be developed by the Meeting Design Team and will be circulated via e-mail. Active feedback and suggestions on the draft agenda are encouraged.

Attachment 1
August 22-23, 2007
Participant Contact Information

Attachment 1
August 22-23, 2007 Meeting
Participant Contact Information

Name	Organization
Dave Ellis**	DuPont
Mike Rominger**	DuPont
Maria Hunt	URS Corporation
Andrea Leeson	SERDP/ESTCP
Brandt Butler	URS Corporation
Bryan Ashby	Delaware Dept. of Natural Resources and Environmental Control Div of Solid & Hazardous Waste Management Branch
Carlos Pachon	U.S. Environmental Protection Agency
Carol Johnston	Ironbound
Charles Iceland	World Resources Institute
Chuck Newell	GSI
Dale Sands	EarthTech
Dan Watts**	New Jersey Institute of Technology
David Major	GeoSyntec Consultants
David S. Woodward	EarthTech
Deborah Goldblum	U.S. Environmental Protection Agency
Dick Brownell	Malcolm Pirnie, Inc.
Dick Raymond	Terra Systems
Erica Becvar	Air Force AFCEE
Erv Bales	NJIT
Frank Evans*	National Grid Property, Ltd.
Frank Gavas**	Delaware Dept. of Natural Resources and Environmental Control
Gil Meyer*	DuPont
Glen Schultz	Waste Management
Harnoor Dhaliwal	NJIT
Holly Fling	Cherokee Investment Services
Jane Anderson	Chevron Environmental Management Company
Janice Barber*	Dow Chemical Company
Janine MacGregor*	New Jersey Dept. of Environmental Protection
Jenny Phillips	U.S. Environmental Protection Agency Office of Site Remediation Enforcement
Jim Polini	Delaware Dept. of Natural Resources and Environmental Control
John Gallagher	Cherokee Investment Services
Lisa Axe	NJIT
Maile Smith	Northgate Environmental Management, Inc.
Michael Caldwell	Waste Management
Mike Houlihan**	GeoSyntec Consultants
Mike Kavanaugh*	Malcolm Pirnie, Inc.
Nick Lagos	LFR
Nicola Harries*	CL:AIRE
Paul Favara	CH2M Hill
Paul Hadley*	California Environmental Protection Agency
Penny McDaniel*	EPA Region 9
Ralph Nichols**	Savannah River National Laboratory
Rich Dulcey	ERM

Attachment 1
August 22-23, 2007 Meeting
Participant Contact Information

Name	Organization
Sheryl Telford	DuPont
Stella Karnis*	Canadian National Rail
Stephanie Fiorenza**	British Petroleum
Tim Metcalf	Honeywell

Teleconference attendees are noted by asterisks.
SURF 4 Meeting Design Team members are noted by two astericks.

Attachment 2
CL:AIRE Sustainable Remediation Meeting
Nicola Harries CL:AIRE

UK SUSTAINABLE REMEDIATION MEETING Update

Nicola Harries – Project Director CL:AIRE
22nd August 2007

Contaminated Land: Applications in Real Environments

CL:AIRE

Background

The English Government through its Departments – Department of Communities and Local Government (CLG) and Department for Environment, Food and Rural Affairs (DEFRA) and English Partnerships (EP) who are the National Regeneration Agency for England have asked CL:AIRE to take forward this initiative to bring together stakeholders in the remediation industry to develop the concepts of sustainable remediation decision making.

Contaminated Land: Applications in Real Environments

CL:AIRE

18th June 2007 Meeting London

Invited audience of 28 people representing the following sectors:

- •Government
- •Regulator
- •Industry
- •Environmental Consultants
- •Technology Vendors
- •Contractors
- •Other European Organisations
- •NGO
- •Academia

Contaminated Land: Applications in Real Environments

CL:AIRE

Meeting

- The day was independently facilitated with much of the day broken into small group working.
- CL:AIRE had endeavoured to split the audience to ensure that there was a variety of expertise within each group.
- Presentations were given after scene setting offering key organisations perspectives and examples of developing good practice.

Contaminated Land: Applications in Real Environments

CL:AIRE

Plenary Session

Success Criteria

- Each group was asked to agree two /three success criteria that they felt should be used for judging sustainability in remediation.

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CL:AIRE

Results

Group 1 :

1. Invest in improved site characterisation to reduce the need for remediation
2. Sustainable remediation for one planet living
   - Link to local stakeholders
   - Consideration/benefit to community and society at all levels
3. Develop a 'measurement framework'
   - Quality
   - Quantity
   - Variable scales – global/local

Contaminated Land: Applications in Real Environments

CL:AIRE

Group 2 :

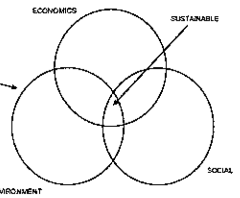
1. Policy
   - Responsibility/stewardship
   - Zero carbon (net) ie Code for sustainable development
   - Framework – decision making
2. Metrics
   - Qualitative
   - Quantitative
   - What works now (measuring/calculating) → Practical Tools
   - Transparent standards
3. Today
   - Ongoing interest
   - Sharing perspectives

Group 3 :

- Need for common approach
- Link it to verification
- Increase weighting in options appraisal (currently only 5-10 points out of 100)
- Carbon labelling vs. carbon footprint
- Verification role – perhaps Carbon Trust ?
- Where to start – eg Atkins start at operational phase rather than go to minute detail
- Threshold of significance for sustainability vs. Cost benefit Analysis
- Embed sustainability in remedial design
- Have teeth without being prescriptive
- Offset elsewhere
- Use of existing metrics for air, land, water

Group 4:

Is 'sustainability' this?



- Define aspects and Key Performance Indicators
- Define boundaries
- How do we compare aspects?
- How do we get buy-in from stakeholders?
- How do we incentivise stakeholders?
- What are the barriers to implementation of sustainable redemption (eg waste regsl)?

Summary of Group Session

Main priority areas/common themes that had been identified from the group sessions that needed addressing to demonstrate success were grouped under the following headings:-

1.Metrics/ Framework – buy-in of a trusted system
2.Incentives/Barriers
2a.Carbon Trading
2b.Investment in Characterisation
3. Affect on Design and Delivery eg Peer Review, what works where, Policy eg Brownfield Strategy

Brainstorm Actions

Split into groups according to their areas of greatest interest. It was decided due to overlap that areas 2 - Incentives/Barriers and 2b – Investment in Characterisation would be part of 3 – Design and Delivery, leaving just three areas for further discussion:

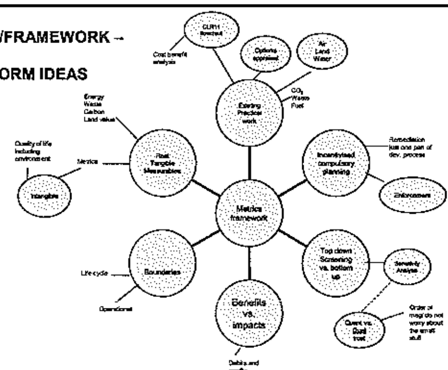
•Metrics/Framework
•Carbon Trading
•Affect on Design and Delivery

The three groups were then requested to brainstorm priority actions relating to their areas identifying those areas that require action, when can the actions be carried out, taken forward and by who, taking account of 3 aspects:-

•Urgency
•importance
•Ability to lever action

METRICS/FRAMEWORK –

BRAINSTORM IDEAS



CARBON TRADING – BRAINSTORMED IDEAS

•Soil trading*
•Bank of Clean soil traded for contaminated soil to be cleaned *
•Carbon Trading*
•Carbon avoidance versus. Reduction * - setting up remediation projects as profit centres
•Independent validation of schemes
•Water trading*
•Resource trading*
•Carbon value now/future
•'British Bank of Sustainability'*
•Ethical investment funds
•Effect of future land use on carbon value over life time of use
•Operation and management of a carbon market – who, how?

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DESIGN & DELIVERY – BRAINSTORMED IDEAS

- Would it change what we do now? (1)
- Need for partnering (1)
- More expensive? (1)
- Impact on 'cowboys' – raise standards (1)
- Stop a lot of clean up jobs happening – monitoring (1)
- Assessors? (4)
- Penalties and incentives/Green procurement (2)
- Need to build on knowledge now and test and pilot (full scale demonstrations) (1)
- How do we implement, can we use existing regulations. framework, ie can Cost Benefit Analysis/Life Cycle Analysis be used with sustainability? (3)

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CLAIRE

DESIGN & DELIVERY – BRAINSTORMED IDEAS (continued)

- Link with planning system – modify? DCLG and Defra are currently consulting on planning process. Planning does not cover all remediation (about 90%). IPPC is used for existing sites. (1)
- Tiered approach (3)
  - Low impact/low cost
  - Good robust metrics
  - Conceptual model
- Generic screening/generic processes and flexible (3)
- Four areas for further work:
- Pilots/ Demonstration projects
- Incentives
- Tool
- Assessors

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METRICS/FRAMEWORK

1. Proposed Action
- Review sustainability assessment tools from <u>outside</u> remediation community. (Look for simple approaches).
- Review existing tools within industry, eg CLR 11.
- Determine what can be re-used/adapted and identify where are there gaps/and where new tools are needed.

2. Proposed Action
- Define boundaries – where to start/stop in lifecycle analysis
  - Take examples of a variety of remediation sites
  - Map supply chain for different sites
    - Map available data/measurements – keep practical
    - Develop lifecycle inventory
  - Draw actual boundaries and keep practical and avoid possible duplication with automotive, design, manufacturing, materials sector
  - Time factor and future use of site (modelling?)

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CLAIRE

METRICS/FRAMEWORK

3. Proposed Action
- To develop a UK approved atmospheric emissions modelling tool (CO2, Nox etc). May be something simple like P20 that regulator understands.
  - Considering pertinent remedial technologies
  - Research emissions data
  - Boundaries? Investigate supply chain
- Further research to consider what should be assessed (and how), ie
  - Landfill resource, imported materials (resource depletion)
  - Land value
  - Societal value
  - Ecosystem value
- Straightforward?

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CLAIRE

METRICS/FRAMEWORK

4. Proposed Action
- Include (system) within planning system and offer incentives (eg save time (quick process) or money (tax incentive). (Mirror Regulatory Approach in Part IIa sites (through options appraisal))
  - (Build on best parts of both – multi-tiered system (reasonable and proportionate))
  - (Not sure on voluntary remediation)

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CLAIRE

CARBON TRADING

1. Proposed Action

- Time effects on carbon trading

-Derivative from carbon market
-Derivation from robust measurement framework

2. Proposed Action

- British Bank of Sustainability
- Soil trading
- Resource trading, eg water trading

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CL:AIRE

CARBON TRADING

3. Proposed Action

- Carbon trading facility/bank
  - Linked to energy use (current schemes linked to emissions control)
  - Method (robust) for measurement of carbon impact
  - Validation /audit scheme (independent)
  - Carbon valuation/appraisal
  - Set of standards for method of measurements

Contaminated Land: Applications in Real Environments

CL:AIRE

DESIGN AND DELIVERY

1. Proposed Action

Assessors (LA, consultants, independent)
- Training
- Raise awareness
- Competence framework

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CL:AIRE

DESIGN AND DELIVERY

2. Proposed Action

- Demonstration Projects (based on framework implementation)
  - Identify site owners/partners (eg EP, Olympics, Developers)
  - Steering Committees: regulators and all stakeholders (site owners, consultants and UK SURF)
  - Government Department responsible for regeneration (Communities and Local Government)
  - Europe

Contaminated Land: Applications in Real Environments

CL:AIRE

DESIGN AND DELIVERY

3. Proposed Action

- Identify incentives to push sustainability forward (also penalties)
- Steering Committee to commission scoping study or assessment of measures that could be implemented/used (eg green procurement, planning gain, etc)

Contaminated Land: Applications in Real Environments

CL:AIRE

DEVELOPING A SUSTAINABILITY REMEDIATION FRAMEWORK – WAY FORWARD

PHASE1 – Set up Steering Group and individual Work Packages

WP1	WP2	WP3	WP4
Literature Survey	Review CBA frame work	Existing tools outside industry	Existing tools inside industry

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CL:AIRE

Way Forward

- WP1 – Output from literature survey – policy development, metrics/indicators, key learning, tools available and potential overlap.
- WP2 – Review the current CBA framework and assess how workable it is to sustainability. The current 3 volumes, (1 for soil and 2 for groundwater) need the individual tiers to be separated out more clearly and expanded to reflect on the wider environmental impacts and identify parameters that have greater applicability to sustainable remediation.
- WP3 – Review existing tools and identify what parameters are covered by other industries sustainability assessment tools and could have applicability including Life Cycle Analysis.
- WP4 - Review existing tools and identify what parameters are covered by the different tools and identify potential overlaps. Existing tools include: Dupont, National Grid, Atkins, Golders, Entec, Shell, BP, EA CBA.

Currently

- Getting proposals from organisations to take forward individual work packages
- Hope to have this finalised at end of September to take to government departments/NGOs to get their buy in and funding.
- Set up Steering Committee

Thank you

Any Questions

Attachment 3
Update on EPA Region 3/ DuPont Martinsville Pilot Program
Deb Goldblum, EPA Region 3

Region 3 RCRA / DuPont Sustainability in Remediation

An Evolving Pilot

Deborah Goldblum
EPA Region 3
RCRA Corrective Action
SURF 4 – Newark, NJ
August 22, 2007

RCRA Remedy Selection Criteria

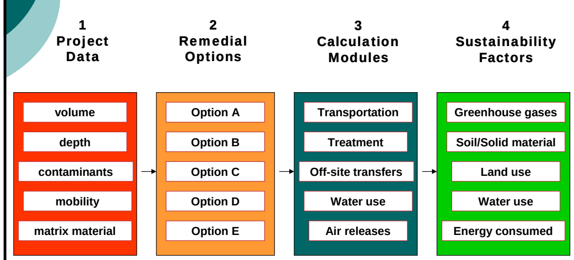
Threshold Criteria
- Protect Human Health & the Environment
- Control Sources
- Meet Cleanup Objectives

Balancing Criteria
- Long-term reliability
- Reduction of toxicity, mobility or volume
- Short-term effectiveness
- Ease of implementation
- Cost
- Community acceptance
- State acceptance
- Sustainability

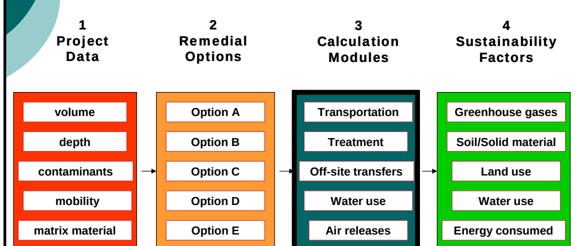
DuPont Credit and Debit Matrix (April 07)

Media or Impact	Credit (+)	Debit[1] (-)
Greenhouse Gases (CO_2 equivalents)	Sequestration	CO_2 generated by fuel used during remediation CO_2 generated by manufacturing of consumables
Resources		
Soil/Solid Material (tons)	Reused-recycled soil or soil-substitute (crushed concrete)	All soil required Off-site disposal
Land (acres)	Beneficially reused (brownfields, wind field, solar field) Wetlands created or upgraded	Permanently deed restricted
Water (gallons)	Reused-recycled	All water used or captured for treatment Water for dust control
Energy (kWh)	Renewable energy generated on-site	Required by remediation Required for manufacturing of consumables

Conceptual Framework for Sustainability Analysis



Conceptual Framework for Sustainability Analysis



Project Data - Unit H1

- Former finish oil disposal pond
- Chlorinated VOCs in soil & groundwater
- PCBs, arsenic (coal ash) in soil
- About 100' diameter; impacts 3.5 to 8 feet bgs
- Groundwater about 90' bgs
- Soil volume 63,000 cf

Remedial Options – Unit H1

Source remediation to meet MCLs throughout the plume

- Excavate (source material removal) and landfill + MNA
- Excavate & ex-situ thermal treatment + MNA
- Cap + MNA
- SVE + MNA
- Zero valent iron (ZVI) in-situ treatment + MNA

Calculation ZVI + MNA (April 07 Matrix)

Media or Impact	Credit (+)	Debit[1] (-)
Greenhouse Gases (CO_2 equivalents)	❑ Sequestration	❑ CO_2 generated by fuel used during remediation ❑ CO_2 generated by manufacturing of consumables
Resources		
○ Soil/Solid Material (tons)	❑ Reused-recycled soil or soil-substitute (crushed concrete)	❑ All soil required ❑ Off-site disposal
○ Land (acres)	❑ Beneficially reused (brownfields, wind field, solar field) ❑ Wetlands created or upgraded	❑ Permanently deed restricted
○ Water (gallons)	❑ Reused-recycled	❑ All water used or captured for treatment ❑ Water for dust control
Energy (kWh)	❑ Renewable energy generated on-site	❑ Required by remediation ❑ Required for manufacturing of consumables

Calculation Module - ZVI + MNA Identify Components

Task	Item	Quantities
Mobilization and Site Prep	Time Staff Equipment	10 days 11 - 1 Super, 1 Eng'r, 9 Operators & Laborers Man lift, forklifts (2), crane, mix head, others
Crane and Mix Head Assembly	Time	5 day
Shallow Soil Mixing	Time Staff Equipment Materials	17 days 11 - 1 Super, 1 Eng'r, 9 Operators & Laborers Mix head/crane, fork lifts, excavator 70 ton ZVI, 50 ton bentonite, 200 ton kiln dust 130,000 gal water
Demob, including grading	Time Staff Equipment	4 days 11 - 1 Super, 1 Eng'r, 9 Operators & Laborers Excavator, man lift, forklifts (2), crane, mix head
Asphalt Paving	Time Staff Equipment Materials	4 days 8 - 1 Super, 1 Eng'r, 6 Operators & Laborers Asphalt spreader, backhoe and roller 6" subbase, 3" base coarse, 2" top coarse

Calculation Module – ZVI + MNA Greenhouse Gases

Fuel from remedy

- Mobilization/demobe
- Soil mixing
- Regrading
- Sub-base installation
- Delivery of ZVE
- Delivery of kaolinite
- Delivery of flyash
- Sampling events

Gasoline (gallons)

Diesel (gallons)

CO2 from consumables

- ZVI
- bentonite
- kiln dust

Process Model Examples - CO2 Emissions

Combustion of Fuels			CO2 emissions				
Fuel	Quantity	Unit	Pre-Combustion	Combustion	Total	Data Source	Total GWP kg CO2 eq
			lb CO2	lb CO2	lb CO2		
Diesel	1000	Gal	3258	22543	25801	nrel.gov/lci	
Gasoline	1000	Gal	2776	17403	20179	nrel.gov/lci	
	Quantity	Unit	kg CO2	kg CO2	kg CO2		
Diesel	1	kg	0.46	3.18	3.64	nrel.gov/lci	
Gasoline	1	kg	0.46	2.86	3.31	nrel.gov/lci	
Propane	1	kg	0.48	3.00	3.48	ecoinvent	3.59
Consumables	Quantity	Unit	kg CO2	kg CO2	kg CO2		Total GWP kg CO2 eq
Electricity, US Average	1	kWh			0.85	nrel.gov/lci	0.861
Electricity, US Average	1	kWh			0.73	MSU data	0.77
Cement	1	kg			0.74	Ecoinvent	0.77
Concrete	1	cubic yard			195.47	Ecoinvent	202.53
HDPE Sheet	1	kg			2.41	Plastics Europe	2.47
High Alloy Steel Pipe	1	kg			4.99	Ecoinvent	5.31
Carbon Steel Pipe	1	kg			1.85	Ecoinvent	2.02
PVC pipe	1	kg			2.35	Industry data	2.58
Activated Carbon	1	kg			6.45	Kirk-Othmer,nrel.gov/lci	
Asphalt	1	USD			2.00	US Input-Output DB	2.49
Zero Valent Iron	1	kg			1.21	Ecoinvent	1.32
Kiln Dust	1	kg			0.74	Co-product of Cemer	0.77
Bentonite	1	kg			0.44	Ecoinvent	0.47
Transportation - Use the table below from NREL, then the combustion data above to get to energy and CO2							
	Quantity	Unit	lb CO2	lb CO2	lb CO2		
Xport - Tractor trailor	1000	ton-miles	34.2	236.7	270.9	nrel.gov/lci	
	10.5	Gal Diesel					
	Quantity	Unit	kg CO2	kg CO2	kg CO2		
Xport - Tractor trailor	1000	tonne-kg	0.009	0.059	0.068	nrel.gov/lci	
	18.67	Gal Diesel					
	Quantity	Unit	kg CO2	kg CO2	kg CO2		
Earthwork	1000	kg earth	0.244	1.688	1.932	Ecoinvent	
	0.53	kg Diesel					

Calculation Module – ZVI + MNA Greenhouse Gases

Fuel (gal) X CO_2 Conversion
Consumables (gal) X CO_2 Conversion

CO_2 Released (ton equivalents)

ZVI Treatment → 85 CO_2 ton equivalents
MNA → 15 CO_2 ton equivalents

100 CO_2 ton equivalents

Greenhouse Gases Adjusted CO_2 Equivalents

Contaminants (lbs) X CO_2 Conversion

CO_2 Released (ton equivalents)

Unit H1 → 218 CO_2 ton equivalents

Sustainability Factors ZVI Treatment + MNA

Media or Impact	Credit (+)	Debit[1] (-)
Greenhouse Gases (CO_2 equivalents)	(218) CO_2 ton equivalents from contaminant destruction	100 CO_2 ton equivalents from remedy & consumables
Resources		
○ Soil/Solid Material (tons)	0	200 tons of soil required to cap area
○ Land (acres)	<1 acre available for use	0 acres permanently deed restricted
○ Water (gallons)	0 gallons reused/recycled	130,000 gallons of water used
Energy (kWh)	0 kWh of renewable energy generated	371,853 of energy used by remedy & consumables

DuPont Credit and Debit Matrix (August 07)

Media or Impact	Credit (+)	Debit[1] (-)
Greenhouse Gas (CO_2 equivalents)	❑ Sequestration in-situ ❑ Sequestration by plants ❑ Destroying GWP equivalents ❑ Immobilization of contaminants	❑ Generated by manufacture of consumables ❑ Sequestration loss by permanent vegetation removal ❑ Generated by fuel consumed during activity ❑ Ex-situ, on-site air emissions treatment ❑ Generated by off-site management of residuals ❑ Future release of contaminants (e.g. ??)
Resource Use		
Soil/Solids	❑ Reused-recycled soil or soil-substitute ❑ Improved soil usability	❑ All off-site soil required for remedy ❑ Off-site disposal
Land	❑ Unrestricted reuse ❑ Restricted reuse – i.e. renewable energy or brownfield ❑ Wetlands created or upgraded ❑ Conservation easement for preserving trees/ecological resource	❑ Permanently deed restricted ❑ Permanent access restriction
Water – address/assess where a critical (local) issue	❑ Restored aquifer or surface water body ❑ Reused-recycled ❑ Re-injected groundwater	❑ Public or surface water use e.g. Water for dust control or ongoing O&M (i.e. growing grass on caps) ❑ Groundwater captured for remediation – where critical
Air	❑ Odor control	❑ Contaminant emissions ❑ PM10 and PM 2.5 ❑ Acid rain compounds
Energy Use	❑ Avoided energy from recovery of energy-rich waste materials ❑ Renewable energy created and used by remedy	❑ Energy use by remediation activity ❑ Required for manufacture of consumables ❑ Ex-situ, on-site air emissions treatment ❑ Consumption by off-site management of residuals
Occupational Risk	❑ Controls or measures to reduce hazardous exposure	❑ Exposure hours on-site ❑ Exposure hours for travel and delivery ❑ Road miles traveled for personnel and consumables

DuPont Quantitative Assessment (August 07)

	Parameters	ZVI-Clay In-Situ Treatment + MNA	Excavation & Off-Site Disposal + MNA	Ex-Situ Thermal Desorption + MNA	Soil Vapor Extraction + MNA	Capping + MNA
Greenhouse Gas (ton - CO_2)		100	267	601	321	36
Adjusted Greenhouse Gas (ton - CO_2 Equivalents)		(118)	267	383	147	36
Efficiency (lb CO2/lb-contaminant destroyed)		170		1,200	770	
Efficiency (lb-contaminant destroyed/lb CO2)		0.006	0.000	0.0009	0.001	0.000
Energy Usage (kWh)		371,853	975,588	2,411,844	764,749	117,037
Occupational Risk	*Exposure Hours*	3,562	4,364	5,482	3,952	612
	Mileage	10,942	109,815	15,662	16,742	4,645
Resource Usage	*Potable Water (gal)*	0	0	0	0	0
	Groundwater (gal)	130,000	0	0	0	0
	Soil (ton)	200	3,400	400	170	1,200
	Landfill Space (acre-ft))	0	2	0	0	0
	Land (Acre)	0.3	(0)	0.3	0.3	0.3
	Air	0	0	0	0	0

Tiered Matrix

Media or Impact	Credit (+)	Debit[1] (-)
Greenhouse Gases and Energy		
○ Greenhouse Gases (CO_2 equivalents)	❑ Sequestration in-situ ❑ Sequestration by plants ❑ Destroying/immobilizing GWP equivalents	❑ Generated by fuel used ❑ Generated by manufacture of consumables ❑ Generated by on-site air emissions treatment ❑ Generated by off-site management of residuals ❑ Sequestration loss by permanent vegetation removal
○ Energy (kWh)	❑ Avoided energy use through reuse of energy-rich waste materials ❑ Renewable energy created and used by remedy	❑ Used for remediation activity ❑ Used for manufacture of consumables ❑ Used for on-site air emissions treatment ❑ Used for off-site management of residuals
Resources		
○ Soil/Solid Material (tons)	❑ Reused-recycled soil or soil-substitute ❑ Improved soil usability	❑ All off-site soil required for remedy ❑ Off-site disposal
○ Land (acres)	❑ Cleanup supports options for use/reuse ❑ Wetlands created or upgraded ❑ Conservation easement for preserving trees/ecological resource	❑ Permanent deed and access restrictions severely limit use/reuse
○ Water (gallons)	❑ Reused-recycled ❑ Re-injected groundwater	❑ Public or surface water use e.g. Water for dust control or ongoing O&M (i.e. growing grass on caps) ❑ Groundwater captured for remediation – where groundwater resources are critical
Site Specific Issues		
○ Noise	❑Noise Control	❑Noise
○ Odor	❑Odor Control	❑Odors
○ Light	❑Light Control	❑Light

Tier 1 – GHG and Energy

	ZVI-Clay In Situ Treatment +MNA	Excavation & Off-Site Disposal + MNA	Ex-Situ Thermal Treatment + MNA	Soil Vapor Extraction* + MNA	Capping + MNA
Tons of CO_2 Equivalents	100	267	601	321	36
CO2 Sequestered	(218)	0	(218)	(174)	0
Tons of Adjusted CO_2 Equivalents	(118)	267	383	147	36
Energy Use	371,853	911,883	2,348,094	764,749	177,037
Renewable Energy	0	0	0	0	0
Total Non-Renewable Energy	371,853	911,883	2,348,094	764,749	177,037

* SVE assumes 80% destruction

Tier 2 - Resources

	ZVI-Clay In Situ Treatment +MNA	Excavation & Off-Site Disposal + MNA	Ex-Situ Thermal Treatment + MNA	Soil Vapor Extraction* + MNA	Capping + MNA
Soil/Solids	200	3,400	400	170	1,200
Reused Soil/Solids	0	0	0	0	0
Water	130,000	0	0	0	0
Reused Water	0	0	0	0	0
Land	0.3	0	0.3	0.3	0.3
Reusable Land	0.3	0	0.3	0.3	0

Tier 3 – Site Specific Issues

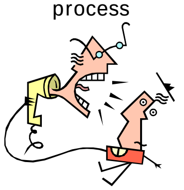
	ZVI-Clay In Situ Treatment +MNA	Excavation & Off-Site Disposal + MNA	Ex-Situ Thermal Treatment + MNA	Soil Vapor Extraction* + MNA	Capping + MNA
Noise	High	High	High	High	Moderate
Odor	Moderate	High	High	Moderate	Moderate
Light	Moderate	High	Low	Moderate	Moderate

Challenges

- Determining credit/debit approach for land use
- Relevance of water use in certain areas
- Implementability

Feedback

- Leads to more innovation
- Fosters collaborative process



- Dangerous – too much opportunity for monkey business
- Remedy at every site will be natural attenuation
- Slow down cleanup due to review time

Where's This Going…

Attachment 4
History of New Technologies and How It Can Help SuRF
Gil Meyer, DuPont

How Society Views New Technologies

Gil Meyer

August 22, 2007

The miracles of science

Agenda

- How society deals with new technologies
- How individuals perceive risks & benefits
- What we can do to facilitate acceptance

How does society deal with "young" technologies?

- Trains
- Pasteurization
- Electricity
- Nuclear power
- Tomatoes & potatoes
- Vaccines
- Blimps
- Biotechnology

4 Factors for Acceptability of Technologies

Relative economic advantage over existing technology

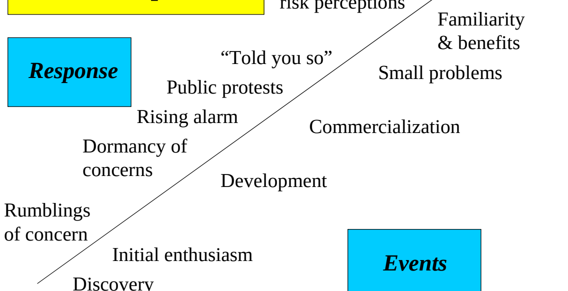
Social value and prestige

Compatibility with vested interests

Visibility of the direct advantages

Source: Guns, Germs and Steel

The Rough Road to Public Acceptance



How we perceive risk

7

What should we be doing?

- Yes, promote acceptance
- But also, prevent rejection

8

Promoting Acceptance

- Highlight benefits
- Ensure openness
- Manage expectations
- Small steps

9

Preventing Rejection

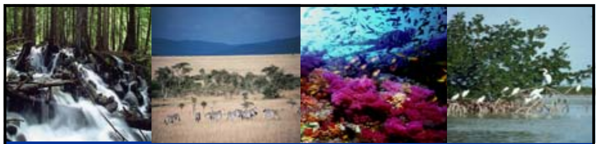
- Good stewardship
- Rapid response to problems

10

DUPONT

The miracles of science™

Attachment 5
Ecosystems Evaluations
Charles Iceland, World Resources Institute



The corporate ecosystem services review

Charles Iceland, CFA
World Resources Institute

SURF Meeting
August 22, 2007

World Resources Institute

World Resources Institute (WRI)

WRI is a global, non-profit environmental think tank that goes beyond research to find practical ways to protect the Earth and improve people's lives

World Resources Institute

What was the Millennium Ecosystem Assessment (MA)?

Largest assessment of health of ecosystems ever undertaken

Examined links between ecosystems and human well-being

Partnership of UN agencies, five conventions, business, and NGOs

Provide authoritative source of information to decision-makers

1360 experts from 95 countries over 4 years; peer reviewed

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Provisioning services: Goods produced or provided by ecosystems

- Food
  - Crops
  - Livestock
  - Capture fisheries
  - Aquaculture
  - Wild foods
- Fiber
  - Timber
  - Cotton, hemp, silk
  - Biomass fuel
- Fresh water
- Genetic resources
- Biochemicals, natural medicines & pharmaceuticals

World Resources Institute

Regulating services: Benefits obtained from regulation of natural processes by ecosystems

- Air quality regulation
- Climate regulation
  - Global (CO_2 sequestration)
  - Regional and local
- Water purification and waste treatment
- Water flow regulation
- Natural hazard regulation
- Erosion regulation
- Disease regulation
- Pest regulation
- Pollination

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Cultural services: Non-material benefits obtained from ecosystems

Recreation

Ecotourism

Spiritual and religious values

Ethical and "existence" values

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A key MA finding: 60% of world's ecosystem services degraded

	Degraded	Mixed	Enhanced
Provisioning	• Capture fisheries • Wild foods • Biomass fuel • Genetic resources • Biochemicals, natural medicines, & pharmaceuticals • Fresh water	• Timber • Fiber (e.g., cotton, hemp, silk)	• Crops • Livestock • Aquaculture
Regulating	• Air quality regulation • Regional & local climate regulation • Erosion regulation • Water purification & waste treatment • Pest regulation • Pollination • Natural hazard regulation	• Water regulation • Disease regulation	• Carbon sequestration
Cultural	• Spiritual, religious, or cultural heritage values • Aesthetic values	• Recreation & ecotourism	

Source: Millennium Ecosystem Assessment, 2005

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Trends identified by the MA are important to business because companies and ecosystems are inter-related

World Resources Institute

Examples of industries benefiting from ecosystem services

NOT EXHAUSTIVE

	Degraded	Mixed	Enhanced
Provisioning	• Capture fisheries • Wild foods • Biomass fuel • Genetic resources • Biochemicals, natural medicines, & pharmaceuticals • Fresh water	• Timber • Fiber (e.g., cotton, hemp, Beverage Electric utility Agribusiness	• Crops • Livestock • Aquaculture
Regulating	• Air quality regulation • Regional & local climate regulation • Erosion regulation • Water purification & waste treatment • Pest regulation • Pollination • Natural hazard regulation	• Water regulation • Disease regulation Insurance Comm. real estate Tourism	• Carbon sequestration
Cultural	• Spiritual, religious, or cultural heritage values • Aesthetic values	• Recreation & ecotourism	

World Resources Institute

Questions corporate managers are asking

What are the implications of ecosystem service degradation for my company?

What are the business risks my company could face?

What new business opportunities might arise?

How should my company respond?

World Resources Institute

WRI, Meridian, and WBCSD are partnering to develop and road-test the corporate ESR methodology

Collaborating organizations

World Resources Institute

Meridian Institute

World Business Council for Sustainable Development

Road testers

Akzo Nobel

BC hydro

DuPont

Mondi

Rio Tinto

syngenta

World Resources Institute

Steps in a corporate ecosystem services review (ESR)

Step	Determine scope	Identify priority ecosystem services	Analyze trends in priority services	Assess business risks and opportunities
Key activity	Define corporate boundaries in which to conduct ESR	Systematically assess corporate dependence and impact on ecosystem services	Assess conditions and trends in priority ecosystem services	Identify business risks and new opportunities due to trends in priority ecosystem services
		Determine priority services		Outline strategies to address risks & opportunities

World Resources Institute

Step 4. What risks or opportunities to your company do these ecosystem service trends pose?

Category	Description
Operational	• Higher cost of inputs or insurance premiums • Disruption to business operations • Improved efficiency or substitutes
Regulatory & legal	• New government regulations, extraction moratoria, user fees, penalties, taxes, etc. • Lawsuits • Restrictions on expansion of operations
Reputational	• Damage to brand & image • Challenge to "license to operate" • Damage to employee relations
Market/product	• New products, services, or markets • New revenue stream from natural assets
Financing	• More rigorous lending policies • Higher rates

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Case example: Regulatory and reputational risk

- Relies on nature's freshwater provisioning services
- 2004: Water license for bottling plant in Kerala (southern India) suspended
  - Community government
  - State high court
- 2005: India-wide protests demanding stop to production
- 2004-2006: Sales in India declined 8 straight quarters

Source: "Coke 'drinks India dry'". The Guardian, 19 March 2006; "Cola companies told to quit India". BBC News, 20 January 2005; "New report confirms water pollution by Coca-Cola in India". Hindustan Times, 20 July 2006.

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Case example: Responding to operational risk

- Energia Global, now part of Enel
- Dam in Sarapiqui watershed, Costa Rica
- Relies on erosion regulation services of forests on upstream slopes
- Deforestation for agriculture → sedimentation → lower power output
- Pays upstream landowners for reforestation, forest conservation, and sustainable forestry

Source: Malavasi,. E.O. and J. Kellenberg, "Program for Payments for Ecological Services in Costa Rica" 2003.

Case example: New revenue streams from assets

- Conducted "eco-asset inventory" and appraisal of a 12,000-acre tract in the Canaan Valley, West Virginia, U.S.
- Appraised value doubled from $16 million to $33 million
- Property sold to federal government (USFWS) at lower price
- Company claimed a $17 million charitable tax deduction for "bargain sale"
- $6 million in tax-related savings

Source: Jessica Fox, EPRI Solutions

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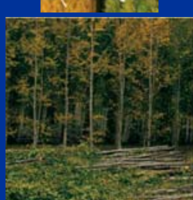
Case example: New revenue streams from assets



- Timber company and largest private landowner in Idaho, U.S.
- 670,000 acres of forest
- Forests provide recreation value to hikers, birdwatchers, anglers, trail riders, hunters
- Draws 200,000 visitor use days per year
- 2007: Starting to charge recreational user fee for visitors
  - Annual permits for vehicles
  - Hunting licenses
  - Camping fees

Source: "Potlatch Corp. to charge fees for access to N. Idaho forests" Associated Press, October 2006

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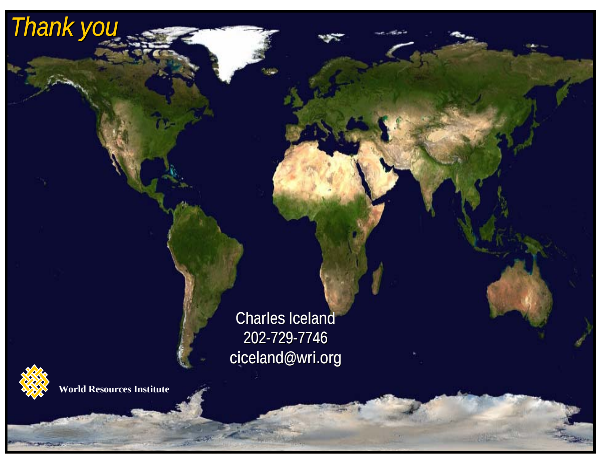
Thank you



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World Resources Institute

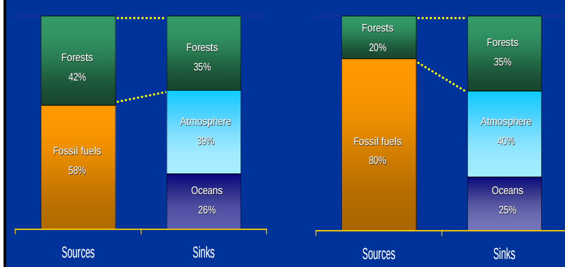
Appendix

World Resources Institute

Sources and sinks of carbon

Carbon flow over past two centuries
100% = 480 gigatons of carbon

Annual carbon flow in 1990s
100% = 7.9 gigatons of carbon per year



Source: Millennium Ecosystem Assessment

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Attachment 6
The Longevity of Carbon Dioxide (CO_2) in the Atmosphere

Dan Watts, NJIT

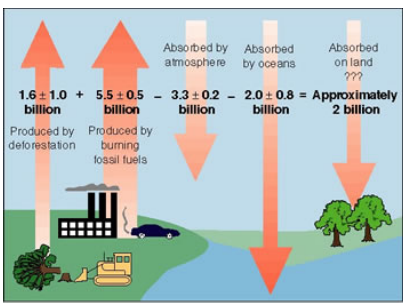
Atmospheric Persistence of Carbon Dioxide

The Facts, Assumptions, and Uncertainties

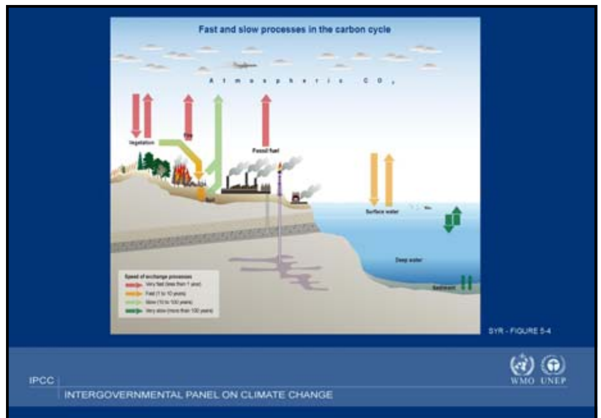
Simple Question

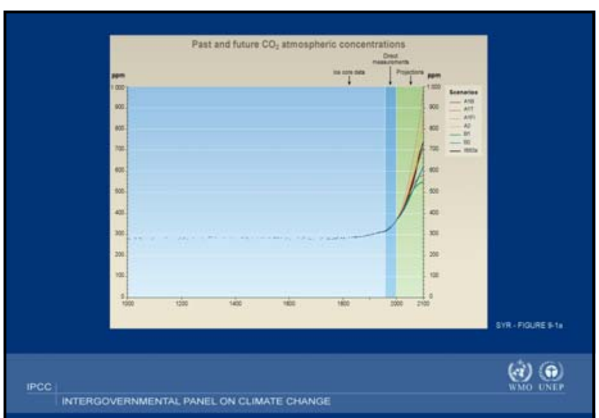
- How long does CO2 released to the atmosphere, stay in the atmosphere?
- Complex Answer—Not Totally Resolved

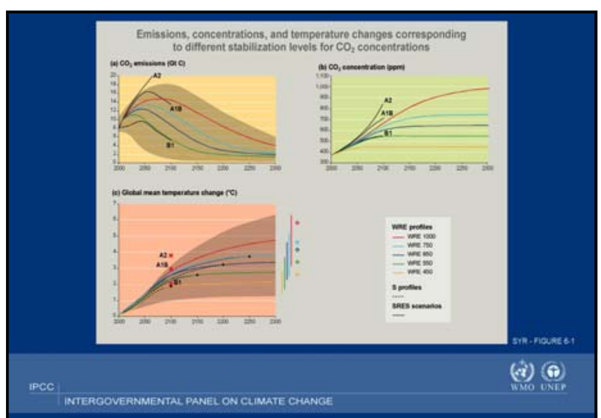
The CO2 Balance

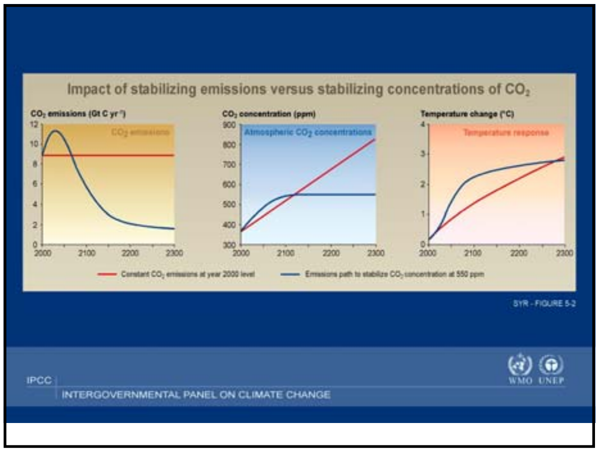


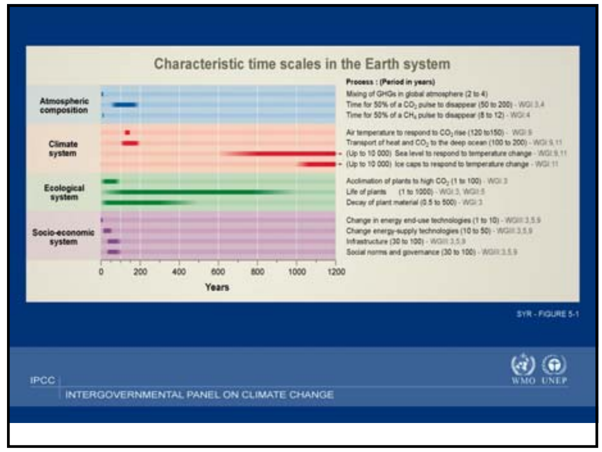
From: Climate Change Information Resources

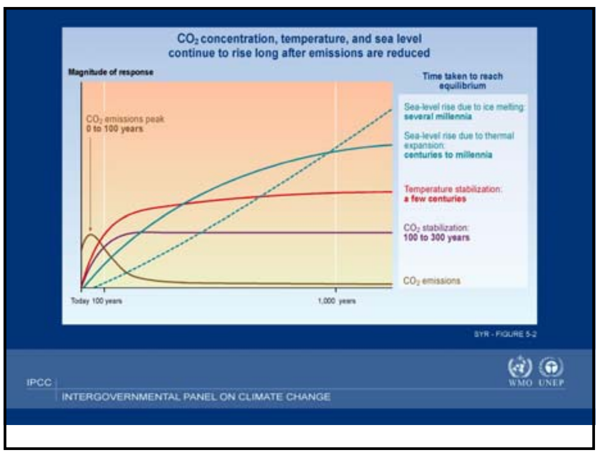







Impact of stabilizing emissions versus stabilizing concentrations of CO_2
CO_2 emissions (Gt C yr^{-1})
CO_2 emissions
CO_2 concentration (ppm)
Atmospheric CO_2 concentrations
Temperature change (°C)
Temperature response
Constant CO_2 emissions at year 2000 level
Emissions path to stabilize CO_2 concentration at 550 ppm
SYR - FIGURE 5-2
IPCC
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO UNEP


Characteristic time scales in the Earth system
Atmospheric composition
Climate system
Ecological system
Socio-economic system
Process : (Period in years)
Mixing of GHGs in global atmosphere (2 to 4)
Time for 50% of a CO_2 pulse to disappear (50 to 200) - WGI 3,4
Time for 50% of a CH_4 pulse to disappear (8 to 12) - WGI 4
Air temperature to respond to CO_2 rise (120 to150) - WGI 9
Transport of heat and CO_2 to the deep ocean (100 to 200) - WGI 9,11
(Up to 10 000) Sea level to respond to temperature change - WGI 9,11
(Up to 10 000) Ice caps to respond to temperature change - WGI 11
Acclimation of plants to high CO_2 (1 to 100) - WGI 3
Life of plants (1 to 1000) - WGI 3, WGII 5
Decay of plant material (0.5 to 500) - WGI 3
Change in energy end-use technologies (1 to 10) - WGIII 3,5,9
Change energy-supply technologies (10 to 50) - WGIII 3,5,9
Infrastructure (30 to 100) - WGIII 3,5,9
Social norms and governance (30 to 100) - WGIII 3,5,9
Years
SYR - FIGURE 5-1
IPCC
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO UNEP


CO_2 concentration, temperature, and sea level continue to rise long after emissions are reduced
Magnitude of response
Time taken to reach equilibrium
Sea-level rise due to ice melting: several millennia
Sea-level rise due to thermal expansion: centuries to millennia
Temperature stabilization: a few centuries
CO_2 stabilization: 100 to 300 years
CO_2 emissions
CO_2 emissions peak 0 to 100 years
Today 100 years
1,000 years
SYR - FIGURE 5-2
IPCC
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO UNEP

Attachment 7
National Grid Sustainability Calculation Tools
Frank Evans, National Grid

Use of Metrics in making Better Sustainable Remediation Decisions

22 August 2007
US SURF 4 Meeting

Frank Evans
National Grid Property, UK

nationalgrid

Best I can do.....

I am in England...
...in an office
...on the telephone
...and its raining outside!

nationalgrid

Outline of Presentation

- National Grid business perspective
- What is Sustainable Remediation?
- What metrics should we use?
- Remediation Design/Options Appraisal process
- Measurement of Environmental Impacts
- Using output for Management Decisions
- Next Steps

nationalgrid

National Grid Perspective - Landowner

- Manages environmental risks associated with its gasworks portfolio (both surplus and operational land) and electricity-related sites.
- Operates both in UK and US
- Historical use of sites
- Remediation programme sustained for 10 years
- Sale of surplus property and significant contribution to UK Brownfield regeneration
- High % materials re-use in remediation programme
- Leading user of remediation technologies
- Corporate commitments to tackling climate change

nationalgrid

Tackling Climate Change

- Target to reduce carbon emissions by 60% by 2050. Currently 35% reduction against baseline
- Measures include:
  - Reduce CO_2 at compressor stations on gas network
  - Replace old pipes in gas network (less leakage)
  - Reduce SF_6 leakage across electricity network
  - Seek 5% improvement in energy efficiency through employee engagement
- Technology initiatives (e.g.)
  - Extract lost energy at Pressure Reduction Stations

nationalgrid

Surplus and Operational land: Differences

- Surplus land
  - Development potential
  - Effective transfer of liabilities
  - Closure with regulator prior to site sale
  - Concentrated and shorter remediation timescales
  - Land value is a factor
  - Developer confidence
  - Provision of warranties
  - Ex-situ remediation approaches
  - UK National Grid
- Operational land
  - Retained land-holding
  - Retention of associated liabilities
  - On-going regulator agreement
  - Longer remediation timescales
  - Land value less important
  - Plant and equipment remediation constraints
  - In-situ techniques
  - Both US & UK National Grid

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What is Sustainable Remediation?

Assume it fits in with some sort of wider hierarchy

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What is Sustainable Development?

'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs'

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Aims for Sustainable Development in UK

- Social Progress which recognises needs of everyone
- Effective Protection of the Environment
- Prudent use of Natural Resources
- Maintenance of high and stable levels of Economic Growth and Employment

Ref. A better Quality of Life - A Strategy for Sustainable Development for the UK. 1999

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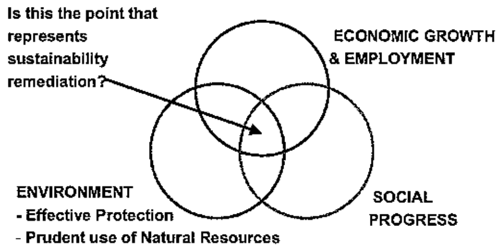
What is Sustainable Remediation?



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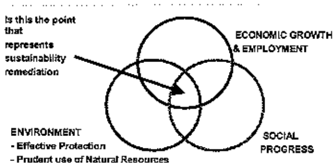
What metrics do we want to use?



- Environment
- Social Progress
- Economic

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Cost Benefit Analysis

- Potential to be explored
- Part of UK toolbox for making remediation-decisions and UK guidance available
- Can environmental, social and economic factors associated with 'sustainability' all be expressed as monetary units?
- Costs > Benefits = Unsustainable?
- Costs < Benefits = Sustainable?

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Costs v Benefits of Remediation

- Financial costs (£)
- Carbon footprint
- Use of landfill
- Use of virgin aggregates
- Use of water resource
- Traffic movements
  - Emissions
  - Accident rate
- H&S risks to workers
- Ecological impacts
- Risk reduction….
  - Human Health
  - Water resources
  - Ecological receptors
- Brownfield regeneration
- Protects greenbelt
- Removal of property blight
- Employment
  - Practitioners
  - Use of land

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Remediation Options Appraisal

- Remediation Design process require Remediation Options Appraisal
- ROA required to justify 'internal approval' to spend statutory provision. Remediation option agreed by programme mgr.
- Expectation of regulator and part of CLR 11
- National Grid Approach
  - Site Characterisation inputs
  - Assessment of Site-specific Factors
  - Constraints and Development of Remediation Objectives
  - Preliminary assessment of remediation options
  - Detailed assessment of remediation options

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Example of Constraints Analysis

Project Timescales	**e.g. Delivery by agreed sale date (note that this should be an iterative and 2-way consideration with the selection of remediation strategy influencing the agreement of a realistic sale date)**
End-use	**e.g. Residential across entire site Known zones for mixed residential/commercial Current use as operational compound**
Operational issues	**e.g. PRS overlies known tar tank sources Gas pipe crosses known tar tank sources (cost/benefit analysis of plant relocation may also require consideration)**
Site factors	**e.g. Area (vacant and operational), topography, access, vegetation, areas of hard-standing, Surrounding land-uses. Underlying strata type. Nature of contaminants**
Relevant Stakeholders view	**e.g. Client preference for source removal. Neighbouring properties in contact with SPH concerning cross-boundary issues. Regulator requirement for groundwater quality criteria. Planning restrictions on hours of operation**
Cost	**Minimise with reference to above factors**
Sustainability	**Maximise with reference to above factors**

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Conceptual Example of ROA Output

	Viability	**Environmental Impacts**			**Cost**
		CO2	***Waste***	***Local***	
Landfill as hazardous	Yes	Road haulage to Teesport from site CO2 emissions for job = 2X kg	20%	Least. Shorter site works	£1.4M
Bioremediate to non-haz and dispose	Yes	Local disposal. CO2=Xkg	20%	High-Medium. Long site works	£1.2M
Thermal desorption	Yes	CO2 emissions = 2X kg	90%	Highest/PR management. Long site works	£1.5M
Landfill tar tanks & S/S	No - Residential target prevent use	CO2 = 1.5X kg	60%	-	£1.2M
Bioremediate for re-use	No - Residential target prevent use	-	-	-	-
Soil washing	No -Soils too fine	-	-	-	-

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Remediation Impact Assessment Tool

- How do we measure Environmental Impacts of a remediation project
- Spreadsheet-based tool that consultants can use to assess sustainability of different remediation options
- Based around our key Environmental Aspects as identified by ISO 14001 management system

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National Grid: Key environmental aspects

- Local
  - Noise
  - Dust
  - Vibration
  - Odour
- Regional/Global
  - CO2 emissions (kg)
  - Waste re-use (%)

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UK Environment Agency report

- Noise and Vibration
- Dust and Odour
- Air Emissions
- Visual Impact/Intrusiveness
- Road safety/Congestion
- Resource depletion
- Energy Usage
- Waste generation/minimisation
- Fate of contaminant/legacy
- Impact on surface water
- Impact on groundwater
- Impact on ecology
- Final Site Condition/perception

Ref. Environment Agency Report P238 (2000) 'Assessing the Wider Environmental Value of Remediating Land Contamination: A Review'

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Remediation Techniques

- Landfilling,
- Screening/sorting
- Soil washing,
- Ex-situ bioremediation,
- Direct-fired thermal desorption,
- Solidification/soil stabilisation.

- Why? - because they represent most projects in programme and contribute to current targets. More in future

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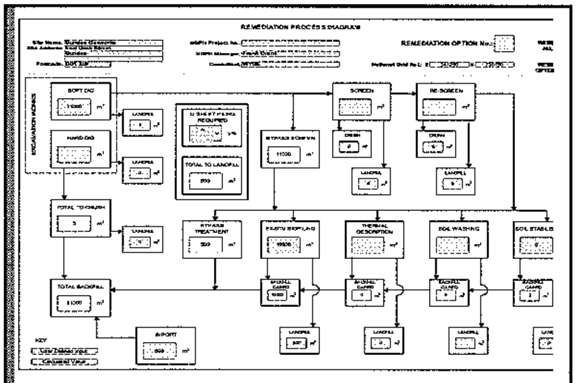

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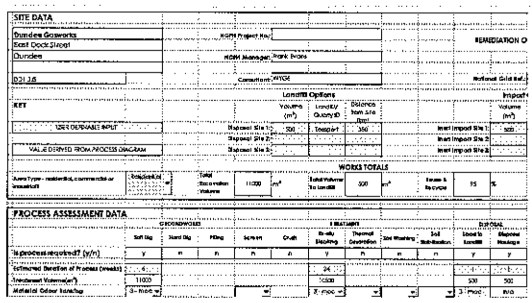

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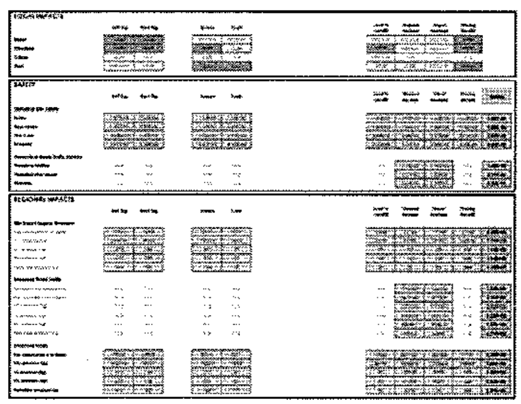

How do you use output?

- Company Objectives include:
  - Maximise materials re-use
  - Minimise impact on Climate
  - Maximise land value
  - Minimise costs
  - Safety performance is high priority

- Challenges for project and programme managers in balancing all of the above

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The easy project to select!

	Option A1	Option A2	Option A3
Materials Re-use	☺	☺	☹
Climate Impact	☺	☹	😐
Local Impact	😐	😐	☺
Land Value	☺	☺	☺
Cost of project	☺	😐	😐

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The harder decision to be made!

	Option B1	Option B2	Option B3
Materials Re-use	😐	☺	☹
Climate Impact	☺	☹	😐
Local Impact	😐	😐	☺
Land Value	☹	☺	☺
Cost of project	☺	😐	😐

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Safety Performance

- Unreliable to use predictive tool
- Road traffic statistics give a reliable indicator of risks associated with road travel
- Construction statistics do not take into account remediation technology selection or Company H&S cultures
- Need a reliable dataset to use effectively otherwise unrealistic predictions
- Communications challenge in selecting projects that are predicted to have 'higher' safety risk irrespective of environmental gains and cost savings

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Next Stages in UK

- National Grid
  - Refine and validate model based on measured site data (e.g. fuel consumption, local complaints)
  - Consider adding further aspects and remediation techniques in later versions
  - Evaluate internal decision making as a consequence
  - Engage US counterparts
- UK Remediation Sector
  - CL:AIRE arranged workshop
  - Review tools and review metrics

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Attachment 8
Superfund Remedial Program Energy and Carbon Footprint: Initial Analytical Approach for Site Cleanup Treatment Technologies
Carlos Pachon, OSWER

Superfund Remedial Program Energy and Carbon Footprint:

Initial Analytical Approach for Site Cleanup Treatment Technologies

Carlos Pachon
Office of Superfund Remediation & Technology Innovation
OSWER, EPA
pachon.carlos@epa.gov

Agenda

- Greener Remediation – the concept
- Initial analysis of remedial project energy and carbon footprints
- Conclusions and next steps

2

What is "Green Remediation"?

Working definition of the term:

Green Remediation - The practice of considering the environmental effects of a remediation strategy (i.e., the remedy selected and the implementation approach) early in the process, and incorporating options to maximize the net environmental benefit of the cleanup action.

3

OSWER's Greener Remediation Strategy

- Goal – Foster the adoption of greener remediation practices across cleanup programs
- Approach:
  - A. Benchmarking: State of the practice.
  - B. Identifying opportunities for improvement at cleanups
  - C. Capacity building and networking practitioners
  - D. Creating "enabling" mechanisms
- Subset of "greener revitalization" efforts

4

Identifying Opportunities

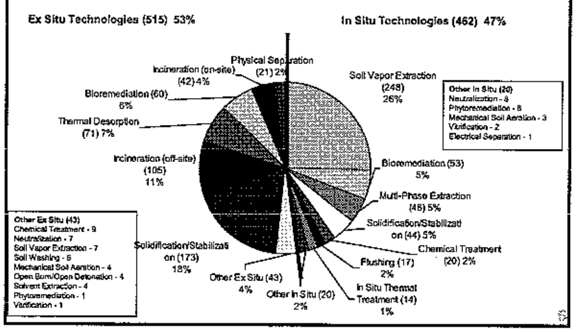
The following presentation focuses on energy and carbon footprint analysis of the Superfund Remedial program

- » Review of remedy decisions in Superfund
- » Initial approach to quantifying the energy and carbon footprint
- » Suggestions for further analysis o alternatives to minimizing the energy and carbon footprints
- » Goal is not to alter the remedy selection process, but to identify and pursue the most sustainable (greener) implementation practices

5

Remedies Selected in Superfund

Source Control Treatment Projects 1982-2005
Total of 977 projects



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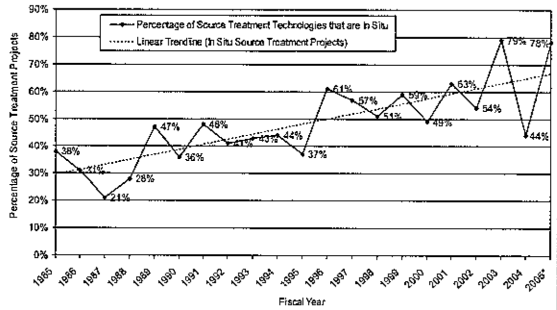
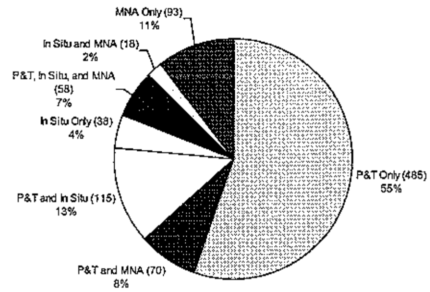
In Situ Technologies for Source Control in Superfund



Groundwater Remedies

Total Number of Sites = 877



Energy and Carbon Modeling of Selected Remediation Technologies

- Remedies analyzed:
  - Pump & Treat (selected at 86% of Superfund sites)
  - Soil vapor extraction (26% of SC projects)
  - Multiphase extraction (10% of IS GW remedies)
  - Air sparging (29% of IS GW projects)
  - Thermal desorption (10% SC projects)
- Treatment project operating parameters were "standardized" based on engineering reports
- Initial approach does not account for auxiliary activities, such as installing treatment systems, feeding hoppers, etc.

Energy & Carbon Footprint Flash Analysis Findings

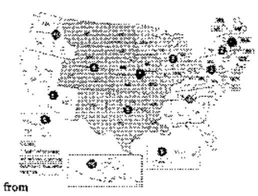
Remedy	Estimated energy use per project (Kwh*10⁶)	Total energy use per year (Kwh*10⁶)	Total carbon emissions per year (Tons)	Total carbon emissions thru 2030 (Tons)
P&T	402	7,669	275,592	5,253,256
SVE	16	121	8,264	82,840
MPE	32	383	16,334	262,519
Air Sparging	23	205	15,454	140,561
Thermal Desorption	48	1,944	11,018	1,331,790
Total		10,322	326,662	7,070,966

Opportunities for Reducing Energy and Carbon Footprints

- Maximizing energy efficiency in site remediation projects
  - Optimizing existing treatment systems
  - Design evaluation
  - Upgrading equipment
- Securing alternative sources of energy
  - Solar & wind power, geothermal, etc.
- Benchmarking CO2 emissions
  - Carbon credits?
  - Carbon offsets?

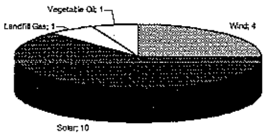
Remediation Projects Powered by Renewable Energy*

- Fifteen sites currently using renewable energy
- Four sites planning the use of renewable energy
- Sites represent 8 of the 10 EPA regions (Regions 5 and 10 not represented)
- Superfund, RCRA, Brownfields, Removal Response, Federal Facilities, and state programs

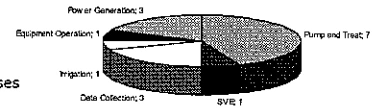


* Information in the following slides in extracted from research performed by Amanda Dellons, NEEMS Fellow at EPA. Publication expected Oct 1 on http://cluin.org

Remediation Projects Powered by Renewable Energy*



Energy Sources



Energy Uses

Renewable Energy System Capacity

Site	Energy Type	Capacity (kW)
Altus AFB	Solar	0.20
Crozet Township Arsenic Site	Solar	0.39
Apache Powder	Solar	1.44
Pemaco	Solar	3.00
Lawrence Livermore National Lab Site 300	Solar	3.20
BP Paulsboro	Solar	275.00
Aberdeen Proving Ground O- Field	Solar	**
Raytheon Beech Aircraft Site	Solar	**
Savannah River Site	Solar	**
Former Nebraska Ordnance Plant	Wind	10.00
FE Warren AFB	Wind	1320.00
Massachusetts Military Reservation	Wind	1650.00
Getty Gasoline	Wind	**
St. Croix Alumina Facility	Wind/Solar	10 scfm @ 45psi 0.83kW (solar)
OII Landfill	LFG	420.00
Grove Brownfield	Vegetable Oil	**
** Capacity data not available		

Achieved Benefits and Cost Savings

Examples of emissions and cost savings achieved at various sites (cited from personal communication with project managers)

Altus AFB Altus, OK	200 W PV system	$1,000 per year plus capital costs (power lines)
BP Paulsboro Paulsboro, NJ	275 kW PV system	571,000 lbs/year CO_2 1,600 lbs/year SO_2 1,100 lbs/year NO_X
Pemaco Maywood, CA	3 kW PV system	4,311 lbs/year CO_2 3 lbs/year SO_2 4 lbs/year NO_X
FE Warren AFB Cheyenne, WY	1,320 kW wind farm (power generation)	$3 million over 20 years 4,866 tons/year CO_2
OII Landfill Monterey Park, CA	6 LFG microturbines	$400,000 per year

Conclusions

- We can reduce the energy footprint of most remediation technologies through alternative energy sources and optimization.
- Should we focus on benchmarking and implementing best management practices for remedies with the greatest total energy and carbon load?
- Further analysis needed to make any policy or management decisions, however;
- Opportunities exist now to increase the net benefit of the remedial program.

Attachment 9
Metrics from Cherokee
Holly Fling, Cherokee Investment Services, Inc.

Defining Sustainability at Cherokee Sites

Why Sustainability?

Cherokee strives to develop sites that improve and protect human health and environmental quality, enhance social well-being for site users and the wider community, and add value to the local economy, while generating returns for Cherokee, our development partners, and our investors.

Phase	Approach	Economic	Social	Environmental	Relevant Third Party Standards
Site Selection	Act as catalyst	▪ Identify sites that add value to the local community ▪ Identify undervalued real estate ▪ Create financially successful projects ▪ Create public-private partnerships	▪ Develop places that enhance social well-being for site users and the wider community ▪ Generate productive activity in formerly blighted, contaminated and unhealthy locations ▪ Partner with local stakeholders ▪ Support efficient land use	▪ Remediate brownfield sites ▪ Revitalize sites which are: - Contaminated - Infill - Adjacent to mass transit - Blighted - Critical to improve local environment	▪ LEED-ND ▪ LEED-NC
Site Planning	Focus on integrated, whole systems design	▪ Promote efficient use of existing community infrastructure and other resources ▪ Promote ancillary development of blighted areas ▪ Capitalize on market demand for progressive planning ▪ Utilize grants and financial support of brownfield and smart growth programs	▪ Create public spaces and community amenities with connectivity to other neighborhoods ▪ Maximize access to transportation alternatives and services ▪ Solicit and incorporate public input and stakeholder engagement ▪ Foster diverse communities ▪ Design for a high quality of life and sense of community and place ▪ Identify appropriate density ▪ Mix housing types and income levels ▪ Preserve historic structures ▪ Respect and integrate local culture	▪ Preserve and restore the community's natural assets ▪ Design for energy efficiency and the reduction of pollution and waste ▪ Exceed environmental regulations ▪ Design for biking, walking, and transit use ▪ Plan street connectivity ▪ Provide transportation alternatives and multi-modal options (e.g., rail or bus transit) ▪ Promote the use of on- or off-site renewable energy ▪ Maximize water efficiency and employ water conservation techniques	▪ LEED-ND ▪ SITESS (ASLA) ▪ DPZ SmartCode ▪ LAND Code (Yale) ▪ ASTM E1984-03
Site Design and Construction	Focus on integrated, whole systems design	▪ Create economic prosperity for all development stakeholders ▪ Improve tax base and support state and local government fiscal needs ▪ Increase property value ▪ Create new jobs ▪ Select local contractors and service providers	▪ Create healthy living and working environments ▪ Provide affordable and mixed-income housing ▪ Consider culture and history in design ▪ Plan for evolution of building use ▪ Design for safety ▪ Educate on the history of the site	▪ Incorporate low impact design and construction ▪ Use non-toxic, next generation, salvaged, or recycled products ▪ Recycle construction and demolition waste ▪ Maximize the use of on- and off-site alternative energy ▪ Minimize waste generation and consumption of nonrenewable resources ▪ Minimize development impacts on land and water resources	▪ LEED-NC, LEED-CI, LEED-CS ▪ Energy Star ▪ Regional standards (e.g., Earthcraft) ▪ State and city green building programs ▪ Cradle-to-Cradle ▪ Enterprise Green Communities

NOTE: This document, like the methods we use to implement our sustainability goals, will evolve over time. While we have ultimate control during the site selection, planning and development phases, our influence over design and construction may be minimized if the site is purchased from us. In situations like this, we work with local partners whose experience with sustainable development may very. Moving forward, we see an opportunity for rapid evolution in this organizational model. In addition, to complement the environmental standards, we aim to add more third-party benchmarks (or create our own) for economic and social goals for our projects.

Attachment 10
Metrics from a variety of DuPont Sites, our Framework for Evaluation

Dave Ellis, DuPont, and Brandt Butler, URS Corporation

Metrics from a variety of DuPont sites and our framework for evaluation

SURF 4
New Jersey Institute of Technology
Newark, NJ

August 22, 2007

David E. Ellis Ph.D., DuPont
Brandt Butler Ph.D., URS

The miracles of science

Presentation Objectives

Examine the use of metrics at historic and planned DuPont sites

- at a dissolved arsenic remediation - East Chicago
- at a brownfield redevelopment - Reichhold
- at a recycling site - Brevard

Show DuPont's evaluation framework and our approach to using sustainability metrics on projects

Sustainable Remediation through Recycle

East Chicago, IN

- Arsenic in groundwater at former manufacturing facility
- Waste BOF slag as active agent in permeable reactive barrier

Reichhold Chemical, Chicago IL

- Soil contamination at former manufacturing facility
- Brownfields – 6 acre
- Recycled concrete in lieu of clean fill

Brevard, NC Landfill

- Closed landfill with waste x-ray film (PET – polyethylene terephthalate)
- Recover 80,000,000 lb waste plastic – off-set new production

East Chicago Site Background

Site History

- Diversified chemical manufacturing facility started in 1880's
- Purchased by DuPont in 1928
- Produced a wide variety of inorganic chemicals, included zinc and arsenic compounds
- Made FREONs, lead arsenate, colloidal silica, sulfuric acid, ag chem intermediates, etc.
- 440 acres, some undeveloped

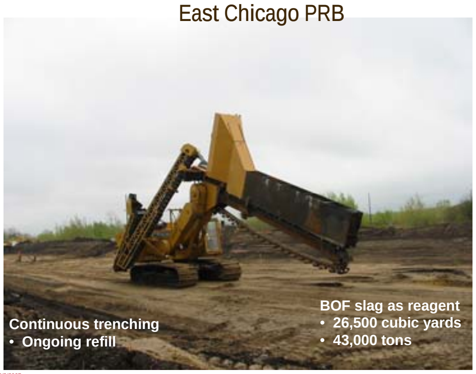
PRB Driving Force

- Demonstrate adequate groundwater migration control
- Achieve "yes" status for EI-750 metric as a GPRA baseline facility

PRB Development

- Pump and treat would have required a huge system due to the highly permeable aquifer and very broad plume
- PRB alternatives were ZVI vs. innovative material
- Two phases of testing were done in the late 1990's
- A DeWind trenching machine was selected to install a barrier made of BOF slag

East Chicago PRB



East Chicago PRB: The Movie

East Chicago Site Restoration

East Chicago Work Elements

Task	Item	Quantities
Field-Scale Test	**Time** **Staff** **Materials** **Equipment**	**5 days** **9 - Supervisor, Oversight, Operators** **225 ton – BOF Slag** **Trencher, Loader, Support Vehicles**
Mobilization, Site Preparation, Demobilization	**Time** **Staff** **Equipment**	**14 days** **13 - Supervisor, Oversight, Operators** **Dozer, Loader, Excavator Support Vehicles**
Dewatering and Benching	**Time** **Staff** **Equipment**	**21 days** **20 - Supervisor, Oversight, Operators** **Dump trucks (3), Dozers (2), Trencher, Loaders (2), Excavators (2), Dewatering Pump, Support Vehicles**
Deliver Slag	**Time** **Equipment**	**700+ trips** **Dump trucks**
PRB Installation	**Time** **Staff** **Materials** **Equipment**	**27 days** **20 – Supervisor, Oversight, Operators** **40,000 ton – BOF Slag** **Dump trucks (3), Dozers (2), Trencher, Loaders (2), Excavators (2), Dewatering Pump, Support Vehicles**

East Chicago – ZVI PRB
Summary of Sustainability Assessment

East Chicago – Slag PRB
Summary of Sustainability Assessment

East Chicago
Summary of Sustainability Assessment

Using slag instead of iron substantially reduced the greenhouse impacts of the PRB

Transporting the slag and the PRB construction released similar amounts of CO_2

Now that the PRB is in place there are no resources consumed for operating this remediation

Reichhold Chemical

A paint plant that operated for nearly 100 years

A six acre property near downtown Chicago

After closing the property reverted to DuPont ownership

Cleaned up, sold, and redeveloped

Over 500 inner-city jobs created

The Reichhold Chemical Site - Before

The former Reichhold Chemical site before remediation. Downtown Chicago is in the background.

The Reichhold Chemical Site - After

The current property with active retail outlets Kohl's and Best Buy, plus a two-story parking garage.

Reichhold Chemical Dig and Haul

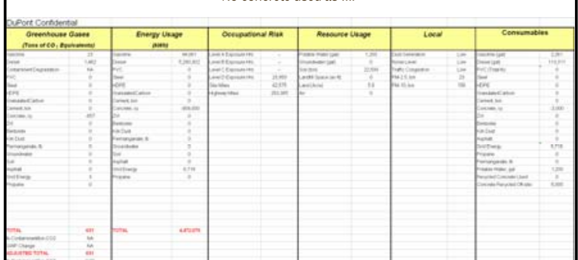
Task	Item	Quantities
Mobilization and Site Preparation	**Time** **Staff**	**12 days** **6 – Supervisor, Oversight, Operators**
Excavation and Loading (2 campaigns)	**Time** **Staff** **Materials** **Equipment**	**140 days** **6 to 12** **23,000 ton backfill** **Excavator (2), Loader (2), Roller. Support Vehicles**
Waste Hauling	**Loads** **Equipment**	**4,600 – hazardous and non-hazardous** **Transport, landfill dozer**
Recycled Concrete	**Material**	**3,500 ton brought on-site** **6,000 ton sent off-site**

Reichhold Chemical
Summary of Sustainability Assessment 1

Recycled concrete used as fill

Reichhold Chemical
Summary of Sustainability Assessment 2

No concrete used as fill



Reichhold Chemical
Summary of Sustainability Assessment

No further action letters were obtained from State and Federal regulators.

The biggest variation in CO_2 emissions is caused by using recycled concrete as fill

We aren't able to uniquely connect sustainability of the remediation actions to post-remediation use.

Brevard, NC Polymer Recycling

Manufactured components and x-ray film

Off-spec films were disposed in an industrial landfill

The material is homogeneous

The landfill contains an estimated 80,000,000 lb of PET

The PET Polymer at Brevard

Brevard Landfill PET Recovery

Task	Item	Quantities
Mobilization, Site Prep, Waste Disposal, Demobilization	Time Staff Equipment	10 days 8 - Supervisor, Oversight, Operators Dozer, Loader, Support vehicles
Load-out and segregate–40,000 ton (500 ton/day)	Time Staff Equipment	80 days Same Dozer, Loader, Excavator, Support vehicles
Contractor Transport to ship (270 miles one way)	Time Staff Equipment	80 days (transport time = calculated) 1/truck Truck(s)
Transport Overseas – 40,000 ton (Charleston to Oakland to Shanghai)	Time Equipment	Transport time Container ship
Clear overburden and trees; Replace Overburden	Time Equipment	10 days Dozer, Loader, Support Vehicles

Brevard
Summary of Sustainability Assessment

Brevard
Summary of Sustainability Assessment

The sustainability assessment is dominated by the CO_2 vale of the recovered and recycled PET. (This is also true for the cost of the operation)

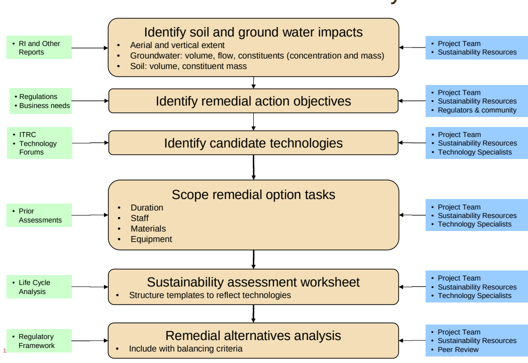
It's clear that resource recovery efforts can be important for lowering greenhouse gas emissions

Greenhouse gas credits for CO_2 emissions avoided could really the economics of similar projects:

If CO_2 credits were worth $25 per ton then these CO_2 credits would be worth $2,663,000

At $4 per ton, these CO_2 credits would be worth $426,000

DuPont's Remediation Sustainability Framework



DuPont Sustainable Remediation Metrics - Definitions

Managed Mass of Contaminants	**Pounds of contaminant in the material remediated**
Water loss	**Gallons of water lost to the system from which is it removed**
PM 2.5	**Particulates**
Waste generated	**New wastes created during the remediation. For example, neutralization sludge from catalytic oxidation of VOC's**
Occupational risk	**Exposure hours as a surrogate for risk**
Economic Value	**Increase in economic value of the site after remediation**
CO_2	**All CO_2 emissions**
GWP Credits	**The potential value of equivalent CO2 credits from remediated contaminants. Especially CFC's, HFC's, and chlorocarbons**
Efficiency immobilizing metals	**Pounds of metal immobilized divided by the total CO2 emitted**
Efficiency destroying organics emitted	**Pounds of contaminants destroyed divided by the total CO2**
Recycled mass	**Pounds of material put into productive re-use**
Ecological Value	**Ecological value of the remediated are, in dollars**
Landfill volume	**Cubic yards of material sent to any kind of landfill**

Sustainable Remediation Metrics Matrix

DUPONT CRG SUSTAINABILITY METRICS FOR PROJECTS

	Managed Mass of Contam	Water loss	PM 2.5	Waste Gener.	Occ Risk	Econ. Value	CO2	GWP Credits	Efficiency Immob. Metals	Efficiency Destr. Organics	Recycle mass	Eco value	Landfill Volume
(maximize or minimize)	max	min	min	min	min	max	min	max	max	max	max	max	min
landfill	X		X	X	X	X	X	X	X	?	X	X	X
dnapl	X	X		X	X	?	X	X		X	X		
ground water	X	X		?	X		X	X		X	?		
contaminated soils	X		X	X	X	?	X	?	X	X	?	X	X
contaminated sediments	X	?	?	X	X	?	X	?	X	X	?	X	X
lnapl	X	X		X	X	?	X			X	?		
surface water	?	X			X		X			?		X	
air			?		X		X			?			
sludge impoundment	X	?	?	X	X	?	X	X	X	X	X	?	X
PRB	X	?			X		X	X	X	X			

X = Valuable metric at all sites
? = Valuable metric at some sites
= Valuable metric at few sites

Revised Sustainable Remediation Metrics Matrix

CRG SUSTAINABILITY METRICS FOR PROJECTS

	Managed Mass of Contam	Water loss	PM 2.5	Waste Gener.	Occ Risk	Econ. Value	CO2	GWP Credits	Efficiency Immob. Metals	Efficiency Destr. Organics	Recycle mass	Landfill Volume
(maximize or minimize)	max	min	min	min	min	max	min	max	max	max	max	min
landfill	X		X		X		X		?		?	X
dnapl		X			X		X	X		X	?	
ground water	X	X			X		X		?	X		
contaminated soils	X	?	X		X		X					X
contaminated sediments	X		?		X		X					X
lnapl	X	X			X		X			X	?	
surface water	X	X			X		X					
air					X		X			?		
sludge impoundment	X		?		X		X			X		X

X = Valuable metric at all sites
? = Valuable metric at some sites
= Valuable metric at few sites

DuPont's Remedy Selection Matrix

	Safety	**Risk Reduction**	**Regulatory**	**Public Relations**	**Business Risks**	**Technical**	**Implementati on Cost**	**Sustainability**
General Objectives:	Minimize H&S exposure	Protect human health and the environment	Control off-site COC migration, plume stability	Maintain positive relationships	Eliminate / minimize	Long-term effectiveness no O&M	Minimize and/or Predictable Cost	Net Benefit to the Environment
ZVI/Clay								
Dig & Haul								
SVE								
Ex-Situ Thermal								
Capping								

Sustainability is only one factor in the remedy selection matrix.

Sustainability Metrics Conclusions

Recycling during remediation has a very large impact on estimated greenhouse gas emissions. That impact can be positive or it can be negative

CO_2 emission is the best measure of remediation sustainability. It is similar to - but not the same as - energy use.

Occupational risk closely tracks CO_2

Efficiency metrics are good for spotting anomalies

There is a limit to how many metrics can be used effectively. We suggest using five or less.

We saw no simple way to connect brownfield remediation to brownfield redevelopment. Future uses are not dependent on cleanup methods in the case where no contaminants remain.

The miracles of science

Attachment 11
Metrics at a BP site
Stephanie Fiorenza, BP,
and Dick Raymond, Terra Systems

Sustainability of Proposed Remedial Technologies at a Superfund Site

Sludge Pit Remediation

Stephanie Fiorenza, BP and Richard Raymond, Terra Systems

SURF 4
August 22-23, 2007
NJIT

Site Information

- Superfund site in Texas
- Site was a chemical plant and refinery waste disposal facility
- Focus is on a 6.4 acre sludge pit. Remedial approaches being evaluated:
  - Sludge stabilization and solidification (2 approaches)
  - On site Incineration
  - Off site Incineration
- Sludge stabilization and solidification on site is favored, but appropriateness of specific approach still to be determined.

Sampling the Sludge Pit

1 - A long-stick trackhoe with a ¾ CY bucket was mobilized to the impoundment berm and used to collect sludge samples.

Placement of Samples

2 - A small pit was excavated in the berm beside the excavator to contain the sludge sample.

Approach

- Screen remedies on key sustainability parameters
- Modify sustainability analysis tool developed by URS and DuPont

CO_2

- Evaluate leading remedial options

Screening Sustainability Parameters

IMPACTS or DEBITS

Parameter / Technology	CO_2 emissions	VOC emissions	Land Usage/Time	Water Usage
S/S with pumping	Y	Y	Y	Y
S/S without pumping	Y	Y	Y	N
Incineration On site	YY	N	N	N
Incineration Off site	YY	N	N	N

Metrics for the Remedial Approaches

- Sludge stabilization and solidification w/wout groundwater extraction
  – VOCs
  – Land
  – Water
  – CO_2
- On Site Incineration
  – CO_2
- Off Site Incineration
  – CO_2

Modified Analysis Spreadsheet

TASK	Volume	Units	Equip.	Fuel/Unit	Total Gal	CO2 Em	CO2 Tons
PreConstruction/Tank Demo+Contents Mgt.							
Plan Prep							
Construct Temp. Facility							
Mob/Demob							
Transfer Tank Water to Deep Well	286000	Gal	Truck	0.00	71.50	1600.46	0.80
Transport Tank Oil--Offsite Incin.	535200	Gal	Truck	0.00	2354.88	52711.63	26.36
Transfer Tank Sludge to Sludge Pit	10000	cy	Truck	0.08	833.00	18645.87	9.32
Front End Loader	10000	cy	FE Loader	0.67	6690.00	149748.96	74.87
Tank/Piping Demolition					0.00	0.00	0.00
Hauling Scrap Metal to Processor	800000	lbs	Truck	0.00	250.40	5604.95	2.80
Front End Loader	800000	lbs	FE Loader	0.00	2400.00	53721.60	26.86

Carbon Dioxide Equivalents

	S/S in situ + GW	S/S on site	Incineration on site	Incineration off site
Preconstruction activities	141	141	141	141
Soil Management	8020	18,094 S+S	7169 S+S	8791 S+S
Sludge Management	1800	------	------	-----
Incineration	------	-----	84,648	91,080
O&M activities	59			
Total (tons CO_2)	9,953	18,235	98,932	107,090
Contaminant Removal (lbs)				
Ton Contaminant/Ton CO_2	10.4	32.4	5.9	5.5

Additional Parameters

	Occupational Exposure	Mileage	Activity Risk	Community – noise, dust, traffic
S/S in situ, with pumping	Y	N	Y	N
S/S on site, without pumping	Y	N	Y	N
On site Incineration	Y	N	Y	Y
Off site Incineration	Y	Y	Y	Y

Variable Metrics, Impacts

Different sites have different key sustainability parameters

Metrics vary by site

Remedial Approach has different effects on different sustainability parameter

For this case, remedial tasks that most impact CO_2

- Treatment method
- O&M

A Sustainable Approach to Sustainability?

- Keep Goal in mind – better remedial solution
- Screen key sustainability parameters – will vary by site and remediation technology

  use for decision-making in remedy selection,

  holistic design of remedies

  qualitative analysis
- Tailor Detailed Assessment to end needs

  quantitative analysis for carbon trading, e.g.
- A Detailed Assessment Implies Verification
- Must Consider contaminant destroyed/ CO_2 generated if looking at CO_2 equivalents

Simplify, Simplify

SITE KNOWLEDGE

↓

QUALITATIVE SCREENING

↓

SHORT LIST OF TECHNOLOGIES

↓

SCOPE OUT TASKS

↓

DETAILED SUSTAINABILITY ASSESSMENT OF UNIQUE TASKS

RELATIVE ANALYSIS

↓

CONTAMINANT REMOVAL/CO_2 GENERATED

Attachment 12
Perspective from a Brownfield Redeveloper
Jim Poling, DNREC

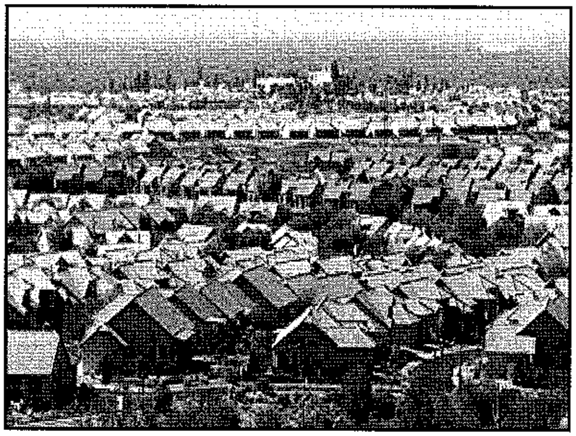
LINKAGES BETWEEN DELAWARE'S BROWNFIELDS DEVELOPMENT PROGRAM AND SUSTAINABLE DEVELOPMENT

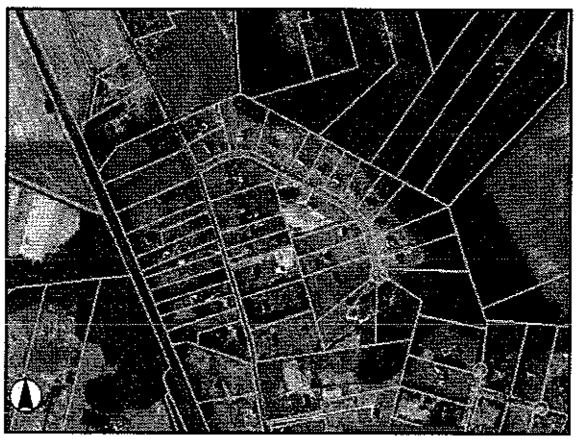
Sustainable Remediation Forum

Newark, New Jersey
August 23, 2007

James M. Poling, J.D.
Brownfields Administrator

WHAT DOES UNSUSTAINABLE DEVELOPMENT LOOK LIKE?



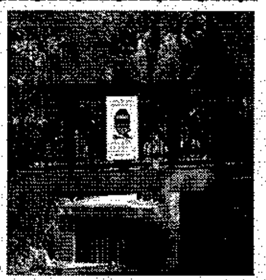


SUSTAINABLE/SMART GROWTH GUIDING PRINCIPLES

- Guide Growth to Areas that are Most Prepared to Accept it in Terms of Infrastructure and Thoughtful Planning
- Preserve Farmland and Open Space
- Promote Sustainability, Infill and Redevelopment
- Facilitate Attractive, Affordable Housing
- Protect Our Quality of Life While Slowing Sprawl
- Provide a Variety of Transportation Choices

Obstacles to Sustainable Redevelopment

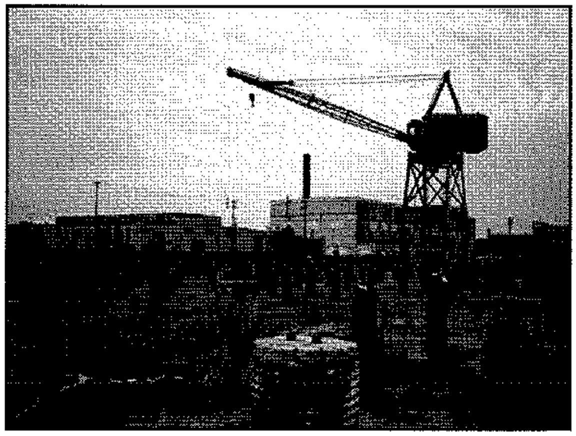
- Traffic Congestion
- Desire for the 'Levittowner' Experience
- Crime and Social Issues
- Overcapacity (CSOs)
- Rehabilitation Limitations (Fire Code Restraints)
- Blighted and Contaminated Properties (Brownfields)



BROWNFIELD RESOLUTIONS

- Develop a More Efficient Brownfield Program
- Conduct Community-Based Inventories
- Educate Municipalities and Counties as to the:
  - Economic Possibilities of Brownfield Redevelopment
  - The Risks Posed by Contamination
  - The New Brownfields Development Program
- Assist in Providing Affordable Housing
- Assist in Developing Community Gardens

What Does a Brownfield Look Like?



BROWNFIELDS DEVELOPMENT PROGRAM

- Began as Part of a Livable Delaware Task Force
- Targeted to Potential Purchasers Who Did Not Cause or Contribute to the Contamination and were Willing to Take a Risk
- Goal Was to Make the Program More User-Friendly

HSCA DEFINITION OF A BROWNFIELD

"Brownfield means any vacant, abandoned or underutilized real property, the development or redevelopment of which has been hindered by the reasonably held belief that the real property is environmentally contaminated."

Primary Obstacles To Brownfield Redevelopment

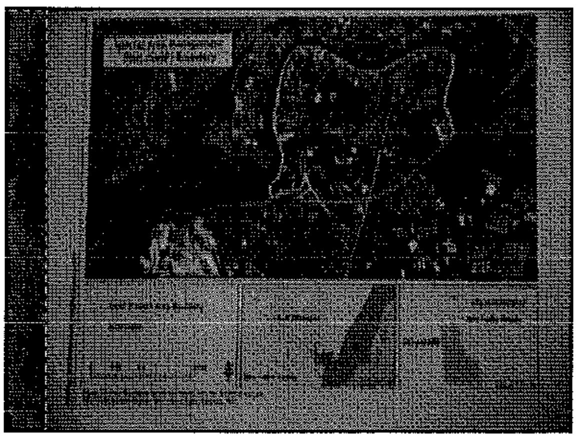
- Uncertainty in Cleanup Process, Types and Amounts of Contamination
- Cost of Environmental Investigation/Remediation
- Time to Complete Environmental Process
- Liability Fears

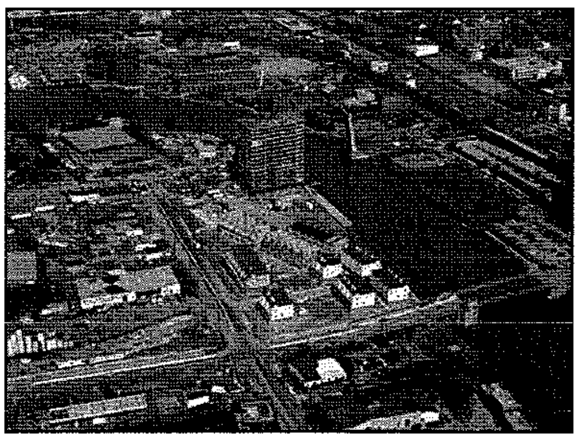
Delaware Brownfields Redevelopment Initiatives

- Plan for Redevelopment with all Stakeholders
  - Cities, Communities, Counties
- Liability Incentives (BDA and Brownfields VCP)
- Reduce Uncertainty in Site Cleanup Process
  - Brownfields Development Program (BDP)
- Financial Incentives
  - $5 Million Grants & Loans

BROWNFIELD INVENTORIES

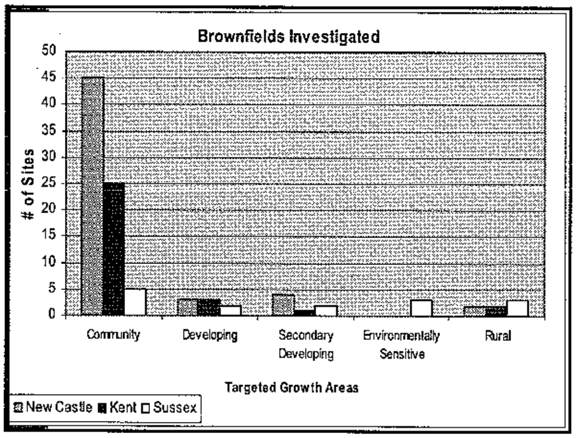
- State-wide Inventory Conducted in 1999
- No Community Involvement
- Listed 670+/- Potential Sites
- Wilmington Special Area Management Plan Conducted in 2003-2005
- Considerable Community Involvement, Especially in Data Specifications
- Listed 120+/- Potential Sites in a 4 Square Mile Area

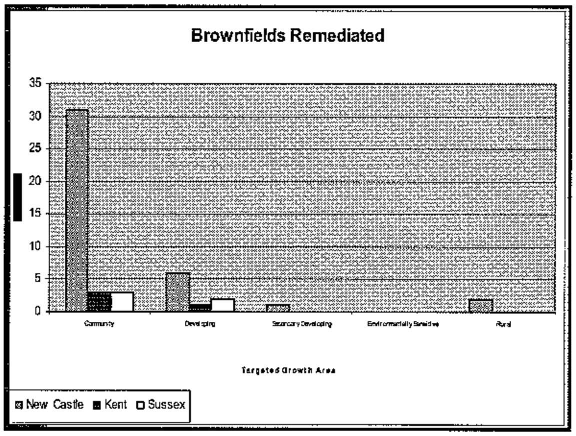




COMPREHENSIVE PLANS

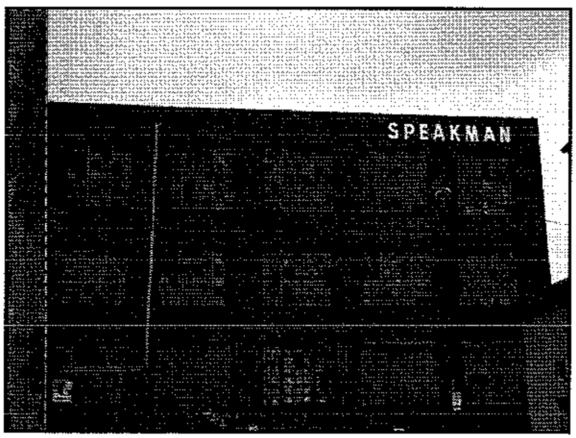
- Complement Local Brownfield Inventories
- Addressed in Either/Both Environmental or Economic Sections
- Assist in Planning for Annexations

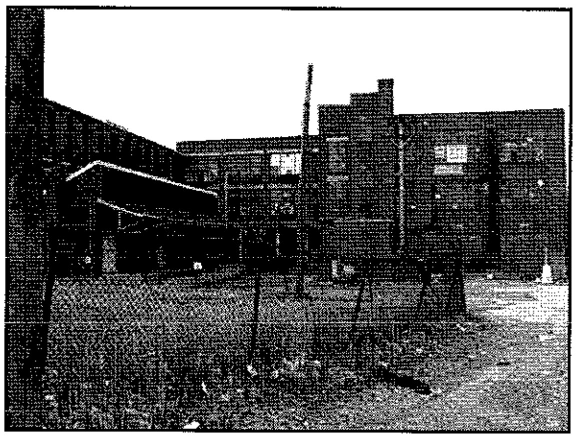




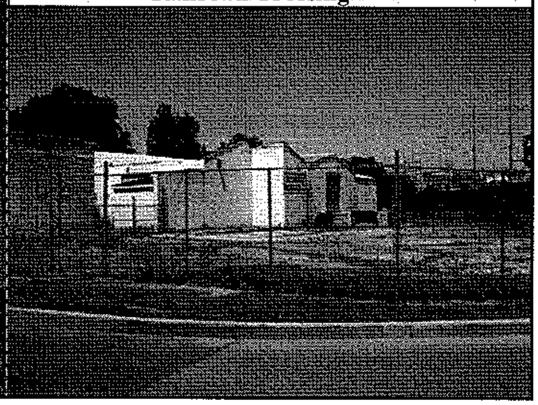
AFFORDABLE HOUSING

- Increased Funding to Public, Non-Profit Entities
- Typical Partners:
  - Municipalities
  - Housing Authorities
  - CDCs





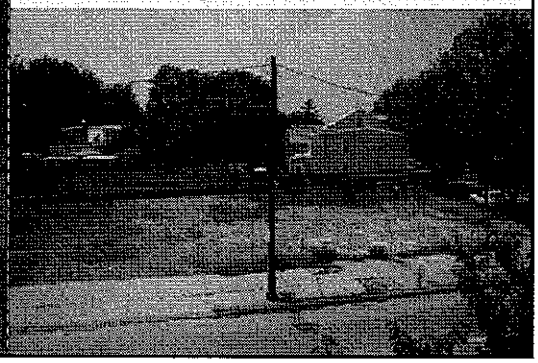
Railroad Crossing



Habitat For Humanity

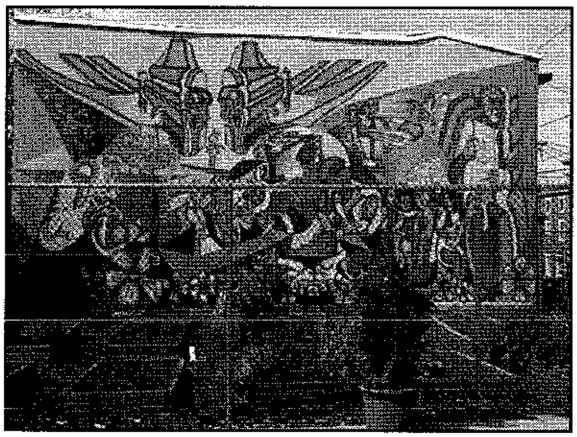
Pavilion Project

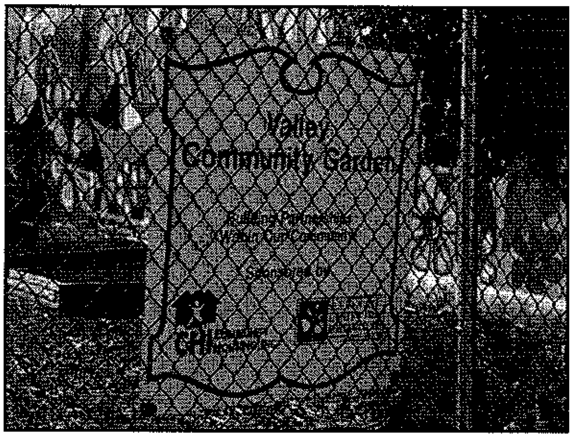
Neighborhood House



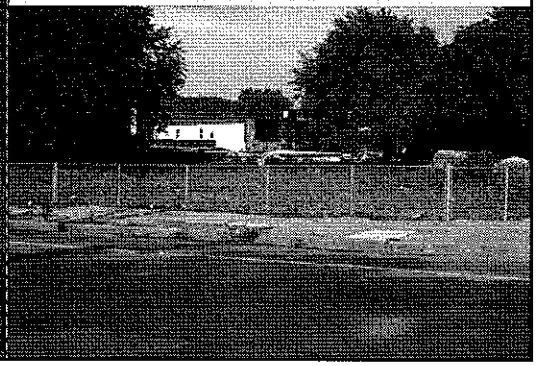
COMMUNITY GARDENS

- Brownfields Program Provides Funding for Investigation and Remediation of Garden
- Work Through a 'Straw Man' to Purchase Property and then Turn Over to a Community Organization
- Community Must be Willing and Desirous of a Community Garden
- Often Employ Deed Controls Preventing Use Change





Hogar Crea



NEXT STEP:EVALUATE SUSTAINABILITY

- Does Brownfield Redevelopment Promote Sustainable Smart Growth Initiatives
- Affordable Housing Without Gentrification
  - Meets Community Needs (Involvement)
- Incremental Cost of Upgrading Transportation Infrastructure
- Market Failures (Overpricing)
- Environmental Tradeoffs:
  - Higher Density vs. Stormwater Runoff
  - Potential for Increased Strain on Sewer Capacity

CONTACT INFORMATION

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Attachment 13
Somersworth Landfill
Dave Major, GeoSyntec Consultants

Geosyntec consultants

Somersworth Landfill NPL Site Sustainability Post Mortem

David Major, Ph.D.
SURF 4

NJIT
July 2007

engineers | scientists | innovators

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Background

- 26-acre disposal site operated by City of Somersworth, New Hampshire
- Operated from mid-1930s, converted to landfill 1958
- City burned residential, commercial, and industrial wastes at the site
- U.S. EPA-recommended traditional presumptive pump and treat (P&T)/waste encapsulation
- Remedy valued at more than $16 million (capital cost)
- Initial goal – find a more cost effective alternative to attain risk and regulatory compliance objectives as outlined in the Record of Decision (ROD)

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EPA Remedy Implications

- Expensive
- Would of required
  - upgradient groundwater diversion trench
  - a soil-bentonite slurry wall surrounding the entire landfill
  - P&T system operation with power consumption and potential to dewater wetland
  - Sludge disposal (Hazardous)
  - RCRA Cap

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Alternative Remedy

- Downgradient PRB (ZVI) on edge of landfill
- Permeable cap to allow infiltration through landfill waste to flush chemicals to treatment wall
- Pumping from bedrock only
- Use of passive diffusion bag samplers
- Risk sharing of cost for innovative ZVI wall with EPA
- $5.5 million in reduced capital cost
- $1.3 million in reduced O&M cost
- $10.5 million in deferred cost (25 years)

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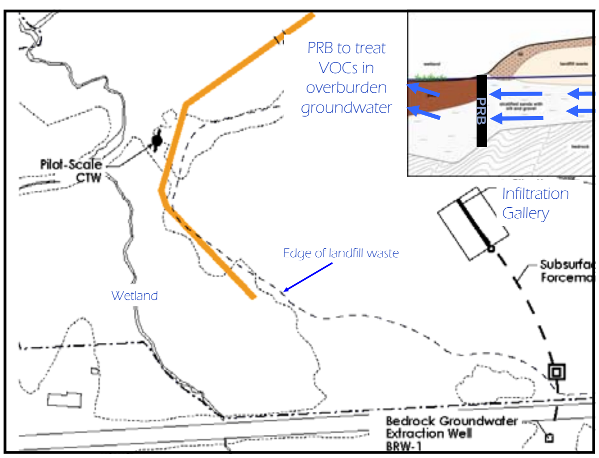

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Sustainability Metrics

- Significant reduction in energy/GHG and Safety Issues
  - Minimum construction/associated traffic (27,000 12 cy trucks)
  - Passive system (no energy for treatment)
  - P&T component reduced from 140 gpm for overburden/bedrock to 9 gpm bedrock groundwater extraction and infiltration behind PRB
  - No hazardous sludge collection and disposal (originally up to 400 lbs/day)
  - Passive sampling
- Maintain/enhanced natural system
  - Wetlands maintained (some alternatives dewatered 40 to 190 acres)
  - Community enjoyment
  - Scrap metal used in ZVI PRB
  - Enhanced natural degradation process in source and downgradient (source/plume treatment)
  - Methane generation consumed (via natural cap)
- Regulatory Acceptance
  - Risk sharing/ROD

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Conclusions

- Got to the right sustainability end points but driven there by cost considerations
- Are sustainable remediation systems inherently more cost effective too?

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Attachment 14
Feedback from Questions from Day 1 and 2

Feedback

Day 1 Question: What Metrics Issue Causes You the Most Concern?

- The wide range and depth of metrics considered and their use: i.e., no consensus on metrics or what sustainability is
- Asset value comparison; Sustainability metric vs. primary cleanup objectives; Carbon trading
- Value of Metrics/Sustainability. Where does remediative YT in the grand scheme, i.e., <1%
- Presuming that my metrics are the most important to the others reviewing/evaluating. Land use hard to value
- When individual consider sustainability above other goals of the cleanup.
- Land Lifetime Sustainability; Ex: Sustainability remediation (necessarily) sustainable reuse.
- Placing sustainability in the proper decision analysis context – so everyone is looking at it with the same optics
- Calculated Value
- I am concerned that the number of metrics & metric inputs and the process to evaluate those metrics becomes too cumbersome.
- How does one weight the relative importance of different metrics? Ex: Dave Ellis mentioned how a "broken leg" cannot easily be translated into a cost.
- How can "functional unit" be defined?
- Heavy focus on energy and CO_2 emissions, what about other "sustainability issues?
- What "equivalent" to use for technology screening comparisons (e.g., gallon of groundwater conserved, unit of energy conserved, # CO_2 emitted, etc.).
- Excessive reliance on energy with site metrics in the remedy selection process
- Balancing metrics. What's most important?
- Energy consumption - for some technologies, at some sites, do the environmental restoration benefits outweigh the energy consumed to implement and support that technology.
- Transparency and ability to calculate and communicate. Bound timeframes
- Value of GHG credits in costing of sustainability
- When to use sustainability metrics in alternative evaluation and selection
- The detail of the metrics and therefore the "implementability" of the metrics, is what concerns me. Also the consistency.

- For vacant site, how do you value land over time – will land values change differently in different areas of an area over time: Water view, financial viability LT of are contaminated land in NYC with a water view can be $1x106 to $1x10? Land inVisalia, CA may be $1x104 to 3x104. Modelling?
- How to be "complete" in evaluating a new factor. E.G., if you recycle concrete and recover aggregate and rebar does that change the answer.
- Incorporation of conservation of resources. CO_2 doesn't seem to address efficiency of remediation.
- Are we too focused on GHG metric? Can the 5 metrics be more "holistic" to embrace 1 GHG, 2 Water Use, 3 Energy, 4 Land Use, 5 Beneficial reuse of waste and/or property and combined into on meaningful "score" or algorithm
- Site specific differences will impact your ability to use certain metrics. The weighting factor you apply for certain metrics. Socretal benefits (of clean site) may outweigh any benefits a non-clean closure may result in
- Need to include social aspects along with environmental and economic. Inability to create a true picture of value creation through the sustainability process
- Considering CO_2 emissions or CO_2 credits as the best [only] measure of sustainability, including broader parameters – soil and water credits
- Varibility. Numbers for CO_2 equivalence, or how far down the process chain you go back to track a metric make it impossible to consistently judge without clear guidelines established.
- Over-complexity/ Ease of use

Day 2: Imagine you are discussing sustainability with key stakeholders. Is there any barrier in that meeting preventing a full discussion of sustainability (i.e., is anything missing)? Include the number of SuRF meetings that you attended and whether you work for industry, government, etc.

- Likely lack of overall impact understanding; 2 sessions; corporate
- Yes – A common definition of sustainability; 1; Corporate
- Caps, transfer problem ? sustainable (e.g., workshop on rem. in NJ up development along Hudson near George Washington bridge (south). From a green building ? ? ? S means making the earth a better place for my grandchildren. Caps – delay problem for them!
- Real understanding of sustainability; Sustainability remediation must be linked to sustainable ? (1) NG0
- The biggest barrier to a comprehensive discussion about sustainable remediation is a lack of a definition of "Sustainable Remediation". What is the scope? Are we all on the same page? #surf meetings :1 affiliation: regulatory
- Without some common understanding on what we are not talking about, it may take a long time to have a productive discussion. 2 sessions reg.

- Barriers to having a full discussion of sustainability in remediation with all stakeholders? Many have no experience or knowledge of the sustainability movement. Regulators often bogged down in bureaucratic process (lack of guidance, "CYA" attitudes). Weight of subjective factors. Surf meeting:1 affiliation: industry consultant
- Different definitions of sustainability and different value for ? components. Need agreement of terms. Company (4)
- 1. Education/Understanding of stakeholders. 2. Consultant. (1) session
- Barrier to discussion. What is the scope of sustainability – Sustainable Remediation or Sustainable Redevelopment. Corporate Rep Surf meeting (1)
- Owners by all parties in the sustainability metrics (short term vs. long term). Expand full understanding how CO_2/GHG factors ? to the solution of remedy. What does sustainability mean to each party? Do all agree sustainability is a valued metric in the selection process? Corporate owner/operator (1) session
- Yes! There is a fundamental gap in holistic model, with variables defined, and variable weights assigned specific to local site. We need a sample (less than 6 variable) model to drive to a desired, most favorable outcome. Previous surf = (0) Affiliation: Consultant
- Yes – a primary PRP that has no interest in sustainability and is entirely cost driven. A PRP group that can't reach consensus in the role sustainability should play in a technical decision. First Surf Session. Consulting-named provider
- I don't see how we are including environmental/impact or conservation resulting form remedial actions. (2)/GOCO
- Yes – Understanding what sustainability really means is what it looks like. (4) Consultant
- Discussion of Stakeholders at Remedial Opportunity. Barriers: Technical knowledge of participants, Selfish interests of participants, Greed. Missing: Maybe empathy. Number of surf sessions (1) Remedial provider
- Definition of Sustainability Attributes. (3) Regulator
- Better understanding of long term sustainability – in 50yrs will someone have to come back? How Do We?/ Do We Need To? Clarify sustainability needs, def., rules in regulations/guidance. Some of us need: Access to tools, Online Primer, Feedback opportunity. More Quantification Examples: meetings, Service Provider
- What's missing? 1. Understanding of sustainability by the other meeting participant. 2.Quantitative vs. Qualitative understand. 3. Need and Importance of sustainability attended all 4 surfs. corporation
- Value of Intangibles. Ranking/Priorities of Variables. (4) Surf. Remediation Provider

- I expect there is a disagreement on what issues are relevant to sustainable remediation (1) Surf Session. R&D Funding Organization
- Things Preventing Full Discussion: 1. Different Definitions of Sustainability. 2. Hard to do quantitative. 3. Difficult to weigh importance of different metrics. 1st Surf Session Environmental Consultant
- Barriers. What the most important “future state” is. Common agreement of what’s most important? Land use, CO_2, Or, how to manage differing desires. (4) Sessions. Consultant
- What else do we need to know? A move complete “framework” for defining the categories considered in the evaluation, and an approach for refining that list to those that can be quantified. This can (and I think should) take the form of a life-cycle analysis. 3rd Surf meeting for me. Affiliation – Consultant
- Is there any barrier in that meeting preventing a full discussion of sustainability?Regulations, Life-Cycle Emissions, Short term Risk vs. Long term Risk. (1) Surf Sessions NJIT - Affiliation
- Unwilling Participants – this might turn into yet another bureaucratic obstacle to getting my remediation moving. Desire for detail – people wanting to get to bogged down with conversion factors, and which #’s or metrics to use. 2nd meeting Regulatory
- Regulatory. If many of the factors associated with the concept are qualitative and/or involve the use of professional judgement, how do you assure unbiased/uniform application?
- Barrier to Full Discussion: Education of the concept, -If you discuss, how are you going to implement? We don’t have the answer. Then there is also time required to do the assessment. Define how fits within PBM, PBC, PBRM, and ROP as those initiatives are driving the DOD environmental restoration program. (1) DOD