Sustainable Remediation Forum (SURF)
SURF 9: February 24 and 25, 2009
Oakland, California

SURF 9 was held in Oakland, California, at Northgate Environmental Management's office on February 24 and 25, 2009. Those individuals that participated in the two-day meeting are listed in Attachment 1 along with their contact information. Remote participants are not included in the listing. The meeting marked the ninth 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. Previous meeting minutes are available at <**www.ibackup.com**>. The username is surfarchive, and the password is surf.

Meeting Opening

The meeting began with Dave Ellis (DuPont) welcoming all participants and thanking Northgate Environmental Management for hosting the meeting. Dave also thanked Chevron and BP for providing the funding for the meeting facilitation and note taking. Dave asked the group to think about the following three questions:

- What can SURF accomplish that is unique from other organizations to help move sustainable remediation forward?
- What should the structural style of SURF be?
- What are the next big steps that SURF should take?

Dave then updated participants on the status of the white paper, stating that the document was submitted to the publisher and thanking everyone for their hard work. He told participants that he believed that the resulting document reflects respect for all opinions, has diverse authorship, and takes an honest approach.

Maile Smith (Northgate Environmental) welcomed all participants to Oakland and discussed some meeting logistics. She then introduced Bart Croes, the Research Director of the California Air Resources Board. Bart described the Air Resources Board, which is a test bed for advanced regulations and has an $8 million/year research program. The Board provides scientific and technical input to policy, providing performance-based standards for technologies, incentive funding for various initiatives, and market-based programs for issues such as greenhouse gases. Bart then summarized California's air pollution problem, explaining that over 90% of Californians breathe unhealthy air. The Board's work on climate change prompted the Global Warming Solution Action of 2006, which mandates that California's emissions return to 1990 levels by 2020. Bart described the mix of strategies being used to reach the goal and the projected economic and environmental benefits. Presentation slides are provided in Attachment 2. Discussions were brief and focused on the larger issue of balancing hypothetical risks vs. real risks and whether risks are being allocated properly. One participant noted that the remediation industry spends billions of dollars on the hypothetical risk of site cleanup vs. the real risk of air pollution.

With the participants energized after Bart's presentation, Mike Rominger (meeting facilitator) stated the meeting theme of "After the White Paper – Planning for the Future." Mike discussed

meeting logistics and ground rules (e.g., expectation that attendees will be active participants, show respect for others, appreciate and encourage divergent opinions, refrain from marketing, and be familiar with previous meeting minutes so the meeting can focus on new information). He also noted that it was assumed that nothing discussed or presented contains confidential information. Prior to the meeting, export control compliance was verified. Mike also read the following antitrust statement:

> "It is not the purpose of this meeting to discuss an existing or planned situation involving any party, whether a participant here today or not, concerning the price, customer base, volume, market, quality, design or cost structure of any commercial product or service, or to plan any course of action having an exclusionary or discriminatory effect."

Mike thanked the Meeting Design Team for their work in planning the meeting agenda. SURF 9 Meeting Design Team members were as follows: Kathy Adams (Writing Unlimited), Buddy Bealer (Shell), Carol Dona (U.S. Army Corps of Engineers), Dave Ellis (DuPont), Paul Favara (CH2M Hill), Paul Hadley [California Department of Toxic Substances Control (DTSC)], Karin Holland (Haley & Aldrich), Phil McKalips (Environmental Standards), Mike Miller (CDM), Mike Rominger (DuPont retiree), Maile Smith (Northgate Environmental Management), Paul Tornatore (Haley & Aldrich), Dan Watts (New Jersey Institute of Technology), and Dave Woodward (AECOM Environment).

The draft mission statement from the February 2007 meeting was read as follows: "To establish a framework that incorporates sustainable concepts throughout the remedial action process that provides long-term protection of human health and the environment and achieves public and regulatory acceptance." Sustainable concepts were further defined as those that "balance economic viability, conservation of natural resources and biodiversity, and enhancement of the quality of life in the surrounding community."

Efforts to achieve "sustainable neutral environmental behavior" continued at this meeting. Name badges and tent cards were reused. Many participants used public transportation to travel to the meeting location. In addition, interested meeting participants walked to a happy hour and dinner after the first day of the meeting. Efforts to achieve sustainable neutral behavior are ongoing and will continue at future meetings.

News Items

Participants discussed the news items below at the beginning of the meeting. These news items were shared with SURF members via e-mail the week after the meeting. E-mail addresses and phone numbers for news item contacts are provided in Attachment 1.

- Mike Miller (CDM) is organizing a sustainability session at the 25th Annual International Conference on Soils, Sediments, Water, and Energy. The conference will be held October 19-22, 2009, at the University of Massachusetts at Amherst. The deadline for abstract submittal is early April, and a volunteer is needed to co-chair the sustainability session with Mike. For more information, contact Mike directly or visit the conference web site at <**http://www.umasssoils.com/papers.htm**>.

- Elie Haddad (Haley & Aldrich) mentioned that over 300 people attended the free, one-day symposium Global Perspectives on Green Remediation—Making Clean 'Green' on February 4, 2009. The California DTSC presented the symposium in conjunction and in cooperation with the U.S. Environmental Protection Agency (USEPA) and the Groundwater Resources Association. Many people attending the SURF 9 meeting also attended the symposium, and everyone agreed that the symposium was a success. Elie thanked SURF members Paul Hadley and Mikos Fabersunne, both of the California DTSC, for all of their hard work. Information about the symposium is provided at <**http://www.dtsc.ca.gov/OMF/Grn_Remediation.cfm#CP_JUMP_325621**>.
- Steve Linder (USEPA Region 9) mentioned that the California Water Board hosted four public meetings to collect information and ideas for updating the California Leaking Underground Fuel Tanks (LUFT) manual and to invite discussions on how to improve the overall process of underground storage tank (UST) remediation within the state. This initial input was used to create a Wiki site that enables all interested parties to contribute to the content of the new LUFT manual. To contribute to the effort, go to <**http://www.caluftmanual.org/wiki/index.php/Main_Page**>. For more information about the project, contact Steve Linder or Erik Magnan or visit the California Water Board's web site at <**http://www.caluftmanual.org/**>.
- Tiffany Swann (GSI Environmental) provided an update regarding the Air Force Center for Engineering and Environment (AFCEE) sustainable remediation tool. Beta comments are being reviewed, and the tool is expected to be released in mid-April to early May 2009. For additional information about the tool, read past meeting notes or contact Tiffany.
- Erica Becvar (AFCEE) told participants that she will be speaking about green remediation and the Air Force perspective at the Air National Guard Civil Engineer Workshop. The conference will be held April 28-30, 2009, in Phoenix, Arizona. Additional information about the conference is available at <**https://resweb.passkey.com/Resweb.do?mode=welcome_gi_new&groupID=160038**>. She will also be a panel member for "Green Remediation: The Sustainable Remediation Forum" at the 21st Annual National Tanks Conference and Exposition in Sacramento, California, as well as presenting in the green remediation session of the conference. Fellow SURF member Curt Stanley will be chairing a workshop at this conference. The conference will be held March 30 to April 1, 2009; additional information is available at <**http://www.neiwpcc.org/tanksconference/**>.
- Curt Stanley told participants that he will be a panel member on the topic of sustainable remediation at the Association for Environmental Health and Sciences (AEHS) 19th Annual Meeting & West Coast Conference on Soils, Sediments, and Water. Fellow SURF member Paul Hadley will be chairing a session at the conference. The conference will be held March 9 to 12, 2009, in San Diego, California. Additional information about the conference is available at <**http://www.aehs.com/conferences/westcoast/index.htm**>. Curt will also be a panel member at a conference on Sustainable Property Transactions: Doing Contaminated Site Re-Developments in a Downturned Market in Washington, DC on

April 6 to 8, 2009. For more information, go to <**http://www.rtmcomm.com/conference_full.php?ConfID=35**>.

- At the EcoForum Conference & Exhibition in Sydney, Australia, Curt Stanley will serve as the keynote speaker on sustainable remediation. Paul Nathanail and Paul Bardos of SURF UK will also be keynote speakers. The conference will be held April 28 to 30, 2009; additional information is available at <**http://www.ecoforum.net.au/2009/**>.
- Carol Dona (U.S. Army Corps of Engineers) updated the group on the progress of the tool for incorporating sustainability into the Army's environmental remediation program. Currently the tool is undergoing an internal review, and an external review should be complete by April 2009. Carol invited SURF members to contact her about the tools being used to integrate sustainability concepts in remediation. Carol's brief presentation is provided as Attachment 3.

Presentations

SURF 9 presentations both continued the general education commitment about sustainable remediation and provided insights into the efforts and approaches of other organizations and the implications for SURF's structure and organization moving forward. Presentations and subsequent discussions are summarized in the subsections below.

Diffusion, 14 Compartments, and Sustainability

Tom Sale (Colorado State University) presented emerging concepts for managing chlorinated solvent releases. Currently, recognition is growing that diffusion is a critical process driving the nature of subsurface releases of chlorinated solvents. Most critically, at sites with older releases, much of the contaminant mass may be present in low permeability zones and these contaminants have the potential to drive the longevity of chlorinated solvent sites. Tom described a 14 compartment conceptual model that was developed that recognized the importance dense, nonaqueous phase liquid (DNAPL), aqueous phase, sorbed phase, and vapor phase chlorinated solvents (in transmissive and low permeability zones). The primary value of the 14 compartment model is that it drives a holistic analysis of chlorinated solvent releases and recognizes the limitation of strategies that address only select parts of the problems. Tom said that the next step is to tie the theme of holistic approaches to chlorinated solvents and sustainable remediation concepts. Presentation slides are provided in Attachment 4.

Discussions focused on three areas: the need to evaluate long-term costs, the concept of restoration vs. remediation, and the reality of heterogeneous geology. One participant noted that without long-term costs, the full picture of impacts is not realized. Increasing costs over time and the fact that different organizations have different methods of addressing long-term liability complicate matters. The group seemed to agree that it was necessary to be honest about how long systems will operate and how much it will cost. Another participant mentioned the concept of restoration vs. remediation, citing that cleanup to restoration levels is driven by plaintiffs, natural resource damage assessments, and the like. He suggested that cleanup objectives be matched against technologies and that sustainability be added as a 10^{th} criterion to the National Contingency Plan (NCP) as a way to put boundaries around the problem. Another participant pointed out the reality and complexities of heterogeneous geology at many sites and how

heterogeneous geology limits the universe of feasible technologies for cleanup. Someone else agreed, saying that, at some sites, a lot of mass is present outside of the source zone. At these sites, remediation professionals are not observing the levels of improvement in groundwater quality that they thought because the aquifer is acting as a buffer to stabilize contaminant concentrations.

The ITRC Green and Sustainable Remediation Team

Tom O'Neill [New Jersey Department of Environmental Protection (NJDEP) and Interstate Technology and Regulatory Council (ITRC)] presented the background of the ITRC and described the efforts of the ITRC Green and Sustainable Remediation Team. As the leader of this team, Tom described the team's goal of providing "documents and training that educate state regulators and other environmental professionals on how to appropriately incorporate sustainability and green technologies into the cleanup process." The three-year schedule for the team includes a state survey and development of an overview document in Year 1, technical regulatory guidance in Year 2, and training modules in Year 3. Tom then stressed the collaborative nature between the ITRC and SURF that is desired and mentioned that the work of both organizations can complement each other to help move sustainable remediation forward. Presentation slides are provided in Attachment 5.

Discussions focused on membership costs and the value of a collaborative relationship between the ITRC and SURF. Tom directed participants to find detailed membership information at <**www.itrc.org**>, but noted that, as an industry affiliate member, companies can place employees on whichever teams they want and costs depend on the company size. Based on a show of hands, eight meeting participants are currently on the ITRC Green and Sustainable Remediation Team. The group seemed to agree that this overlap between ITRC and SURF membership would help keep the lines of communication open between the two organizations. All participants seem to agree, noting that ITRC and ASTM are both moving forward and that SURF needs to decide how it fits into the mix.

RBCA Evolution in the U.S.: Considerations for SURF Initiatives

Curt Stanley (Shell Global Solutions) and Dave Woodward (AECOM Environment) presented the evolution of risk-based corrective action (RBCA) to draw comparisons as to how SURF can approach the upcoming challenges of sustainable remediation (e.g., how to integrate sustainable considerations holistically). Curt and Dave stressed the importance of training and tools to simplify the process and the importance of having a multi-stakeholder group developing the tool to ensure a higher probability of success. Finally, the presenters told participants that ASTM is developing a standard on sustainable remediation and that it is time to decide how SURF is going to contribute. Presentation slides are provided in Attachment 6.

Discussions focused on questions about the RBCA Leadership Council and the role that SURF could serve in collaboration with the efforts underway at ASTM and ITRC. The presenters explained that the RBCA Leadership Council was similar to SURF in membership and their role was to look for opportunities to raise awareness about the topic and determine how to effectively use resources. One participant asked about the timing of the ASTM standard. Curt responded that he thought the standard would be developed within a year and noted the importance of SURF, ITRC, and ASTM communicating so that all are working in the same direction. Participants seemed to agree that communication between SURF, the ITRC, and ASTM would

be instrumental to success and that SURF needs to determine how to contribute. One participant mentioned the vapor intrusion guidance as the nonexample to follow. Another participant mentioned that ITRC could provide training on the ASTM standard, and Tom O'Neill said that he would take the idea back to his ITRC team for discussion. Someone else suggested hosting a global summit on green and sustainable remediation with the goal of having "one voice" to communicate issues.

Working Toward Sequestration Commercialization in the West Coast Region

Larry Myer [Lawrence Berkeley Laboratory and West Coast Regional Carbon Sequestration Partnership (WESTCARB)] presented WESTCARB's efforts to evaluate the geologic sequestration opportunities in the west coast of North America. In Phase I of the project, regional-scale assessments were performed to identify sedimentary basins with storage potential, collect data on structure and reservoir properties, and make storage resource estimates. Phase II of the project is underway and will involve conducting small volume carbon dioxide injection tests at two locations representative of major sequestration opportunities in the region. Larry discussed the specifics of the pilot projects, their goals, and technical objectives. Phase III of the project, just getting underway, is a 10-year large volume project that involves the injection of 1 million tons of carbon dioxide over four years into a saline formation in the San Joaquin basin. Larry explained that the project seeks to demonstrate both the viability of the basin as a major storage target in the region and the commercial scale sequestration methodologies for site characterization and monitoring. Finally, Larry told participants that these pilots have shown the variability across the region during implementation of all aspects of the technology. Presentation slides are provided in Attachment 7.

Discussions focused on unknown seismic issues (e.g., faults) and the impact of this practice on drinking water supplies. Larry explained that faults could serve as seals to keep carbon dioxide contained or conduits for carbon dioxide leaking. Geomechanical impacts are considered during the design of the projects, and Larry stated that it is his preference not to locate projects on faults. One participant said that water surveyors are concerned about the potential impact of injections on drinking water supplies. Larry responded by telling participants that: (1) the injection occurs below drinking water sources, (2) injection locations are selected only in areas where there is a high confidence in the seals, and (3) characterization and monitoring is performed to ensure that the proper geologic structure exists. Larry then told participants that, in the worst-case scenario, the well could be depressurized and the carbon dioxide could be extracted and vented back to the atmosphere.

Sustainability Considerations for Sediment Remediation Sites

John Ryan (AECOM Environmental) presented the challenges involved in cleaning up sediment sites associated with large urban water bodies where there are multiple sources and uses. Remedies at these sites are estimated to take years or decades to implement and even longer to achieve cleanup goals. Developing a sustainable remedy for these "mega sites" requires an increased understanding of sustainable metrics and how they can be addressed in the context of a long-term adaptive management approach. John contrasted typical sediment remedies in terms of energy use, carbon footprint, worker and community impacts, resource consumption, effects on bioavailability, and habitat and biota impacts both during and after during and after the remedy implementation phase. Presentation slides are provided in Attachment 8.

Discussions focused on the importance of considering a hybrid of ideas and approaches at large sediment remediation sites.

Green Remediation: Estimating the Environmental Footprint at a Corrective Action Cleanup

Karen Scheuermann (USEPA Region 9) presented a pilot analysis of a site cleanup to estimate the environmental impact of the cleanup remedy in comparison with two alternatives. The hazardous waste treatment facility is located in East Palo Alto, California, and is now closed and undergoing RCRA corrective action for groundwater contaminated with volatile organic compounds. Karen described the approach, which involved the analysis of on-site activities and transportation of materials and personnel to the site. The resources required to manufacture materials used on-site were also analyzed, but not extensively. The following aspects of the remedies were compared: resource use (including fresh water, construction materials, and electricity), air emissions (including carbon dioxide), and waste generation. Karen presented the methodology used in the analysis and draft results, which were estimates. She explained that the hope is that this methodology can serve as a starting point for green analyses within USEPA Region 9. Karen opened the discussion by asking participants for any recommendations and insights regarding improvements to the methodology or developing a framework for applying the results to remedy decision-making. Presentation slides are provided in Attachment 9.

Discussions focused on potential upgrades to the methodology and approach. One participant suggested that a comparison of sustainability parameters be conducted for 10 years after remedy completion. Another participant suggested that although secondary impacts were considered in the analysis, primary impacts (e.g., biota, flora, fauna) were not evaluated. He believed that a consideration of both primary and secondary impacts could change the result of the analysis. Other participants expressed concern that water for the pump-and-treat system was not factored into the analysis. Additional discussions focused on the challenge of considering the problem holistically, protecting human health and the environment not only within the site but also beyond the fenceline.

SURF Web Site

Lowell Kessell [Good EarthKeeping Organization (GEO)] updated participants about the web site for SURF, which is located at <**www.sustainableremediation.org**>. The web site currently contains a description of the forum, a mission statement, a location for meeting notes and report downloads, and contact information. At SURF 8, Lowell had posed questions to participants to obtain feedback on the web site content and management, potential web site advertising opportunities, and potential advertisement of the site. A survey was sent to SURF members in January 2009 to determine the answers to these and other questions. Lowell presented the survey results and noted the urgency of resolving outstanding issues and moving forward before the white paper publication in June. Presentation slides are provided in Attachment 10.

Discussions focused on those participants willing to volunteer for the Web Site Team to address issues such as obtaining volunteer hosting organization to cover maintenance costs and creating and maintaining web site content. The following individuals volunteered to participate on the Web Site Team with Lowell: Julia Bussey (AMEC Geomatrix), Dave Ellis (DuPont), Tim Havranek (ENTRIX), Elie Haddad (Haley & Aldrich), Chuck Newell (GSI Environmental),

Dick Raymond (Terra Systems), Maile Smith (Northgate Environmental Management), and Tiffany Swann (GSI Environmental).

Sustainable Remediation White Paper Update and Rollout

As Dave Ellis (DuPont) had mentioned at the beginning of the meeting, the white paper was completed and submitted to the *Remediation Journal* at the beginning of February 2009. (More detailed information about the genesis of the white paper and its content is provided in previous meeting notes at <**www.ibackup.com**>.) Dave discussed the concept of a Sustainable Remediation Panel for the *Remediation Journal*. In the past, the journal had a Monitored Natural Attenuation Panel that was quite successful. For each issue, the panel would select a question and a short introduction regarding the subject would be provided for readers. Then, members from the panel would write a response that was generally one to three double-spaced pages with about three to five responses per issue. Dave asked for volunteers for the panel. The following participants volunteered: Carol Baker (Chevron), Julia Bussey (AMEC Geomatrix), Dave Ellis (DuPont), Paul Favara (CH2M Hill), Karin Holland (Haley & Aldrich), Mike Houlihan (Geosyntec Consultants), Chuck Newell (GSI Environmental), Maile Smith (Northgate Environmental Management), Dan Watts (New Jersey Institute of Technology), Rick Wice (Shaw Environmental & Infrastructure Group), and Dave Woodward (AECOM Environment).

Consistent with the meeting theme of planning for the future after the white paper publication, chapter facilitators presented potential reactions to the white paper (see Attachment 11). Participants then gathered into smaller breakout groups to discuss each chapter (except the introduction) and the potential reactions and responses. Similar themes and ideas were apparent in all of the breakout group discussions. Many groups developed a list of potential questions that SURF will need to be ready to answer when the white paper is published (see Attachment 12). All participants seemed to like the idea of creating a document with frequently asked questions and answers so that SURF members will be able to consistently and accurately respond to inquiries after the white paper is published. Some participants thought that the frequently asked questions could be used to design the next meeting, identifying important topics that need to be discussed. All breakout groups seemed to agree that SURF needs to be proactive and prepared when the white paper is published.

With that in mind, the following individuals volunteered to help develop and/or implement an action plan for the white paper rollout based on SURF 9 discussions: Carol Baker (Chevron), John Ryan (AECOM Environment), Tiffany Swann (GSI Environmental), Elisabeth Hawley (Malcolm Pirnie), Karin Holland (Haley & Aldrich), Tim Havranek (ENTRIX), Mohit Bhargava (Battelle Environmental Restoration), and Rick Wice (Shaw Environmental & Infrastructure Group).

Next Big "Stake in the Ground" Discussion

SURF 9 participants divided into three groups to address the three questions below, considering the resources needed, potential partners, scope, and timing. A summary of each group's discussion is provided in the paragraphs below. Additional details regarding the discussions are provided in Attachment 13.

1. How will SURF communicate what we have learned and what we will learn?

2. How will SURF participate in developing and implementing appropriate standards and metrics across our industry?

3. How will SURF help society develop a consensus on the value of sustainability relative to the other values used for making remedial decisions?

Rick Wice (Shaw Environmental & Infrastructure Group) led the group discussing the first question about communication. This group thought that SURF should deliver the information, provide training, and provide education and perform outreach. Activities involved in delivering information were listed as publishing the white paper; maintaining the web site and updating it; hosting conferences, seminars, and expert panels; and advertising via press releases and links at appropriate web sites. Hosting webinars with the ITRC and Clu-In and developing guidance documents were mentioned as some training ideas. The education and outreach activities mentioned were expanding membership, using Wiki to communicate, providing a means for ongoing discussion (i.e., SURF and the Remediation Journal), and hosting meetings with professional societies and the like.

Carol Baker (Chevron) led the group discussing the second question about standards and metrics. After some discussion, the group developed the following action plan (see Attachment 13 for details):

- ❒ Author papers that provide definitions of metrics, propose metrics, and/or suggest what the metrics should look like.
- ❒ Develop an effective mechanism to distribute papers and other documents that SURF creates.
- ❒ Make a business case decision as a group what role SURF should assume.
  - Integrator: Put out tool and information ourselves (high cost: $$$$)
  - Facilitator: Use ASTM Leadership Council as role model (medium to high cost: $$$)
  - Interpreter: Act as a link between groups (medium to low cost: $$)
  - Organized Infiltrator: Participate in work of other groups and help coalesce the work (low cost: $)
- ❒ Determine funding mechanism for SURF. (The funding will influence SURF's role and level of effort.)
- ❒ Invite representatives from the ITRC, ASTM, and Association of State and Territorial Solid Waste Management Officials (ASTSWMO) to the next SURF meeting to facilitate dialogue.

Karin Holland led the group discussing the third question about consensus. After some discussion, the group developed the following priorities (see Attachment 13 for details):

1. Sustain the sustainable remediation thinking.
2. Define "What does sustainability mean to me" (to ourselves and to different stakeholders).
3. Identify outreach strategies that will provide SURF with the greatest bang for the buck.

4. Spread the word. (SURF wishes to take the actions necessary to lead the field; all participation in this movement is welcome.)
5. Provide leadership through example.
6. Consider monetary incentives.

Participants seemed to agree that the discussions of all three groups could be summed as "money makes the world go round." All agreed that SURF is at a point of transition, and members need to decide some key issues regarding organizational structure and focus before moving forward. Everyone also agreed that there is a high level of energy for moving forward and building on the foundation that the white paper provides.

SURF Organizational Structure Discussion

At SURF 8, Dave Woodward (AECOM Environment) presented the historical and future perspectives of SURF and the challenges associated with the organization's growth. As options to these challenges, Dave described various organizational structures and the group discussed the options.

At SURF 9, the discussion continued. Dave Ellis (DuPont) suggested two options to focus the group discussion: SURF could become the Sustainable Remediation Society or the Society for Remediation. Dave explained that the Sustainable Remediation Society would, in concept, imitate SURF's existing focus and efforts, but have a more formal structure. The Society for Remediation, on the other hand, would tackle the entire profession of remediation, with sustainability as a subset. Participants discussed their opinions of both options. In summary, those participants favoring the Society for Remediation liked the idea because the larger focus is future oriented and SURF would be able to fill a void in the field. Participants favoring the Sustainable Remediation Society liked the narrower focus and were hesitant to lose momentum (sustainability vs. remediation in general) at this critical time. After a lengthy discussion, participants voted on which option they liked better. Through a show of hands, the majority of participants preferred the Sustainable Remediation Society option. A few participants noted that SURF could begin with this option and then grow into the Society for Remediation.

Participants agreed that a smaller group of members was needed to discuss the details of both options other organizational issues (e.g., fees to cover resources). A SURF Leadership Group was formed consisting of a balanced team of problem owners, consultants, academia, and regulators. SURF 9 participants elected to nominate and add members to the existing SURF Work Group, which was formed during SURF 7. The SURF Leadership Group consists of the following members: Dan Watts (New Jersey Institute of Technology), Tom Sale (Colorado State University), Dave Ellis (DuPont), Stephanie Fiorenza (BP), Curt Stanley (Shell Global Solutions), Paul Favara (CH2M Hill), Dave Major (Geosyntec Consultants), Dave Woodward (AECOM Environment), and Paul Hadley (California DTSC). Participants agreed that this group would present proposed structure(s) at the next meeting and determine a fee structure for future SURF meetings.

Path Forward

The following path forward items were identified at the meeting:

1. The National Brownfields Association will host the next meeting, which will be held June 16 and 17, 2009, in Chicago, Illinois. Meeting logistics will be forwarded as they become available. A draft agenda will be developed by the Meeting Design Team and will be circulated via e-mail. Active feedback and suggestions are encouraged.
2. Based on feedback at the meeting, volunteers for the design team are as follows: Buddy Bealer (Shell Oil Products), Mohit Bhargava (Battelle Environmental Restoration), Julia Bussey (AMEC Geomatrix), Carol Dona (U.S. Army Corps of Engineers), Dave Ellis (DuPont), Elie Haddad (Haley & Aldrich), Tim Havranek (ENTRIX), Steve Koenigsburg (ENVIRON), Mike Miller (CDM), Ann Rosecrance (Conestoga-Rovers & Associates), Rick Wice (Shaw Environmental & Infrastructure Group), and Dave Woodward (AECOM Environment). Additional members are welcome. Meeting Design Team members should expect to spend about eight hours on the effort between now and the next meeting.
3. Based on discussion items at SURF 9, the Leadership Group will (1) present proposed structure(s) at SURF 10, determine fee structure for future SURF meetings, (2) develop and implement an action plan for white paper rollout with help of volunteers (see #4 below), and (3) further evaluate the next "big stake in the ground" for SURF based on the summary of SURF 9 group discussions.
4. The following individuals volunteered to help develop and/or implement an action plan for the white paper rollout based on SURF 9 discussions: Carol Baker (Chevron), John Ryan (AECOM Environment), Tiffany Swann (GSI Environmental), Elisabeth Hawley (Malcolm Pirnie), Karin Holland (Haley & Aldrich), Tim Havranek (ENTRIX), Mohit Bhargava (Battelle Environmental Restoration), and Rick Wice (Shaw Environmental & Infrastructure Group).
5. The following individuals volunteered to help address the web site issues discussed during the meeting: Julia Bussey (AMEC Geomatrix), Dave Ellis (DuPont), Elie Haddad (Haley & Aldrich), Tim Havranek (ENTRIX), Chuck Newell (GSI Environmental), Dick Raymond (Terra Systems), Maile Smith (Northgate Environmental), and Tiffany Swann (GSI Environmental). Lowell Kessel (GEO) will lead this group of volunteers. By the next meeting, the group will transition the web site to a volunteer hosting organization to cover maintenance costs and prepare the web site for the white paper rollout.

Attachment 1
SURF 9 Participant Contact Information

SURF 9 Participant Contact Information*

Participant	Affiliation
Adams, Kathy	Writing Unlimited
Baker, Carol	Chevron Energy Technology Company
Baker, Ralph	TerraTherm
Bhargava, Mohit	Battelle Environmental Restoration
Boughton, Bob	California DTSC
Broderick, Bill	WRS Compass
Bussey, Julia	AMEC Geomatrix
Chambers, Deni	Northgate Environmental Management
Croes, Bart	California Air Resources Board
Curnock, David	United Technologies Corporation
Dona, Carol	U.S. Army Corps of Engineers
Duplancic, Neno	Locus Technologies
Ellis, Dave	DuPont
Espino Devine, Catalina	Chevron Energy Technology Company
Fabersunne, Mikos	California DTSC
Favara, Paul	CH2M Hill
Fiorenza, Stephanie	BP
Foster, Ben	LFR
Gill, Mike	U.S. EPA Region 9
Haddad, Elie	Haley & Aldrich
Hadley, Paul	California DTSC
Harris Bishop, Rusty	U.S. EPA Region 9
Havranek, Tim	ENTRIX
Hendrickson, Nancy	CH2M Hill
Holland, Karin	Haley & Aldrich
Houlihan, Mike	GeoSyntec Consultants
Kavanaugh, Mike	Malcolm Pirnie
Kessel, Lowell	GEO Inc.
Koenigsberg, Stephen	ENVIRON
Lee, Alana	U.S. EPA Region 9
Leyva, George	San Francisco Regional Water Quality Control Board
Linder, Steve	U.S. EPA Region 9
Magnan, Eric	U.S. EPA Region 9
Maughon, Mike	Tetra Tech NUS, Inc.
Miller, Mike	CDM
Myer, Larry	Lawrence Berkeley Lab
Newell, Chuck	GSI Environmental
O'Neill, Tom	New Jersey Department of Environmental Protection
Peargin, Tom	Chevron Energy Technology Company
Raymond, Dick	Terra Systems
Reackhof, Sharron	PG&E Environmental Remediation
Rominger, Mike	DuPont Retiree
Rosecrance, Ann	Conestoga-Rovers & Associates
Ryan, John	AECOM Environment

* Remote attendees are not listed.

SURF 9 Participant Contact Information*

Participant	Affiliation
Sale, Tom	Colorado State University
Scheuermann, Karen	U.S. EPA Region 9
Smith, Maile	Northgate Environmental Management
So, Charlie	Shaw Environmental & Infrastructure Group
Stanley, Curt	Shell Global Solutions
Steen, Alexis	ExxonMobil Environmental Services Company
Swann, Tiffany	GSI Environmental
Torrens, Jake	AMEC Geomatrix
Watts, Dan	New Jersey Institute of Technology
Wells, Elizabeth	San Francisco Regional Water Quality Control Board
Wice, Rick	Shaw Environmental & Infrastructure Group
Woodward, Dave	AECOM Environment

* Remote attendees are not listed.

Attachment 2
California's Air Pollution and Global Warming Strategies

California's Air Pollution and Global Warming Policies

Bart E. Croes, P.E., Chief
Research Division

California Air Resources Board
California Environmental Protection Agency

1. Air Resources Board
2. Policy Drivers
3. Air Pollution Policies
4. Global Warming Policies

Governing Board

Appointed by Governor, traditionally bipartisan

Rule-making body for motor vehicles, air toxics, consumer products, greenhouse gases

Clean Air Act exemptions for motor vehicles if "extraordinary and compelling" conditions

Stationary and area source oversight

Public workshops and stakeholder meetings

Public and legislative support

Scientific/Technical Input to Policy

Legislative requirements

- Automotive Engineer and M.D. on Governing Board
- Health-based ambient air quality standards
- Extramural research program with external oversight committee
- University of California peer review of scientific basis for regulations

70% engineers and scientists

In-house research and technical work

Air quality field and modeling studies in major airsheds

Air Pollution Management Instruments

Performance-based emission standards

- Aftertreatment effective but source turnover can be slow
- Retrofits and repowering also beneficial
- Fuel improvements provide immediate benefits

Incentive funding

- $150M per year for diesel engines
- $1B for port trucks and equipment

Market-based programs

- Carbon emission trading for large sources under design
- Mitigation fees, feebates and others being explored

New authority for land use planning (Senate Bill 375)

1. Air Resources Board
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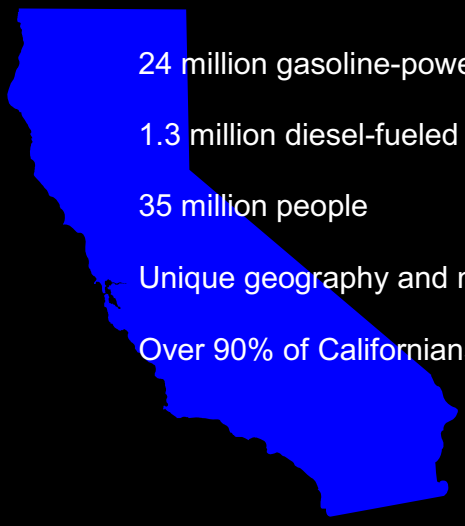
4. Global Warming Policies

California's Air Pollution Problem



- 24 million gasoline-powered vehicles
- 1.3 million diesel-fueled vehicles and engines
- 35 million people
- Unique geography and meteorology confine air pollutants
- Over 90% of Californians breath unhealthy air

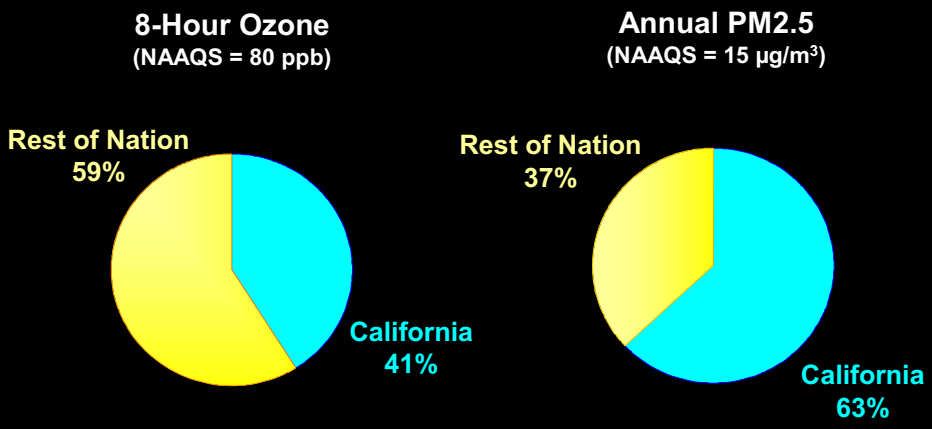
Unique, Adverse Meteorology

Lowest Per Capita Emission Targets

Onshore circulation pattern, high temperatures, stagnant air masses, and mountain ranges that trap pollutants lead to ...

	Population (million)	Carrying Capacity (tpd)	Carrying Capacity ($VOC+NO_X$) (lb/person/yr)
Los Angeles	16.9	840	36
San Joaquin Valley	4.1	630	69
Houston	5.5	1360	181

California's Disproportionate Air Pollution Exposure



Population-weighted and minus national ambient air quality standard (NAAQS), based on 2000-2002 data

Air Pollution and Premature Death

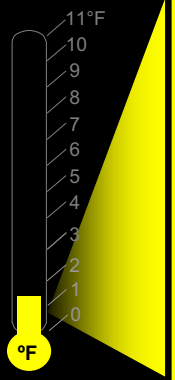
California Estimates for 2005

Pollutant	Annual Deaths*
PM2.5	14,000 to 24,000
Ozone	800
Toxic Air Contaminants	400

* At least a factor of two uncertainty.

California Climate Impacts

over the past 100 years



1.3ºF (0.7°C) higher temperatures

7 inch sea level rise

12% decrease in fraction of runoff between April and July

snowmelt and spring blooms advanced 2 days/decade since 1955

4-fold increase in wildfire frequency (over 34 years)

Cal/EPA-OEHHA, "Environmental Protection Indicators for California" (2002), *www.oehha.ca.gov/multimedia/epic/Epicreport.html*

Westerling et al., "Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity", *Science* (2006)

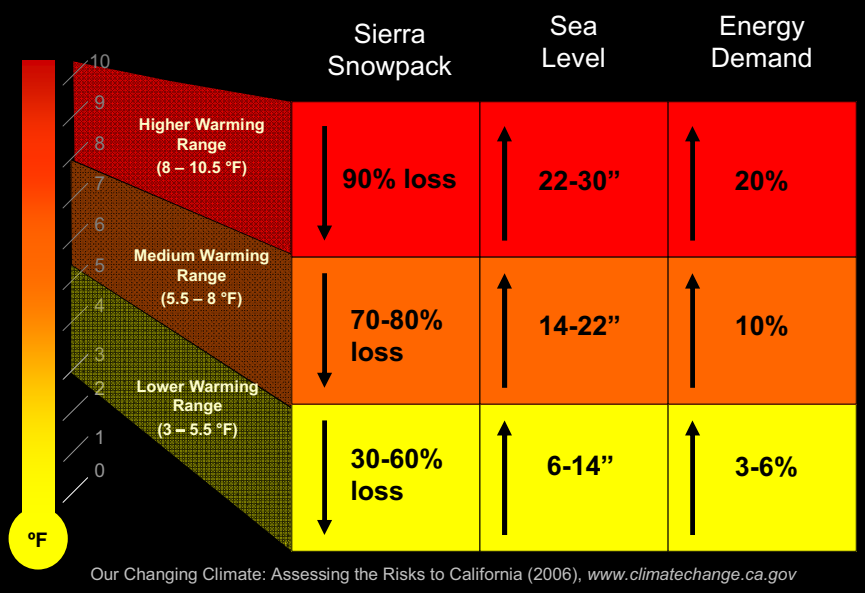
Lyell Glacier

Yosemite National Park

1903

2003

Projected Climate Impacts on California, 2070-2099
(as compared with 1961-1990)



Our Changing Climate: Assessing the Risks to California (2006), *www.climatechange.ca.gov*

1. Air Resources Board
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Air Quality After WWII

Unhealthy levels of lead, NO_2, SO_2, CO, ozone, particulate matter, and air toxics

Poor visibility

Difficulty breathing

Extreme eye irritation

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Technology-based Regulations

Mobile Sources (99% reduction)

- Aftertreatment (3-way catalysts, diesel traps)
- Technology (closed loop systems, on-board diagnostics)
- Cleaner fuels (sulfur, aromatic and olefin removal)

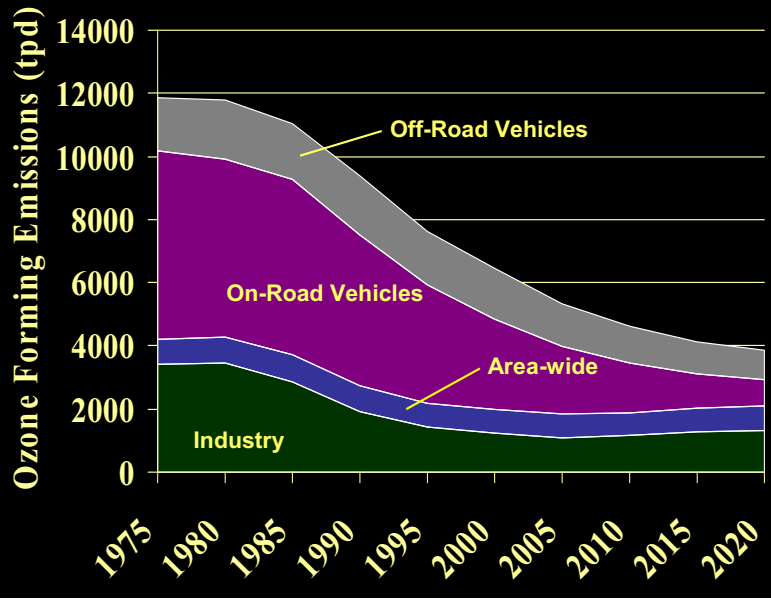
Stationary Sources (90% reduction)

- Low-NO_X burners
- Selective catalytic reduction
- Cleaner fuels (compressed natural gas)

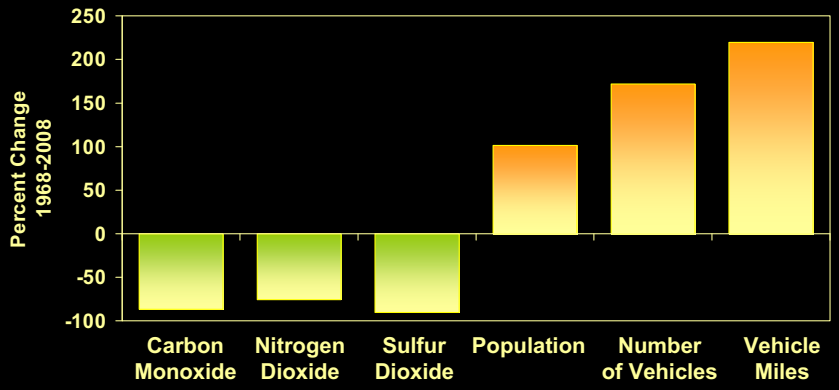
Area Sources (>75% reduction)

- Vapor recovery
- Low-VOC coatings and solvents

Statewide Emissions Trends

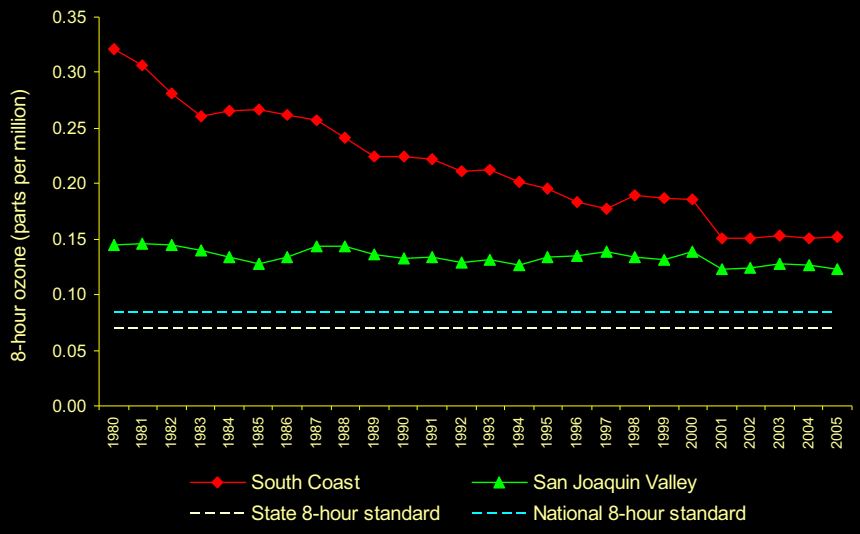


Pollution Reduced Despite Growth

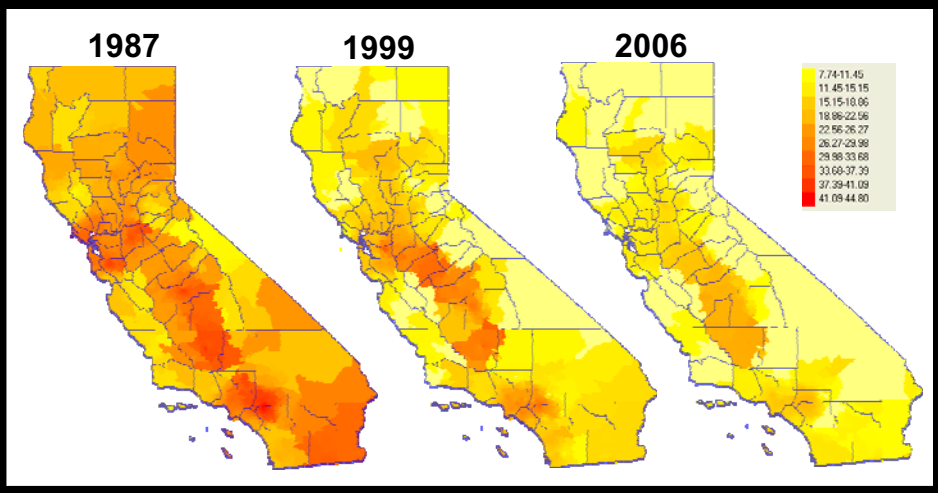


18

8-Hour Ozone Trends



PM2.5 Exposures



COSTS OF CONTROL

~$10 billion per year

BENEFITS OF CONTROL

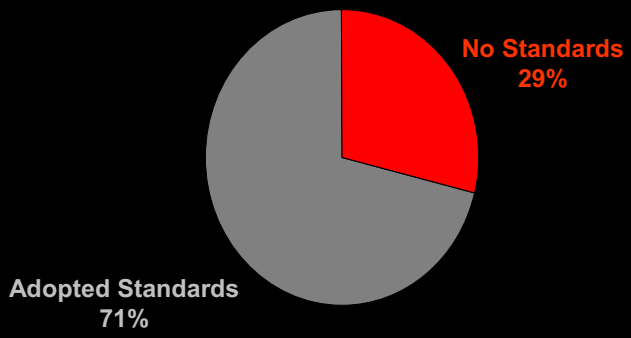
~$4 in health benefits for each $1 of control

32,000 jobs and $6.2 billion in revenues for air pollution control (2001)

21

Many Developing Countries Have Adopted New Engine Standards First Demonstrated in California

Percentage of ***World Vehicles*** With CA/US/EU New Engine Standards



Current Air Pollution Targets

Diesel Engines

75% below 2000 levels by 2010, 85% below by 2020

Replace or retrofit every diesel engine in California

Goods Movement

2001 emission levels by 2010

Diesel PM risk 85% below 2000 by 2020

1. Air Resources Board
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Governor Schwarzenegger's Greenhouse Gas Targets

By 2010, reduce to 2000 emission levels*

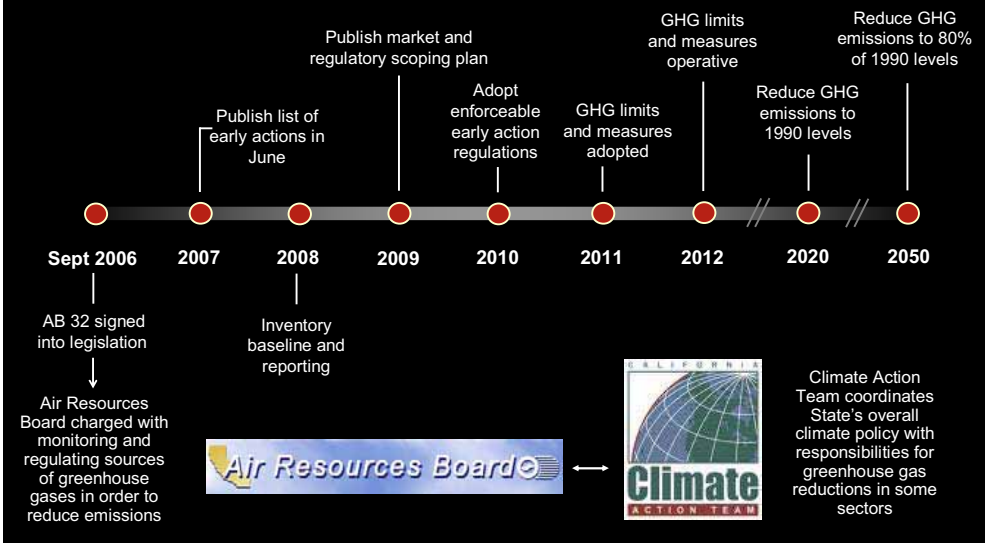
By 2020, reduce to 1990 emission levels**

By 2050, reduce to 80% below 1990 levels

* Equals ~60 million tons emission reductions, 11% below business as usual (BAU)

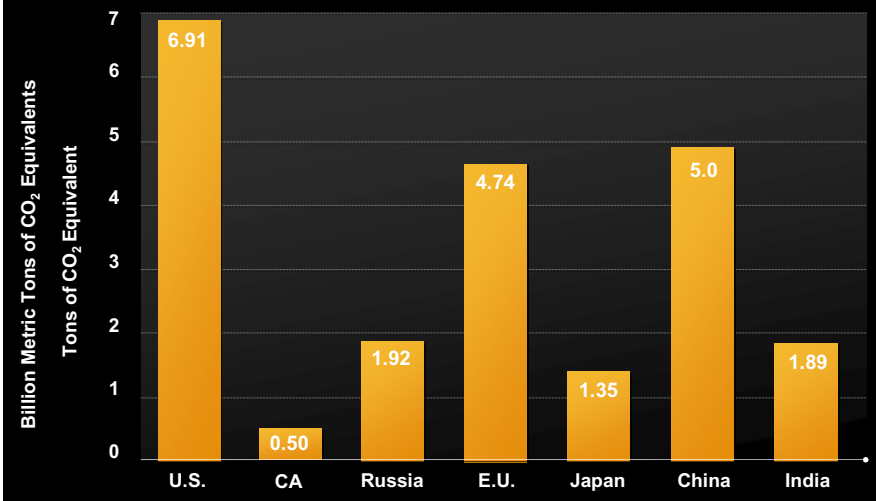
** Equals ~174 million tons emission reductions, 29% below BAU

California Global Warming Solutions Act of 2006 (Assembly Bill 32)



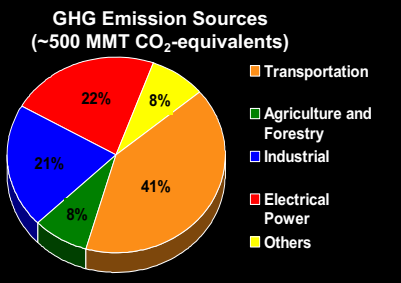
GHG Emissions Per Country / Region

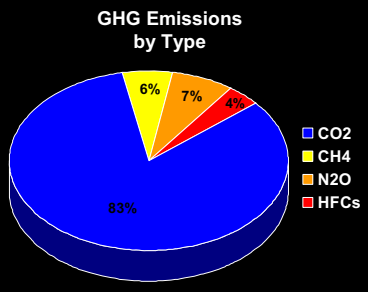
2001-2002



Climate Analysis indicators Tool (CAIT US Version 1.0, CAIT version 4.0), World Resources Institute (2007), data includes CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 with out-of-state electricity generation for California

California Greenhouse Gas Emissions

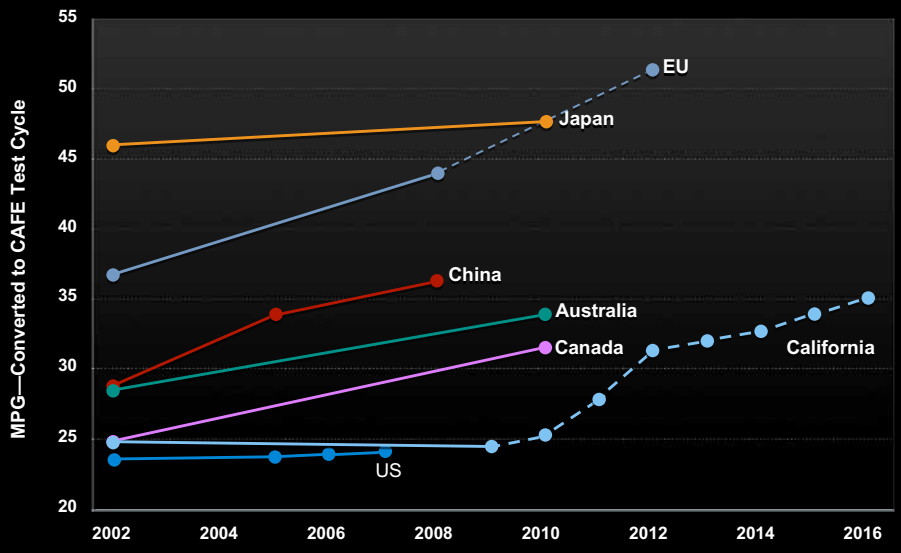




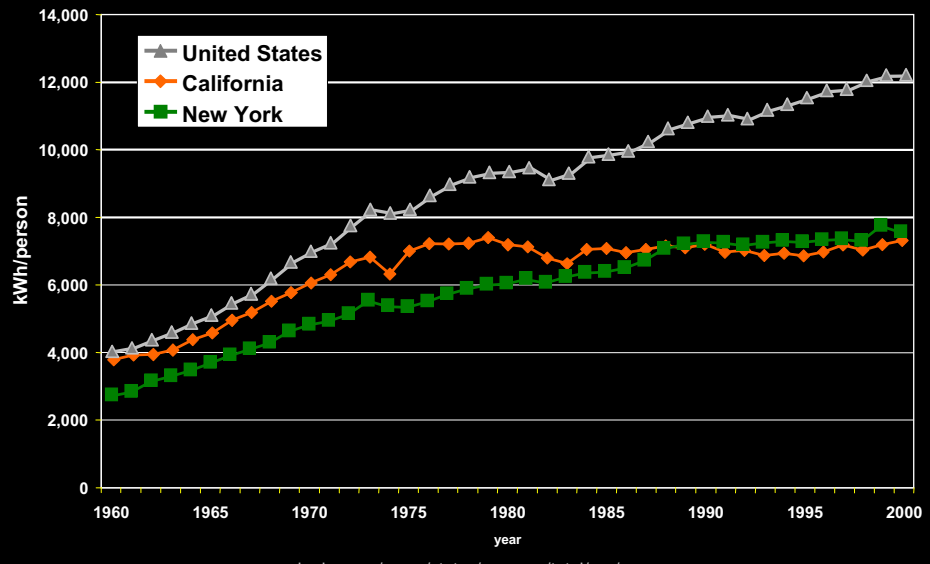
CO_2, N_2O CO_2, CH_4, N_2O CO_2 CO_2 HFCs

ARB, "Greenhouse Gas Inventory Data: 1990-2004" (2007)
www.arb.ca.gov/cc/inventory/data/data.html

Comparison of Fuel Economy and GHG Emission Standards Around the World

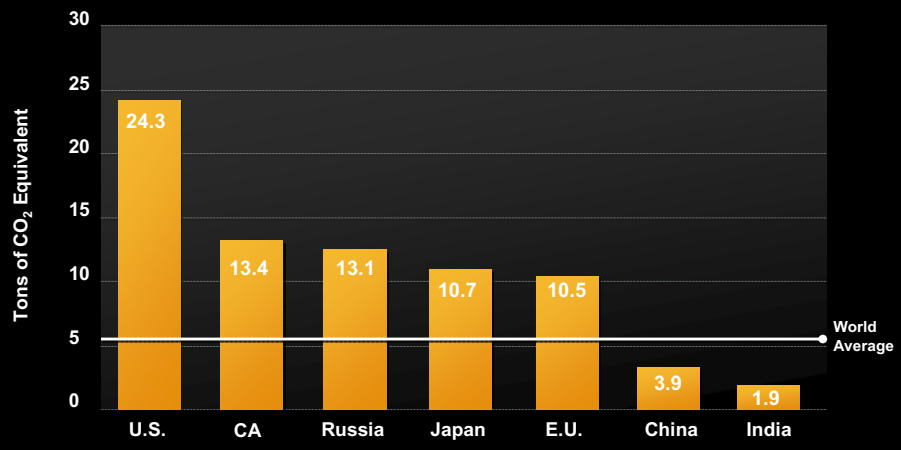


Per Capita Electricity Consumption



www.eia.doe.gov/emeu/states/sep_use/total/csv/use_csv

GHG Emissions Per Person
2001-2002



Climate Analysis indicators Tool (CAIT US Version 1.0, CAIT version 4.0), World Resources Institute (2007), data includes CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 with out-of-state electricity generation for California

How to Reach 2020 Goal?

Mix of Strategies (market mechanisms, regulations, voluntary measures, fees)

Key elements

Transportation (fuels, engine efficiency, VMT)
Renewable Energy Portfolio Standard
Energy Efficiency Programs
Green Building Strategy
Control of High-GWP Gases
Cap and Trade Program (linked to WCI)
State, Regional, and Local Partnerships
Education and Outreach

Projected Economic and Environmental Benefits

Increased economic production of $33 billion

Increased overall gross state product of $7 billion

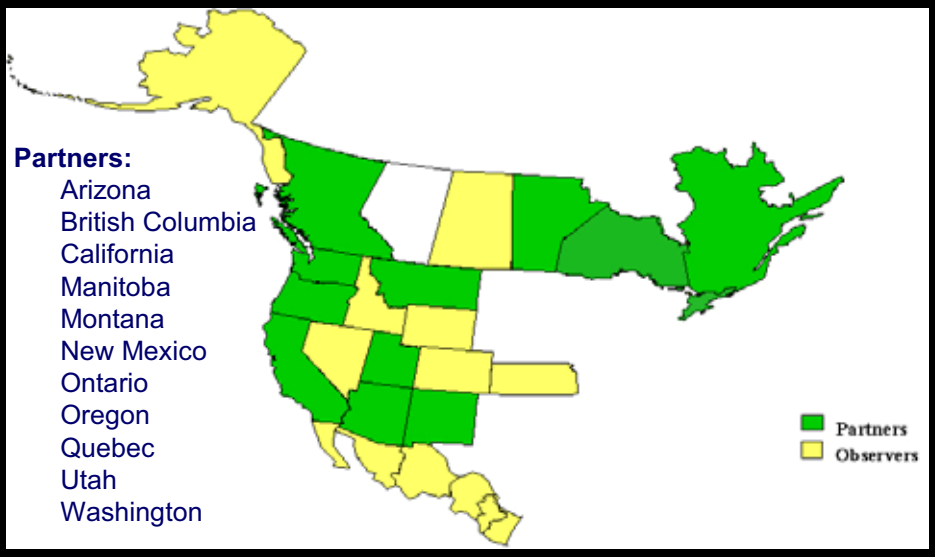
Increased overall personal income by $16 billion

Increased per capita income of $200

Increased jobs by more than 100,000

Avoided 400 premature deaths statewide

Western Climate Initiative



Linking to a Regional Program

Each partner jurisdiction adopts and implements its own program, with consistency among WCI partner programs

Trading across jurisdictional lines authorized through administrative agreements among partner jurisdictions

One auction design and coordinated auctions

Consistent rulemaking provisions and protocols

Address potential competitiveness issues in allocation formula

Interaction with Federal Activity

Develop recommendations on policy issues that can influence national legislation and regulatory development

Promote strong state involvement in developing federal climate policies and regulations

Invite participation by U.S. EPA officials and other federal lead agencies

Promote federal actions, funding opportunities and incentives for activities that support achieving California cap in 2020

The Next 40 Years

Yesterday's Successes

- Attainment for lead, CO, SO_2, NO_2
- Peak ozone reduced 75%
- PM2.5 and toxics reduced 50%

Today's Challenges

- Public health remains top priority
- Ozone and PM2.5 in Los Angeles and the San Joaquin Valley
- Diesel and goods movement
- Climate change program

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Attachment 3
Update: Tool for Incorporation of Sustainability into Army Environmental Remediation

US Army Corps of Engineers

Update: Tool for Incorporation of Sustainability into Army Environmental Remediation

Carol Lee Dona, Ph.D., P.E.
Michael M. Bailey, Ph.D., P.G.
US Army Corps of Engineers
Environmental and Munitions Center of Expertise
Omaha, NE
24 February 2009

US Army Corps of Engineers

Guidance Structure and Application

- Decision flow chart(s) and on-line resources.
- Covers complete remediation process

US Army Corps of Engineers

Current Approach: Augment Existing Platforms

- Existing platforms inherently sustainable
- Platforms augmented in tool with additional sustainable practices for each environmental remediation phase
  - Planning – Total Project Planning
  - Investigation- TRIAD
  - Remedy Selection – National Contingency Plan
  - Remedy Implementation – Value Engineering
  - Remedy Operation and Maintenance – Remedial System Evaluations
  - Site Closeout – Waste Diversion/Minimization

US Army Corps of Engineers

Future Approach – Incorporate Formal Sustainability Evaluation when Tool(s) Available

- Tool Characteristics
  - Appropriate for Federal Government environmental remediation projects
  - Non-proprietary
  - Affordable
  - Ease of use (Excel or similar platform)
  - Can evaluate the complete set of common soil/groundwater remediation technologies (remedy selection); earlier use possible for remedy optimization
  - Can weight the relative importance of different sustainability variables.
  - Tiered levels of evaluation complexity, for example screening and detailed evaluations.
  - Acceptance by the environmental remediation community as a standard tool.

Contract Considerations

Contract type	Existing	Future
Fixed Price	Yes	Yes
Cost Reimbursement	Yes	Yes
Performance Based	Possible if sustainability enhances contract performance measures i.e. cost	Yes

US Army Corps of Engineers

Contractual Mechanisms –Performance-Based Contract - how to make sustainability performed-based

- Performance incentive – a percentage of contract
- Proposal submittals identify the resources where sustainability will be incorporated, the extent to which each resource will have sustainable methods incorporated, and the weighting for each resource within the overall incentive
- Contract awarded on technical merit, with sustainability incorporation one evaluation criteria
- Contractor awarded the portion of incentive based on the amount of sustainability incorporated compared to that stated in the submittal.

US Army Corps of Engineers

Example

- Identification of resources and sustainability incorporation in proposal
  - Water – 30% savings potable drinking water use
  - Energy – 30% of total energy renewable energy
  - Waste Minimization – 65% diversion
- Incentive calculation
  - 0.25 water + 0.5 energy + 0.25 waste
  - Assume contractor achieves 20% decrease water usage, 25% renewable energy, 50% waste diversion
  - % incentive awarded= 78%

US Army Corps of Engineers

Path Forward

- Draft tool presently in internal EM-CX review.
- Peer/Corps Headquarters review, April 2009; finalization of tool December 2009.

Questions

- Contact Carol Lee Dona at (402) 697-2582, carol.l.dona@usace.army.mil

Attachment 4
Diffusion, 14 Compartments, and Sustainability

Diffusion, 14 Compartments and Sustainability

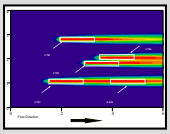
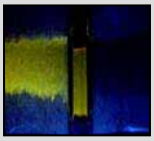
Tom Sale

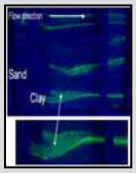
Colorado State University / Center for Contaminants Hydrology

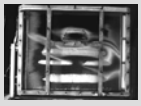
Sustainable Remediation Forum

February 24-25, 2009
Northgate Environmental – Oakland CA
Technical Symposium and Workshop
Technical Session 2B
Washington, DC - December 3rd 2008

Innovation

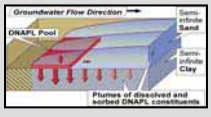



- **Innovation can be defined as:**
  - **new products, business process, and organic changes that creates wealth or social value – OECD think tank**
  - **fresh thinking that creates wealth – Richard Lyons - Goldman Sachs**

- **Sustainable Remediation:**
  - **A holistic perspective**
  - **Net environmental benefit**
  - **A collective reflection of social values**



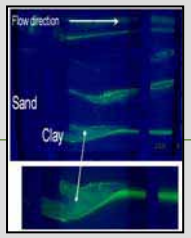
	Source Zone		Plume	
Phase / Zone	Low Permeability	Transmissive	Transmissive	Low Permeability
Vapor				
DNAPL			NA	NA
Aqueous				
Sorbed				

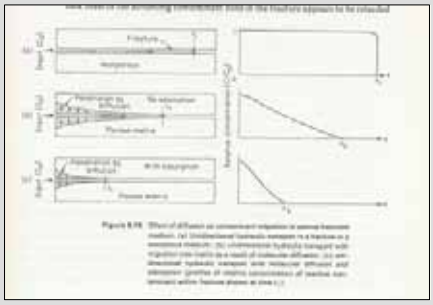
A holistic perspective

ρ_{ice} = 0.92 gm/cm^3

Diffusion

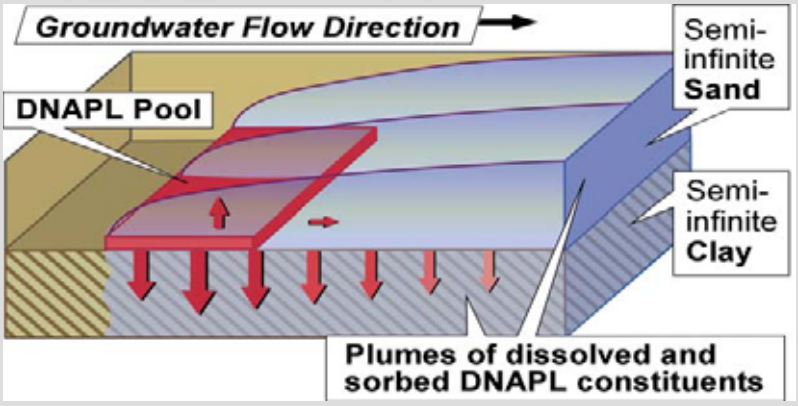
- One of two fundamental processes driving transport
- Historically broadly ignored transport and remediation practice





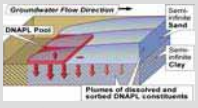
Freeze, R.A. and J.A. Cherry (**1979**), Groundwater, Prentice Hall, Inc., Englewood Cliffs, NJ., Pp 410-413.

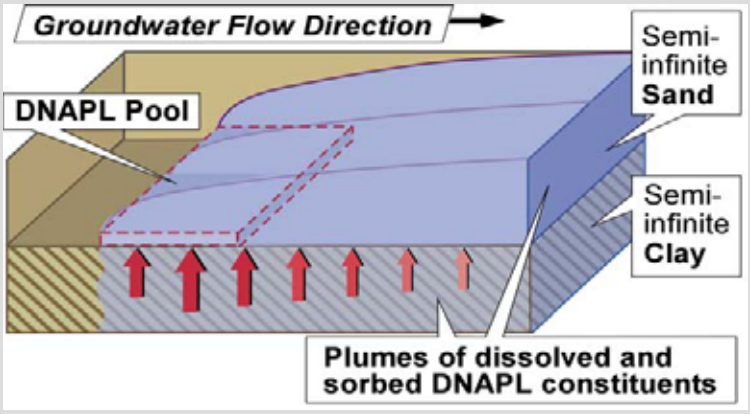
Thought experiment
(Part A)



AFCEE (2007), Source Zone Initiative and Sale, Zimbron, and Dandy (2008), Journal of Contaminant Hydrology

Thought experiment
(Part B)

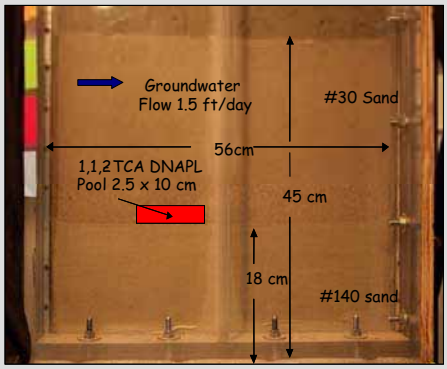


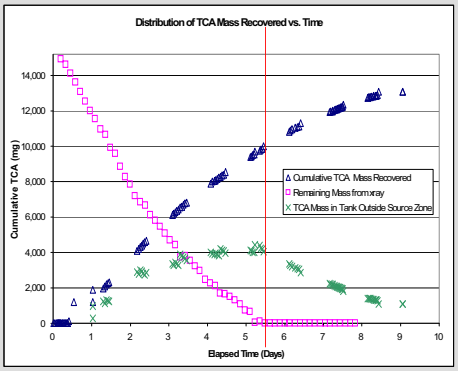


AFCEE Source Zone Initiative (2007) and Sale, Zimbron, and Dandy (2008), Journal of Contaminant Hydrology

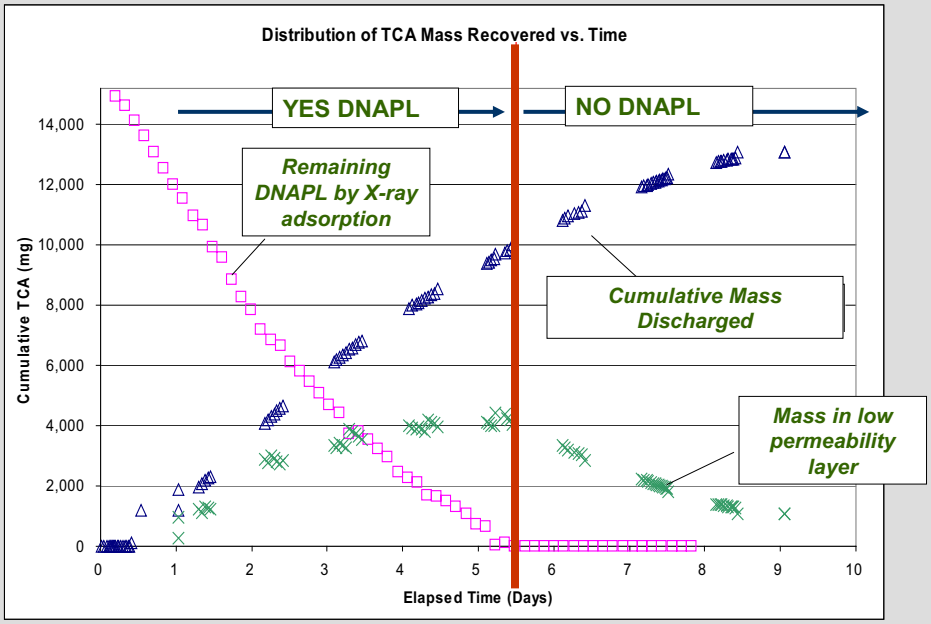
Two layer sand tank study

Colorado School of Mines (Tissa Illangasekare and Bart Wilkins)



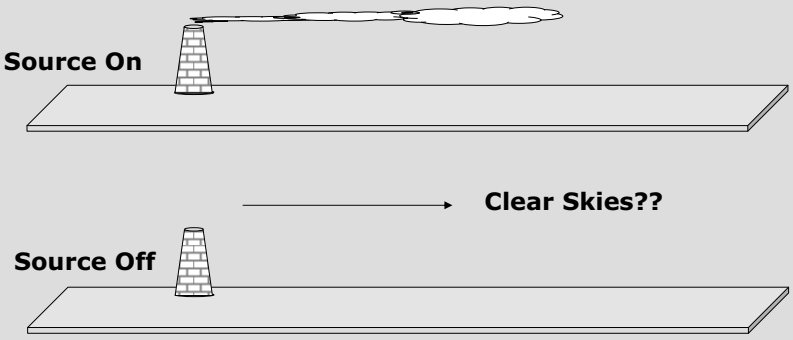


AFCEE Source Zone Initiative (2007)



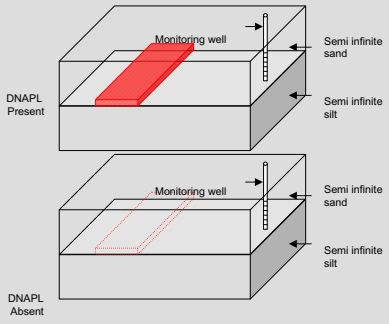
AFCEE (2007)

What happens after the source is addressed?



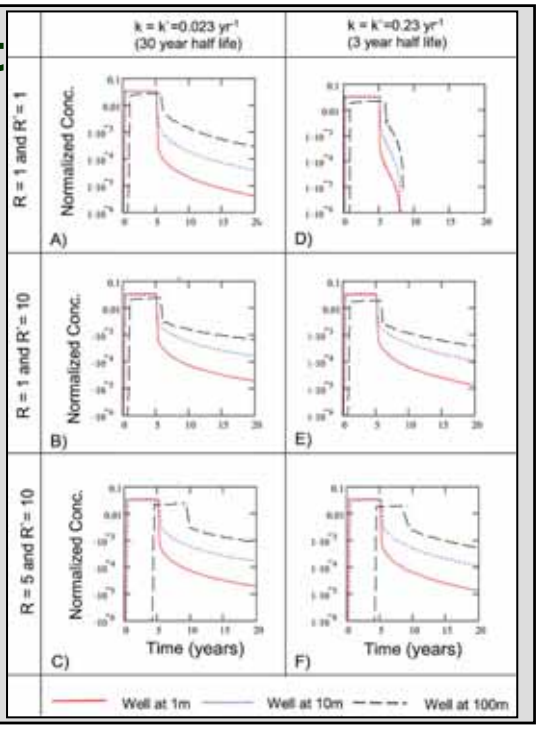
Downgradient WQ benefits

Colorado State Univ.



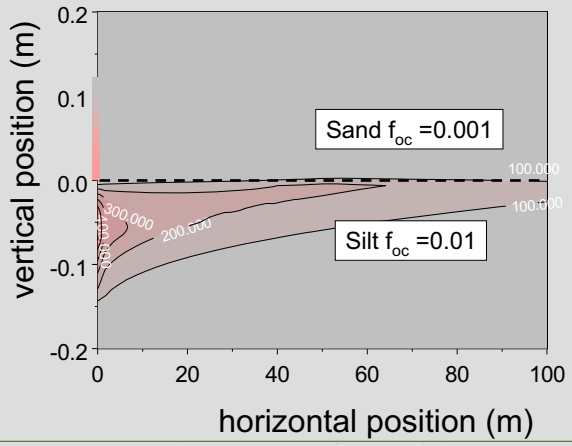
Chapman and Parker (2005) Water Resources Research,

Sale, Zimbron, and Dandy (2008), Journal of Contaminant Hydrology



After the "source" is gone…

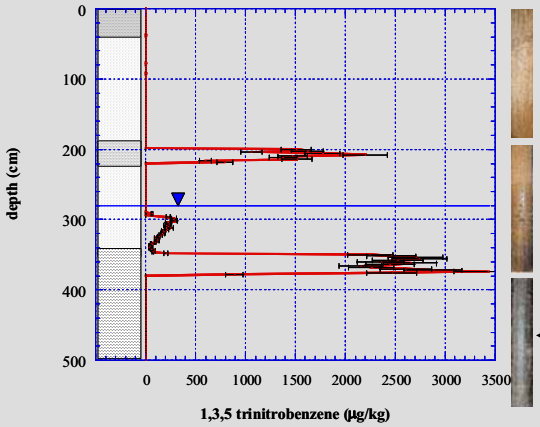
Total Conc (mg/ 1000cm^3 porous media)
Contour Interval 0-1500 mg/L

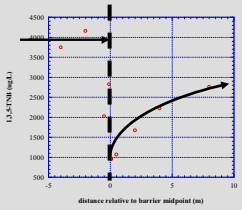


AFCEE (2007) and Sale, Zimbron, and Dandy (2008), Journal of Contaminant Hydrology

Pueblo Chemical Depot

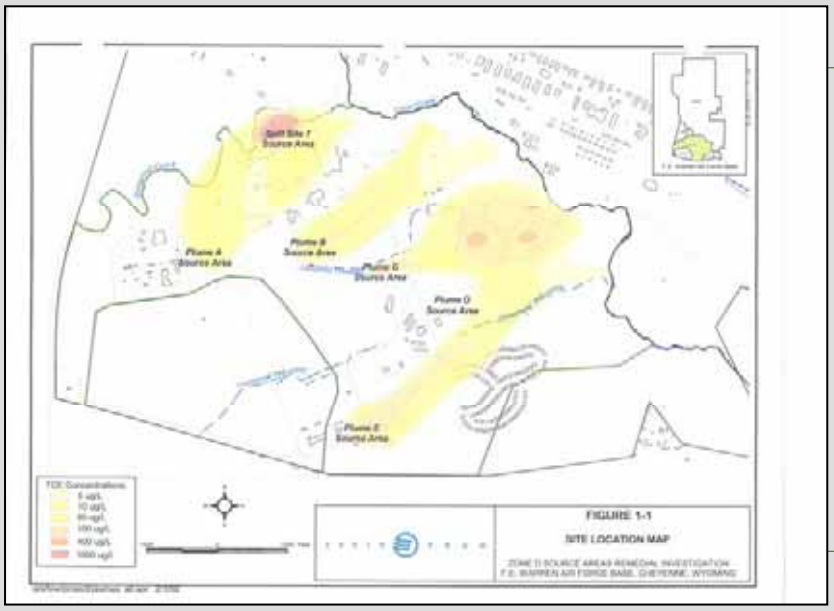
(ER-0519)



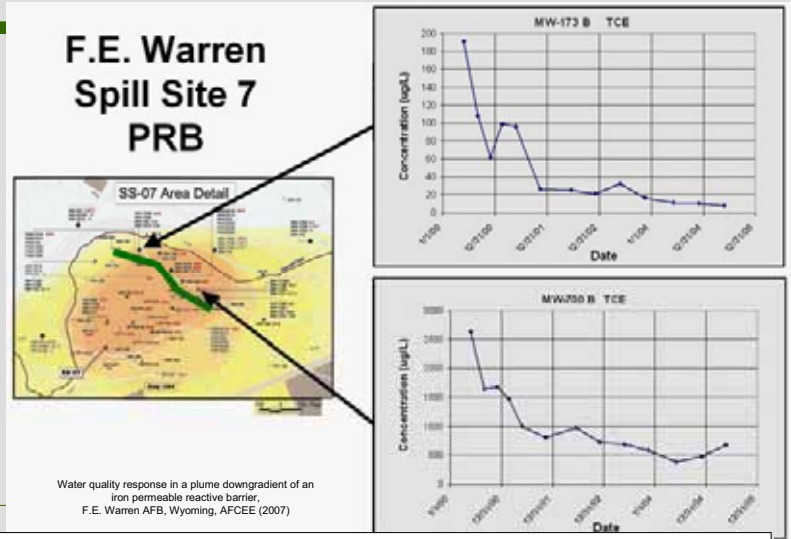


f_{oc} ~2%

F.E. Warren AFB



How will reduced loading from sources affect plumes?



Water quality response in a plume downgradient of an iron permeable reactive barrier, F.E. Warren AFB, Wyoming, AFCEE (2007)

See WRR Chapman and Parker 2005, AFCEE (2007), JCH Sale et al., 2008

Back Diffusion – The Movie
Lee Ann Doner – (2008) MS CSU

A Holistic Perspective

- 14 compartments that need to be considered
- The problem depends on the setting and the release (age)

Nonaqueous phase liquid and water sharing pore space in sand (Wilson 1990)

	Source Zone		Plume	
Phase / Zone	Low Permeability	Transmissive	Transmissive	Low Permeability
Vapor				
DNAPL			NA	NA
Aqueous				
Sorbed				

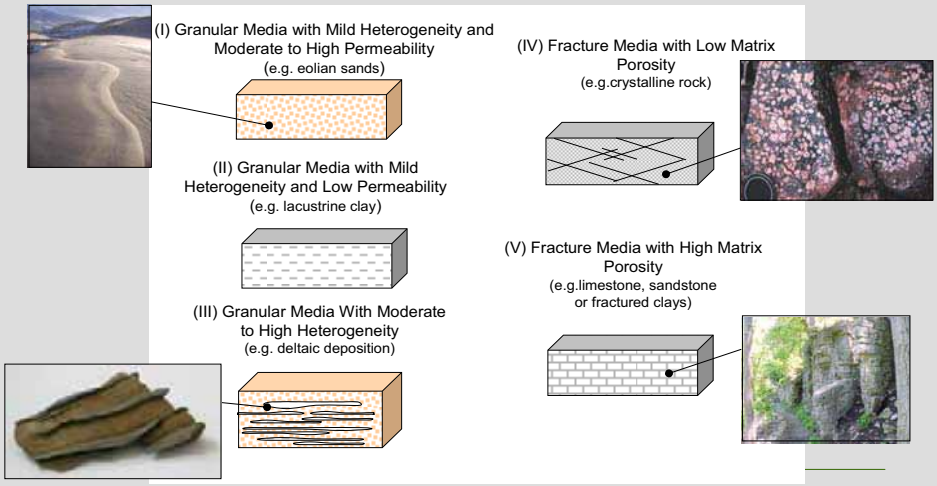
14 compartment model

	Source Zone		Plume	
Phase / Zone	Low Permeability	Transmissive	Transmissive	Low Permeability
Vapor				
DNAPL			NA	NA
Aqueous				
Sorbed				

Mass transfer via diffusion is critical

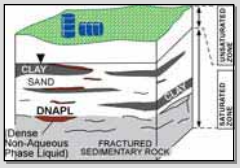
Type Setting

(following USEPA 2003 & NRC 2005)



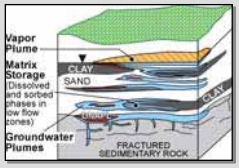
Aging of Releases
Type III Setting

Early Stages



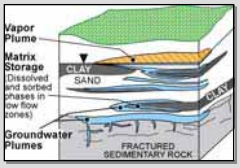
	SOURCE		PLUME	
Zone/Phase	Stagnant	Transmissive	Transmissive	Stagnant
Vapor	LOW	MODERATE	LOW	LOW
DNAPL	LOW	HIGH		
Aqueous	LOW	MODERATE	MODERATE	LOW
Sorbed	LOW	MODERATE	LOW	LOW

Middle Stage

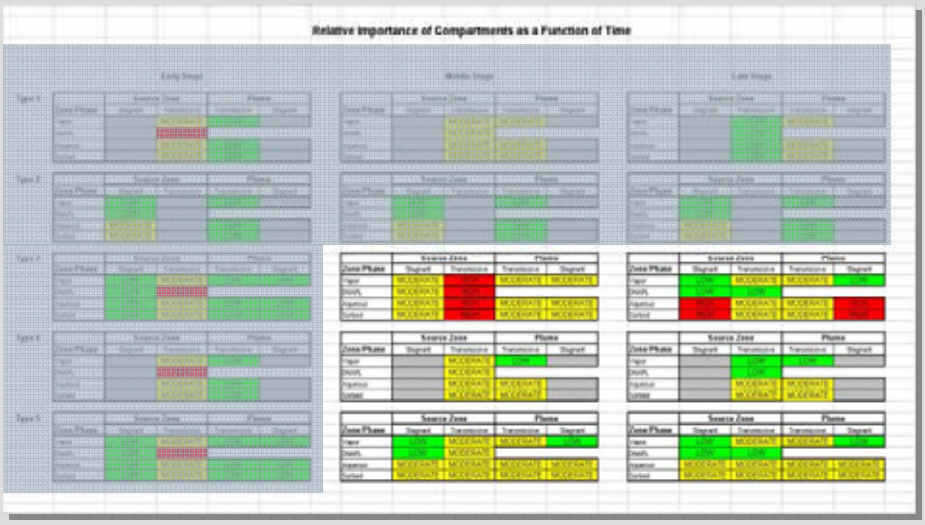


	SOURCE		PLUME	
Zone/Phase	Stagnant	Transmissive	Transmissive	Stagnant
Vapor	MODERATE	MODERATE	MODERATE	MODERATE
DNAPL	MODERATE	MODERATE		
Aqueous	MODERATE	MODERATE	MODERATE	MODERATE
Sorbed	MODERATE	MODERATE	MODERATE	MODERATE

Late Stage



	SOURCE		PLUME	
Zone/Phase	Stagnant	Transmissive	Transmissive	Stagnant
Vapor	LOW	LOW	LOW	LOW
DNAPL	LOW	LOW		
Aqueous	MODERATE	LOW	MODERATE	MODERATE
Sorbed	MODERATE	MODERATE	MODERATE	MODERATE



Aging of Releases

Comment on characterizing sites using convention wells

Characterization of a Type 3 setting at late stage using conventional monitoring wells

Phase / Zone	Source: Low Permeability	Source: Transmissive	Plume: Transmissive	Plume: Low Permeability
Vapor				
DNAPL				
Aqueous				
Sorbed				

Importance	Number	Actual			Total	Max
		2	1	0		
2	6			6	0	24
1	7	2	2	3	6	14
0	1		1		0	0
Total	14	2	3	9	6	38

Grade 16% F

Screening Technologies

Mapping anticipated performance

Phase / Zone	Source Zone		Plume	
	Low Permeability	Transmissive	Transmissive	Low Permeability
Vapor	Extraction of contaminated groundwater from transmissive zones is likely to have little effect on vapor in the vadose zone.			
DNAPL	Depletion of aqueous phase from transmissive zones will cause slow release from low permeability zones	DNAPL has the potential to be a long term source of aqueous phase	Not Applicable	
Aqueous		Pumping groundwater from the source zone will cause direct depletion of aqueous phase in transmissive zones	Pumping groundwater from the source zone will drive direct depletion of aqueous phase in transmissive zones	Depletion of aqueous phase from transmissive zones will drive slow release from low permeability zones in plumes
Sorbed		Depletion of the aqueous phase in transmissive zones will drive release of sorbed compounds. Note release of sorbed phase can be a slow process		

How Does PUMP AND TREAT* Affect Contaminants in the 14 Different Compartments?

* (when used for treatment, not containment)

Key: Technology has this effect on contaminants in this compartment

- *Direct depletion*
- *Depletion but as a secondary effect*
- *Limited secondary effect*
- *Largely unaffected*

Effectiveness of Pump and Treat

Late stage Type 4 setting

Key: *Relative Location of Contaminant Mass*

Zone/Phase	Source Zone				Plume			
	Stagnant		Transmissive		Transmissive		Stagnant	
Vapor	0	0	0	0	0	0	0	0
DNAPL	1	0	1	0				
Aqueous	1	0	3	1	3	1	1	0
Sorbed	1	0	2	1	2	1	1	0

Key: *Expected Technology Performance*

Technology Rating = 10
Maximum Rating = 12
Relative Effectiveness = 83%.

Effectiveness of source excavation as a function of stage (Type III)

Early Stage

	Source Zone				Plume			
Zone/Phase	Stagnant		Transmissive		Transmissive		Stagnant	
Vapor	3	0	3	1	1	0	1	0
DNAPL	3	0	3	2				
Aqueous	3	0	3	1	2	0	1	0
Sorbed	3	0	3	1	2	0	1	0

Excavation - Early Stage Type 3 Setting
Technology Rating = 15. Maximum Rating = 15. Relative Effectiveness = 100%.

Late Stage

	Source Zone				Plume			
Zone/Phase	Stagnant		Transmissive		Transmissive		Stagnant	
Vapor	3	0	3	1	1	1	1	0
DNAPL	3	0	3	0				
Aqueous	3	3	3	1	2	1	1	2
Sorbed	3	3	3	1	2	1	1	2

Excavation - Late Stage Type 3 Setting
Technology Rating = 38. Maximum Rating = 54. Relative Effectiveness = 70%.

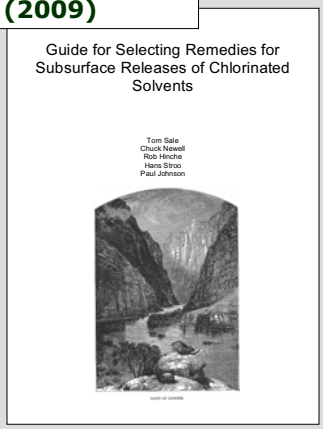
ESTCP Deliverables

http://www.estcp.org/Technology/upload/ER-0530-FAQ.pdf

- 25 Questions
- Short answers
  (31 pages)
- 1-hour read

Second Deliverables

Coming Soon
(2009)



- +100 pages
- Tool box
- Things to think about
- Not prescriptive
- References for those who need more
- Audience – Decision makers

Opportunity

Highlight current knowledge in support of sound decision for releases of chlorinated solvents

↓

Better use of resources

↓

Better environment

Closing – Diffusion, 14 Compartments and Sustainability

- Taking holistic view of the problem is essential
- A older sites much of "the problem" may be in the plumes
- Diffusion is a unifying theme
- Contaminants in low permeability zones may drive time frames
- Optimism regarding what can be achieved

Acknowledgement

- University Consortium for Field-Focused Groundwater Contamination Research (John Cherry…)
- Colleagues and students
- Research Sponsors (funding and ideas)

Attachment 5
The ITRC Green and Sustainable Remediation Team

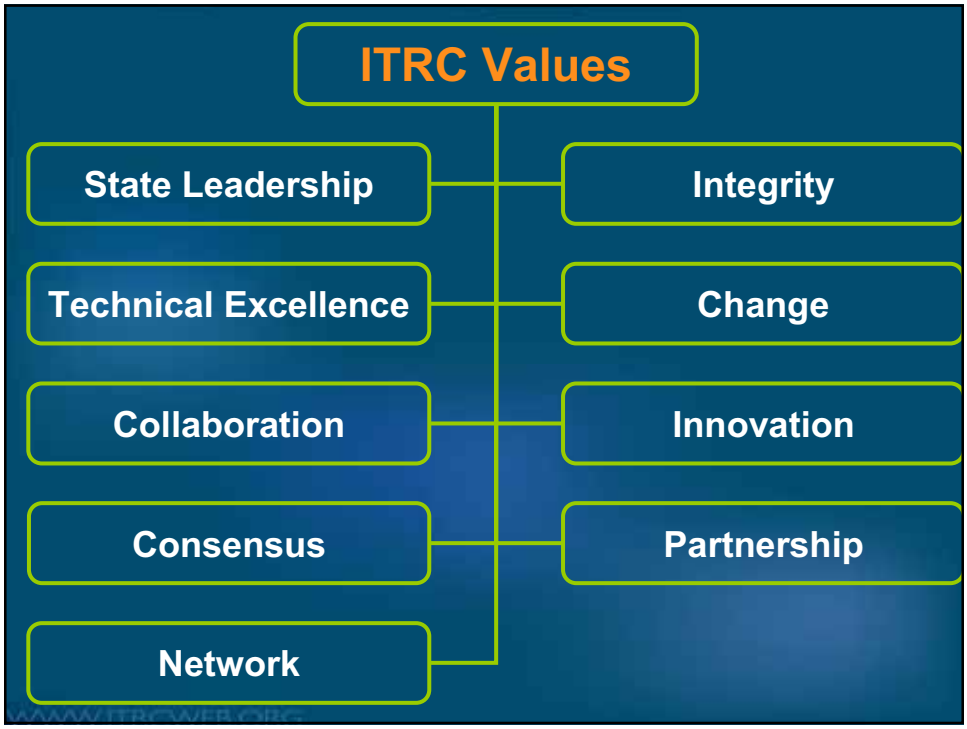
Green and Sustainable Remediation

How ITRC Reduces Regulatory Barriers to the Use of Innovative Environmental Approaches

Tom O'Neill
ITRC Team Leader
Green & Sustainable Remediation Team

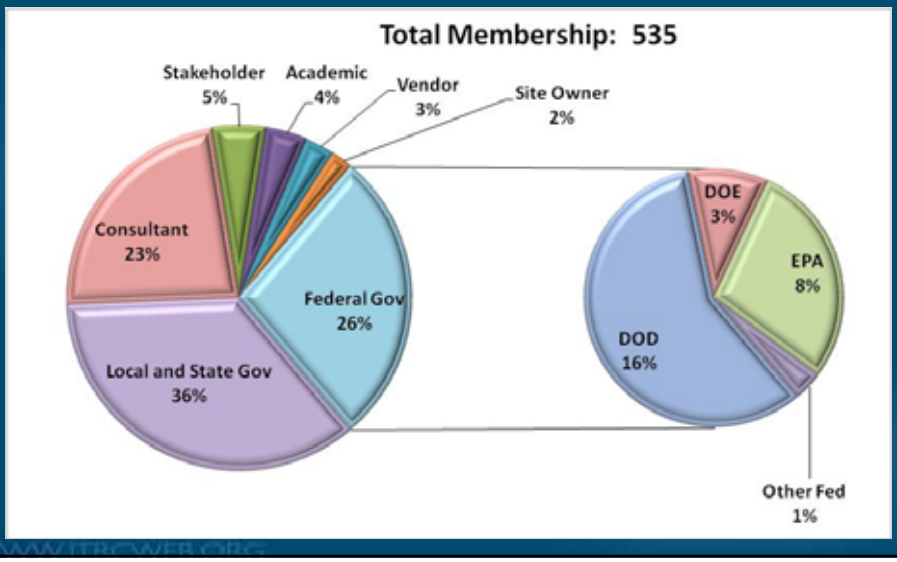
Our Mission and Role

Reduce barriers	to the use of innovative environmental technologies
Improve the clean up process	by educating on environmental technologies and processes
Provide a national consensus	on approaches to implementing innovative environmental technologies


ITRC Values
State Leadership
Integrity
Technical Excellence
Change
Collaboration
Innovation
Consensus
Partnership
Network

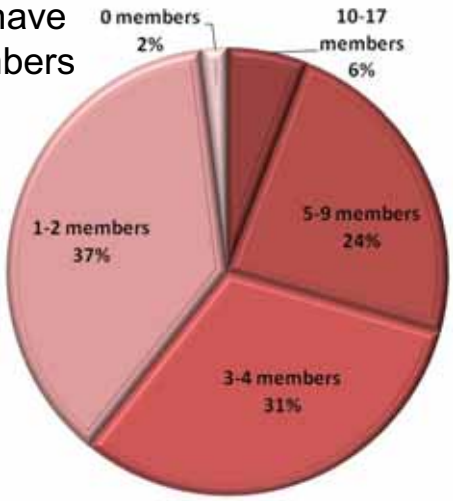

INTERSTATE
COUNCIL
ITRC
TECHNOLOGY
REGULATORY
ECOS
Who We Are
Members
State government
Federal government
Industry
Consultants
Academia
Community stakeholders
Tribal representatives
Federal Partners
DOE
EPA
DOD
Industry Partners
56 Total
ARCADIS
Chevron
GORE
bp
API
SUNCOR
ExxonMobil
ConocoPhillips
LANGAN

ITRC Membership Distribution

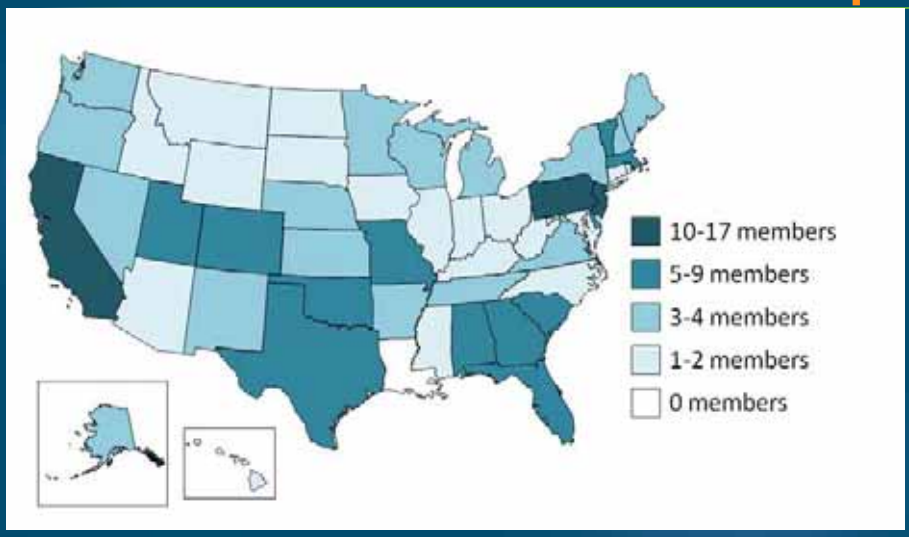


Distribution of State Members

70% of states have
2 or more members



Geographic Distribution of State Membership



How we do it

We use a proven, cost-effective approach to advance environmental solutions.

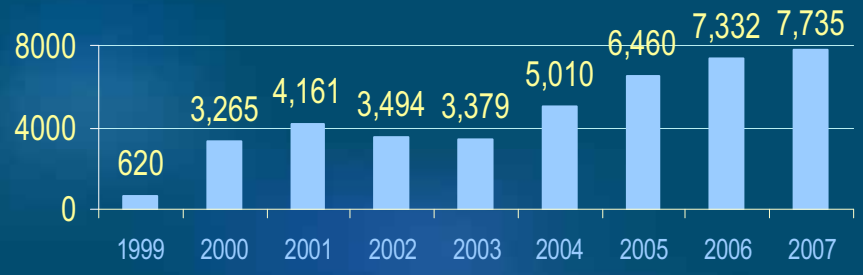
100 Documents
60 Training courses
40 Technical Teams

2009 Project Portfolio

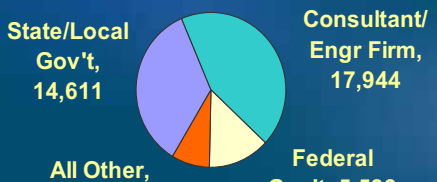
Ongoing	Implementation	New
• Integrated DNAPL • LNAPL • Metals & Rads • Mining Waste • Phytotechnologies • Sediments • Remediation Risk Management • UXO Wide Area Assessment	• Bio DNAPL • EACO • Perchlorate • Rads D&D • RPO - PBM • UXO Quality Considerations	• Green & Sustainable Remediation • Multi-Incremental Sampling • Biowall Technology • Environmental Impacts of Ethanol and Bio-Based Fuels • In Situ Stabilization and Solidification

Internet Based Training

48,000 people trained thru Q3 2008



60 courses over 10 years



2008 State Engagement

- 44 states have committed POCs in 2008
- 33 POCs submitted State Action Plans (SAP) for coordinating activities
- Provided state environmental priorities and input on 2009 proposals
- Responded to 5 state surveys
- Review of 6 documents
- Participated in 9 training dry runs

Why Green and Sustainable Remediation?

- No nation-wide guidance on how to best incorporate green and sustainable remediation into a regulated cleanup process.
- No consistency on how to use and interpret sustainability metrics and/or life cycle analysis.
- Need a way to communicate best practices to state regulators and environmental consultants

ITRC's Green and Sustainable Remediation (GSR) Team

Goal:

Provide documents and training that educate state regulators and other environmental professionals on how to appropriately incorporate sustainability and green technologies into the cleanup process.

ITRC's Green and Sustainable Remediation (GSR) Team

- What metrics are most useful and have the greatest impact?
- What is a consistent and appropriate way of interpreting the metrics?
- How can we minimize the overall risk to human health and the environment by applying sound GSR practices?
- How can we reduce energy consumption or use alternative sources of energy that will be less harmful to overall environment?
- How do we promote the use and development of GSR technologies?

GSR Team Selection

GSR Team proposal was ranked **1 of 9** team proposals by the ITRC Board of Advisors and liaisons (weighted average with state input weighted higher)

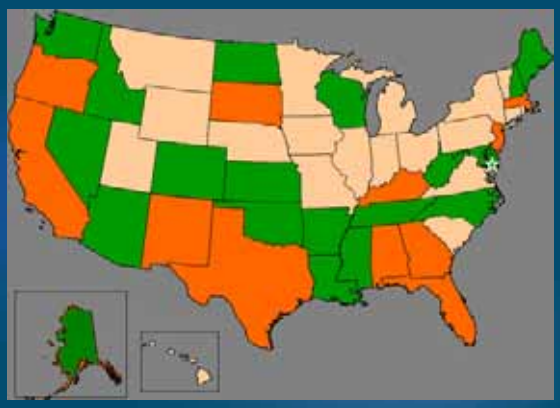
Membership Group	Rank Out Of 9
Combined EPA ranking	5
Combined DOD ranking	3
Combined DOE ranking	3
Combined State ranking	2
ASTSWMO ranking	2
Citizen stakeholders	1
Combined industry ranking	4

GSR Team Leadership and Composition

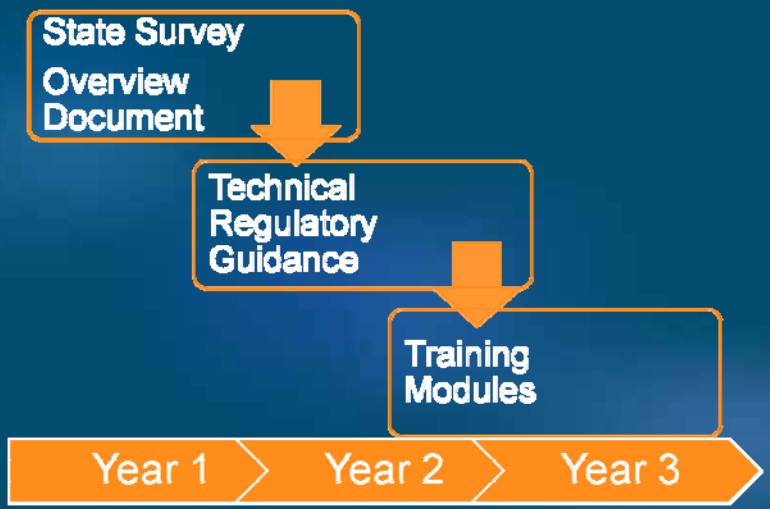
- Tom O'Neill – NJ Department of Environmental Protection
- 26 states have committed a team member (as of Aug 2008) or resources for product review and implementation
- Team membership commitments from major industry organizations, DOD, DOE, EPA, and citizen stakeholders

State Participation

- Committed a team member (as of Feb 2009): AL, CA, FL, GA, KY, MA, NJ, OR, PA, SD, TX, VA (12)
- Committed resources for product review and implementation: CT, FL, HI, IL, IN, IA, KY, MI, MN, MT, NE, NY, OH, PA, RI, SC, UT, VT, WY (19)



Schedule



WWW.ITRCWEB.ORG

Since 1995, we've been helping expedite quality regulatory decision-making, while protecting human health and the environmental.

GSR Team Web Page:

http://www.itrcweb.org/teampublic_GSR.asp

GSR Team Proposal:

http://www.itrcweb.org/planning.asp

Questions?

Tom O'Neill

New Jersey Department of Environmental Protection

Site Remediation Program

P.O. Box 413

401 State St. 6th. Flr.

Trenton, NJ 08625-0413

609-292-2150 desk **609-292-1975 fax**

tom.o'neill@dep.state.nj.us

Attachment 6
RBCA Evolution in the U.S.: Considerations for SURF Initiatives

Shell Global Solutions

RBCA Evolution in the US
Considerations for SURF Initiatives

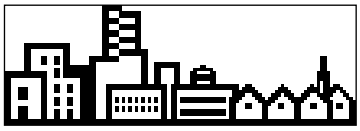
Curt Stanley
Shell Global Solutions

Dave Woodward
AECOM Environment

Drivers for Change

- Abandoned or stigmatized sites
  - land development and reuse (Brownfields)
- Multiple regulatory corrective action programs
  - RCRA
  - CERCLA
  - state corrective action programs
  - voluntary action programs
- Extended time to complete corrective action
- Limited resources
  - responsible party and regulatory agencies
  - less legal more cleanup

NATIONAL ISSUES
Resource Limitations



- **Administrative Burden**
  - 50 - 500 LUST sites per regulatory staff member
- **Site Investigation and Remediation Costs**
  - Soil: $10K - 125K
  - Groundwater: $100K - $1 Million
  - Total Liability: $18B - $180 Billion
- **Real Estate Transactions**
  - Undeveloped properties, extensive delays

Shell Global Solutions

"The Need (Mid 90's)"

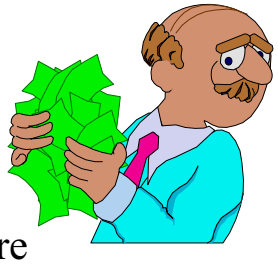
• UST's -	165,000 sites
• RCRA Corrective Action -	3,000 facilities
• Superfund -	550 sites (non-federal)
• DOD -	8,300 sites (at 2,000 installations)
• DOE -	10,500 sites (at 137 installations)
• Other Federal Agencies -	700 facilities
• States -	29,000 sites
• Brownfield's -	450,000 sites

* Modified from EPA "Cleaning Up the Nation's Waste Sites" (July 1997)

Shell Global Solutions

Brief History of RBCA

1970's - 1980's: Learning the technical basis of RBCA



- Collection of reliable data
- Remediation technologies
- High costs to society
- Prevention is better than cure
- Worked very hard but few successes

Shell Global Solutions

Brief History of RBCA (cont.)

1990's - present: ASTM RBCA

'92 - '94	Development of framework
Nov '94	ASTM ES 38-94
Dec '95	ASTM E 1739-95
Mar '96	PIRI (EPA/Industry partnership)
Jan '97	49 states & territories –> RBCA
May '95	ASTM Chemical Release RBCA
1997	RBCA Leadership Council
1997	EPA Outreach (RCRA/CERCLA)
'97 - '98	Chemical Release RBCA Guide
1998	RBCA 2 Training
1998 -	International RBCA Development
2000	ASTM 2081-00
2000-01	RBCA E&P Applications

Shell Global Solutions

What Should be Expected of the Corrective Action Process?

- **Protective of human health and the environment**
- **Technically defensible**
- **Resource-efficient**
- **Actions that are linked to site-specific exposures and risks... Not capabilities of remedial technologies**
- **Closure. . . "No Further Action" or "No Further Interest"**
- **Availability of a site for current and reasonably anticipated future use**

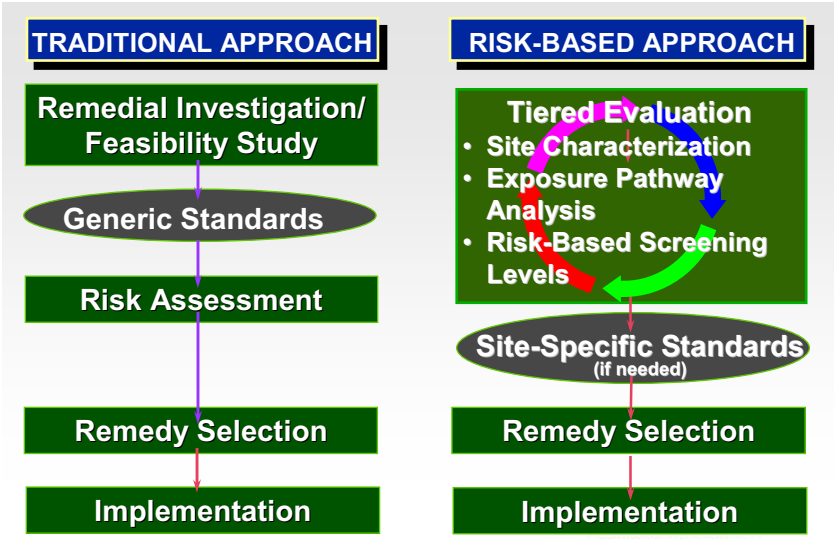
Risk-Based Corrective Action (RBCA)

A streamlined **framework** in which exposure and risk assessment practices are integrated with traditional components of the corrective action process to ensure that appropriate and cost-effective remedies are selected, and that limited resources are properly allocated

RBCA Goals:

- ☑ protection of human health and environment
- ☑ consistent and technically-defensible
- ☑ appropriate and resource-efficient remedies are selected
- ☑ optimal allocation of limited resources
- ☑ practical and resource-efficient approach
- ☑ allow corrective action and redevelopment to proceed together

Corrective Action Process



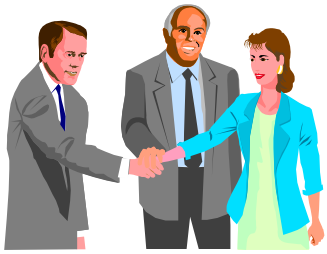
What RBCA Is and Is Not!

RBCA is NOT…	RBCA is a tool to…
• A license to pollute	• Manage & clean sites
• A do nothing alternative	• Identify best action(s)
• About saving money	• Allocate resources
• Leaving behind contamination	• Determine site specific safe levels
• Handwaving	• Use best avail. science
• To confound, complicate decision making	• Facilitate consistent and systematic decisions
• Solution to all problems	• Find prudent solutions

Who is ASTM?

ASTM is an organization that has historically focused on promulgating standards for engineering tests and specifications for engineering materials.

ASTM "standards" are developed through a rigorous consensus-building process, that may also include external peer review (as in the case of RBCA).



Members vote to approve standards, and all negative ballots must be resolved.

ASTM - 100 Barr Harbor Drive, West Conshohocken, PA.19428
(610) 832-9585

ASTM "RBCA" Development

Authored by a multi-functional and multi-disciplinary collection of ASTM E-50 Subcommittee members, representing:

- State Regulators
- Reimbursement Fund Managers
- USEPA Staff
- Insurance Industry
- Banking Industry
- Chemical Industry
- Oil Industry
- Academia
- Consulting

- **Regulatory Managers**
- **Hydrogeologists**
- **Toxicologists**
- **Environmental Engineers**
- **Environmental Scientists**
- **Modelers**

Why a RBCA Standard?

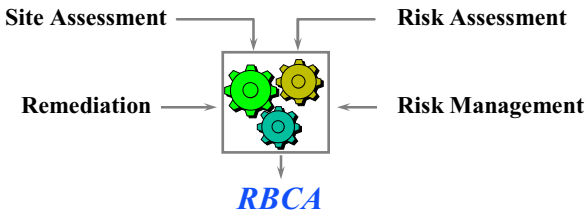
- Provide a flexible, technically defensible framework for corrective action that has applicability to a wide range of sites
  - guidance for the development of RBCA programs
  - broaden the applicability of the petroleum RBCA standard
- Provide an approach to corrective action that can span several regulatory programs
  - starting point for the integration of multiple regulatory programs into a site-wide corrective action activity
- Provide an understanding to the user of the policy issues critical to risk management decisions
- Provide a technically defensible process for achieving “No Further Action” or “No Further Interest” status

Features of Risk-Based Corrective Action

- Encourages user-led initiatives
- Encourages stakeholder involvement to resolve policy issues and uncertainty upfront
- Provides a framework for corrective action
- Recognizes the diversity of sites
- Encourages development of conceptual site model
- Provides appendices for direction and examples

How does RBCA Work ?

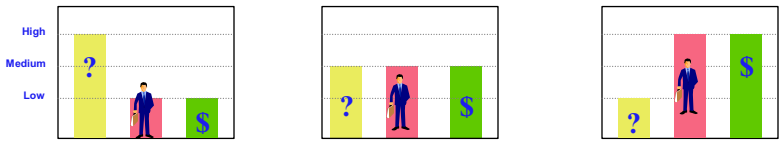
RBCA is a 3-tiered framework that allows the user to make cost-effective risk management decisions. It integrates the following:



Result: RBCA framework, or philosophy, upon which regulatory agencies can build their own customized risk-based guidance.

Why 3 Tiers (Levels) in RBCA?

LEVEL OF PROTECTION REMAINS CONSTANT ACROSS ALL TIERS



Tier 1 → Industry Risk Management Decision → **Tier 2** → Industry Risk Management Decision → **Tier 3**

Rapid Screening Tier
- low cost
- requires minimal site data
- conservative values to screen sites

Next Level of Complexity
- moderate cost increment
- more site data requirements
- uses simplistic fate and transport models
- sets alternative point(s) of compliance

Sophisticated Risk Assessment
- higher costs, data needs but offers least conservative clean-up alternatives

How is a RBCA Program Developed and Implemented?

ASTM Risk-Based Corrective Action - outlines a framework for integrating exposure and risk assessment practices with traditional components of the corrective action process.

- Describes steps and philosophy to build the framework and to incorporate risk management decisions into corrective action programs.
- Sensitive to regulatory agency policies.
- Provides appendices which serve as examples only for program consideration.

*** It is the difficult responsibility of the implementing organization to understand the technical and policy issues and to develop them in a way which enhances the state and/or regulatory program.**

Policy Decisions

PIRI

ASTM RBCA Framework **Regulatory Program**

Shell Global Solutions

RBCA Customization: Technical Policy Decisions

- Target risk limits
- Land use issues
- Ground water use issues
- Chemical(s) of concern
- Data requirements
- Site classification procedures
- Exposure assumptions and pathways
- Point(s) of demonstration
- Fate and transport
  - natural attenuation
  - modeling procedures
- Remedy selection criteria
- Interim remedial action
- Institutional controls
- Engineering controls
- mass reduction vs. risk reduction
- Stakeholder involvement

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Remediation in RBCA

- Definition
- The RBCA Paradigm
- Use of the “Site Conceptual Model”
- Developing a “Holistic/Sustainable Perspective”
- Remediation “Technologies”

Remedial Action

- A process which reduces actual or potential exposure (and risk) to chemicals at a site to an acceptable level, commensurate with reasonable land use.

The evolution of remediation philosophy

- **Pre RBCA**
  - **What is the most we can clean up?**
  - Emphasis on technology for mass reduction.
- **RBCA**
  - **How much do we need to clean up to be protective of human health and the environment?**
  - Emphasis on AUL's and technology for risk reduction.

Holistic Considerations

- Risk-Based
- Science-Based
- Environmental/Sustainability-Based

Consideration of Risk, Science, and Environmental/Sustainability Factors

- Process to communicate issues to all stakeholders
  - ITRC NAPL Work Group
  - ASTM
  - SURF
  - ASTSWMO
- Implementing rational change
  - Integration with field staff (regulatory, industry, consulting)

Partners in RBCA Implementation (PIRI)

- Once the ASTM RBCA standard had been developed, there was a need to train federal and state regulators
- PIRI was developed as a stakeholder group consisting of members from the EPA, States, Industry, and ASTM
- Training for the states helped each state develop a program that was consistent with that state's regulatory program
- Over 48 States and Territories developed environmental regulations and guidance based on RBCA

Partners in RBCA Implementation (PIRI)

VOLUNTARY MEMBERS	ROLE	
ASTM	v RBCA training programs	
U.S. EPA	v Funding and leadership via ASTM Cooperative Agreement	
Industry	v Funding and tech support via MOU.	
State Agencies	v Information exchange, peer support, guidance	

Goal: Support training and RBCA program implementation for environmental regulatory agencies nationwide.

EPA - PIRI Press Release

What are the specific goals of the partnership?

- The primary goal of the Partnership is to ensure necessary support for any state UST program interested in receiving RBCA training and technical assistance in the design and implementation of a RBCA process.
- The Partnership is founded on the objective of providing ASTM RBCA training modules 1-3 to all interested state UST programs. Once all interested states have received each of the training modules, the focus of the Partnership will shift to exclusively supporting states' implementation efforts.

EPA – PIRI Accomplishments

- **Since its inception in March 1996, PIRI has done much to lay the groundwork for state implementation of RBCA and to clearly communicate the benefits of a RBCA approach.** By gaining insight into the unique needs and experiences of many different stakeholders from many geographic regions, the PIRI meetings serve as an insightful forum for developing truly effective state RBCA programs. Further, sharing these experiences will lead to a more streamlined, integrated national approach to RBCA programs. The current list of PIRI Accomplishments include:
- Establishment of the EPA-ASTM Cooperative Agreement
- Establishment of the ASTM Private Sector Account
- RBCA Training for State UST Programs
- Certification by the ASTM Training Task Group of the Initial Group of RBCA Trainers
- Finalization of the PIRI MOU
- Designation of Key Stakeholders
- Finalization of the PIRI Issue Papers

PIRI Issue Papers (EPA website)

1. Issues Associated With Natural Attenuation
2. The Definition Of Contaminant In Risk-Based Corrective Actions
3. No Further Action Letters In Risk-Based Corrective Actions
4. Selection Of Carcinogenic Target Risk Levels For Soil And Groundwater Remediation
5. Off-Site Movement Of Chemicals Of Concern In Risk-Based Corrective Actions
6. Institutional Controls In Risk-Based Corrective Actions
7. Groundwater Nondegradation Policies In The Development And Implementation Of Risk-Based Corrective Action Programs
8. Using TPH In Risk-Based Corrective Action

EPA Risk-Based Directive (ASTM Website)

- On March 1, 1995, the EPA issued a directive from the Office of Solid Waste and Emergency Response to the 10 EPA regional offices on the use of risk-based decision-making in underground storage tank corrective action programs. **OSWER Directive 9610.17 encouraged the use of risk-based decision making. It also specifically referenced E 1739 as one possible starting point for the development of a process using the risk-based approach described in the directive**. EPA's acceptance of E 1739 as a suitable tool for state programs triggered a nationwide interest in RBCA and spurred demand for the ASTM RBCA training course. Now was the time to deliver the goods.

Initial RBCA Program Development

Objective - To provide a strong technical base rather than an emotional base for making risk-based decisions.

- Development of a Stakeholder Group
- Understanding of the RBCA Process
- Understanding of technical issues
  - Fate and Transport
  - Risk Assessment
- Understanding of policy issues

TRAINING

ASTM/PIRI RBCA Training

- The objective of the ASTM RBCA training course is for the user to learn and understand the RBCA process along with the fundamental technical aspects of risk and exposure assessment. The planned outcome is the successful state implementation of RBCA programs.

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Module 1

- The course is structured around three distinct training modules. Module 1 is an introduction to the concept of RBCA. It is designed to inform all levels of stakeholders on the fundamental logic and process of RBCA. It is a short introductory course that was created with the manager in mind; someone who should be knowledgeable of RBCA, but may not necessarily be involved in the day-to-day corrective action activities. It is also an ideal introduction to the concept of RBCA for those who follow up with the more thorough training in Module 2.

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Module 2

- Module 2 consists of a comprehensive two-day workshop that provides detailed explanations of the key issues involved in risk assessment including toxicity assessment, exposure assessment, risk characterization, equilibrium partitioning, groundwater fate and transport, air fate and transport, and the RBCA framework. Module 2 is geared toward everyone who will be using the RBCA process, including state regulatory personnel, environmental consultants and site owners. It also provides sufficient information to help a state get started in establishing a RBCA program.

Module 3

- Module 3 consists of guidance on program implementation. Often, the Module 3 training would involve volunteers from industry and other state regulatory programs who would provide hands-on assistance in developing the state's RBCA program.

Intermediate Program Development
(Resolving the Tough Issues)

Developing Technical/Policy Guidance

- Risk Assessment Requirements
- Fate and Transport Requirements
- Tiered Data Requirements
- Uncertainty and Conservatism
- Institutional Issue Guidance
- Risk Management Guidance

Developing Technical/Policy Guidance

- Risk Management Guidance
  - Remedy Selection Criteria
  - Institutional Control
  - Engineering Controls
  - Active Remediation
  - Risk Communication

Final Program Development

- Regulatory/Legislative Adjustment
- Tool Development
  - Worksheets, Spreadsheets (Lookup Tables), Simple Models, Guidance Documents.
- Pilot Projects
- Fine Tuning
- Program Implementation
  - TRAINING

RBCA Tools

- Guidance
  - background, motivation, purpose, technical support, and use
- Worksheets
  - a focused collection of organized information
    - sources, receptors & beneficial site use, site characteristics, etc.
- Spreadsheets
  - aid comparison of site information to applicable risk-based criteria

Worksheets - Analytical Data and Comparisons

- Worksheets help focus investigations and ensure appropriate data collection
- Worksheets included for Data Comparisons to RBSLs (Risk-Based Screening Levels):
- for relevant exposure pathways and receptors
  - to indicator chemical screening levels
  - for salts (agricultural, vegetation) screening
    - Evaluation of Salinity in Soils
  - for Petroleum Mixtures
- RBSLs are not remediation levels
- RBSLs critically depend on technical policy decisions
- Includes Spreadsheets (Look-Up Tables) for developing RBSLs for both individual chemicals and petroleum mixtures

Roadmap to RBCA

- Staff training & identification of key policy issues
- Initial customization and documentation
- Development of tools (worksheets,spreadsheets)
- Stakeholder involvement throughout process
- Case studies to test policy decisions
- Modification of Look-up Tables (Evergre
- Training of industry and consultants
- Full-scale implementation
- Research focused on pathways

Benefits Summary

Historical Problems	RBCA Feature
All sites treated equal	Optional Classification System
Generic Standards	Tiered Approach
Compliance at every point	Alternate Compliance Points
Inconsistency	Consistent Framework
Risk Assessment - Formal Approach	Risk and Exposure Concepts Integrated Throughout Process
Large Resource Expenditure	Effective Resource Utilization

The Evolution of Remediation Philosophy

- **Pre RBCA**
  - **What is the most we can clean up?**
  - Emphasis on technology for mass reduction.

- **RBCA**
  - **How much do we need to clean up to be protective of human health and the environment?**
  - Emphasis on AUL's and technology for risk reduction.

- **SRBCA**
  - **New Metrics! (Lost Resource Service, GHGs, Jobs, etc.)**
  - What role should sustainability metrics have in how to remediate?
  - What role should sustainability metric have in when to remediate?
  - Advance existing RBCA socio-economic considerations (safety, prioritized spending, resource efficiency, etc.)

Why SRBCA?

- It fits naturally with existing RBCA socio-economic metrics
- It provides an opportunity to simply modify an existing framework vs. starting from scratch
- It lends itself to a similar tiered approach (as in AFCEEs Sustainable Remediation Tool)
- It establishes a flexible framework with significant credibility due to its association with an internationally respected organization

SRBCA Tools

- Guidance
  - background, motivation, purpose, technical support, and use
- Worksheets
  - a focused collection of organized information
    - New metrics, how they factor into how to remediate and whether to remediate.
- Spreadsheets and Tools
  - aid comparison of site information to applicable risk-based criteria
  - DuPont, AFCEE SRT, CN, BP, others

Role of SuRF and ITRC in SRBCA?

- Sustainable Remediation Forum (SURF)
  - brought global resources and stakeholders together
  - laid the groundwork for a standard
  - has already defined the controversial issues
  - has a head start on tools and training materials
  - Represents opportunity for SuRF members to lead ASTM effort
- ITRC – The Green Remediation Team
  - Establishes financial resources to support agency involvement
  - Establishes a training platform

Attachment 7
Working Toward Sequestration Commercialization in the West Coast Region

WESTCARB Regional Partnership

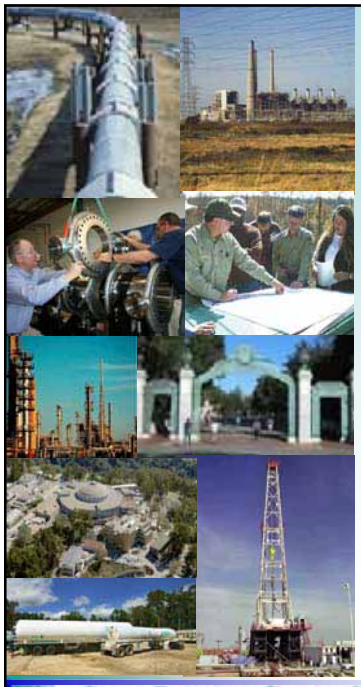
Working Toward Sequestration Commercialization in the West Coast Region

Larry Myer
WESTCARB Technical Director
California Energy Commission
(916) 651-2073; lrmyer@lbl.gov

Sustainable Remediation Forum
Oakland, CA
February 25, 2008

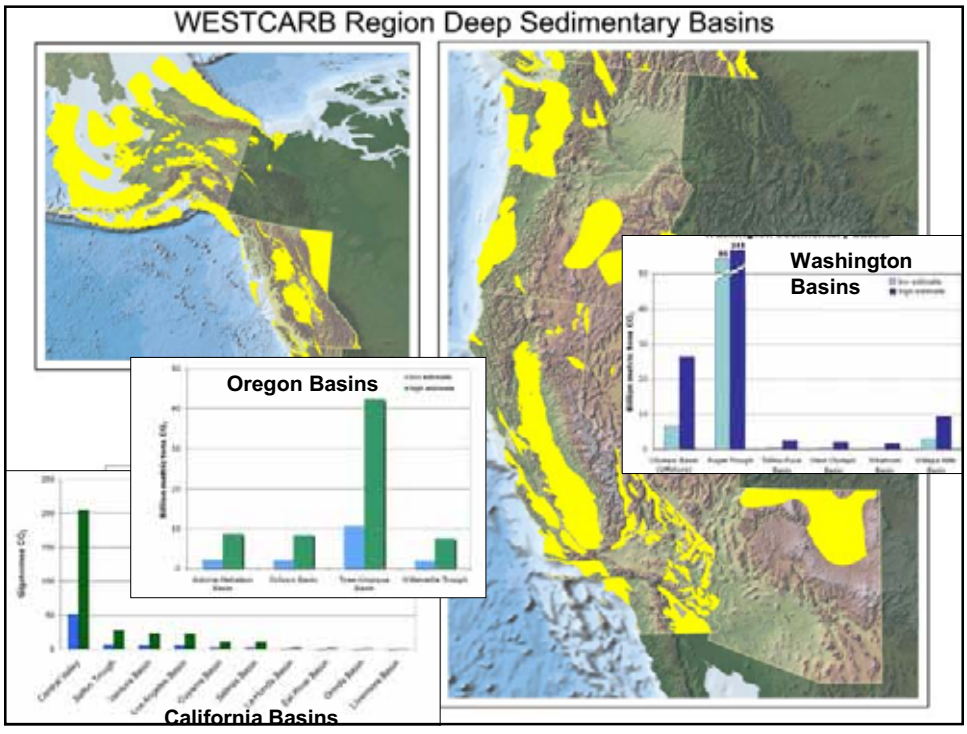
US DOE Regional Partnership Program (RCSP) Addresses Implementation Issues

- Opportunities for terrestrial and geologic CO_2 storage are being evaluated
- Phase I (complete): focus on regional assessments
- Phase II (underway): focus on pilot studies
- Phase III (just starting): large volume geologic field tests



WESTCARB Features Strong and Diverse Partners

- More than 80 organizations comprising:
  - Resource management and environmental protection agencies
  - National laboratories and research institutions
  - Climate project standards organizations and other nonprofits
  - Oil and gas companies; power companies; pipeline companies
  - Colleges and universities
  - Trade associations and policy coordinating bodies
  - Service firms and consultants
- Led by California Energy Commission (CEC)

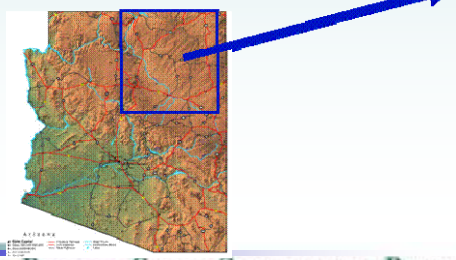


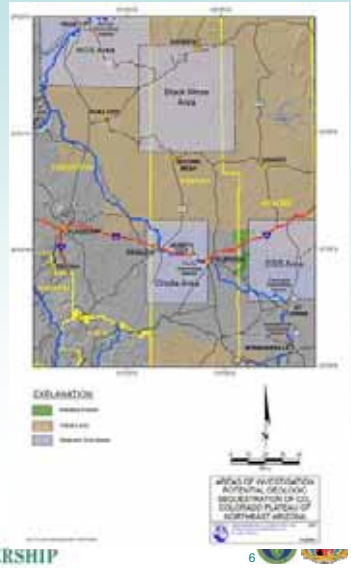
Field Tests Provide Regional Knowledge Base Essential for Commercial Implementation

- Tests are representative of best sequestration options, unique technologies and approaches, in region
- Tests involve site-specific focus for
  - Testing technologies
  - Assessing capacity
  - Defining costs
  - Assessing risks
  - Gauging public acceptance
  - Exercising regulatory requirements
  - Validating monitoring methods

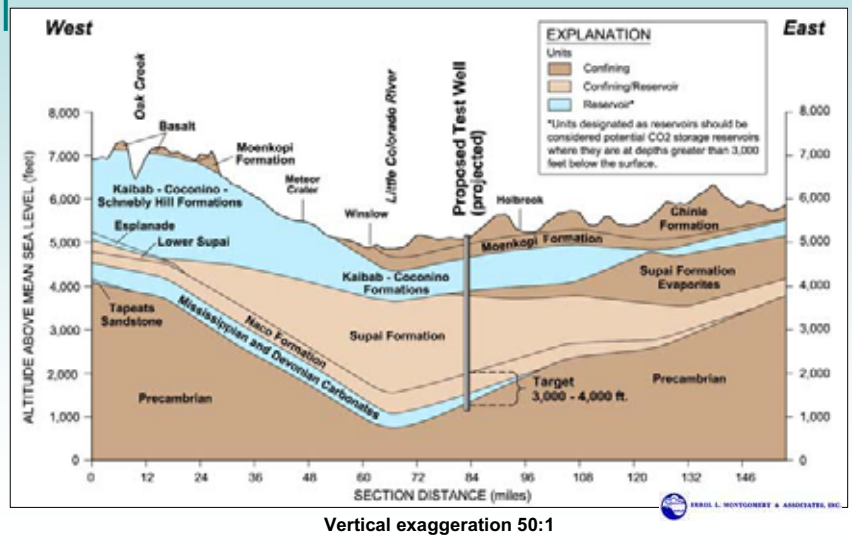
Arizona Utilities CO_2 Storage Pilot

- Industrial partners: Salt River Project, Arizona Public Service, Tucson Electric Power, Arizona Electric Power Cooperative, National Rural Electric Cooperative, Peabody Energy
- Establish sequestration potential of Colorado Plateau
- Regional studies led to selection of Cholla area for pilot





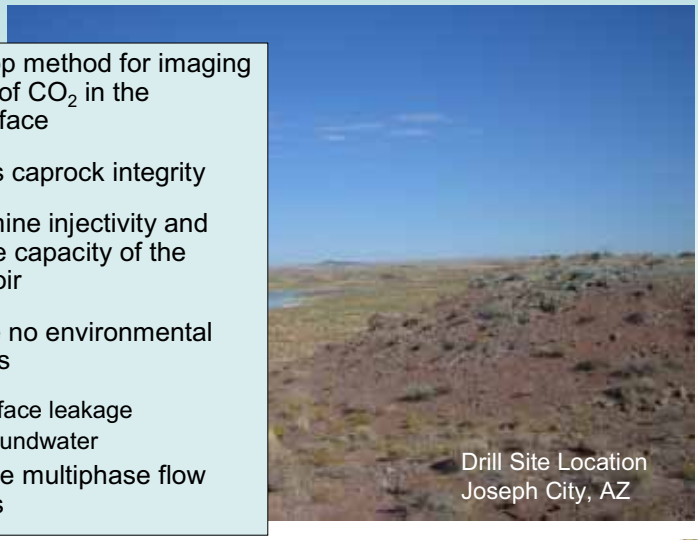
Geologic section in southern Colorado Plateau



Vertical exaggeration 50:1

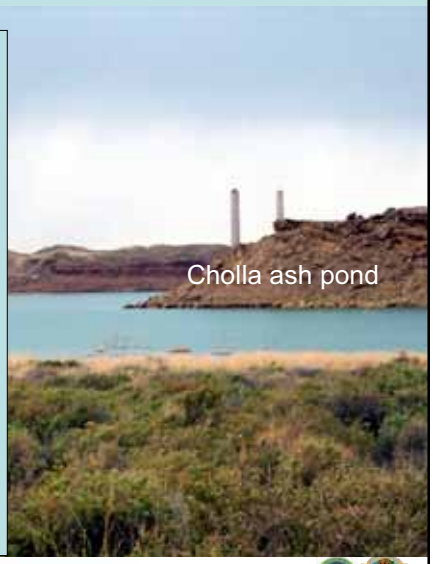
Pilot Test Scientific Objectives

- Develop method for imaging extent of CO_2 in the subsurface
- Assess caprock integrity
- Determine injectivity and storage capacity of the reservoir
- Assure no environmental impacts
  - Surface leakage
  - Groundwater
- Validate multiphase flow models



Summary of Pilot Test Activities

- Obtain permits
- Drill a single well about 4000 ft deep near the ash storage pond about a mile northeast of APS's Cholla Power Plant
  - Drilling scheduled for April, 2009.
- Perform injectivity test using saline water
- Truck in commercial-grade CO_2 and inject 2000 tons into the well
- Monitor the CO_2 in the subsurface using wire-line logs, fluid sampling, pressure and temperature, and pre- and post-injection vertical seismic profile (VSP)

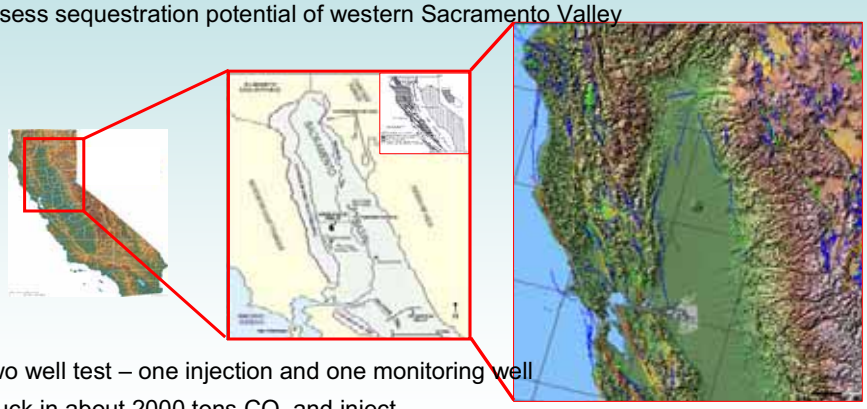


Permitting and Public Outreach Underway

- DOE Environmental Questionnaire/NEPA – Approved by DOE
- US EPA Region 9, UIC Class V permit – currently in public comment period
- Aquifer Protection Program permit, Arizona Department of Environmental Quality – currently in public comment period
  - All formations producing >5gal/day, regardless of salinity, are protected
- Drilling permit, Arizona Oil & Gas Conservation Commission

Northern California CO_2 Storage Pilot

- Lead industrial partner: Shell
- Assess sequestration potential of western Sacramento Valley



- Two well test – one injection and one monitoring well
- Truck in about 2000 tons CO_2 and inject
- Monitor CO_2 in the subsurface

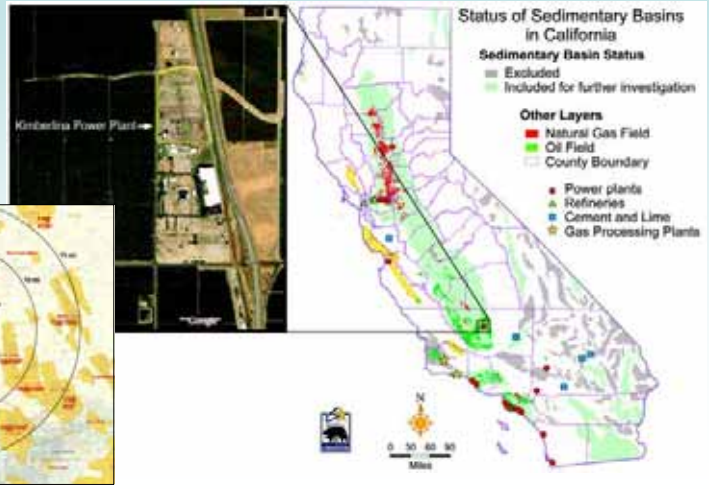
Source: Shell

Permitting and Public Outreach

- Underground Injection Control (UIC) permit: US EPA, Region 9 – Class V, Experimental
- Drilling permit: County
- NEPA; CEQA (County lead)
- Inform state and local agencies and political leaders
- Direct landowner contact
- Public meetings

WESTCARB Kimberlina Large Volume CCS Test Provides Underpinnings for Commercialization in California

Many nearby oilfields are EOR-suitable



(J. Johnson, LLNL)

Source: California Geological Survey

Kimberlina Test Objectives

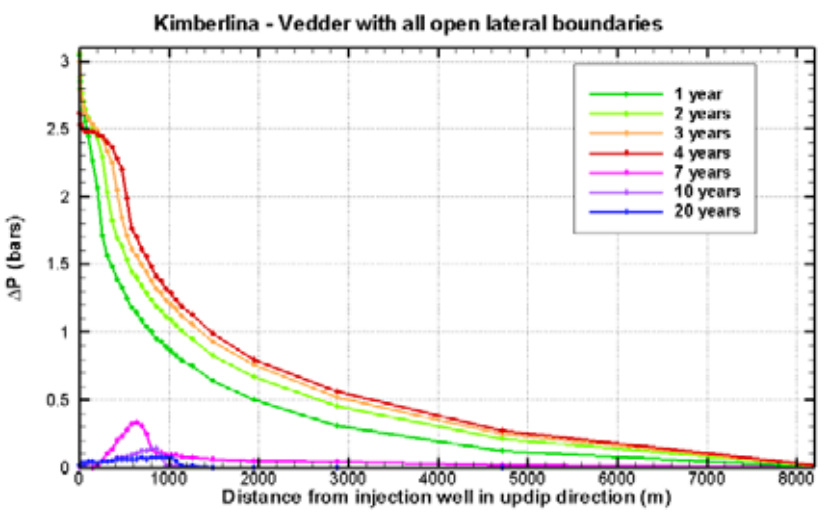
- Conduct a large volume CCS test (1 million tons CO_2); nominal 10-year project
  - Assess the best geologic target in California
- Co-locate project with advanced, commercial "sequestration friendly" oxy-combustion technology – Clean Energy Systems
  - Planned as first commercial-scale facility of its type in U.S.
- Demonstrate commercial-scale injection site characterization, operations, maintenance, and monitoring (Schlumberger)
- Conduct research to improve technologies for reservoir modeling/simulation and engineering, risk assessment, and measurement/monitoring (LBNL, LLNL, Stanford)

Managing Risk

- Risk assessment program
  - CF assessment of leakage risk
  - Overall project risk assessment
- Project management plan
  - Contracts/legal agreements
- Comprehensive site safety plan
- Careful site characterization
  - Old wells
  - Subsurface geology
- Careful well construction and injection
- Careful well construction and injection
- Prediction of plume behavior
- Comprehensive monitoring program
  - Operational EH&S
  - Assurance monitoring
  - Storage security monitoring
- Mitigation plan
- Public outreach program
- Plan for site stewardship after Phase III

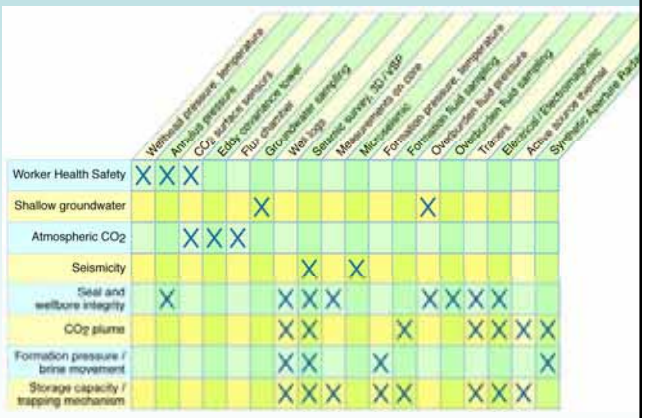
Plume Won't Intersect Known Wells

Pressures Increases Over Large Area But Dissipates Quickly



Multiple Methods Provide Data Monitoring Needs

- Worker EH&S
- Assurance monitoring – shallow groundwater; atmospheric levels; seismicity
- Storage security – seal and wellbore integrity; plume movement; brine movement; capacity/trapping



Summary

- Field test of various sizes provide knowledge base essential for commercialization
- Small scale pilots provide cost-effective initial evaluation of sequestration potential
- Large scale injections build knowledge base for risk management, monitoring, operations at scale
- Variability across the region is the norm: geology, geologic understanding, regulations, public perceptions….

Attachment 8
Sustainability Considerations for Sediment Remediation Sites

AECOM

Sustainability Considerations for Sediment Remediation Sites

John Ryan
Erika Germiani
Merv Coover
Anne Fitzpatrick

Presented @SURF 9 Oakland CA 2/25/09

Outline

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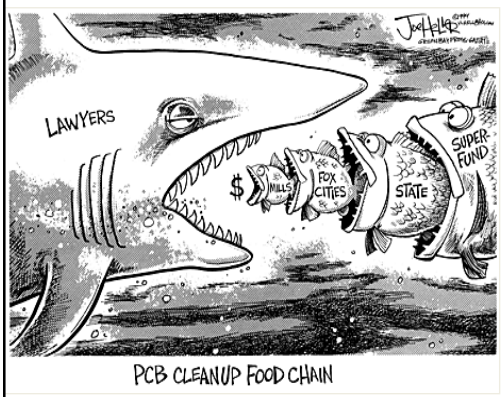
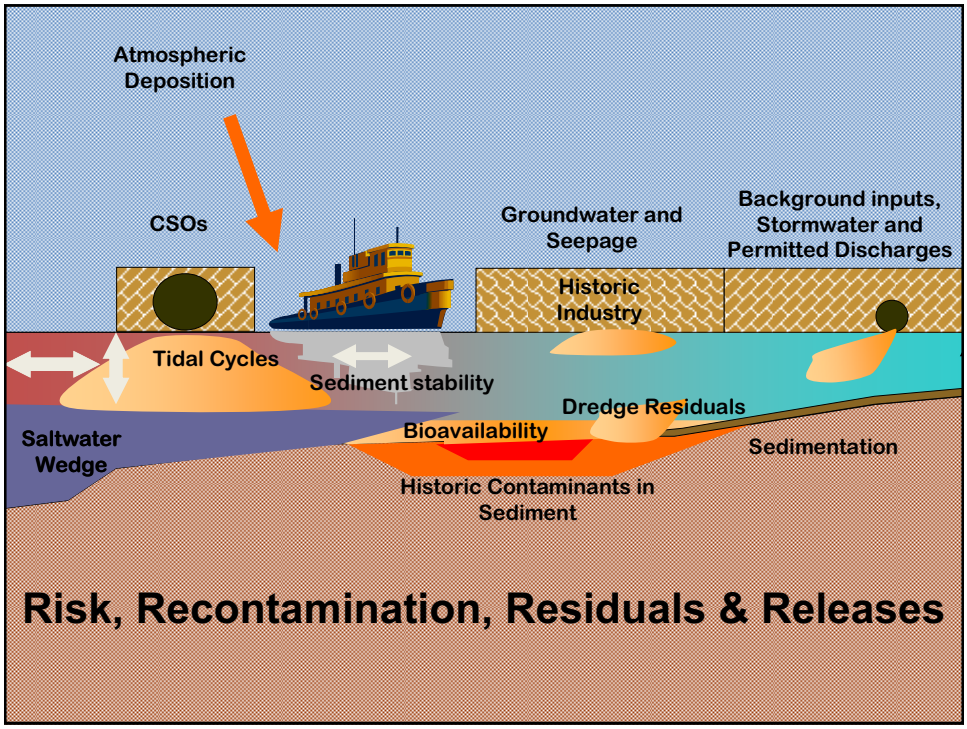


PCB CLEANUP FOOD CHAIN

- The challenges posed by Mega Sediment Sites
- Cleanup Approaches
- Sustainable metrics and remedy selection criteria
- Conclusions & recommendations



Cleanup levels for PCBs (& other PBTs) may be lower than background

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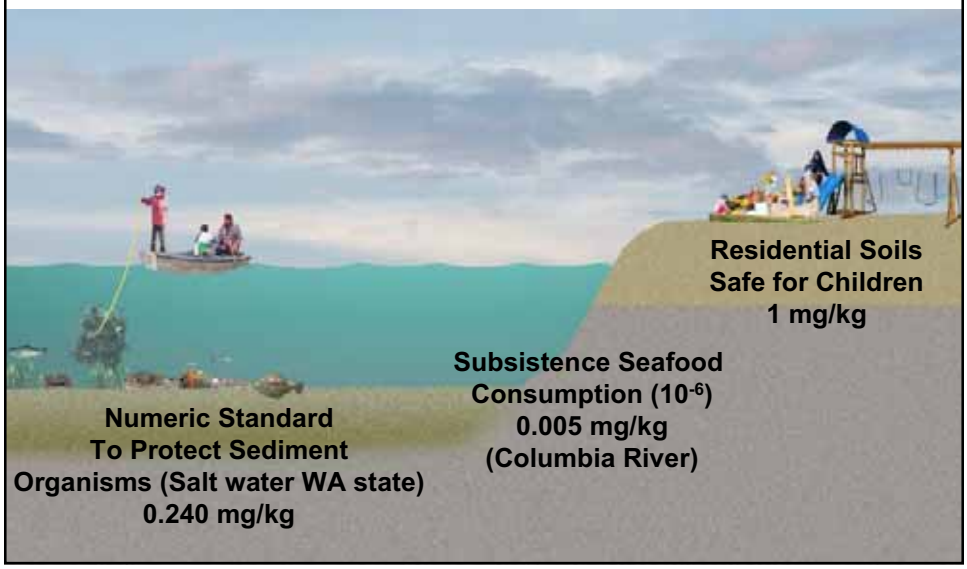

Remedies often combine technologies

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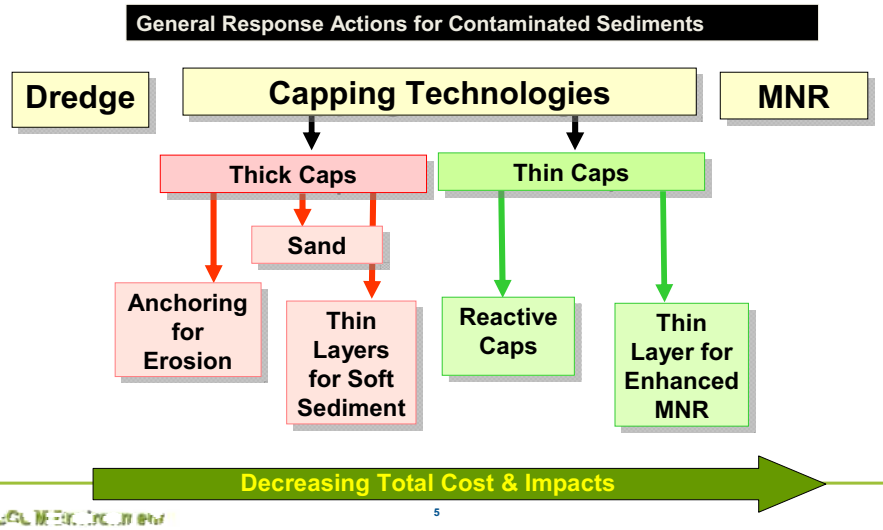

Sustainability metrics & remedy selection criteria

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Metric	Long Term Effectiveness	Short term Effectiveness	Reduction in MTV	Costs & Community
Residual Risk	✓			
Biota & Habitat		✓		
Community Impacts		✓		
GHG & Air emissions		✓		
Worker risks		✓		
Bioavailability			✓	
Resource Utilization			✓	
Adaptive Use/ Management				✓

Long Term Effectiveness
Waiting for the "Perfect" Clean Up

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- Total elimination may not be possible
- Ubiquitous contaminants
- Significant uncertainty in predicting the magnitude and duration of consumption advisories
- Recontamination due to dredge residuals or from on-going upland sources emphasizes importance of adaptive management
- Degree of complexity increases as the area increases
- How long do we wait?

Short-Term Effectiveness considers construction time & impacts

AECOM

- Construction time influenced by dredge volumes and existing transport capacity
- Source Control schedule must be considered in project phasing
- Time to achieve objectives should consider both construction and recovery time frames
- Short-term impacts consider:
  - Traffic & air emissions
  - Biota
  - Worker health & safety

Sustainability metrics & short term effectiveness

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Input data → **Calculation equations** → **Output data**

Sources:

- U.S. EPA
- Department of Labor
- Trade associations
- Site-specific data
- Implementation time frames

Developed by AECOM

- GHG
- SOx/NOx/Particulates
- Worker incident rates
- Energy consumption
- Ecological footprint

Only **FIRST ORDER EFFECTS** are calculated.

Estimated Number of Deadly Accidents During Remedial Action Implementation

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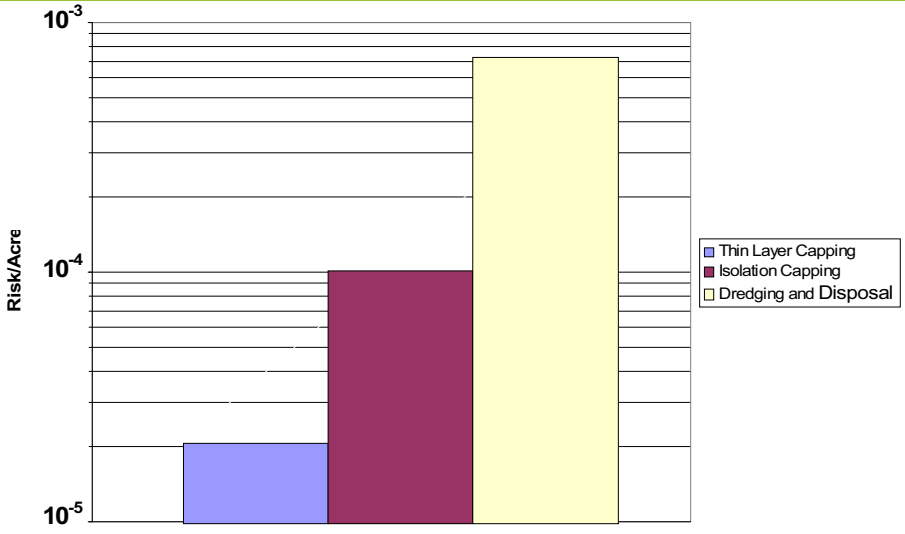
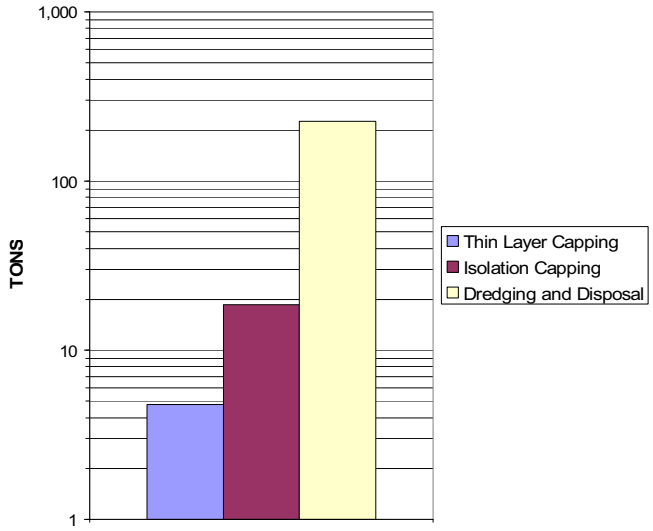


Estimated CO_2 Emissions per Acre Generated During Remedial Action Implementation

AECOM



Types & rates of equipment use affect estimates of GHG emissions

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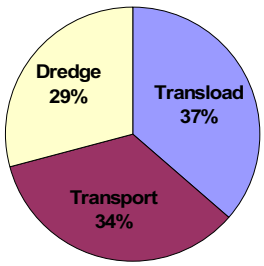
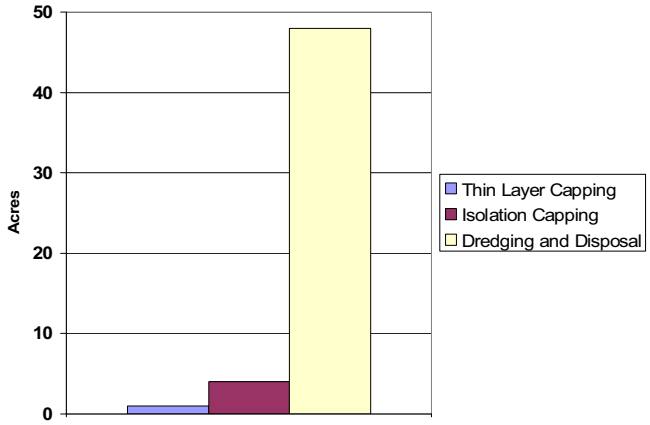


Estimated Ecological Footprint Needed to Uptake CO_2 Created by Remedial Actions

AECOM



Short Term Effectiveness of Dredging Other Considerations

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- Longer implementation time than other options
- Dredge residuals
  - Contaminant re-suspension
- Habitat, fish and biota
  - Elevated contaminants in fish tissue may last for years
  - Substantial disruption to ecosystem
- Air emissions
  - methane
  - NOx/SOx/Particulates

Capping & MNR require that potential disturbance factors have been evaluated & addressed

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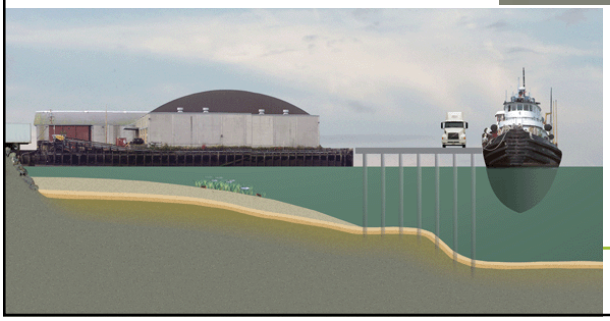
- Geologic Processes
  - Wind & Waves Erosion
  - Seismic
- Navigation & Land Use
  - Dredging, Infrastructure
  - Prop Wash, Anchor Drag



- Biological Disturbance
  - Benthic

Short term Effectiveness: Monitored Natural Recovery is an important tool in achieving RAOs

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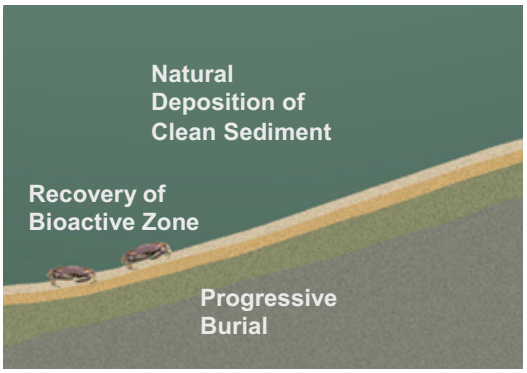
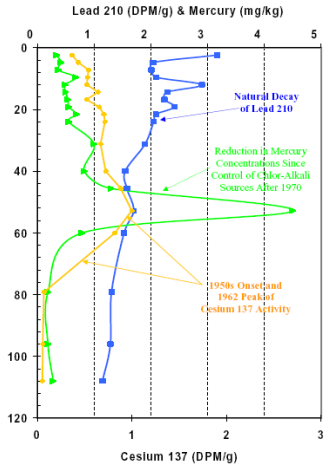
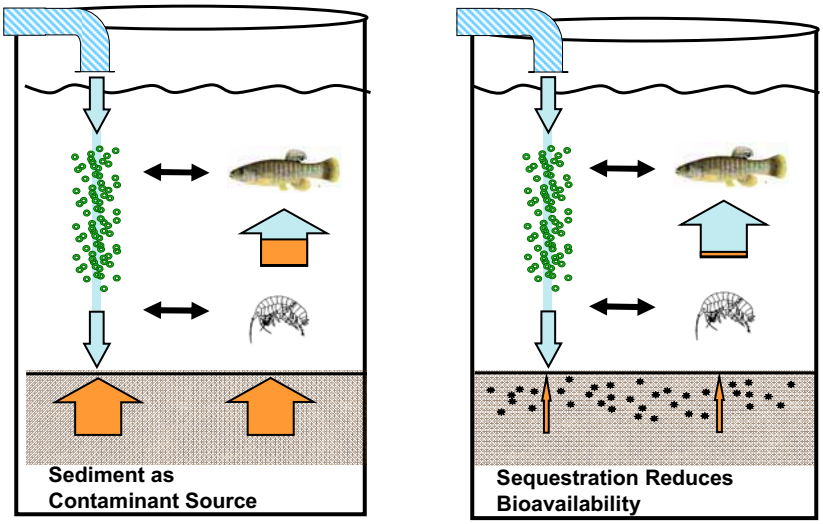
- Time frames generally set at 10 years or less
- Empirical data & Recovery Modeling
- Verification Monitoring is needed





Reduction in MTV
Reactive caps show promise as "Green Technology"

AECOM



Reductions in MTV
Limited beneficial reuse options available

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- Physical separation may be applicable to sediments w/ > 50% sands
- Liability concerns limit reuse options

Addressing Community Concerns
Land uses, impacts, costs and time

AECOM

Concerns about Monitored Natural Recovery	Concerns about *In-Situ* Capping	Concerns about Dredging and Excavation
• Property value/transferability • Concerns with leaving waste in place • Long timeframe for recovery • Extended loss of resources and uses • Spreading of contamination due to flooding/other disturbance • Perception of "do nothing" remedy, doubts about effectiveness	• Property value/transferability • Concerns with leaving waste in place • Loss of resource/harvesting rights • Navigational limitations • Increased flooding • Disturbance of aquatic habitat • Loss of ship anchoring access • Cap erosion or disruption • Contaminant migration through cap	• Increased truck or rail traffic • Costs – Who Pays? • Noise, emissions, and lights • Siting of new disposal facilities • Loss of capacity at existing disposal facilities • Construction time frame • Infrastructure needs on adjacent land • Disturbance of aquatic habitat • Resuspension/spreading contamination

Adaptive management is essential to developing sustainable solutions –NRC 2007

AECOM

...the remediation of contaminated sediment is neither simple nor quick, and the notion of a straightforward "remedial pipeline" that is typically used to describe the decision-making process for Superfund sites is likely to be at best not useful and at worst counterproductive. *Given that remedies are estimated to take years or decades to implement and even longer to achieve cleanup goals, there is the potential—indeed almost a certainty—that there will be a need for changes, whether in response to new knowledge about site conditions, to changes in site conditions from extreme storms or flooding, or to advances in technology (such as improved dredge or cap design or in situ treatment).*

These possibilities reiterate the importance of phased, adaptive approaches for sediment management at megasites.

Conclusions/Recommendations

AECOM

- Complex sites require a phased, adaptive management approach using combined remedies
- Additional work needed to accurately estimate GHG emissions
- Emerging science on bioavailability can inform monitoring approaches and technology development, in particular reactive caps
- Improved sustainability assessments should consider the full range of impacts and real world limitations of remedial technologies, in particular with respect to dredging
- More work is needed on a suite of green technologies & BMPs that span the entire life cycle of cleanup from assessment through long term monitoring.

Attachment 9
Estimating the Environmental Footprint at a Corrective Action Cleanup

Green Remediation

Estimating the Environmental Footprint at a Corrective Action Clean-up

Pilot Study at Romic East Palo Alto

Karen Scheuermann, US EPA Region 9
scheuermann.karen@epa.gov

25 February 2009

Green Remediation

In Theory:

Consider all environmental effects of remedy implementation and incorporate options to maximize the net environmental benefit of cleanup actions.

In Practice:

Case studies with greener remedies.

Development of tools, guides, and standards.

Pilot studies to estimate footprints.

2

Purpose of the Pilot Study

- Compare the environmental effects of the alternative remedies at a clean-up site
- Create a methodology for future calculations at other clean-up sites:
  - Deciding among alternative remedies
  - Improving existing remedies

Pilot study is still in progress and results at this stage are preliminary.

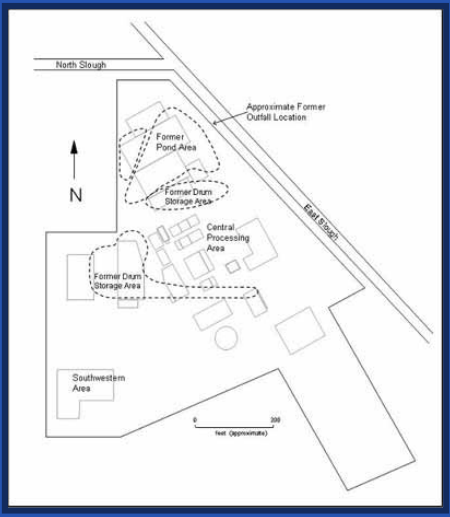
3

Pilot Site: Romic East Palo Alto

- 14-acre hazardous waste management facility
- Soil and ground water contaminants are VOCs (such as TCE and PCE)
- Area of contamination to a depth of 80 feet

4

Remedy Alternatives at Romic



Alternative 2 (Hybrid)
- Extraction wells *and* bioinjection wells
- 30 years to complete

Alternative 3 (Bioremediation)
- Bioinjection wells only
- 10 years to complete

Alternative 4 (Pump and Treat)
- Extraction wells only
- 40 years to complete

Alternative 3 has already been chosen for Romic, so this analysis did not affect the remedy decision.

5

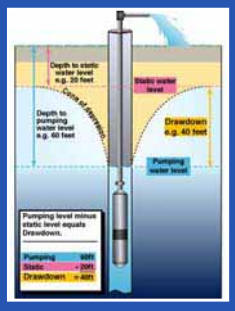
Remedy Alternatives at Romic

Bioremediation:

uses injections of cheese whey and molasses to the ground water

Pump and Treat:

includes treatment of ground water in an air stripper followed by carbon filters



6

Questions to Be Answered

- Is it possible to determine the environmental footprint of the alternative remedies?
- Did we select the "greenest" remedy?
- How important is it to take into account off-site manufacture of materials used on-site?

7

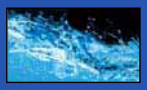
Boundaries of the Pilot Study

- **Functional Unit:**
  Ground water remediation.
- **Temporal Boundary:**
  Construction and active life of each alternative remedy.
- **System Boundary:**
  On-Site Activities (Level 1)
  Transport To and From Site (Level 2)
  Manufacture Off-Site (Level 3)

8

At Romic We Evaluated…

- *Resources and Energy Used*
  - Water
  - Construction Materials
  - Electricity
  - Fossil Fuel
- *Wastes Generated*
  - Spent Carbon
  - Wastewater
- *Air Emissions*
  - NO_X, SO_X, PM, CO_2



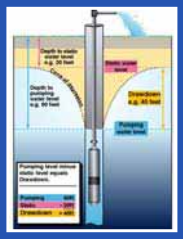




9

Level 1: On-Site Activities

Well Construction



Groundwater Extraction

BioInjections

Groundwater Treatment

10

Level 2: Transport To and From Site

Operators to Site

Wastes off Site

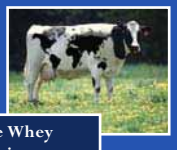
Materials to Site

11

Level 3: Off-Site Manufacture

PVC Pipe Manufacture

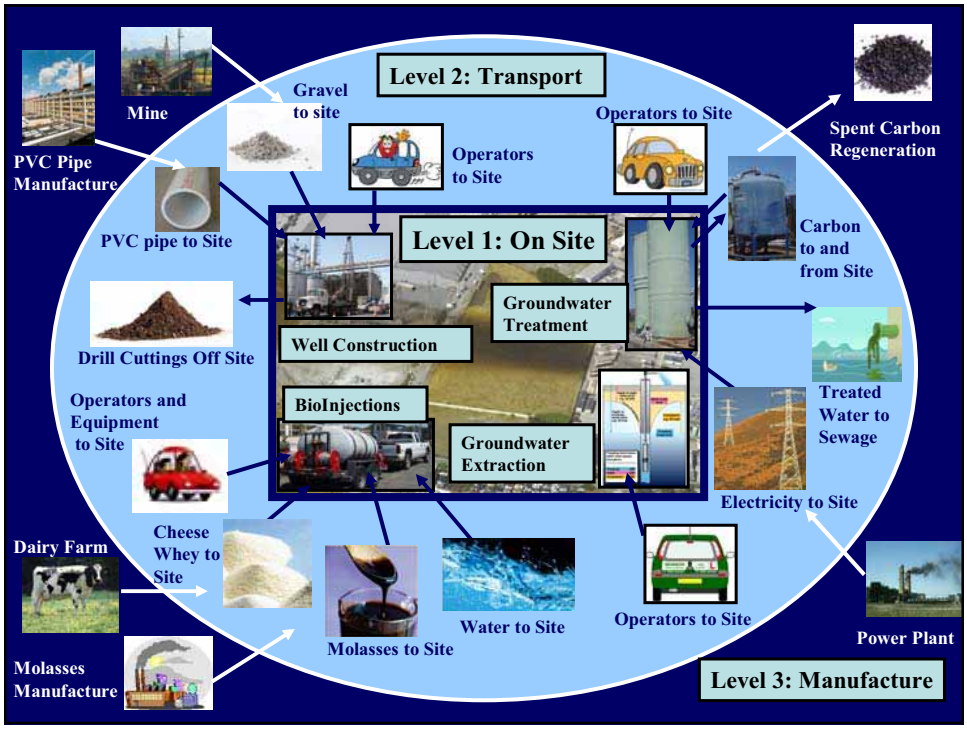
Gravel Mining



Cheese Whey Processing

Electricity Production

12



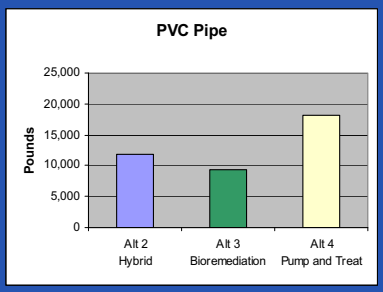
Sources of Information

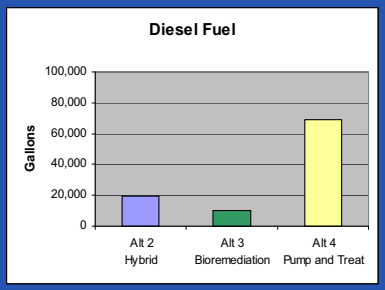
1. EPA Project Managers
2. Official Documentation
3. Romic Staff and Consultants
4. Analyst Assumptions
5. Web Searches
6. Back-of the Envelope Estimates

14

15

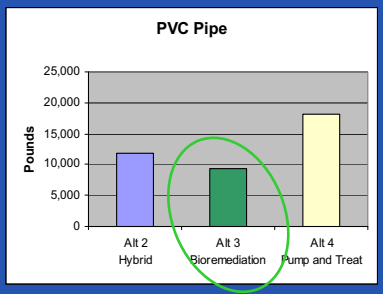
Results – Materials and Fuel

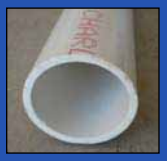


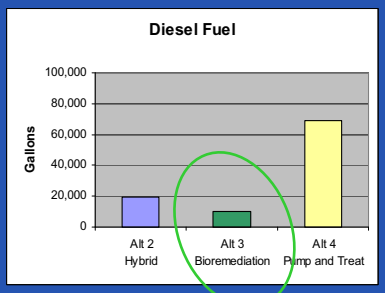


16

Results – Materials and Fuel

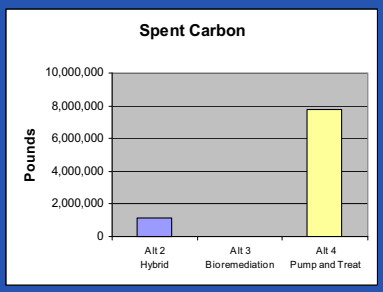


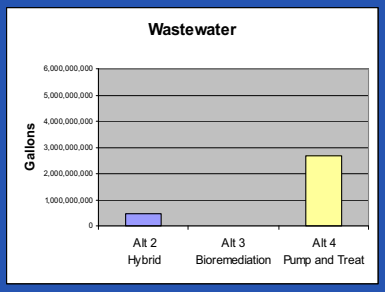




17

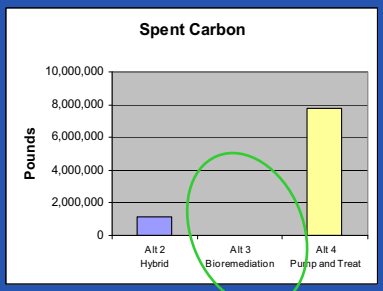
Results – Wastes Generated

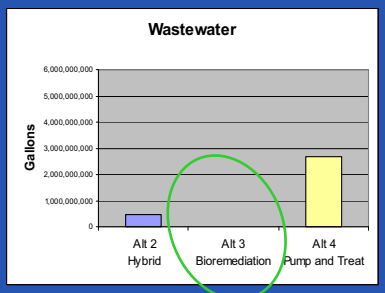




18

Results – Wastes Generated

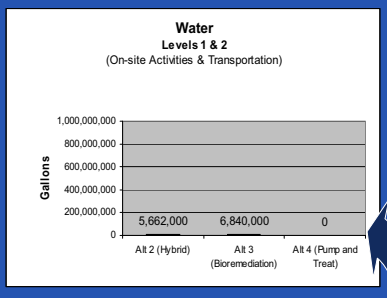




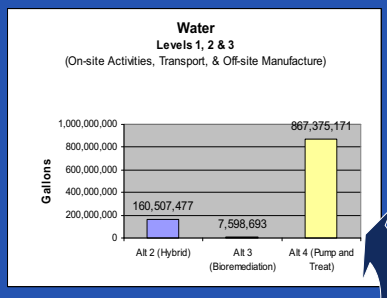
19

Results – Water

Including Level 3 activities in the analysis substantially increases our estimate of the water footprint.



Looking at on-site activities and transportation only



Looking at activities in all three levels

These values are for the life-time of each alternative remedy.

20

Results – Water

Issues related to water:

- Water withdrawn vs water consumed.

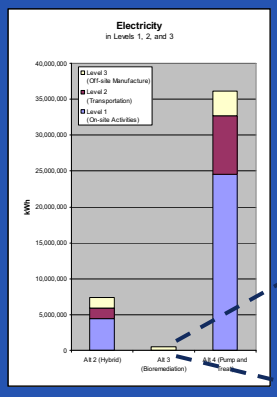
- Water withdrawn in "water scarce" areas vs water withdrawn in "water abundant" areas.

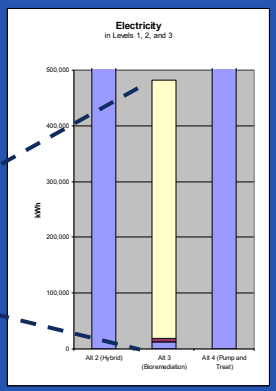
- Quality of water withdrawn or consumed: potable vs non-potable.

Maybe all water is not equal… should we take this into consideration?

21

Results – Electricity





These values are for the life-time of each alternative remedy.

We are used to taking into account on-site electricity in evaluating environmental footprints.

However, electricity used for transport and manufacture are also important.

22

Results – Electricity

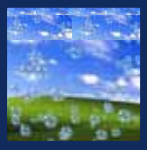
Issues related to electricity:

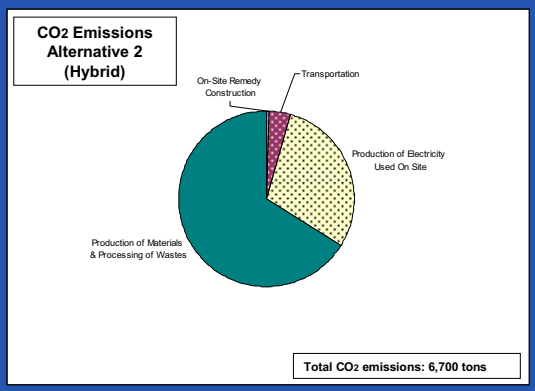
- Electricity use also contributes to CO_2 emissions – be careful to avoid "double counting".

- We still may want to account for electricity use separately because of infrastructure impacts.

23

Results – CO_2 Emissions



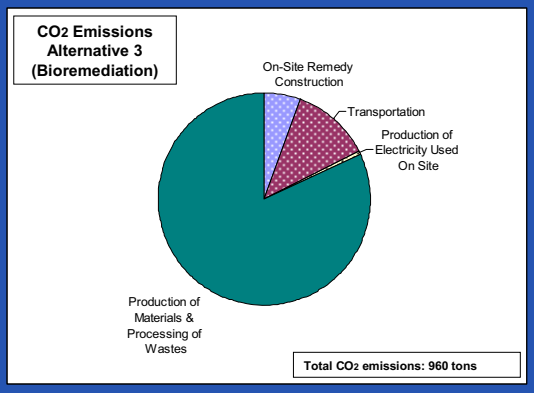


These values are for the life-time of the alternative remedy.

Off-site activities, even those not related to production of electricity used on-site, are a big part of the CO_2 footprint.

24

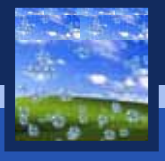
Results – CO_2 Emissions

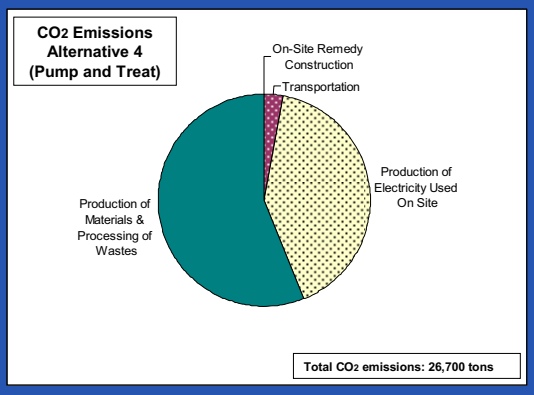


These values are for the life-time of the alternative remedy.

Off-site activities, even those not related to production of electricity used on-site, are a big part of the CO_2 footprint.

Results – CO_2 Emissions





These values are for the life-time of the alternative remedy.

Off-site activities, even those not related to production of electricity used on-site, are a big part of the CO_2 footprint.

Results – CO_2 Emissions

Issues related to CO_2:

- Some CO_2 emission factors may include resource extraction and others may not, resulting in inconsistency in the analysis.

- Should we take into account likely lower emissions of CO_2 per unit material produced in the future?

27

Improving Level 3 (Manufacturing) Estimates

We performed complete (but back-of-the envelope) Level 3 calculations for:

- Water use
- Electricity use
- CO_2 emissions

We would like to add Level 3 calculations for:

- Wastes generated
- Fossil fuels consumed
- Air toxics emitted

We are working with EPA life-cycle analysis experts (in EPA's Research Office in Cincinnati) to improve and add to our Level 3 calculations.

28

Applying results to our decision-making

We need to balance the various aspects of each remedy.

29

Applying results to our decision-making

	Alternative 2 Hybrid	Alternative 3 Bioremediation	Alternative 4 Pump and Treat
Materials Used			
Water (gallons)	200,000,000	8,000,000	900,000,000
Electricity (kWh)	7,000,000	500,000	40,000,000
Waste Generation			
Spent Carbon (lbs)	1,000,000	0	8,000,000
Wastewater (gallons)	500,000,000	0	3,000,000,000
Air Emissions			
CO_2 (tons)	7,000	1,000	30,000
Other			
Road Distance (miles)	300,000	200,000	600,000
Remediation Time (years)	30	10	40

- Balance local effects with global effects.
- Balance effects of disparate items:
  - natural resource depletion
  - waste generation
  - environmental contamination
  - years to complete remedy

Comparison of impacts among alternatives:

relatively high impact
relatively medium impact
relatively low impact
impacts similar

30

Applying results to our decision-making

	Alternative 2 Hybrid	Alternative 3 Bioremediation	Alternative 4 Pump and Treat
Materials Used			
Water (gallons)	200,000,000	8,000,000	900,000,000
Electricity (kWh)	7,000,000	500,000	40,000,000
Waste Generation			
Spent Carbon (lbs)	1,000,000	0	8,000,000
Wastewater (gallons)	500,000,000	0	3,000,000,000
Air Emissions			
CO_2 (tons)	7,000	1,000	30,000
Other			
Road Distance (miles)	300,000	200,000	600,000
Remediation Time (years)	30	10	40

- Balance local effects with global effects.
- Balance effects of disparate items:
  - natural resource depletion
  - waste generation
  - environmental contamination
  - years to complete remedy

Comparison of impacts among alternatives:

relatively high impact
relatively medium impact
relatively low impact
impacts similar

31

Using results to improve remedies

	Alternative 2 Hybrid	Alternative 3 Bioremediat	Treat
Materials Used			
Water (gallons)	200,000,000	8,000,000	900,000,000
Electricity (kWh)	7,000,000	500,000	40,000,000
Waste Generation			
Spent Carbon (lbs)	1,000,000	0	8,000,000
Wastewater (gallons)	500,000,000	0	3,000,000,000
Air Emissions			
CO_2 (tons)	7,000	1,000	30,000
Other			
Road Distance (miles)	300,000	200,000	600,000
Remediation Time (years)	30	10	40

Look at opportunities to reduce fresh water use:

use reclaimed water for bioinjections of cheese whey and molasses

Comparison of impacts among alternatives:

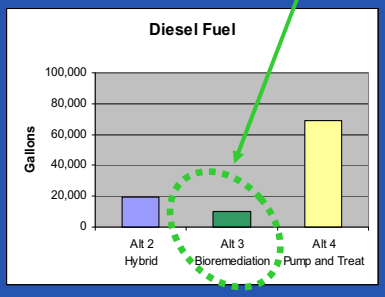
relatively high impact
relatively medium impact
relatively low impact
impacts similar

32

Reducing Impacts – Diesel Fuel

During remedy construction Romic has agreed to:

* Use diesel particulate filters
* Reduce idling time
* Use ultra low sulfur diesel or another clean fuel



33

Observations

for our bioremediation system…

- Most of the fresh water use occurred in on-site activities.
- Most of the electricity use occurred in off-site activities.
- Electricity used on site accounted for only 1% of the total CO_2 footprint.
- Other off-site manufacture accounted for about 80% of the total CO_2 footprint.

  Especially important for the CO_2 footprint were:
  -- bioremediation materials (whey, molasses)
  -- production of fossil fuels
  -- manufacture of well construction materials

34

Observations

for a typical pump and treat system…

- All the fresh water use occurred in off-site manufacture.
- About a third of the electricity use occurred in off-site activities.
- Electricity used on site accounted for about 40% of the total CO_2 footprint.
- Other off-site manufacture accounted for about 55% of the total CO_2 footprint.

  Especially important for the CO_2 footprint were:
  - -- reactivation of granulated carbon
  - -- treatment of wastewater

35

Conclusions

- Yes, it's feasible to <u>estimate</u> the environmental footprint of a corrective action remedy.
- Yes, we selected the "greenest" remedy at Romic.
- For the three remedy alternatives at Romic, it was very important to include off-site manufacturing activities in estimations of the environmental footprint.

36

NEXT STEPS: Specific to Romic

- Improve the life-cycle inventory inputs for Level 3 (manufacturing) calculations
- Complete Level 3 calculations for waste, fossil fuels, and air toxics
- Run calculations for other aspects of the three alternative remedies:
  - soil excavation
  - groundwater monitoring
  - capping contaminated areas

37

NEXT STEPS: Big Picture

- Complete five additional pilots
- Continue to refine the methodology
- Develop guidance document
- Promote Green Remediation in general and exchange information with others interested

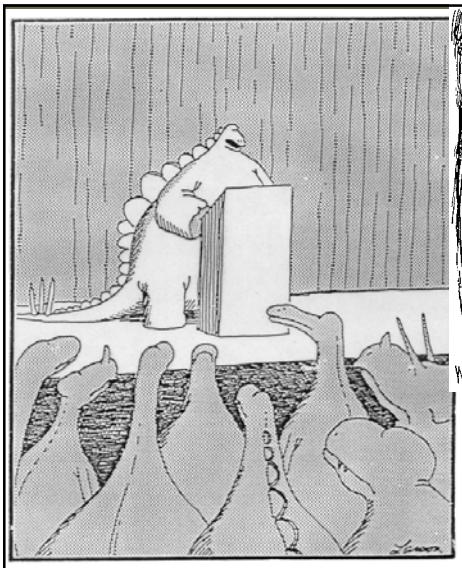
38

Promoting Green Remediation

Bringing Sustainability to Our Site Clean-ups!

39

Attachment 10
SURF Web Site



"The picture's pretty bleak, gentlemen... The world's climates are changing, the mammals are taking over, and we all have a brain about the size of a walnut."

Lowell Kessel
GEO Inc

SuRF USA
SUSTAINABLE REMEDIATION FORUM USA

Sustainable Remediation Forum (SuRF) USA goes live!

Preparing for prime time…

Conan O'Brien

Background - SuRF Website

3

- Why?...Don't really exist without a website
- www.sustainableremediation.org
- Currently contains
  - Description of the forum
  - Mission statement
  - Location for meeting notes / report downloads
  - Provide links to organizations, Firms, Affiliates
  - Contact info (e.g. for any questions call Dave Ellis)

Background - SuRF Website

4

- Determine needs
- Learn more about desires of members
- Distinguish needs from desires

Example Questions

- Who should manage content?
- Color, layout, # pages
- How would you improve it?
- Would you like to volunteer?

sultsSuRF Website

5

- 82% Would you want your company logo displayed on the web site?
- 66% Would you want your personal contact info… …l on the web site?
- 87% Should we make SURF's bibliogr…
- 65% SURF's bibliography contains c… documents. Should those comme…
- 73% Would we want to host a dialog… …site?
- 83% Would we want a members-only area … …e?
- 88% Does web site color, layou… …#pages work for you?
- 39% Would you like to jo… …he site content, design and management team?
- 22% Should Su… …ffer Advertising?

Does this make sense?

sultsSuRF Website

6

- How would you improve the site content?
  - *Download minutes from meetings*
  - Download reports (EPA and others)
  - Upload information for collaboration
  - Download case studies
  - Show all members involved
  - Form a website team
  - Blog
  - Sustainability news

SuRF Website

7

- Website Management Team Needed
- Cost of website hosting and maintenance
  - Cost for future web site maintenance labor ~$75/month for 2 hours by third party
  - G.E.O. Inc. donated domain and initial website design

Live Website

8

- Website already contains basic information but requires direction and content management
- Website will be in constant change with updates throughout it's life
- Photos and short summaries will be required for all SuRF activities
  - Meetings
  - Conference / Symposium participation (e.g. DTSC, AEHS, Battelle)

SuRF Website

9

- Build team this month-who would like to join the team? (sign up list available)
- Determine volunteer hosting organization (if available) or determine source of funds to cover maintenance costs.
- Begin updating and managing content and design changes next month or when feasible

10

Attachment 11
Potential Reactions to the SURF White Paper

Some Potential Reactions to the SURF White Paper

Compiled by the WP chapter facilitators

Chapter 1 – In the beginning……

- We thought we knew what we were doing
- We spent a lot of money and energy
- We traded cleaner soil for dirty air
- We didn't reduce much risk to the public
- We watched as remedies reached asymptotes
- We tried new remedies – and repeated previous steps
- But now, a change is coming……

Now we think we see things a little more as they really are

So what's changed?

- Now we fear climate change
- 30+ years of experience in remediation
- A cohesive and collaborative effort to utilize that experience (SURF)
- Unparalleled international interest in doing things better - even in remediation
- It really is time for a change……

Chapter 2 Questions/Issues

- Did not include my state's green remediation program, tool, etc.
- Do not agree with definition of sustainable remediation.
- Stakeholder definition.
- Legislative/regulatory requirements for green remediation

- How is SuRF different from the newly formed ITRC Group?
- How do I make sure that this is not used as a tool to walk away?
- How long will it be before Sustainable Remediation tools are imposed as a regulation?
- Is this green remediation evaluation costly?
- Where do I learn more about sustainable remediation and SuRF?
- Are there plans to expand or update the survey?

Section 3 - Metrics

Possible Controversies

- Why isn't my tool included?
- Why isn't a tool or methodology recommended?
- Why isn't guidance on usage of a tool provided?

- Possible Internal Question - Why is the description of my tool so short or different from what I provided?

Barriers to Sustainable Remediation

The Machiavelli World View of Change

"*There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.*

For the reformer has enemies in all those who profit by the old order, and only lukewarm defenders in all those who would profit by the new order, this lukewarmness arising partly from fear of their adversaries … and partly from the incredulity of mankind, who do not truly believe in anything new until they have had actual experience of it."

Niccolo Machiavelli (1469-1527)

Barriers to Sustainable Remediation

Updated Machiavelli World View of Change

1. *Anything that was in the world when you were born is normal and ordinary and is just a natural part of the way the world works*
2. *Anything that's invented between when you're fifteen and thirty-five is new and exciting and revolutionary and you can probably get a career in it*
3. *Anything invented after you're thirty-five is against the natural order of things*

Douglas Adams –Salmon of Doubt

Chapter 5
Controversial Concepts

- Hypothetical exposure risk vs “Real” Risk of Remedy (associated with cost-benefit vs. other societal risks or goals)
- MCL vs acceptance of other remedial targets (Regulatory/Society comfort with current evaluation)
- Marketplace incentives
- Need to regulate evaluation of sustainable remedies

Vision Section Controversy

- Technical Guidance – who is suppose to do all this stuff!
- Regulatory Guidance and Policy – what are we suppose to do till this happens?
- Sustainability VS Green Remediation – what’s the difference?
- Metrics and Valuation – are we dreaming?
- Sustainability Scalability – do we really have to look at this for every site?
- Nice framework – what’s next? And when will we see it?

Chapter 6 - Case Studies

These case studies are a force fit – don't prove your case.

What makes these sites good examples?

Who picked these lousy criteria? Mine are way better!

Why isn't MY CUSTOMER'S site on that list?

We have great rules for site assessment. There is no need and no place for evaluating sustainability.

Conclusions and Recommendations

We've already made all the progress we need. Don't rock the boat!

The government knows best. We'll write any rules you need. Now be quiet and go away.

There's no need to change regulations – they account for all conceivable situations.

Our metrics are just fine now. Go away.

It's impossible for slower to be better. You're just shilling for industry.

What's the point of involving academics? They don't know this stuff.

Remedies don't have measureable footprints! Why bother us with all this sustainability nonsense?

Attachment 12
White Paper Response and "What's Next?" Breakout Session

Chapter 2: Description and Current Status of Sustainable Remediation

Participants in this breakout group believed that the two primary reactions for this chapter would revolve around the definition of "sustainability" and "stakeholders" and the fact that the information presented could be out of date because of the rapidly evolving state of practice. The group developed a list of questions and answers so that SURF members can consistently and accurately respond to inquiries. The list of frequently asked questions, as developed during the breakout session, is provided below.

Question: Why are there some tools and initiatives not included in the white paper?
Response: The sustainable and/or green remediation movement is rapidly developing and constantly improving. SURF summarized the current state of practice as of November 2008.

Question: What was the basis for SURF's definition of sustainable remediation?
Response: SURF employed a commonly accepted definition of sustainable remediation based on consensus of multiple stakeholders. SURF believes that the project-specific definitions of sustainable remediation can and should be considered to address all or most site and stakeholder concerns.

Question: How did SURF determine the definition of "stakeholders?"
Response: SURF elected to divide stakeholders into four groups. Site and project-specific stakeholders must be evaluated and identified as needed.

Question: Are there regulatory requirements mandating the use of sustainable remediation?
Response: As of November 2008, no regulatory requirements specifically for sustainable remediation existed in the U.S.

Question: Will SURF update the white paper?
Response: Due to the informality of the SURF group, it is uncertain at this time if the white paper will be updated. (Need consensus on the answer to this question)

Question: Do other countries not listed in the white paper have sustainable remediation programs?
Response: As much as possible, SURF identified and reviewed international programs. SURF was not able to readily identify formal sustainable remediation programs in other countries.

Question: How can I be sure that responsible parties do not use sustainable remediation as an excuse to do less?
Response: The white paper provides guidance on how to evaluate alternatives to achieve regulatory goals. It should be remembered that the first objective of any remediation is protection of human health and the environment.

Question: Is an evaluation of green or sustainable remediation costly?

Response: The cost of an evaluation depends on the level of detail of the evaluation and who performs the evaluation. A rudimentary evaluation usually requires very little time and can provide an order of magnitude comparison of remediation technologies. A more focused evaluation can then be conducted, which could be time consuming.

Chapter 3: Sustainability Concepts and Practices in Remediation

Potential Questions

- ❒ How do I know which tool to use?
- ❒ Do I have to do a sustainable evaluation?
- ❒ How do I pay for a sustainable evaluation?
- ❒ Which metrics are relevant to my site?
- ❒ Will regulators accept the results of a sustainable evaluation?
- ❒ Are tools for evaluating sustainable remediation accurate?
- ❒ When is it appropriate to use life-cycle analysis, net environmental benefit analysis, or a carbon calculator?
- ❒ How is the level of rigor and scalability of analysis selected?
- ❒ How is a value applied to resources?
- ❒ How is a value applied to tradeoffs?

Approaches to Response

- ❒ Prepare a document with frequently asked questions and post it on the SURF web site.
- ❒ Use different tools and compare and contrast results and develop listing of data gaps.
- ❒ Brand SURF as an underwriter's laboratory and brain trust.
- ❒ Revisit membership and participation so that SURF remains an open forum for discussion and includes all stakeholders.
- ❒ Accept questions and develop blog on SURF web site.

Chapter 4: Impediments and Barriers

Potential Reactions

- ❒ Lack of consistency in implementation
- ❒ Lack of understanding of sustainable remediation and resistance to change
- ❒ Perception that site owners are trying to do less remediation

Approaches to Response

- ❒ Outreach
- ❒ Road show
- ❒ Case histories

Selling Point

Sustainable remediation is protective of human health and the environment.

Chapter 5: A Vision for Sustainability

Potential Questions

- ❒ Is it better to have a single normalized metric for multiple criteria (e.g., the dollar) or should we have different metrics for different sustainability criteria evaluated?
- ❒ Should sustainability criteria be weighted and evaluated with other balancing criteria or should specific criteria from the sustainability analysis be integrated into existing balancing criteria?
- ❒ How should I conduct a sustainable evaluation (i.e., tiered vs. rules of thumb vs. detailed)?
- ❒ How do you measure units of sustainable parameters such as greenhouse gases, net environmental benefit, and risk?
- ❒ How do I account for regional differences as there may be different sustainability issues in different regions (e.g., water scarcity, PM10, ozone nonattainment area)?

Drivers for Achieving Vision

- ❒ Technical resources
- ❒ Training
- ❒ Technical guidance
- ❒ Regulatory guidance
- ❒ Education

Chapter 6: Application of Sustainable Principles, Practices, and Metrics to Remediation Projects

Participants in this breakout group noted that no one project is a full "case study." Rather, the chapter is considered a case study with individual projects and sites as examples of sustainable remediation approaches. The group noted that little information and details are provided for the examples in the white paper. To address this concern, the group suggested the following approaches:

- ❒ Use the SURF web site as a forum for feedback, with chapter facilitators taking the administrator role, SURF members serving as moderators, and the general public able to post questions.
- ❒ Post PDFs of abstracts and papers detailing examples in white paper on SURF web site.
- ❒ Use site conceptual models, chronology, sustainability matrix.
- ❒ Use the SURF web site as a repository for all case studies, even those not included in the white paper. (The breakout group did not have consensus on this point.)

During the discussion, the breakout group discussed the fact that there are spatial gaps in the case study examples presented in the white paper (e.g., no USEPA Region 5 example). They noted that, to date, there has been no peer review of the case study examples and wondered if it is worth SURF's time to show "the full picture" of sustainable remediation in the U.S. To close the spatial gap, the group suggested that SURF members share their case study examples at conferences and seminars by serving on panels and participating in sessions about sustainable remediation. In addition, one member of the group thought that the green remediation database of the Federal Remediation Technology Roundtable (FRTR) could be useful, but it was unclear if non-DOD practitioners could access the database. The group agreed that, going forward, it would be important to continue to communicate with SURF UK, ASTM, and ITRC.

Chapter 7: Conclusions and Recommendations

This breakout group discussed the possible pushback that SURF may receive as a result of the actions recommended in the white paper. In order to be prepared, this group discussed the need for outreach tools. The group discussed potential reactions, including those regarding risk (i.e., voluntary vs. involuntary, real vs. hypothetical, and holistic vs. site-specific). The group also discussed the need for additional case studies to combat these reactions and other misperceptions (e.g., sustainable remediation is a way to avoid remediation).

Attachment 13
Next Big "Stake in the Ground" Breakout Session

The "What's Next for SURF Survey"

Gathered barriers and constraints from the White Paper

Surveyed SURF membership on 3 aspects:

- Our willingness to commit
- Importance to our organizations
- Already resolved? (not enough info to use)

The Survey's Issues

	How much are you willing to commit to addressing this issue?	How important is this issue for your organization...?
	Rank by "A Great Deal"	Rank by "Very Important"
Develop an understanding of the Cost-Benefit of sustainable remedies vs other societal risks/goals.	6	3
Develop a strategy for overcoming a reluctance to use a new process for remedy selection.	11	8
Develop an effective Sustainable Remediation education program.	8	10
Develop an effective Sustainable Remediation communications/outreach program.	10	9
Develop a common definition of Sustainable Remediation.	6	7
Develop a common set of sustainability metrics that can be used to assess and monitor the degree of sustainability.	1	1
Develop a regulatory consensus on how to integrate metrics and the to-be-developed sustainability framework into the current regulatory structure.	3	2
Develop technical guidance around Sustainable Remediation.	2	5
Develop a common and accepted set of tools to identify impacts in a Sustainable Remediation scenario.	4	5
Develop a way to compile, compare, and evaluate possible sustainable procedures and approaches.	4	3
Develop an organization that provides stewardship around Sustainable Remediation.	8	10

Dave's Three Questions

How will SURF communicate what we have learned and will learn?

How will SURF participate in developing and implementing appropriate standards and metrics across our industry?

How will SURF help society develop its consensus on the value for sustainability relative to the other values used for making remediation decisions?

Question 1
How will SURF communicate what we have learned and what we will learn?

Deliver Information

- White paper
- Web site with updates
- Conferences, seminars, expert panels
- Third-party advertisements, press releases, Air Force Center for Engineering and the Environment (AFCEE) Tech Notes, USEPA CLU-In web site, *Environmental Science & Technology*, etc. (link third parties to web site)

Provide Training

- Webinars (ITRC, CLU-In)
- Guidance documents

Education and Outreach

- Meetings (professional societies, Battelle, etc.)
- Expand membership
- Wiki
- Discussion forum (e.g., SURF and *Remediation Journal*)

Other Discussion Topics/Issues

- Keep in mind funding and what can we afford to do.
- Coordinate with Brownfield efforts and other sustainability groups and environmental justice concerns.

Question 2
How will SURF participate in developing and implementing appropriate standards and metrics across our industry?

Group Position

- Author papers that provide definitions and/or propose metrics, and suggest what we think the metrics should look like. Be a leader and "idea guy" and "brain trust."
- Develop an effective mechanism to distribute papers and other documents that SURF creates.
- Make a business case decision as a group what role SURF should assume:
  - Integrator: Put out tool and information ourselves ($$$$)
  - Facilitator: Use ASTM Leadership Council as role model ($$$)
  - Interpreter: Act as a link between groups (medium to low cost: $$)
  - Organized Infiltrator: Participate in work of other groups and help coalesce the work (low cost: $)
- Determine funding mechanism for SURF. (The funding will influence our role and level of effort.)
- Invite representatives from the ITRC, ASTM, and Association of State and Territorial Solid Waste Management Officials (ASTSWMO) to the next SURF meeting to facilitate dialogue.

Supporting Notes

1. Identify organizations or individuals that play a role so we know what others are doing and avoid duplication. Potential organizations are as follows: ASTM, ITRC, Federal Remediation Technologies Roundtable (FRTR), Green Cleanup Standards Workgroup, American Petroleum Institute (API), American Society of Civil Engineers (ASCE), ACE, U.S. Green Building Council, National Institute of Standards and Technology (NIST), and WHC.
   - Identify the roles of these organizations (i.e., authors vs. reviewers, do they draft ideas?).
   - Figure out how SURF can complement what others are doing.
2. Determine if other groups are developing or have standards and metrics. Chicken and egg dilemma: Do the standards come first? Do the metrics come first? What spawns what?
3. Identify the stakeholders that could and should be brought into the process.
4. Envision SURF as the "brain trust" or "idea guy." Identify our niche as feeding ideas/metrics into the industry, developing metrics, and developing guidance.
5. Determine if SURF should be the ringleader to facilitate coordination of all other groups.
6. Determine if International Standards (ISO) exist that SURF can use as a starting point.
7. Determine the role of SURF.
   a. Serve as a facilitator. Evaluate if the RBCA Leadership Council could be our model. Leadership Council acted as facilitator to bring interested groups together in a conference type setting (i.e., to bring people under the tent, facilitate the technology transfer between parties, and use workshops and technology transfer opportunities).

   b. Serve as an integrator. Transition from an ad hoc group to a formal group and brand ourselves to strongly influence the development of standards and metrics. Act as experts in sustainable remediation. Continue to set the bar high. Identify characteristics of a good metric and a good standard and feed it into the other groups that are working on this issue.
   c. Serve as infiltrator. Participate in the work of other groups and help coalesce the work.
8. Regardless of role, must consider the significant downside (i.e., numerous guidance documents and tools, conflicting guidance documents, onerous standard) if SURF does not take an active role and as a facilitator or an integrator (see below). Decide which role gets us to the desired endpoint fastest. Ensure that SURF has a seat at the table with other stakeholders at a minimum.
9. Consider starting at the interpreter role and progressing and growing to an integrator or facilitator. Take steps in the direction we want to go. Money will play a big role.
10. Determine how much money and resources we can and will expend.
11. Identify a product like the white paper that can be provided to ASTM. Identify the methodology, framework, definitions, metrics, and sustainable Best Management Practices that SURF supports and recommends. Generate discussion and start dialogue. (Audience could be the ASTM and ITRC, and the purpose of the paper would be to frame future dialogue and discussion.)
12. On a parallel path to writing a paper with metrics, definitions, conversion factors, etc., develop a paper outlining the issues our industry faces surrounding sustainable remediation. Identify the good, the bad, and the ugly. Share with the rest of the world. Implement both efforts (#11 and #12) to advance our case and not wait to dispute issues later.
13. To influence ASTM and open dialogue, take the position of providing ASTM with our thoughts and advice on the SURF view of the guidance, process, and standard (qualitative vs. quantitative) to consider in development of a framework.
14. Decide if SURF will play an active or passive role in standards development. For example, acting in advisory role to the group developing the standard, generally supporting the development of a standard, or giving advice to shape the standard development.
15. Decide how much of the remediation process is included in the sustainable remediation component. Decide what SURF's position is on the scalability question.
16. Compile the conversion factors and constants that others are using to move toward metrics. Share with everyone.

Finally, a question arose on whether we need SURF now that the ITRC and ASTM have entered the discussion. Consensus was that as long as SURF contributes, the group has value. SURF is first out of the gate with tools and definitions and is asking the harder questions (e.g., what is risk?, whose risk?, do we need to trade impacts between soil, water, and air in making remediation decisions?).

Question 3
How will SURF help society develop a consensus on the value of sustainability relative to the other values used for making remedial decisions?

Challenges

1. How do people value sustainability?
    - Value differs among different stakeholders and societies around the world.
    - Value depends on the definition of sustainability.
    - Problem owners do not understand or might not be willing to make a trade off.
    - Sustainability already plays a role in the every day lives of stakeholders.
2. Where do sustainability values fit in with other values?
    - Should sustainability be integrated into the other CERCLA criteria?
    - If sustainability forms part of other criteria, this value should be more explicit.
    - Sustainability may play a different role for different types of remedial project (e.g., RCRA, Superfund, brownfields, underground storage tanks).

How can SURF help society develop a consensus?

1. Define what sustainability means to us and other stakeholders (e.g. the local community).
2. Sustain sustainable remediation thinking within SURF and outside of SURF.
3. Sustain current SURF momentum.
    - Ensure continued participation from regulators, industry, and academia.
    - Ensure on-going support from SURF members during SURF's next steps.
    - Maintain level of effort.
4. Offer incentives (e.g., SURF awards) that could be funded by the USEPA in a program similar to the Climate Leaders Program.
    - Best project
    - Best publication
    - Best regulator
    - Scholarships for students
    - Grants for sustainable remediation projects
5. Offer a sustainable remediation program in colleges (e.g., as part of a geology or engineering degree or by funding academic research).
6. Start a sustainable remediation professional society.
7. Host an annual sustainable remediation conference.
8. Organize community events to encourage community buy-in and set an example to others (e.g., planners, developers). (We are currently acting as implementers and know from experience what works and what doesn't.)
9. Help define regulations. For example, SURF should provide input to future sustainable remediation regulations if such regulations are proposed.

10. Promote sustainability values within our own organizations or companies to help eventually push sustainability values up and down the supply chain.
11. Identity and partner with other key organizations (e.g., Chamber of Commerce, National Association of Manufacturers).
12. Reach out to other societies whose main focus is not remediation (e.g., U.S. Green Building Council).
13. Involve the media (e.g., National Geographic, Time Magazine, National Brownfield Association, U.S. Green Building Council).
14. Produce marketing material (e.g., through a video, the SURF web site, a Wiki).
15. Develop standard metrics, data analysis programs, and other tools.
16. Create a professional directory with listings of people/companies with particular experience.

SURF will not

- ❒ Produce the same outputs as ITRC
- ❒ Develop standards

Priorities

1. Sustain the sustainable remediation thinking.
2. Define "What does sustainability mean to me" (to ourselves and to different stakeholders).
3. Identify outreach strategies that will provide SURF with the greatest bang for our buck.
4. Spread the word. SURF wishes to take the actions necessary to lead the field – all participation in this movement welcome.
5. Provide leadership through example.
6. Consider monetary incentives.