

Sustainable Remediation Forum (SURF)

SURF 15: October 5 and 6, 2010

Pittsburgh, Pennsylvania

SURF 15 was held in Pittsburgh, Pennsylvania, on October 5 and 6, 2010, at Carnegie Mellon University. SURF members that participated in the two-day meeting are listed in Attachment 1 along with their contact information. The meeting marked the 15th 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.sustainableremediation.org.

Meeting Opening

The meeting began with Mike Rominger (meeting facilitator) welcoming members and thanking The Steinbrenner Institute for Environmental Education and Research at Carnegie Mellon University for hosting the meeting. Mike presented the mission statement of SURF and discussed meeting logistics and ground rules. He also explained evacuation procedures from the meeting areas to ensure a safe meeting experience for all. Mike stated that it was assumed that nothing discussed or presented contained confidential information. He explained that export control laws that pertain to the transfer of technology to non-U.S. citizens and their countries do not appear to apply, but advised participants to act appropriately for their organizations. Mike also mentioned antitrust issues.

Efforts to achieve “sustainable neutral environmental behavior” continued at this meeting. Name tags and tent cards were reused. Many participants brought their own coffee mugs and water bottles and used public transportation to travel to the meeting location. Some participants reduced the carbon footprint caused by their travel by purchasing carbon offsets. Efforts to achieve sustainable neutral behavior are ongoing and will continue at future meetings.

Mike thanked the Meeting Design Team for their work in planning the meeting agenda and the current SURF sponsors for supporting the organization. Members interested in sponsorship opportunities should contact Brandt Butler, SURF Treasurer (see Attachment 1 for contact information).

Host Welcome

Dave Ellis (SURF President) welcomed participants and again thanked The Steinbrenner Institute for Environmental Education and Research at Carnegie Mellon University for hosting SURF 15. Dave Dzombak, Faculty Director of the Steinbrenner Institute, welcomed participants to the university’s campus and Pittsburgh. Dave gave a brief history of the university and its continuing tradition of engineering and fine arts. He highlighted the work of the Green Practices Committee of the Steinbrenner Institute, which works to implement environmentally progressive practices on campus. Participants could see one of the committee’s achievements—the Bellfield boiler plant—out of the meeting room window. The plant was built in 1907 to provide steam heat to the Carnegie Museum and historically burned coal and natural gas. Coal-burning operations were replaced by natural gas in 2009, and the plant currently pumps heat to most of the major buildings in the area.

Keynote Speaker

Deborah Lange, Executive Director of the Steinbrenner Institute for Environmental Education and Research and Director of the Western Pennsylvania Brownfields Center, gave an overview of the Pennsylvania Land Recycling Program, presented sustainable brownfield case studies in Pittsburgh, and shared the lessons learned from these projects. Deborah said that the overall goal of the Pennsylvania Land Recycling Program is to encourage the return of brownfield sites into productive use. She listed the four cornerstones of the program: uniform cleanup standards, standardized reviews with time limits, relief from liability, and financial assistance to encourage Phase I and II assessments. Deborah presented the three remediation approaches possible in Pennsylvania and told participants that the state agency does not dictate which approach must be used. As a result, remediation primarily is conducted using site-specific standards and a risk-based approach. Deborah said that many brownfields on the Pittsburgh riverfront have been developed, but neighborhood brownfields remain undeveloped. She said that re-developing neighborhood brownfields is a long, political process because the sites are sometimes the only assets of the surrounding communities. Deborah presented examples of sustainable and less sustainable brownfield re-development. She shared the lessons learned from some of the projects, recommending parking garages vs. surface parking lots, access to the water for sites along the river, and commitment from an anchor tenant to show people that the re-development is viable. Deborah also discussed the lateral economic impact of re-developments. When new stores or a new movie theatre are built as part of a brownfield re-development project, “Mom-and-Pop” Main Street stores within a 10-mile radius are affected negatively. This, in turn, affects the economic viability of these neighborhoods. Presentation slides are provided in Attachment 2.

Discussions focused on the economic and social impacts of re-development and the relationship between developers and the community. One participant from the Pittsburgh area cited the lateral economic impact of the waterfront re-development presented by Deborah, mentioning that local stores in neighboring communities closed because of decreased business. Another participant mentioned the importance of including the local community on a business level rather than as shop workers and stressed the need to support local businesses where they are currently located. Additional discussions involved the idea of using global sustainability as a greater framework for planning and developing to avoid lateral economic impact. Deborah responded that, although data may exist from public or private sources, there does not seem to be a systematic way of addressing the lateral economic impact issue. One participant suggested that third-party organizations (e.g., universities, nonprofit organizations) participate in the discussions with communities and serve as partners in the discussion. Other participants discussed the disconnected relationship between developers and the community. Deborah said that workshops help engage developers sooner rather than later and allow the developers to be brought into the process as a friendly partner vs. an adversary.

Board of Trustees Activity Update

Dave Ellis (SURF President) provided the following summary of the Board’s activities since the last meeting:

- ❑ The Technical Initiatives Committee is developing a formal process for the peer review of SURF documents.

- ❑ SURF meeting notes will be reviewed by members of the Meeting Design Team before publication on the web site.
- ❑ The Board of Trustees authorized the Sustainable Remediation Site Database project in a phased approach. (More about this project is provided on page 6 of these notes.)
- ❑ The Communications and Outreach Committee has developed a SURF communications policy. The Board of Trustees is currently reviewing the draft policy.
- ❑ The Programs and Meetings Committee has set the following dates for the 2011 SURF meetings:
 - SURF 16: February 3rd and 4th – University of South Florida (Tampa, Florida)
 - SURF 17: May 17th and 18th – Chicago-Kent College of Law (Chicago, Illinois)
 - SURF 18: September 21st and 22nd – Boeing Corporation (Seattle, Washington)
- ❑ The Board of Trustees is working on a draft set of goals for next year. This topic will be discussed later in the meeting.
- ❑ SURF members continue to work with Battelle on the sustainable remediation track that will be part of the International Symposium on Bioremediation and Sustainable Environmental Technologies on June 27-30, 2011 in Reno, Nevada.
- ❑ The current membership of SURF is approximately 130.

Paul Favara (SURF Vice President) provided a Treasurer's report detailing the current financial status of SURF (see Attachment 3).

Dick Raymond (Board of Trustees, Member At-Large) reviewed the current election process for positions on the Board of Trustees. To summarize, members can nominate themselves or other members for specific positions in December 2010, the election will be held in January 2011, and the new Board of Trustees will be installed at the next meeting in February. Based on a show of hands, the majority of SURF members were concerned that the current nominating process does not consider leadership continuity issues (i.e., all Board of Trustee members serve a nonstaggered, one-year term). Dick listed potential solutions (see Attachment 4) and conducted yes/no votes by a show of hands to gauge the opinions of meeting participants. Dick agreed to distribute a survey asking the entire membership to vote on these ideas. Then, the nomination process would occur in December and the election would occur next year (i.e., 2011). One participant suggested adding the option of extending the Treasurer position to a two-year term. Another participant requested that the survey allow members to vote for more than one item as a combination of approaches may be preferred. Presentation slides are provided in Attachment 4.

As a reminder, detailed minutes from the Board of Trustees conference calls are available to members at the SURF web site in the members-only portion under "Member Resources," "Documents," "Administrative Documents."

Procedure for Reviewing Technical Initiative Work Products

Paul Favara (SURF Vice President) presented the draft procedure for reviewing technical initiative work products like the documents currently being developed by the Framework Initiative, Parameters and Metrics Initiative, and LCA Process Initiative. The Board of Trustees is currently reviewing the draft procedure, which is provided in Attachment 5. The following action items were suggested during the larger group discussion after Paul's presentation:

- ☐ Integrate regulatory and academic review into the proposed review process.
- ☐ Place critical comments on the front page of the document being reviewed so that the individual processing comments is aware of most important comments to be considered.
- ☐ Strive for consistency of style among documents, but also strive for consistency of presentation by reusing figures.
- ☐ Identify and use three or four figures that tie all of the documents together.
- ☐ Develop a standard way of determining authorship for SURF documents.

SURF members should contact Paul directly (see Attachment 1 for contact information) if they would like to participate on the Technical Initiative Review Team.

2011 Goals

Dave Ellis (SURF President) reviewed the draft listing of the 2011 goals for SURF developed by the Board of Trustees and asked for feedback (see Attachment 6). During the discussion, it was agreed that the list of goals would be distributed to SURF members, and members would be asked to rank the goals in order of preference. Comment boxes would be provided for each response. In addition to this agreed upon action item, the following action items were suggested during the group discussion:

- ☐ Consider discussing the ideas of certification and a research foundation during breakout sessions at the next SURF meeting.
- ☐ Consider partnering with other nonprofit organizations (e.g., Air and Waste Management Association) to help increase membership.
- ☐ Develop a sustainable rating for the professional as well as the project, and follow LEED's [Leadership in Energy & Environmental Design's] example.
- ☐ Consider the question: How does increasing membership grow our goals as an organization?
- ☐ Develop value proposition more clearly. (Scott Saroff will e-mail Dave Ellis with suggestions of people to contact to help develop value proposition.)
- ☐ Determine milestones for each goal, and show progress on web site through graphs.
- ☐ Step up and volunteer!

SURF Activities Update

SURF members continue to work on initiatives that will further the mission of the organization. A portion of the SURF 15 meeting was devoted to updating members on the current status of

these activities and obtaining member feedback on possible next steps. The presentations and subsequent discussions are summarized in the paragraphs below. Attachments 7 and 8 contain the presentation slides.

Government Outreach: Engaging on Sustainable Remediation Sticking Points

Carol Baker (Board of Trustees, Member At-Large) showed participants the latest draft of a presentation designed to initiate dialog between SURF members and regulatory agency personnel with the goal of coming together and moving sustainable remediation forward. The presentation was developed by the Government Employees Outreach Initiative, which is a subcommittee under the Communications and Outreach Committee. Carol gave a brief overview of the initiative and its goals, which have been highlighted in past meeting notes. To spur open discussion with regulators, the presentation highlights the sticking points (i.e., differences) between green and sustainable remediation. Carol said that SURF members would travel to government employee offices to make the presentation and start the dialog. She said that the presentation is a starting point and welcomed input from members. Presentation slides are provided in Attachment 7.

After Carol's presentation, participants discussed the draft presentation and suggested the following improvements and approaches:

- ☐ Include case studies involving environmental justice, brownfields, and current pilot projects that include regulator involvement.
- ☐ Reach out to politicians to inform them (i.e., not lobby) of sustainable remediation and perhaps use the Whitman Group to make connections.
- ☐ Make sure that all appropriate groups in the U.S. Environmental Protection Agency (USEPA) are involved (e.g., native American group, community relations).
- ☐ Consider engaging the political process through Executive Orders rather than legislation.
- ☐ Mention the Navy Fact Sheet, U.S. Army Corps of Engineers guidance, etc., in the presentation.
- ☐ Identify obstacles faced by regulatory project teams.
- ☐ As tools are developed, obtain regulator input by requesting their peer review.
- ☐ Build upon what the agency is doing and agree to disagree on sticking points.
- ☐ Identify social and economic considerations that are sticking points and find the USEPA guidance documents that support those positions.
- ☐ Keep in mind that the presentation is a good tool for states that are trying to catch up with the USEPA.

Carol thanked meeting participants for their input and said that the presentation is located on the web site for review. Members should forward comments and additional case studies to Carol.

SURF Sustainable Remediation Site Database Project: Next Steps

Steven Murawski (Baker & McKenzie) presented a brief background of the sustainable remediation site database that was first discussed at SURF 13 (see past meeting notes for details). The goal of the project is to create a searchable resource for sustainable remediation projects throughout the U.S. The database would contain technical information, legal information, and policy-based information for each project. Steven stated the following objectives of the database:

- ☐ Encourage the government and members of the public to more commonly consider and use sustainable remediation solutions.
- ☐ Provide a data resource for remediation practitioners.
- ☐ Implement one of SURF's goals.
- ☐ Improve SURF's organizational reputation.
- ☐ Attract more professional and academic members to SURF.

Steven said that a proposal was submitted to the Board of Trustees and the Board agreed to move forward with the project in a phased approach. Steven told participants that he is creating a special committee composed of SURF members to evaluate the project and develop a plan for implementation. Future activities involve researching implementation areas (i.e., funding sources, database criteria development, information and content collection, data entry and management options), reporting back to the SURF Board of Trustees, and completing a written plan. Steven said that the goal is to have a plan in place for the Board's consideration well before the next meeting so that if the project moves forward, it can be discussed during SURF 16. Steven asked volunteers to give him their business cards or contact him via e-mail (see Attachment 8 for presentation slides and e-mail address).

Discussions focused on ideas for the database. One participant suggested adding criteria to assess whether a project is sustainable and should be input into the database. Steven responded that his current thinking is to start with USEPA projects that are described on the Internet as sustainable, making sure to show all aspects of sustainability. After information is integrated into a database, Steven said that an auditing protocol could be built based on database information. He also mentioned that the database would focus on only publicly available information.

Discussions concluded with participants agreeing that, collectively, there are many sustainable remediation projects to include. Steven emphasized the importance of obtaining input from every SURF committee when developing the plan that will be submitted to the Board.

Breakout Sessions and Report-Backs

At the meeting, the following groups met: Academic Outreach Initiative, Government Employees Outreach Initiative, and the Technical Initiatives Committee. The Technical Initiatives Committee includes the Framework, Parameters and Metrics, and Life Cycle Assessment (LCA) Process Initiatives. A representative from each group reported back to meeting participants, with the goal of highlighting major efforts and obtaining feedback from the larger group. A summary of the key action items of the groups is provided below.

Mike Rominger reminded participants of the mission, purpose, and objective for each group (see Attachment 9). SURF members interested in joining a particular effort should contact the chairperson mentioned in the summaries below.

Academic Outreach and Government Employees Outreach Initiatives

The Academic Outreach and Government Employees Outreach Initiatives fall under the purview of the Communications and Outreach Committee. Key action items stemming from the breakout discussions of these groups are provided below.

☐ Academic Outreach Initiative

Mike Miller (Initiative Chairperson) summarized the discussions of this breakout session group and listed the following action items that were developed by initiative members:

- **Sustainable Remediation Research Needs**
Initiative members discussed developing a list of research needs in the field of sustainable remediation, and possibly turning it into a statement of need so that researchers have guidance from practitioners in SURF. As a first step, the group plans on holding a brainstorming session at the next SURF meeting to get ideas from the larger SURF organization. Then, the initiative members will review the brainstorming list of research needs and sort, categorize, and summarize them. Finally, the group will prepare a white paper that contains a description of each research need.
- **SURF Presentation for Academic Audiences**
Initiative members discussed developing a presentation for academic audiences that includes case studies and integrates information from the main SURF presentation and academic brochure. SURF members would have an opportunity to provide constructive criticism on the presentation. This presentation would be used by the group to educate professional organizations (e.g., Association of Environmental and Engineering Science Professionals) and academic researchers/departments about SURF and to generate interest in the organization and its efforts.
- **Ongoing Activities**
 - Initiative members and other SURF members continue to recruit academics for participation in SURF meetings. When contacting academics, individuals should ask academics to reach out to colleagues who specialize in economic and social issues to attend and/or present at SURF.
 - Mike reminded members to complete the survey requesting academic contact information. After the information is received, the contact names will be distributed to SURF members and members can sign up to reach out to specific academics. The survey is located on the SURF web site under “Discussion Forum.”

☐ Government Employees Outreach Initiative

Carol Baker (Initiative Chairperson) summarized the discussions of this breakout

session group and listed the following action items that were developed by initiative members:

- **Sustainable Remediation Government Outreach Presentation**
Initiative members discussed integrating the comments obtained from SURF 15 participants into the current draft presentation and submitting a revised draft for Board of Trustees approval. The group agreed that it would be important to piggyback government employee outreach presentations with the 2011 SURF meetings to increase government employee participation.

Consistency and tracking issues were also discussed during the breakout session. Initiative members will write an outreach letter to be used by SURF members to ensure that a consistent message is being conveyed. During Carol's breakout session report-back, one meeting participant suggested providing training to SURF members before presentations are made as another way to ensure message consistency. Carol agreed. Initiative members also discussed the importance of developing or identifying a mechanism to track the government outreach presentations being made to avoid duplication of effort.

Finally, initiative members agreed upon a 2011 goal of making presentations at five government employee meetings [e.g., Interstate Technology & Regulatory Council (ITRC), Association of State and Territorial Solid Waste Management Officials (ASTSWMO)] and 10 state regulatory offices. Carol encouraged interested participants to contact state regulatory representatives that they know and become involved in this process. SURF members contacting government employees as part of this outreach effort should inform Carol Baker of plans to ensure a coordinated and consistent effort.

- **SURF-Government Employee Case Study**
Initiative members discussed the possibility of conducting a case study with government employees (particularly regulators) as a way to increase the credibility of SURF and sustainable remediation in general.
- **Participation in Specific Conferences**
During Carol's breakout session report-back, one participant suggested targeting conferences and/or workshops with a large amount of government employee participation. With that in mind, initiative members were encouraged to consider participating in the Sixth Annual Conference on Design and Construction Issues at Hazardous Waste Sites on April 13-15, 2011 in Philadelphia, Pennsylvania. The conference is sponsored by the USEPA and the U.S. Army Corps of Engineers.

Technical Initiatives Committee

The technical initiatives addressing Framework, Parameters and Metrics, and the LCA Process are included under the Technical Initiatives Committee. Key action items stemming from the breakout discussions of these groups are provided below.

❑ Framework

Karin Holland (Initiative Chairperson) summarized the discussions of this breakout session group, which involved finalizing the framework document that currently is in draft form. SURF members can access the draft document at the SURF web site in the members-only portion under “Member Resources,” “Collaboration Area,” “Technical Initiatives,” “Framework.” Karin outlined the content of the document and presented the key figures. One participant asked how this framework fits with other frameworks. Karin responded that this framework complements other frameworks (e.g., ASTM framework) and is more conceptual in nature. Initiative members identified the following next steps on the road to publication:

- Initiative members should provide comments on the existing draft document to Karin by the end of October 2010.
- Karin will integrate comments into a revised draft, which will be distributed to initiative members and three Board of Trustees members.
- Karin will integrate most recent comments into the document and issue a new draft document for peer review by Thanksgiving. The technical review process developed by the Board of Trustees and described on page 4 of these notes will be used to identify peer reviewers.

At the end of the report-back, Karin emphasized the importance of a consistent message between all of the technical documents being created. Meeting participants agreed.

❑ Parameters and Metrics

Lorraine Larson-Hallock (Initiative Member) stepped in for Brandt Butler (Initiative Chairperson) and summarized the metrics document that the group is preparing. She said that the group envisions the metrics document as being the bridge between the conceptual (i.e., framework document) and the application (i.e., LCA process that manipulates metrics). The framework document could mention how metrics fit in, with the metrics group creating a tool of information. The following action items were developed by initiative members:

- Refine draft document.
- Review LCA document and integrate appropriate information into metrics document.
- Upgrade format with drill-down options (vs. straight listing of information).
- Partner with university to develop the architecture of the document.

❑ LCA Process

Paul Favara (Initiative Chairperson) discussed the guidance document that initiative members are developing that aims to create a standard approach for implementing LCAs for remediation projects. Initiative members agreed that additional work is needed on the step involving the functional unit, which emphasizes one-to-one comparisons. The group is revising the document and hopes to submit it to the internal review team of SURF (pending Board approval of the technical review process described on page 4 of these notes). The goal is to share the document with

the ITRC and ASTM in November 2010. After Paul's breakout session report-back, meeting participants expressed an interest in following the LCA process detailed in the document. Paul told participants that he would share the process with SURF members. After the meeting, Paul invited all SURF members via e-mail to participate on the Technical Initiative Review Team that will be reviewing the LCA guidance document.

Technical Presentations

Technical presentations at SURF 15 revolved around the meeting theme of building bridges among stakeholders, with an emphasis on covering all three aspects of the triple bottom line (i.e., economic, social, and environmental). The presentations and subsequent discussions are summarized in the paragraphs below. Attachments 10 through 13 contain the presentation slides.

Green Chemistry and the Design of Green Oxidation Catalysts

Colin Horwitz (GreenOx Catalysts, Inc.) presented an overview of green chemistry and catalysts, detailing the design of a specific green oxidation catalyst developed by Carnegie Mellon University. Colin defined green chemistry as the "pursuit of products and processes that reduce or eliminate hazard" and said that catalysts are used as a tool in green chemistry to accelerate chemical reactions. TAML[®] [tetramido macrocyclic ligand] activators have been developed that detoxify hazardous chemicals using green oxidation catalysts. These catalysts do not contain toxic elements and use natural oxidants to destroy everyday pollutants (e.g., bisphenol A) that disrupt normal cellular development. At the end of his presentation, Colin asked participants the following question to spur discussion: "How can catalysis, a driver for chemical sustainability, be adapted and adopted for sustainable remediation?" Presentation slides are provided in Attachment 10.

Discussions after the presentation focused primarily on potential unintended products of catalysts and their ability to biodegrade. Colin acknowledged the challenge of generating unintended products when working with catalysts. He said that the most sensitive tests are selected when evaluating toxicity and noted that toxicity is continually evaluated during testing. In addition, Colin said that the reaction can be stopped halfway through the process to observe and evaluate unintended consequences.

Water Usage and Management During Hydraulic Fracturing of Shale

Kelvin Gregory (Carnegie Mellon University) presented the issues of water usage and water management during the hydraulic fracturing of shale. First, Kelvin provided an overview of the hydraulic fracturing technology being used to create new fractures in shale as a means of achieving the permeability required to produce gas in commercial quantities. Historically shale gas has been produced in small volumes using natural fractures in rock, but these small fractures are insufficient for the commercial production of natural gas. Kelvin focused his presentation on the high-pressure water that fractures the formation and increases the formation porosity. The water used for hydraulic fracturing is primarily composed of water and sand. Following fracture, some of this water returns to the surface as "flowback" water. Initial flow rates are high and total dissolved solid concentrations are low. As the formation depressurizes, flow rates decrease. Because the water has been in contact with formation solids for a longer time, total dissolved solid concentrations increase. Kelvin presented the typical constituents present in flowback

water, noting that concentrations of total dissolved solids, strontium, and barium pose the biggest challenges. He said that hydraulic fracturing with recycled flowback water is emerging as a viable management option vs. more conventional options. Carnegie Mellon University is researching the use of abandoned mine drainage water as makeup water during hydraulic fracturing. The drainage water is used as a reagent and combined with dilution water to remove divalent cations that may precipitate in the formation. Kelvin ended his presentation by listing the challenges associated with water usage and management during hydraulic fracturing. Presentation slides are provided in Attachment 11.

After the presentation, participants discussed radioactivity, the potential regulatory issues associated with the use of abandoned mine drainage water, and the potential risks of hydraulic fracturing. Although no radioactive constituents were detected in the results presented, one participant noted that radioactivity is a concern when scaling in the pipes includes radioactive precipitates. When asked about potential issues associated with the use of abandoned mine drainage water, Kelvin said that local stakeholders think its use solves two problems at once: improving the environment and serving as a viable option for makeup water. One participant asked about how the fracturing process is controlled. Although Kelvin could not speak to that topic directly, he told participants that potential risks occur when the fractures come into contact with a potable water source. As a result, the real risk to shallow potable water involves the integrity of the casing and, therefore, whether casings are sufficiently regulated at this time.

Sustainable Water Management

John Smith (Alcoa, Inc.) defined sustainable water management for participants and presented examples to help illustrate the sustainable water management efforts being performed by Alcoa. Sustainable water management can be defined simply as managing water resources while taking into account the needs of present and future users. John described the present and future water challenges that impede this goal and presented the concept of rainwater harvesting moving towards zero water discharge. The main driver for zero water discharge is that both current and future regulations continue to get increasingly stringent, with permitted levels in the low parts per billion (ppb) and parts per trillion (ppt). This was the case where an Alcoa plant had to meet nondetectable polychlorinated biphenyls (PCBs) in the main permitted outfall. At this plant, an innovative enhanced natural media filtration process was developed and deployed as a polishing step. The process has been in operation for three years and treats 130 to 150 million gallons per year of combined storm runoff and treated process wastewater with no discharge violations. John also presented another case study at an Alcoa location that involved replacing a tank-based sanitary wastewater treatment system with constructed wetlands for treatment and a media cell for polishing and disinfection. John said that the system was approved by the regulatory agency and has been operating for 1½ years with 100% compliance. He also said that the overall system represents significant capital and operations and maintenance cost savings compared to a conventional tank-based approach. Presentation slides are provided in Attachment 12.

Discussions focused on getting both practitioners and regulators comfortable with more natural-based wastewater treatment systems. Resistance generally stems from people being risk adverse and wanting assurance of 100% compliance.

Models of Deliberative Democracy: Mechanisms for Citizen Input

Robert Cavalier (Carnegie Mellon University) presented the concept of deliberative democracy and described how this concept can be used as a mechanism to both interact with the public and educate the public. Robert told participants that the idea of deliberative democracy has been around since the 1980s. He presented two models of democracy. The first model is “a thin, liberal democracy” that is vote-centric and leads to electoral battlefields where framing and media marketing lead the way. The second model is a “strong, liberal democracy” that is “talk-centric” and ideally allows for informed, well structured conversations as a means to garner public opinion and influence political debate.

Proponents of deliberative democracy use a number of tools; deliberative polls are a tool used to ensure the representation of all involved. The basic protocols of a deliberative poll, trademarked by Jim Fishkin, involve the following:

1. A scientifically random sample of the population receives well-vetted background information on the issues.
2. The sampled individuals then gather in small, moderated groups to discuss the topic.
3. The groups formulate questions to be asked during a plenary session with experts.
4. The small groups gather after the plenary session to respond to a scientific survey.

The result of this process reflects what the community as a whole might think about a particular issue or policy if that community had time to become informed about the issue and discuss it amongst themselves and with experts.

Robert presented deliberative poll results on the issue of marriage in America to demonstrate the way deliberative polls can illuminate background issues among parties, promote an environment that brings out the best in individuals, and provide an incentive to overcome “rational ignorance.” Robert presented another example involving the Hilltop area in Pittsburgh, Pennsylvania where the population was declining, drug activities were on the rise, and abandoned houses were becoming prevalent. Over 100 citizens from the nine neighborhoods comprising this area participated in a one-day community conversation. As a result of this event, the Hilltop Alliance was formed. Today, the community continues to engage in deliberative practices (e.g., learning circles, action forums). The experience has been positive and stands in sharp contrast to the often contentious but more typical town hall meetings. Presentation slides are provided in Attachment 13.

Discussions focused on the information used in the polls, the different types of deliberative democracy models, and the application of these models to sustainable remediation efforts. One participant asked Robert how the information used in deliberative polling is developed so that it is neutral and unbiased. Robert acknowledged that remaining neutral is a challenge, but stressed that the document development team spends a lot of time listening to the people at community meetings to get a sense of the issues. Then, the team has small meetings with key players and continues to listen. As the document takes shape, more people are invited around the table and a realistic view of the challenges emerges. Robert said that the document is not intended to stand alone—it is always used in the context of a deliberative event. In response to another question, Robert said that there are about nine models of deliberative democracy that can be mixed and matched for groups with multiple stakeholders. Another participant questioned the application of these models to sustainable remediation efforts, which involve working with multiple

stakeholders and considering the sometimes competing aspects of the triple bottom line. The participant believed that perception is the biggest challenge to overcome. Robert disagreed and said he believes the solution is in how the problem is framed. He stressed the importance of educating the public and seeking a compromise, noting that the first five pages of the polling document are aimed at orienting the public about what you're doing. One participant noted that deliberative democracy models seem to fit into the framework that SURF is developing by integrating feedback from stakeholders *throughout* the process. Robert said that additional information about deliberative democracy can be found at Carnegie Mellon University's Program for Deliberative Democracy (<http://hss.cmu.edu/pdd>), Everyday Democracy (<http://www.everyday-democracy.org>), and the National Center for Dialog and Deliberation (<http://www.thataway.org>).

Action Items

The following action items were identified during the meeting:

1. Upcoming meetings are scheduled as noted below. Additional details will be posted on the web site. If you are a SURF member and would like to help plan or host an upcoming meeting, contact Mike Rominger (meeting facilitator) (see Attachment 1 for contact information).
 - SURF 16: February 3rd and 4th – University of South Florida (Tampa, Florida)
 - SURF 17: May 17th and 18th – Chicago-Kent College of Law (Chicago, Illinois)
 - SURF 18: September 21st and 22nd – Boeing Corporation (Seattle, Washington)
2. The work of the committees and initiatives will continue. Action items for specific committee and initiative members are detailed throughout these notes and were distributed to chairpersons immediately after the meeting. The following action items apply to the entire SURF membership:
 - The Sustainable Remediation Government Outreach Presentation is located on the web site and in Attachment 7 of these notes for member review. Members should forward comments on the presentation and additional case studies to Carol Baker (see Attachment 1).
 - SURF members are encouraged to contact state regulatory representatives that they know and make presentations on behalf of SURF. Members contacting government employees as part of this outreach effort should inform Carol Baker (see Attachment 1) of plans to ensure a coordinated and consistent effort.
 - SURF members should complete the survey requesting academic contact information. After the information is received, the contact names will be distributed to SURF members and members can sign up to reach out to specific academics. The survey is located on the SURF web site under "Discussion Forum."

- SURF members interested in reviewing the current SURF Technical Initiative documents should have responded to the e-mail that was sent to the entire membership after the meeting.

All scheduled conference calls for the various committees and initiatives are shown on a calendar on the web site. The calendar is located on the members-only portion of the SURF web site under “Member Resources, Committee Calendar.” SURF members interested in joining a particular effort should contact the co-chairperson directly.

3. Volunteers interested in participating in the SURF Sustainable Remediation Site Database Project should contact Steven Murawski via e-mail (see Attachment 1).
4. The Board of Trustees continues to work on behalf of the SURF membership. Specific action items for Board of Trustee members are as follows:
 - Dick Raymond will distribute a survey so that the entire SURF membership can vote on ideas discussed during this meeting (see page 3). The SURF election process will begin in December 2010 with nominations for positions on the Board of Trustees. Voting will occur in January 2011, and election results will be announced at SURF 16 in February 2011.
 - Dave Ellis will distribute a list of possible 2011 goals to SURF members. SURF members will be asked to rank the goals in order of preference. Comment boxes will be provided for each response. Suggestions mentioned at the meeting and listed in detail on page 4 of these notes should be considered.

As a reminder, detailed minutes from the Board of Trustees conference calls are available to members at the SURF web site in the members-only portion under “Member Resources,” “Documents,” “Administrative Documents.”

ATTACHMENTS

Attachment 1
SURF 15 Participant Contact Information

SURF 15 Participant Contact Information

Participant	Affiliation
Abrams, Stewart	Langan Engineering & Environmental Services
Adams, Kathy	Writing Unlimited
Baker, Carol	Chevron Energy Technology Company
Balaria, Ankit	Syracuse University
Beck, Mike	AECOM
Bingman, Tim	DuPont
Blinn, Leah	NGE Consulting
Cavalier, Robert	Carnegie Mellon University, Dept. of Philosophy
Chambers, Deni	Northgate Environmental Management
Chaudhry, Tanwir	Consultant
Cook, James	HDR Engineering
Denson, Scott	Sunpro Services
Dona, Carol	U.S. Army Corps of Engineers
Duplan, Neno	Locus Technologies
Dzombak, Dave	Carnegie Mellon University, Dept. of Civil & Environmental Engineering
Ellis, Dave	DuPont
Favara, Paul	CH2M Hill
Holland, Karin	Haley & Aldrich
Hook, Christopher	Tetra Tech
Horwitz, Colin	GreenOx Catalysts and Carnegie Mellon University, Dept. of Chemistry
Goldstein, Elena	Tetra Tech
Gregory, Kelvin	Carnegie Mellon University, Dept. of Civil & Environmental Engineering
Kluger, Mark	Dajak, LLC
Kretschman, Steve	WSP Environment & Energy
Krieger, Todd	DuPont
Lange, Deborah	Steinbrenner Institute for Environmental Education and Research
Larsen-Hallock, Lorraine	TechLaw Inc.
Lewis, Ray	Sunpro Services
Marotte, Rick	MACTEC Engineering and Consulting
Maughon, Mike	Tetra Tech
McMonagle, Thomas	AECOM
McNally, Amanda	AECOM
Miller, Mike	CDM
Murawski, Steven	Baker & McKenzie
Nakles, Dave	Carnegie Mellon University, Dept. of Civil & Environmental Engineering
Otis, Josh	Northgate Environmental Management
Petrovskis, Erik	Geosyntec Consultants
Rafalko, Leonard	ERM
Raymond, Dick	Terra Systems
Rees, Todd	Golder Associates
Rominger, Mike	MCR Facilitation Services
Saroff, Scott	Michael Baker, Jr.
Senita, Joe	MACTEC Engineering and Consulting
Simon, John	WSP

SURF 15 Participant Contact Information

Participant	Affiliation
Skance, Olivia	Chevron
Smith, John	Alcoa
Taege, Deborah	Boeing Company
Tipton, Karina	Brown and Caldwell
Unrue, David	Microseeps, Inc.
Waldron, Brad	NGE Consulting
Wice, Rick	Shaw Environmental & Infrastructure Group
Winslow, Laurie	Corporate Environmental Solutions
Woodward, Dave	AECOM Environment
Remote Attendees	
Armstead, Robert	WRS Compass
Fisher, Angela	GE Global Research
Garson, Nick	Boeing Company

Attachment 2
Sustainable Brownfields: Learning Our Lessons

Sustainable Brownfields – Learning Our Lessons

Deborah Lange
October 5, 2010
Sustainable Remediation Forum- 15
Carnegie Mellon

Pennsylvania Land Recycling Program

- Signed into law on May 19, 1995
- Goals
 - To make contaminated sites safe by encouraging voluntary site remediation
 - To return these sites to productive use, creating jobs and stimulating economic growth
 - To develop incentives to balance the costs of brownfield vs. greenfield development

Four Cornerstones

- Uniform cleanup standards
- Standardized reviews with time limits
- Relief from liability
- Financial assistance

Three Remediation Options

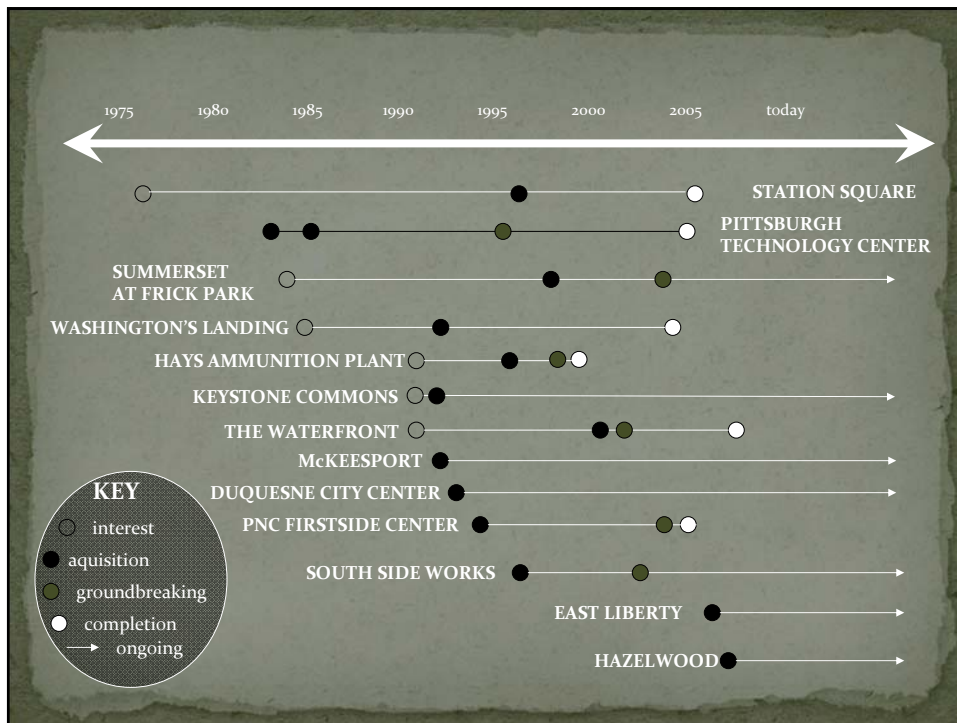
- Remediation may involve one or a combination of:
 - Background Standard: Concentration present but not related to a release at the site
 - Statewide Health Standard: Medium specific concentrations (soil and water)
 - Site-specific Standard: Risk based approach - pathway elimination
- The person doing the cleanup makes the choice, not Department of Environmental Protection

Brownfields in Pittsburgh

- 40 years
- Riverfront
 - Former steel plants
 - 200-300 acres
 - Attractive to developers
- Neighborhoods
 - Small
 - Hidden
 - Important to community

Steinbrenner Institute

5





Examples of Pittsburgh Brownfields

- Sustainable
 - Washington's Landing
 - PNC Firstside
 - Summerset at Frick Park
- Not-so-Sustainable
 - Pittsburgh Technology Center
 - Waterfront
- Stakeholder Engagement
 - Ambridge and Neville Island
- Best of the Best
 - Southside Works

Washington's Landing





PNC Firstside Center



Summerset at Frick Park



Summerset at Frick Park



Pittsburgh Technology Center



Waterfront



Waterfront



Stakeholder Engagement

- Site-Focused Workshops
 - “Jump Start” Developments in Neighborhoods
 - National Experts and Local Stakeholders Work Together
 - Sites Selected by Complexity
 - Not Conferences but Working Sessions



South Side Works





Lessons Learned Getting to Sustainability

- Engage stakeholders
- Connect with community
- Keep waste on-site
- Minimize paving
- Maintain natural amenities
- Build green
- Create public-private partnerships

Attachment 3
Treasurer's Report



SURF 15

Treasurer's Report

Brandt Butler

1



Assets

Current Net Receipts	\$43,958
– Membership	\$12,075
– Sponsorship	\$36,500
– Net Meeting Funds	\$331
– Expenses	(\$4,948)
• SURF Pins	
• Insurance	
• Website	

2





Ongoing Actions

- Regular financial reports to Trustees
- Independent Accounting Services to be performed by Nihill & Riedley, Philadelphia
 - Annual Review
 - Tax Filing
 - Ad hoc Support
 - Estimated annual cost: \$7,700
- Alternative Credit Card Processing
 - PayPal limitations

3



Your Comments and Suggestions?

4



Attachment 4
Board of Trustees Election Process

SURF

Board of Trustees Election Process

Current Procedure

- All Officer & Board positions are 1 year terms
- An individual can serve 2 consecutive terms
- Nominations are made in December
- Election (electronic) is held in January

Question/Concern

- Is the SURF membership concerned about leadership continuity?
 - In the event that a new team of Officers & Board Members replace all of the existing members, what happens to the “knowledge base that the old team developed?

Is The Knowledge Base Important

- A written record is kept for all meetings & posted on our website. This is approximately 26 Board meetings per year in addition to the membership meetings.

Some Options

- Continue with no changes; make changes if continuity become a problem
- During the next election:
 - Extend terms of At Large Trustees to 2 year terms with half of the individuals standing for election every year. “draw straws” for 1 year terms in this next election
 - Add a Past President position (ex officio)

Some Options (cont.)

- Vice President would assume President position the following year
- Obligate Trustees to participate in Board meetings for 3 months after their term ends (ex officio)
- Other

Attachment 5
SURF Procedure for Review of
Technical Initiative Work Products

SURF Procedure for Review of Technical Initiative Work Products (Draft: September 20, 2010)

This procedure outlines the process of reviewing and distributing work products created through Technical Initiatives (TI). This procedure does not address how technical initiatives are initiated and operate nor does it detail how TI work products are published and/or otherwise released.

Roles and Responsibilities

Board TI Leader – board member assigned responsibility for oversight of technical initiatives; the Board TI Leader coordinates reviews with the Board and assures this procedure is followed; the Board TI Leader represents the Board on all TI matters and stays in close contact with Board members to assure the interests of the Board are represented in the TI work products.

TI Review Team – Composition of SURF volunteers who review TI work products. Any member of SURF may participate on the TI review team. Specific members of the Board will also be assigned to the TI Review Team, and will be assigned by the Board.

TI Review Team Leader (RTL) – non-board SURF member that leads and coordinates the activities of the TI Review Team. A TI RTL is selected by volunteers from the TI Review Team

TI Product Leader – SURF member leading the specific TI; responsible for leading the specific focused group of SURF members supporting the focused TI.

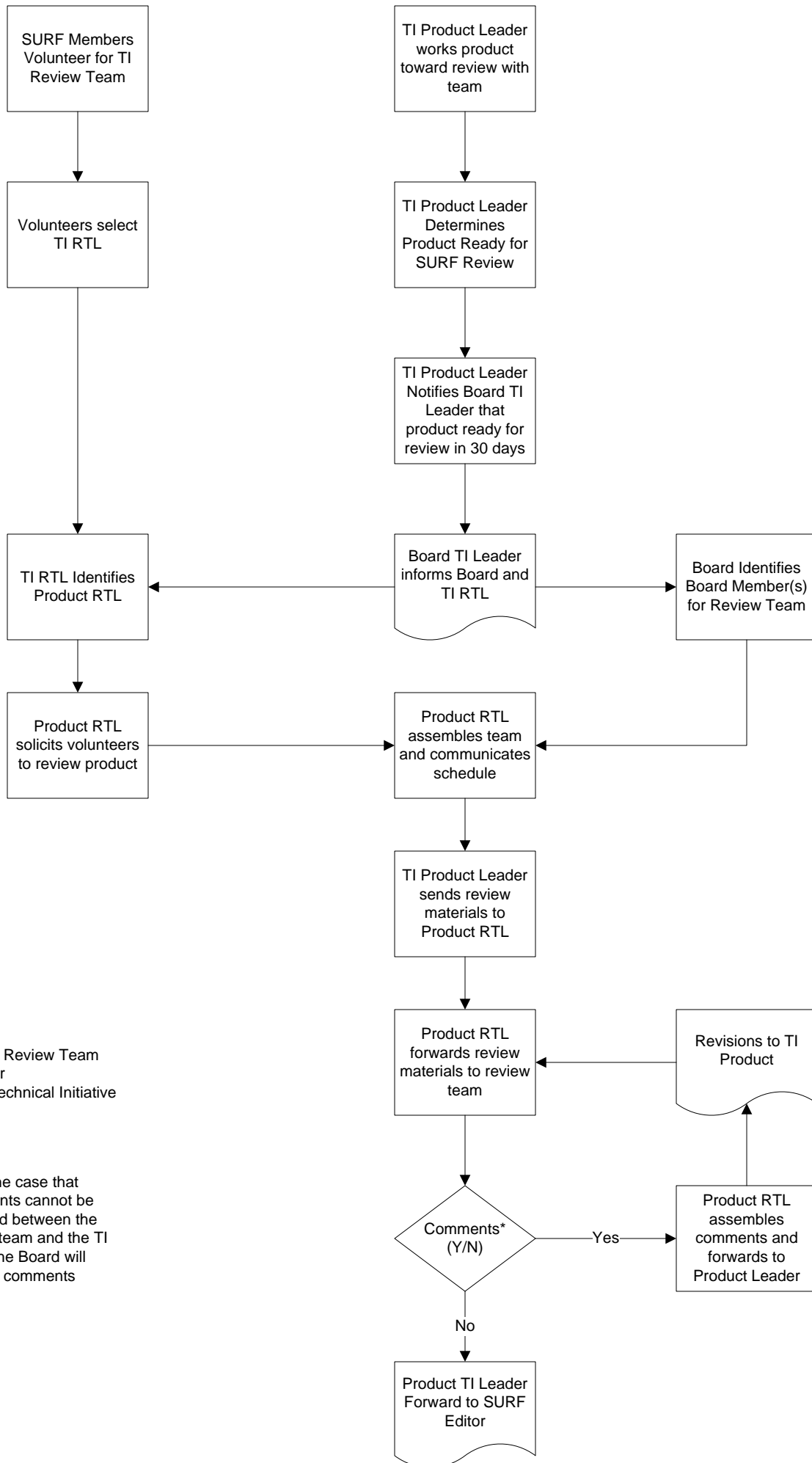
Product RTL – member identified by the TI RTL to coordinate and lead review team for specific TI work product.

TI Work Product Editor – all final TI work products will be edited by a professional editor selected by the Board. The services for TI Work Product Editor will be negotiated on case by case basis.

Review Procedure

1. The Product RTL leads review of TI work products. The TI Product Leader informs the Board TI Leader that a work product will be available for review 30 days prior to issuance of the review copy.
2. The Board TI Leader will coordinate the review among the Board members and the TI RTL. The Board will determine, on a case by case basis, which Board members will participate in the TI Review Team.
3. The Board TI Leader, TI RTL, and Product RTL will develop a review schedule for each TI work product, discuss how the work product will be released, and stay in close communication during the review and finalization of the work product.
4. See attached flow-chart for review process flow.
5. All comments to the draft work products will be adjudicated and agreed upon by all reviewing entities. The final approval of release of the work product is granted by the Board.
6. The final work product is edited by the SURF editor.
7. Legal disclaimer, trademarks, IP – K&L Gates?

SURF Technical Initiatives (TI) Review Process



RTL – Review Team
Leader
TI – Technical Initiative

* = in the case that
comments cannot be
resolved between the
review team and the TI
team, the Board will
resolve comments

Attachment 6
2011 SURF Goals and Objectives: Brainstorm

2011 SURF Goals and Objectives - Brainstorm

1. ***SURF Marketing and Branding***

Brand SURF as the “go to” resource for all things GSR (may help drive membership and we have an opening as ITRC and ASTM are slow to release guidance)

Increase external SURF marketing communications through email announcements, newsletters, conference presence (outreach tables or booths, participation in panel discussions), or webinars (e.g., case studies, training, etc.). At least one external communication per month.

2. ***Increase Membership***

Substantially increase SURF participation. Increase membership to > 250 people and increase SURF meeting attendance to > 100 people by December 31, 2011.

In order to advance the overall objectives of SURF, we should endeavor to solidify the size of the membership base to 250 by the end of 2011, realizing that with increased membership, strategies for providing information and contact benefits beyond those available at meetings will be required in order to meet the needs and expectations of members.

Membership: Increase from the current level of 117 to 250 members...

3. ***Increase Student Chapters***

...and increase the number of student chapters from 1 to 5.

In order to advance the section of the SURF mission related to support of education, we should endeavor to have established by the end of 2011, a total of five student chapters, understanding that this will require developing a support system that provides information to student members about career opportunities, curriculum choices, and outreach by SURF-related speakers and mentors.

4. ***Expand Membership Diversity***

Increase government member participation to improve the diversity of the membership and better represent practitioners of sustainable remediation.

Diversity: Broaden the membership to include other disciplines, i.e., economists, social scientists, lawyers, land use planners, political scientists etc.

Increase industrial member participation to improve the diversity of the membership and better represent practitioners of sustainable remediation.

5. ***Publish (or Perish!)***

Submit at least three official SURF publications to peer reviewed journals by June 30, 2011. This also means that we need to decide what it means to be an "official SURF publication", and what the SURF review process should be.

Complete the framework document and put it out there for others to use, there is a void and a useable framework is not available, and the agencies don't want to develop one as they feel they already have a regulatory process that works.

Education: a) Publish Current Technical Initiatives Documents (current initiatives). b) Develop webinars or other training sessions on each of the 3 primary elements of sustainable remediation and the Technical Initiatives Documents

Identify our “next wave” of Technical Initiatives – put on agenda for SURF 15?

Our second “White Paper”.

6. *Improve Meeting Planning and Organization*

Plan our meetings out so by October of the previous year when people sign up for the next year they already know when the two or three meetings will be held.

Strive to have meeting details and the registration form available at least 45 days prior to each meeting.

Research and invest in a permanent remote meeting A/V solution, owned by SURF and transferable to any meeting location that has an internet connection (e.g., webinar account/software, PA system and roving microphone, laptop with built-in camera/microphone, Skype account, etc.).

7. *Improve Internal Communications*

Draft guidelines for internal and external communications and gain membership support (through review and comment process?). Increase promptness and thoroughness of Board responses to membership inquiries and requests.

Define the purpose, objectives, and endpoint of each initiative and committee—including technical publications or other SURF products—and solicit membership input at the onset of work, periodically during development, and prior to “going live”.

8. *Financial Planning*

Increase SURF's financial stability. Have a bank balance over \$50,000 on December 31, 2011.

Reach out to the membership to gain at least 3 new sponsors in 2011. Retain all 2010 sponsors in 2011.

9. *Establish a Research Foundation*

In order to advance the section of the SURF mission related to support of research, we should endeavor to have in place by the end of 2011, a SURF research program. This might come about by the establishment of a research foundation capable of raising research funds, developing specific research needs, identifying able research teams, and awarding funds to carry out the research.

10. *Establish a SURF Rating or Credential*

Professional Credential: Develop a “Sustainable Remediator” (or some variation thereof) credential.

Attachment 7
Government Outreach: Engaging on
Sustainable Remediation Sticking Points



Government Outreach

ENGAGING ON SUSTAINABLE REMEDiation STICKING POINTS



THE BIRTH OF REMEDiation INDUSTRY

- Remediation industry was born in the late 1970s in response to discoveries of environmental contamination and a need for a better understanding of its impacts on human health & environment
- Environmental regulatory agencies and laws were created, and an industry rapidly emerged
- Cleanup focused on rapid response and completion, typically involving energy-intensive remedies
- Experience has shown that often these remedies have not/cannot achieve acceptable cleanup levels due to technical limitations
- Long-term operations, such as pump-and-treat and SVE, are commonly required after aggressive initial remedial measures (e.g., source removal/treatment)



GOING GREEN AND LIVING SUSTAINABLY

- Increased awareness of global climate change has fueled a desire to lessen greenhouse gas (GHG) emissions
- Energy-intensive remedies are often a significant source of GHGs
 - Ellis et al. (2008) estimated that the difference between two remedies being considered for a NJ site could be as high as 2 percent of the annual GHG emissions for the state
- “Sustainability” is in vogue
 - The capacity to endure; the potential for long-term maintenance of our well being (Wikipedia, 2010)
 - Most segments of industrialized society are rethinking how behavior, reliance on technology, and consumption of energy impact the environment
 - Government is interested (EO 13514)
 - Society is looking for ways to minimize these impacts, or avoid them altogether, so that human activity can become more sustainable

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



THE ENVIRONMENTAL REGULATORY AND REMEDIATION INDUSTRY IS RESPONDING

2006 - Sustainable Remediation Forum (SURF) formed

2007 - EPA Region III Pilot Projects

- EPA sponsored Green Remediation Research
- SURF UK established under CL:AIRE
- CA DTSC “Green Team” established
- IEPA Greener Cleanups Program developed

2008 - US EPA launched Green Remediation Website

- WDNR began work on WISC

2009 - SURF White Paper Published

- ASTM GSR Subcommittee established
- ITRC Green Remediation Team established

2010 – EPA Revised Green Remediation Strategy



Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





GREEN vs. SUSTAINABLE REMEDIATION: WHAT IS THE DIFFERENCE?

- **Green Remediation**
 - The practice of considering all environmental impacts of remedy implementation and incorporating options to minimize the environmental footprints of cleanup actions (USEPA, 2009)
 - Current focus is on minimizing impacts post-remedy selection
 - Primary focus of most regulatory initiatives
- **Sustainable Remediation**
 - Selection and implementation of a remedy whose net benefit on human health and the environment is maximized through the judicious use of limited resources (SURF, 2009)
 - Encourages evaluation of impacts of a remedy during the remedy selection process
 - “Triple Bottom Line” – environmental, economic and social benefits
 - Organizations such as ASTM, ITRC, and SURF are tackling the broader issue of sustainable remediation

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



USEPA GREENER CLEANUP POLICY COMPONENTS

- Total Energy Use and Renewable Energy Use
- Air Pollutants and Greenhouse Gas Emissions
- Water Use and Impacts to Water Resources
- Materials Management and Waste Reduction
- Land Management and Ecosystems Protection

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





SUSTAINABLE REMEDIATION

- Improving traditional remediation through adoption of a thoughtful remediation plan that incorporates the following:
 - Actions that decrease the environmental footprint
 - A cost-effective yet still protective approach
 - Minimal transfer of the problem from one medium to another
 - An increase in community benefits
 - A consideration of safety associated with the action
 - Common sense
- These elements are consistent with USEPA policy and seek to take Green Remediation a step further

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



TENETS OF SUSTAINABLE REMEDIATION

- As environmental professionals we should implement remediation projects in a green (i.e. environmentally responsible) manner
- Green metrics probably have limited role on time-critical remediation projects (i.e. imminent risk) but can be applied
- Protection of human health and the environment are baseline requirements
- All relevant stakeholders should have a say in the decision-making and by default the remedy selection
- Goals include reduced consumption of energy, water and other natural resources; maximization of reuse/recycling; and minimization of carbon footprint, GHGs, and any other deleterious effect of remediation
- We can make better remediation decisions through accounting for metrics that were not previously considered

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





COMMON OBJECTIVES

- Achieve remedial action goals
- Support use/reuse of remediated parcels
- Increase operational efficiencies
- Reduce total pollutant and waste burdens
- Minimize degradation or enhance ecology of site
- Reduce air emissions and GHG production
- Conserve natural resources
- Evaluate recycling options and alternate treatment methods
- Minimize impacts to water quality and water cycles
- Increase sustainability of site cleanups



Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



GREEN VS. SUSTAINABLE STICKING POINTS

- Health and Safety
- Triple Bottom Line
- Ineffective Remedies
- Timing
- Litigation



Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





TOUGH QUESTIONS TO CONSIDER

- How do we weigh the need for site restoration (e.g. cleanup soil, sediment and groundwater) against the resources utilized and unintended consequences that result when attempting to accomplish that restoration?
- Should sustainability metrics be evaluated before or after remedy selection?
- Is it better to have a short-term significant environmental footprint (e.g. excavation, thermal treatment) or extend it over a longer period (e.g. SVE, pump and treat)?



Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



TOUGH QUESTIONS TO CONSIDER

- Does a future carbon constrained world change the game?
- What is a “reasonable timeframe”?
 - Should the timeframe be tied to the goal?
 - Who decides?
- How does one consider social impacts?
- How should health and safety and risk of remedy be considered?
- Does more remediation necessarily mean better remediation?



Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





WHAT IS NEEDED?

- Dialogue is needed to confront challenges/sticking points
 - Regulatory requirements
 - Mandate to restore beneficial use
 - Preference for mass reduction/destruction
 - Fear of “Green Washing”
 - Pop culture jargon
 - We need to learn from our experiences with MNA and RBCA
 - Setting a Precedent

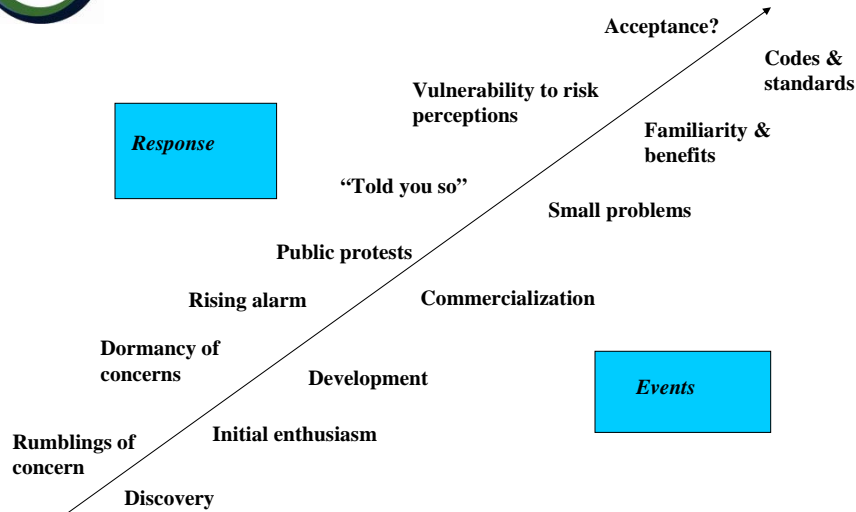


WHAT IS NEEDED?

- Case Studies are needed to:
 - Showcase examples of successful implementation of GSR
 - Illustrate how sustainability metrics can be integrated into the remedy selection and implementation process
 - Analyses of existing remedies
 - How can an existing remedy be made more green and/or sustainable?
 - How might this have been approached if sustainability metrics were considered during remedy selection?



THE ROUGH ROAD TO ACCEPTANCE



Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



SUSTAINABLE REMEDIATION SOIL EXCAVATION CASE STUDY

Former Gun Club (2 adjacent locations in Everett, WA)

- RCRA Corrective Action

Goals

- Reduce, Reuse & Recycle Wastes & Raw Materials
- Reduce Transportation Footprint



Implementation (Required Significant Pre-Planning)

- Conducted depth-discrete soil profiling of 10 acres (broken down into discrete excavation cells)
- Waste disposal profiling (lead & PAHs) of each cell conducted in advance of excavation
- Excavation depth minimized through constant field oversight of each excavation cell
- Separated soil during removal as either non hazardous or hazardous

Location 1 -- 29,000 tons (39% total) of non-haz soil was recycled for use as Portland Cement.

Location 2 -- 5,500 tons (96% total) of non-haz soil was recycled for use as Portland Cement



Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





SUSTAINABLE REMEDIATION SOIL EXCAVATION CASE STUDY

“Triple Bottom Line” Objectives

Environmental

- Compliance
- Footprint Reduction
 - Limited landfill disposal
 - Reduction of pristine source for cement raw material

Economic

- Cost Reduction
 - Careful profiling and excavation management limited soil requiring out of state disposal as hazardous waste (Seattle to Idaho)



Social

- Safety (no lost time accidents)
- Reduced Transportation Footprint & Landfill Disposal
 - 25 miles to either cement manufacturer or landfill transfer station in Seattle, WA
 - Careful segregation minimized volume and transportation of haz waste (800 miles Seattle-Idaho)
 - Soil recycling eliminated 1200 add'l rail cars of non-hazardous soil (250 miles to landfill)
 - Reduced fuel consumption (GHG emission)
- Property Redeveloped for Manufacturing Use
 - Beneficial reuse

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



SUSTAINABLE REMEDIATION FORMER MGP SITE

- Former MGP and CERCLA Site
- Achieved successful risk-based closure by evaluating site-specific bioavailability of key chemical stressors
- Managed removal of 2000+ gallons of coal tar and MGP residuals
- Constructed 2 impermeable barrier and 2 permeable barrier landfills (9+ acres total) in lieu of excavation and offsite disposal
- Installed in situ lining in sanitary and storm sewer to eliminate groundwater infiltration/migration
- Incorporated significant landscape improvements to ensure community acceptance and satisfaction



Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





SUSTAINABLE REMEDIATION BRIGHTFIELD REDEVELOPMENT



- Site redeveloped into a renewable (solar) energy facility
- 1,395 solar modules
 - Largest solar array in New England
 - 450 kw of electricity
 - Results in annual reduction of 589,570 lbs of CO₂
- Environmental and solar energy education center were incorporated into the new facility
- All community concerns were incorporated into the cleanup and redevelopment plans
- Supports the communities economic development strategy
- Attracted attention of elected officials and domestic/international planners

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



Attachment 8
SURF Sustainable Remediation Site
Database Project: Next Steps

The SURF Sustainable Remediation Site Database Project: Next Steps

Baker & McKenzie International is a Swiss Verein with member law firms around the world. In accordance with the common terminology used in professional service organizations, reference to a "partner" means a person who is a partner, or equivalent, in such a law firm. Similarly, reference to an "office" means an office of any such law firm.

Topics

- Brief Background
- Description of Sustainable Remediation Site Database
- Next Steps

Background – SURF Goals

- SURF White Paper (2009)
 - Among other things, identifies the need for a project-based compendium to allow for an objective comparison of sustainable remedies from site-to-site
 - Expand project knowledge
 - Address existing societal and governmental barriers

Background – Key EPA Policies

- EPA has begun developing formal “Green Remediation” Policies
 - *Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites (April 2008)*
 - *U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response (August 2009)*
 - EPA Regional Policies (Since Fall 2009)

Key Similarities Between SURF and EPA

- Primary focus is on environmental component of Triple Bottom Line
 - Struggle with identifying relevant social and economic concepts and metrics
- Recognize that existing regulations and policies may currently limit certain sustainable remediation solutions
- Appreciate that the concept of sustainable remediation is new and dynamic
- Consider carbon footprint and greenhouse gas impacts

Key Differences Between SURF and EPA

- SURF view of sustainable remediation is more expansive
 - Life cycle analysis/beyond four corners of site
 - Natural attenuation considerations
 - Encourage more experimentation and innovation
 - Identify other reasons for choosing sustainable solutions



Sustainable Remediation Site Database

- Create a searchable resource for sustainable remediation projects throughout the U.S.
 - Technical information
 - Legal information
 - Policy-based information



SRS Database Objectives

- Encourage the government and members of the public to more commonly consider and use sustainable remediation solutions
- Provide a data resource for remediation practitioners
- Implement one of SURF's goals
- Improve SURF's organizational reputation
- Attract more professional and academic members to SURF

SRS Database Implementation - Plan

- SURF Board of Trustees
 - Approve formal SRS Database evaluation
 - Create a special committee to conduct evaluation
 - Oversee an incremental process to create a database prototype

SRS Database Implementation

- SURF Board of Trustees has approved formal SRS Database evaluation
- Need to create a special committee made up of SURF members to conduct the evaluation
 - Research implementation areas
 - Report back to SURF Board of Trustees
 - Complete written plan

SRS Database Implementation (cont.)

- Special committee research areas will include -
 - Funding sources
 - Database criteria development
 - Information/content collection
 - Data entry/management options

SRS Database Implementation (cont.)

- Written plan to Board of Trustees will include –
 - Project cost, scope and funding source(s)
 - Description of database search criteria and other key database features
 - Initial database development, data entry and on-going responsibilities



Next Steps

- Provide me with your business card during SURF 15 if you want to participate on the special committee
- OR
- Contact me after the SURF 15 if you're undecided now
 - Volunteers will be contacted soon to begin the formal evaluation process



Thank You

Steven J. Murawski
(312) 861-3738
steven.j.murawski@bakernet.com

Attachment 9
Committees and Initiatives



COMMITTEES AND INITIATIVES

- Look for a committee where you can make a difference!

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



COMMUNICATIONS AND OUTREACH COMMITTEE

- The Committee Leaders are Maile Smith, Stephanie Fiorenza, and Jake Torrens
- Mission
 - Provide a unified and consistent message, internally and externally, for effectively communicating SURF's objectives, activities, and future goals.

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





COMMUNICATIONS AND OUTREACH COMMITTEE

- Key Objectives
 - Distribute information about SURF and committee and initiative activities via the SURF website, newsletter, external publications, and email communications
 - This work is ongoing continual refinement and suggestions for improvement
 - Supported by the “Who Is SURF” presentation
 - Newsletter template developed, and we anticipate the first issue to be distributed prior to SURF 16
 - Longer-term objective to promote SURF and sustainable remediation in general via webinars

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



COMMUNICATIONS AND OUTREACH COMMITTEE

- Develop, update, and share the SURF Communication Guidelines with the Membership
 - A draft is in review with the Committee members and Board of Trustees (comments due 9/20)
 - Guidelines will be shared with the membership at SURF 15 and posted to the website

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





COMMUNICATIONS AND OUTREACH COMMITTEE

- Soliciting suggestions for how to improve the feedback and resolution loop
 - Encourage members to provide feedback and recommendations for improvement of the SURF organization in general
 - A meeting survey form was developed for SURF 14, and will be used for subsequent meetings
 - Soliciting other suggestions for how to improve the feedback and resolution loop

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



ACADEMIC OUTREACH INITIATIVE

- Initiative Chairpersons are Mike Miller (Chair) and Stew Abrams (Vice-Chair)
- Mission
 - Encourage academic participation in SURF as a means to promote the organization, establish linkages, and foster research and innovation.

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





ACADEMIC OUTREACH INITIATIVE

- Statement of Purpose
 - We recognize the substantial value that academics bring to the SURF community through new ideas, technologies, and approaches to sustainable remediation. Therefore, SURF invites all interested professors, students, and researchers to join and actively participate in our discussions.

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



ACADEMIC OUTREACH INITIATIVE

- Current Objectives and Supporting Activities
 - Recruiting new members of SURF from the academic & research communities
 - Collect personal academic contacts from current SURF members
 - Reach out to identified contacts
 - Provide organizational and informational support to newly forming student chapters of SURF

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





ACADEMIC OUTREACH INITIATIVE

- Getting involved in academic research programs related to sustainable remediation
 - Develop a proposal to the SURF Board of Directors to provide letters of support for specific relevant research programs
 - Contact researchers to bring them to SURF meetings and present on their research
- Advertising SURF to the academic community
 - Develop, plan, and implement a SURF-sponsored student paper competition at the Battelle Bioremediation Symposium to be held in June 2011
 - Create a presence at and develop advertising fact sheets for remediation-themed conferences particularly targeted toward academics

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



GOVERNMENT EMPLOYEES OUTREACH INITIATIVE

- Initiative chairpersons are Carol Baker and Todd Martin
- Mission
 - Encourage increased government employee membership and visibility within SURF by:
 - providing information to government employees,
 - fostering discussion/dialogue with government employees about sustainable remediation, and
 - providing government employees with educational opportunities.

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





GOVERNMENT EMPLOYEES OUTREACH INITIATIVE

- Key Objectives
 - Reach out to government employees and encourage them to join this great professional organization through phone calls, emails, letters, SURF meeting attendance and information workshops.
 - We have formed a 5-10 member committee whose purpose is to identify barriers to government employee participation in SURF and generate solutions to overcome those barriers.
 - We have openings on this team. Members participate on monthly teleconferences and either in-person or virtually at 3 SURF meetings throughout the year. The team intends to go out to selected government agencies in 2011 (see #2 below) with a targeted presentation intended to elicit dialogue around sustainable remediation.

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



GOVERNMENT EMPLOYEES OUTREACH INITIATIVE

- Provide information and educational opportunities concerning sustainable remediation to government employees.
 - Currently developing a thought provoking presentation that is designed to raise questions and spark dialogue within the government agency surrounding sustainable remediation.
 - Presentation will be presented face-to-face and/or via webinar, to selected government agencies in 2011.

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





GOVERNMENT EMPLOYEES OUTREACH INITIATIVE

- Increase the diversity of the SURF membership by attracting more government employees.

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.



FRAMEWORK INITIATIVE

- Initiative Chairperson is Karin Holland
- Mission Statement
 - Development of a pioneering sustainable remediation framework with wide applicability and appeal to the remediation community

Copyright © 2010, Sustainable Remediation Forum. All rights reserved.





FRAMEWORK INITIATIVE

- **Objectives**

- Prepare and publish a SURF sustainable remediation framework document
- Provide training relating to SURF's sustainable remediation framework



FRAMEWORK INITIATIVE

- **Key Tasks**

- Complete a first draft of the framework document (by SURF 15)
- Review the draft framework document (at SURF 15)
- Prepare a final version of the framework document with the aim of publication within the next 6-9 months
- Identify forums for providing training relating to the framework
- Schedule training sessions



LIFE CYCLE ASSESSMENT INITIATIVE

- The Initiative Chairpersons are Paul Favara and Todd Krieger
- Mission
 - To prepare a White Paper regarding the state and path forward for the use of LCA in the remediation process



MEETINGS AND PROGRAM COMMITTEE

- The Committee Leader is Dave Ellis
- Mission
 - To recruit hosts and locate venues for SURF's meetings at least one year in advance

Attachment 10
Green Chemistry and the Design of Green Oxidation Catalysts

Green Chemistry and the Design of Green Oxidation Catalysts

Dr. Colin P. Horwitz
Chief Technology Officer
GreenOx Catalysts, Inc.

October 6, 2010
SURF



GreenOx Catalysts, Inc.

1

Outline

- Background
 - green chemistry
 - catalysis
 - oxidation
 - Oxidation catalyst design
 - TAML[®] catalyst design
- TAML[®] catalyst applications
- GreenOx Catalysts, Inc.
 - commercial applications
- Conclusions



GreenOx Catalysts, Inc.

2

1. Minimize or eliminate energy consumption or the consumption of other natural resources;
2. Reduce or eliminate releases to the environment, especially to the air;
3. Harness or mimic a natural process;
4. Result in the reuse or recycling of land or otherwise undesirable materials; and/or
5. Encourage the use of remedial technologies that permanently destroy contaminants

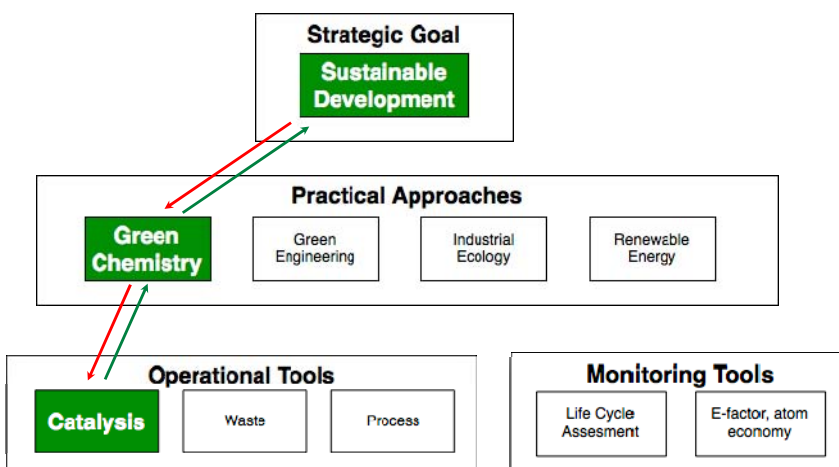


GreenOx Catalysts, Inc.

Remediation Journal, **2009** 19(3), pp 5 - 114, eds. P. Hadley and D. Ellis, Summer

3

Big picture: Sustainable Development



GreenOx Catalysts, Inc.

Catalysis/ Rothenberg, ISBN 978-3-527-31824-7.
www.catalysisbook.org

4

Green chemistry

**pursuit of products and processes
that reduce or eliminate hazard**



GreenOx Catalysts, Inc.

5

Green chemistry

12 Principles of Green chemistry

Prevention	Use renewable feedstocks
Atom economy	Reduce derivatives
Less hazardous synthesis	Catalysis
Design safer chemicals	Design for degradation
Safer solvents and auxiliaries	Real-time pollution prevention
Design for energy efficiency	Inherently safer chemistry

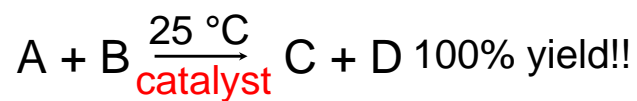


GreenOx Catalysts, Inc.

Anastas, P. T.; Warner, J. C.; Green Chemistry:
Theory and Practice, Oxford University Press: New
York, 1998.

6

Catalysis



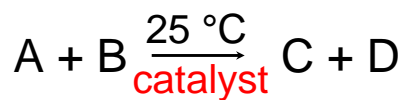
Catalyst - a substance that initiates or accelerates a chemical reaction without itself being affected



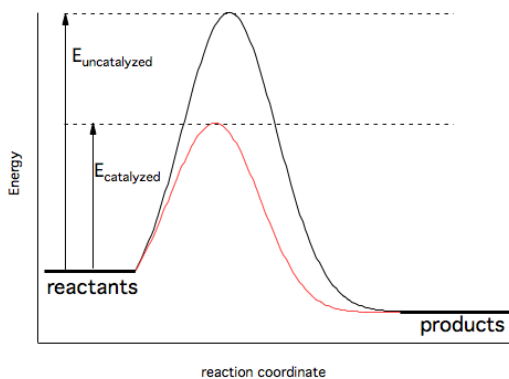
GreenOx Catalysts, Inc.

7

Catalysis



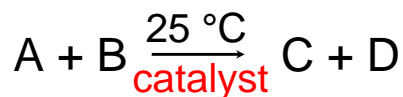
Activation energy



GreenOx Catalysts, Inc.

8

Catalysis



Traditional catalyst markets

oil refining

petrochem

polymers

fine
chemicals

pharma

environmental

Annual catalyst market \$12 - 15 Billion



GreenOx Catalysts, Inc.

9

Oxidation

Oxidation - the *loss* of electrons or an *increase* in oxidation state by a molecule, atom, or ion

- Laundry - bleaching clothes
- Water - wastewater and drinking water disinfection
- Body - liver detoxifying harmful substances **biomimetics**
- Body - aging (anti-oxidants)



GreenOx Catalysts, Inc.

10

Oxidation catalyst design - green

- No toxic elements
- Readily available starting materials
- Straightforward synthesis
- Robust
- High activity
- Design for degradation
- Use natural oxidants (O_2 and/or H_2O_2)
- Toxicity testing

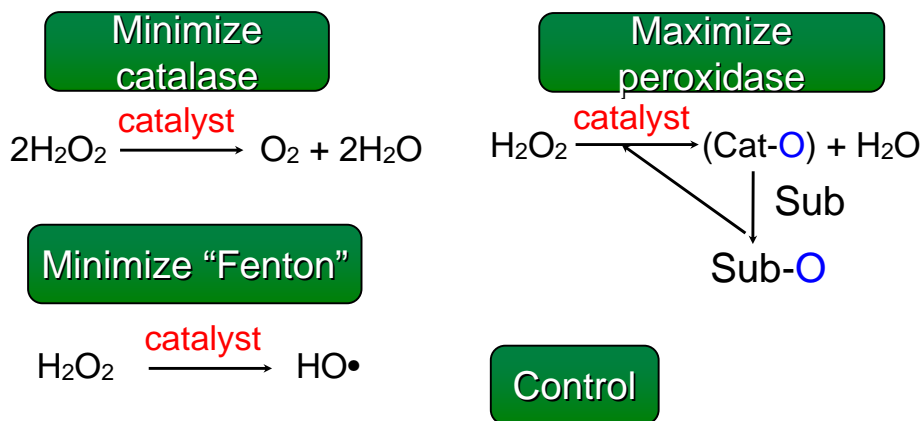


GreenOx Catalysts, Inc.

11



Designing a H_2O_2 activating catalyst



- self-oxidation decay rate
- hydrolysis decay rate
- reactivity and selectivity



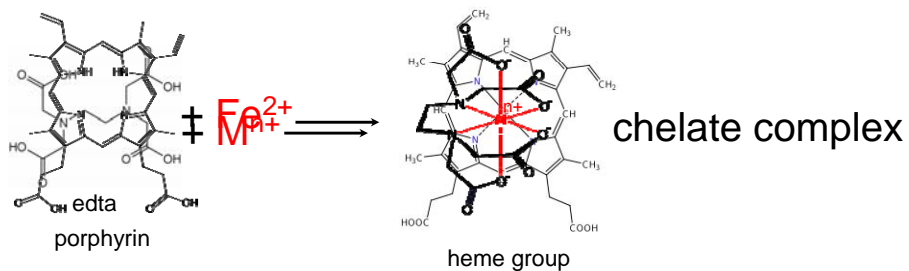
GreenOx Catalysts, Inc.

12



Ligands

Ligand - ion or molecule that attaches to a central metal ion



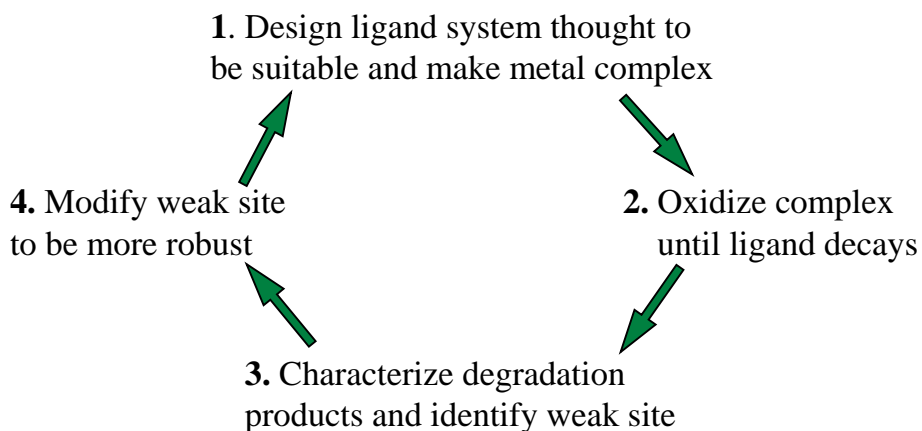
macrocycle



GreenOx Catalysts, Inc.

13

TAML[®] design



Collins *Accounts Chem. Res.*, 1994, 27, 279-285

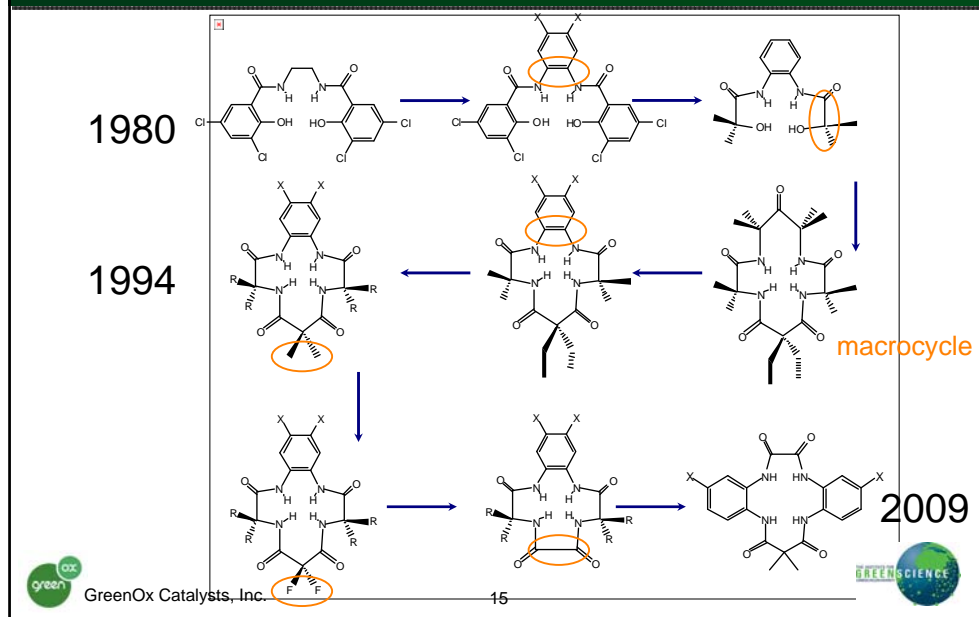


GreenOx Catalysts, Inc.

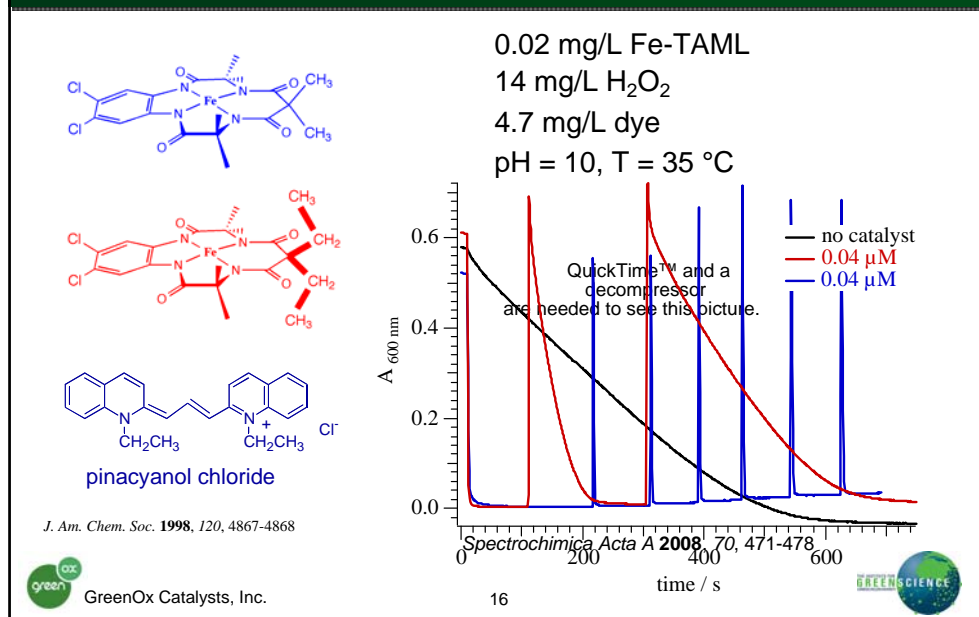
14



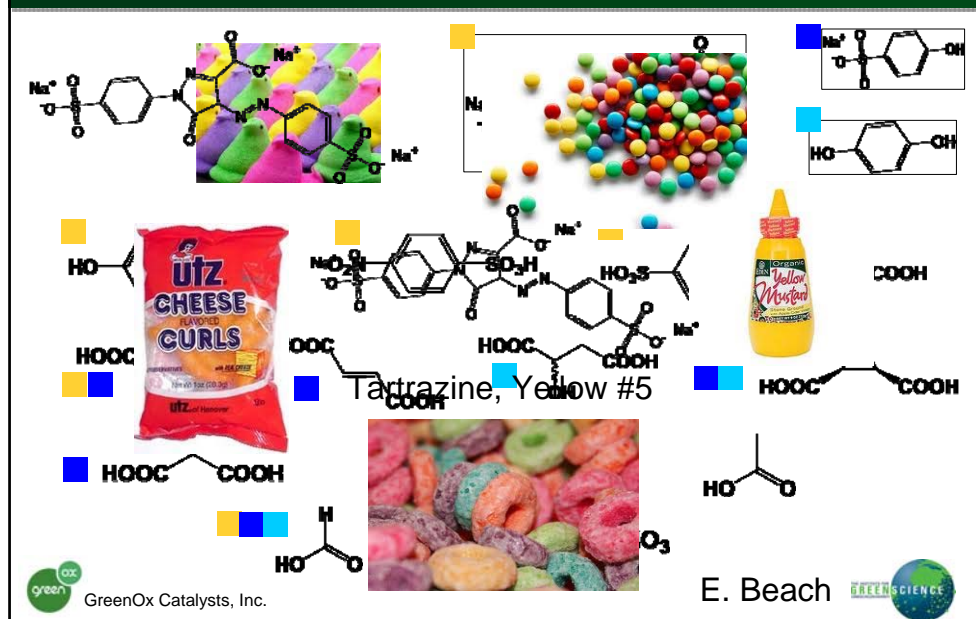
TAML[®] development



Catalyst lifetime - control self-oxidation



Product identification



Endocrine disrupting compounds - EDCs

Exogenous substances that alter function(s) of the endocrine system and cause adverse health effects in an intact organism, or its progeny, or (sub)populations.

- Reduce the production of hormones
- Modify the release of hormones
- Mimic or counteract hormone action
- Modify metabolism rate

http://ec.europa.eu/research/endocrine/index_en.html

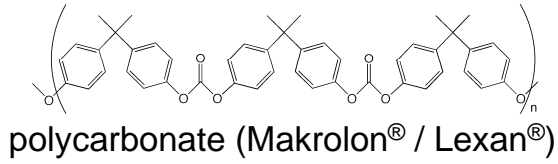
<http://www.greenfacts.org/index.htm>



GreenOx Catalysts, Inc.

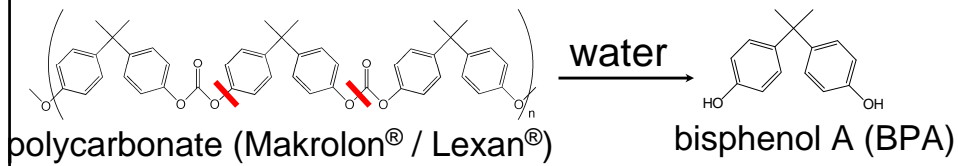
18

Bisphenol A (BPA)



GreenOx Catalysts, Inc.

Bisphenol A (BPA)



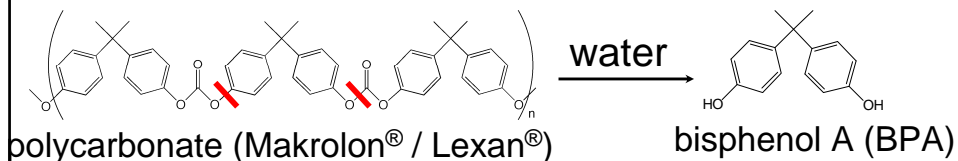
BPA, Chemical Used To Make Plastics, Found To Leach From Polycarbonate Drinking Bottles Into Humans

ScienceDaily (May 22, 2009)



GreenOx Catalysts, Inc.

Bisphenol A (BPA)



Why is Bisphenol A a potential problem?

- 6 billion pounds produced annually
- Estrogen mimic (1930's)
- Adverse health effects found in animal studies
- Treatment with [OCI]⁻ forms chlorinated BPA derivatives
 - exhibit estrogenic activity
 - more persistent than BPA

<http://endocrinedisruptors.missouri.edu/vomsaal/vomsaal.html>

Fukazawa *et al.*, *J. Health Sci.*, **2002** 48, 242

Rubin *et al.*, *Environ. Health Perspect.*, **2006** 113, 391

21

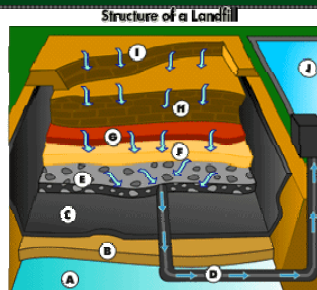


GreenOx Catalysts, Inc.

BPA in the environment

- surface water
- ground water
- atmosphere
- rainwater
- tap water
- fish and shellfish
- influent to sewage treatment
- effluent sewage treatment
- influent to drinking water treatment
- purified drinking water

Bisphenol A Risk Assessment Document
(AIST Risk Assessment Document Series No. 6)
November 2005



J. Environ. Monitor **2003**, 5, 269 - 274
<http://www.ecokids.ca/pub/index.cfm>



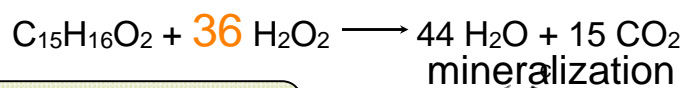
J. Health. Sci. **2002**, 48, 242 - 249
<http://www.sita.com.au/>



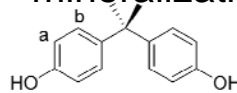
GreenOx Catalysts, Inc.

22

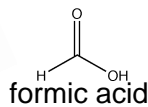
BPA degradation with TAML[®]/H₂O₂



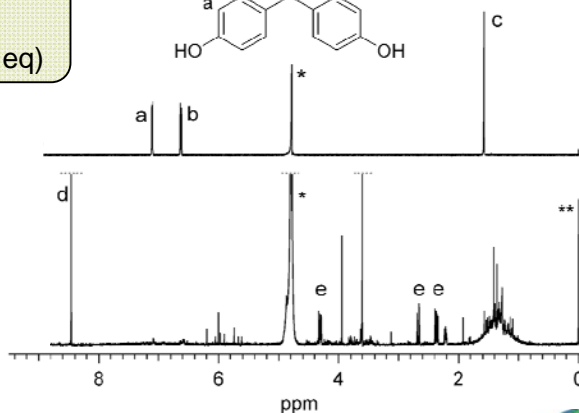
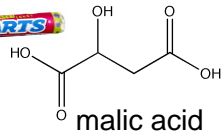
BPA	~1000 ppm
TAML [®]	2 ppm
H ₂ O ₂	8500 ppm (50 eq)



d =



e =



GreenOx Catalysts, Inc.

23



GreenOx Catalysts current application areas

Commercial Laundry

Biocides in metalworking fluids

Soil and groundwater remediation

Next Generation Biomaterials

“Smart” Fabrics



GreenOx Catalysts, Inc.

24

Non-coin laundromats and dry cleaner industry



GreenOx Catalysts, Inc.

25

Greening laundry detergent



- Surfactants
- Builders
- Bleaches and Sanitizers
- Whiteners/Optical Brighteners
- Fragrances
- Fabric Softeners
- Solvents
- Dyes
- Other Components
- Energy Savings



GreenOx Catalysts, Inc.

[About Us](#) [Consumers](#) [Manufacturers](#) [Purchasers](#) [Publications](#)

Design for the Environment An EPA Partnership Program



26

Commercial laundry detergent

<0.1 wt% TAML®

catalyst

plant-based surfactant

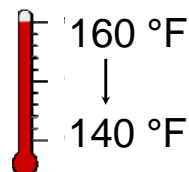
biodegradable

lower temperature

energy savings

less chemical

transportation/energy savings



“The addition of your product to our green surfactant based detergent not only improved the oxygen bleach’s ability to whiten and brighten colors but also improved cleanliness as well.”

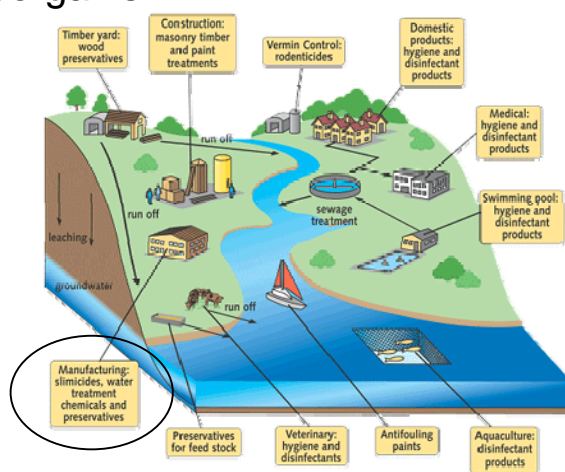


GreenOx Catalysts, Inc.

27

Biocides

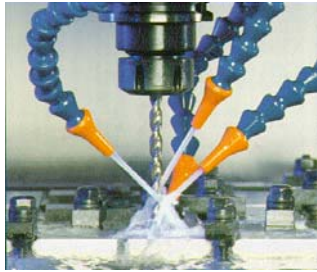
biocide - chemical toxic to a microorganism



GreenOx Catalysts, Inc.

28

Metalworking fluids (MWFs)



Metalworking Fluids

- Transport chips
- Arrest rewelding
- Corrosion protection
- Power reduction
- Extend tool life
- Create certain type of chip
- Cooling
- Lubrication

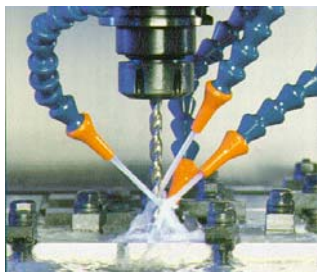


GreenOx Catalysts, Inc.

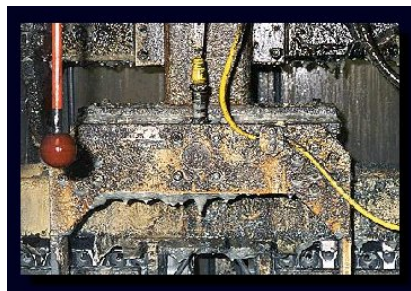
29



Metalworking fluids (MWFs)



biofouling



GreenOx Catalysts, Inc.

30



Metalworking fluids (MWFs)



biofouling
~~→~~
 BIOCIDES



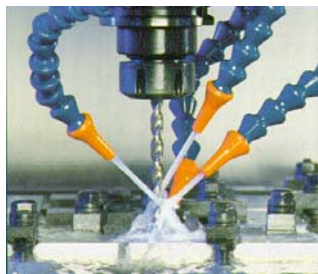
GreenOx Catalysts, Inc.

31

RECOMBINANT
INNOVATION



Metalworking fluids (MWFs)



biofouling
~~→~~
 BIOCIDES

Biocide

PCMC *p*-chloro *m*-cresol

Advantages

- broad spectrum bactericide and fungicide with unique antimicrobial properties
- extraordinary pH and thermal stability

Disadvantages

- odor
- phenolic
- increased disposal costs



GreenOx Catalysts, Inc.

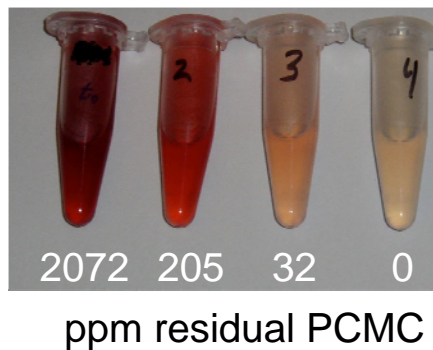
32

RECOMBINANT
INNOVATION



Typical treatment results with TAML[®]/H₂O₂

- Treatment Protocol**
- Adjust pH to 9.5
 - 1 – 4 additions TAML
20 min between additions
 - 2 μ M TAML
 - 30 mM or 45 mM H₂O₂
Cu and Mn interfere



10,000 gallons MWF

200 g TAML[®]

100 gal 50% H₂O₂



GreenOx Catalysts, Inc.



33

Soil Treatment

Pensacola, FL Beach Sand



Sand-DI Water

S-ISCO[®] Treatment

VeruSOL[®]-Marine 200, H₂O₂,
and GreenCAT



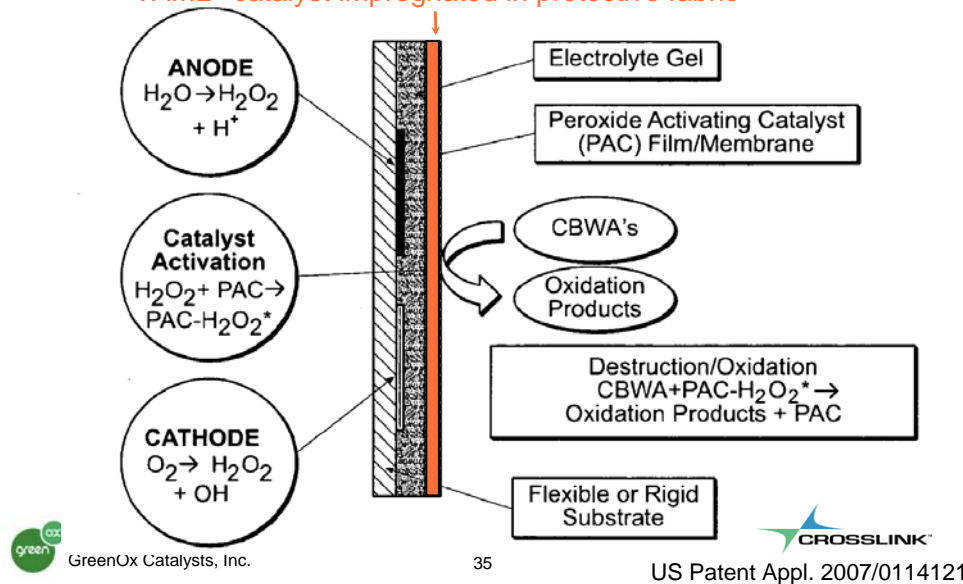
GreenOx Catalysts, Inc.



34

“Smart” fabrics

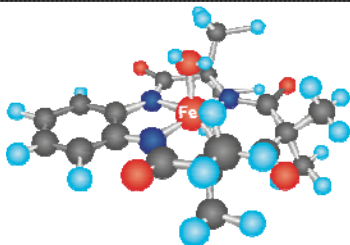
TAML[®] catalyst impregnated in protective fabric



35

US Patent Appl. 2007/0114121

Summary - TAML[®] catalysts



- small molecules
- no toxic elements
- low/no toxicity
- low concentrations ~1 ppm
- mimic enzyme chemistry
- wide range of reaction conditions
- efficient peroxide users
- NOT hydroxyl radical chemistry

GreenOx Catalysts, Inc.

36

Conclusions

- Rational design of oxidation catalysts is possible
- TAML[®] catalysts are widely applicable
 - Application areas have commercial potential
 - Academic application areas are limitless
- Fun for tackling “out of the box” problems



GreenOx Catalysts, Inc.

37

Question

How can catalysis, a driver for chemical sustainability, be adapted and adopted for sustainable remediation?



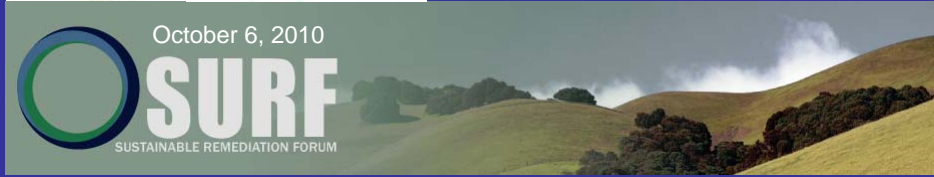
GreenOx Catalysts, Inc.

38

Attachment 11
Water Usage and Management During
Hydraulic Fracturing of Shale

Water Usage and Management During Hydraulic Fracturing of Shale for Natural Gas Production

Kelvin B. Gregory, PhD
Civil and Environmental Engineering
Carnegie Mellon University



CarnegieMellon

Civil and
Environmental
ENGINEERING

Shale Gas Development Overview



Preparation



Drilling



Fracturing



Production



Restoration

CarnegieMellon

Civil and
Environmental
ENGINEERING

Shale Gas Development Overview



Preparation



Drilling



Fracturing



Production



Restoration

CarnegieMellon

Civil and
Environmental
ENGINEERING

Marcellus Shale: One Among Many "Plays"



Source	TCF
Barnett Shale TX	2.1 - 30
Anadarko Basin TX to KS	100
Haynesville Shale Gulf Coast	250
Prudhoe Bay North AK	28
Marcellus NY, PA, WV	168 - 516

CarnegieMellon

Civil and
Environmental
ENGINEERING

Marcellus Shale: Gas in Rock

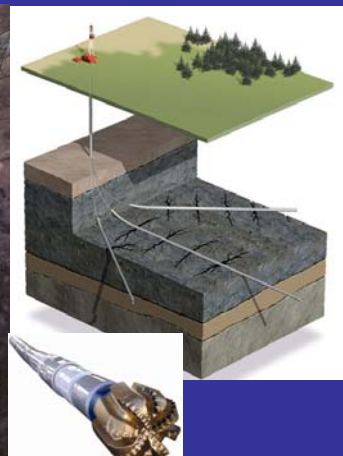


- Low matrix permeability
- Gas production in commercial quantities requires fractures to provide permeability
- Shale gas has been produced for years from shales with natural fractures
- Recent shale gas boom due to new hydraulic fracturing technology to create permeability

CarnegieMellon

Civil and
Environmental
ENGINEERING

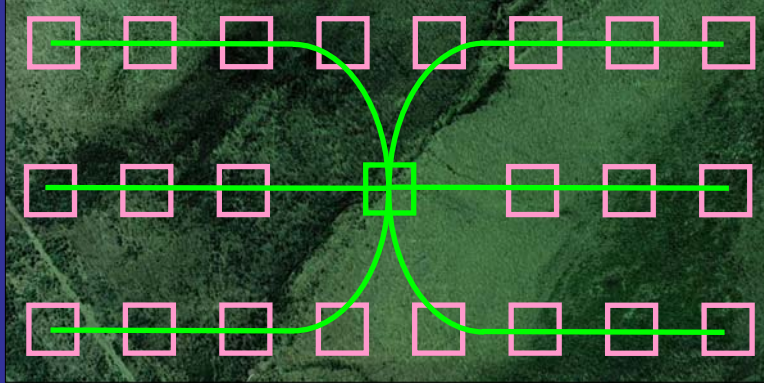
Drilling: Horizontal Wells



CarnegieMellon

Civil and
Environmental
ENGINEERING

Advantages of Horizontal Wells: Centralized Operations, Less Land Disturbance, Less Time, Less Development Cost



- Horizontal (green) develop 500 acres per pad with 2% surface disturbance
- Vertical (pink) on 1,000-foot spacing develop 23 acres per well with 19% disturbance

CarnegieMellon

Civil and
Environmental
ENGINEERING

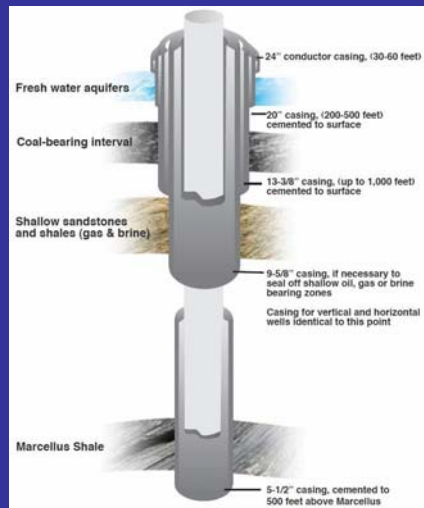
Drilling: Aerial View



CarnegieMellon

Civil and
Environmental
ENGINEERING

Drilling: Well Casing Overview



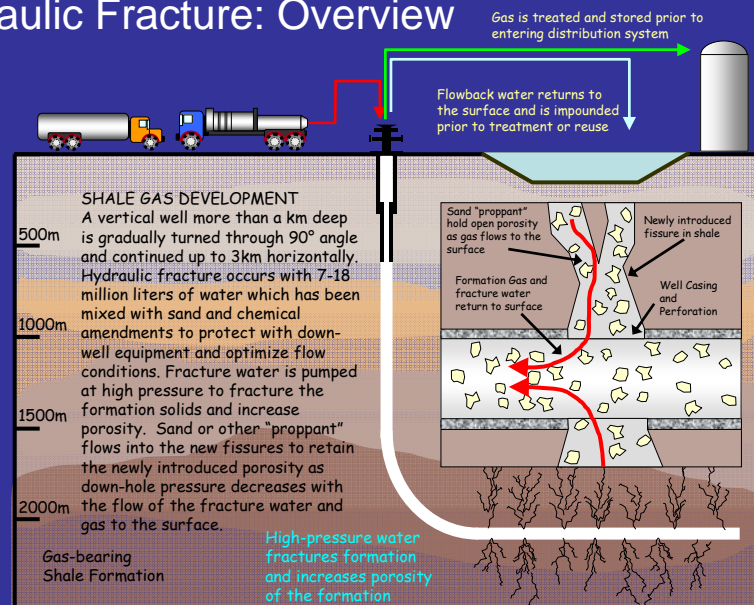
Goal is to isolate important zones with multiple layers of steel and concrete



CarnegieMellon

Civil and
Environmental
ENGINEERING

Hydraulic Fracture: Overview



CarnegieMellon

Civil and
Environmental
ENGINEERING

Hydraulic Fracture: Aerial View



CarnegieMellon

Civil and
Environmental
ENGINEERING

Hydraulic Fracture: Impoundments



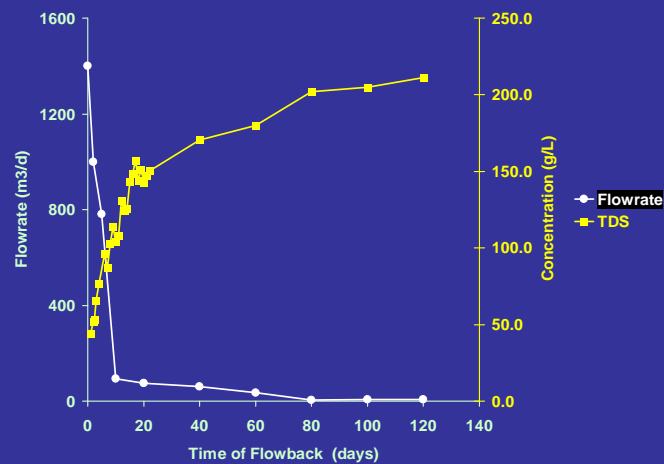
CarnegieMellon

Civil and
Environmental
ENGINEERING

Fracture Water Constituents

Constituent	Composition (% by vol)	Example	Purpose
Water and Sand	99.50	Sand suspension	"Proppant" sand grains hold open microfractures
Acid	0.123	Hydrochloric or muriatic acid	Dissolve minerals and initiate cracks in the rock
Friction Reducer	0.088	Polyacrylamide or mineral oil	Minimize friction between the fluid and the pipe
Surfactant	0.085	Isopropanol	Increase the viscosity of the fracture fluid
Salt	0.06	Potassium chloride	creates a brine carrier fluid
Thickening Agent	0.056	Guar gum or hydroxyethyl cellulose	Thickens the water in order to suspend the proppant
Scale Inhibitor	0.043	Ethylene glycol	Prevents scale deposits in pipes
pH Adjusting Agent	0.011	Sodium or potassium carbonate	Maintain effectiveness of crosslinker
Breaker	0.01	Ammonium persulfate	Delay breakdown of gel polymer chains
Crosslinker	0.007	Borate salts	Maintain viscosity of Fracture fluid as temperature increases
Iron control	0.004	Citric acid	Prevents precipitation of metal oxides
Corrosion Inhibitor	0.002	n,n-dimethyl formamide	Prevent pipe corrosion
Biocide	0.001	Glutaraldehyde	Minimize growth of bacteria which produce corrosive and toxic byproducts

Flowback Rates and TDS



Initially flowrates are very high and TDS concentrations low. As the formation depressurizes, the flowrates decrease, but the water has been in contact with soluble formation solids and the TDS concentrations increase.

Flowback Water Constituents

Constituent	Low ¹ (mg/L)	Medium ¹ (mg/L)	High ² (mg/L)
Total Dissolved Solids	66,000	150,000	261,000
Total Suspended Solids	27	380	3,200
Hardness (as CaCO ₃)	9,100	29,000	55,000
Alkalinity (as CaCO ₃)	200	200	1,100
Chloride	32,000	76,000	148,000
Sulfate	ND	7	1,000
Sodium	18,000	33,000	44,000
Calcium, total ³	3,000	9,800	31,000
Strontium, total	1,400	2,100	6,800
Barium, total	2,300	3,300	4,700
Bromide	720	1,200	1,600
Iron, total	25	48	55
Manganese, total	3	7	7
Oil and Grease	10	18	260
Total Radioactivity	ND⁴	ND	ND



Conventional Flowback Water Management Options: TDS Discharge Limit 500 mg/L

Treatment

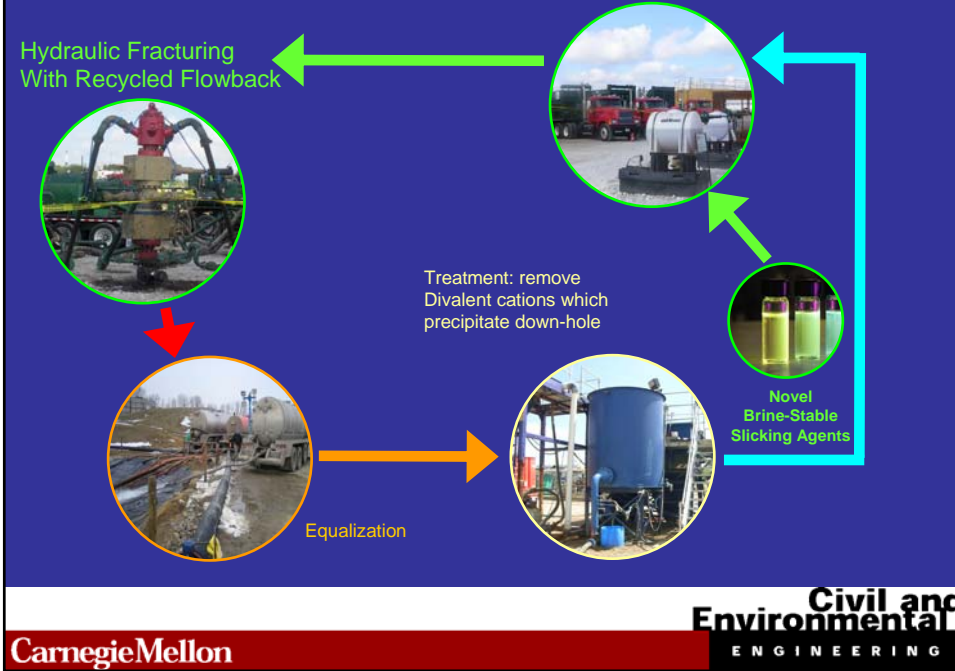
- Reverse osmosis (RO) <40,000 mg/L, \$\$, residuals
- Thermal Distillation. >100,000 mg/L, \$\$\$\$, residuals
- Artificial wetlands (mangroves need <75,000mg/L)

Disposal or Reuse

- Dilution into POTWs, (few permitted, not sustainable)
- Reinjection (class II UIC – only 8 in PA, Hauling \$\$\$)
- Ag Reuse (salinity toxicity at >2000 mg/L)
- Recycling and Reuse (emerging)



Water Reuse: Pretreatment and Fracture



Water Reuse: Pretreatment with Abandoned Mine Water



Abandoned Mine Drainage as Makeup Water for HF

Acidity 73 - 135 mg/L
Fe 80 - 107 mg/L
Mn 1.0 mg/L
Al 0.8 - 2.5 mg/L
Sulfate 763 mg/L

Flow 1400 gpm
pH 6.1

Gladden
Discharge



Chartiers Creek
at Millers Run

Costs for Each Source

Municipal Source, Pumped 2mi	\$0.60/bbl
Surface Water Source, Pumped 2 mi	\$0.43/bbl
Processed (RO) AMD Source, Pumped 2mi	\$0.36/bbl

CarnegieMellon

Civil and
Environmental
ENGINEERING

Industry and Regulatory Challenges

- The Marcellus formation is heterogeneous, even at a local scale
 - Volume of Fracture water is variable
 - Flowback volumes are variable
 - Flowback water quality is highly variable
- The additives in hydraulic fracture water are not consistent, proprietary
- Availability of Make-up water is a major cost and subject to local constraints
- Treatment, Disposal, Reuse options are subject to local constraints

CarnegieMellon

Civil and
Environmental
ENGINEERING

Attachment 12
Sustainable Water Management

PENDING

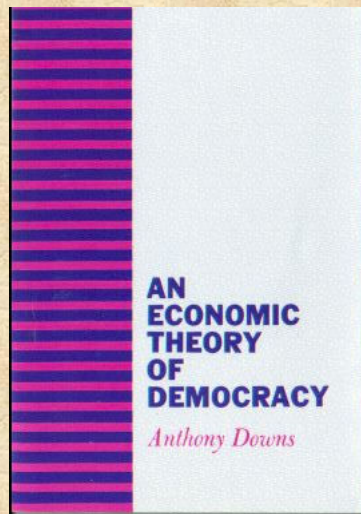
Attachment 13
Models of Deliberative Democracy:
Mechanisms for Citizen Input

Models of Deliberative Democracy: Mechanisms for Citizen Input

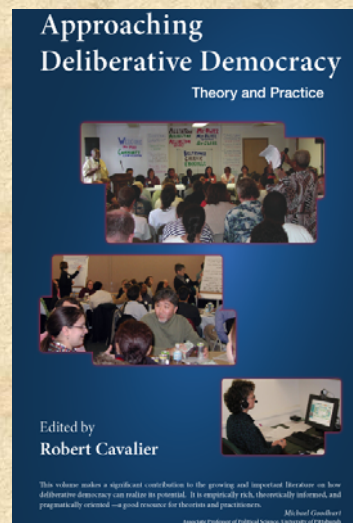


Robert Cavalier
Carnegie Mellon University

Two Models of Democracy: The Market and the Forum



A thin, liberal Democracy



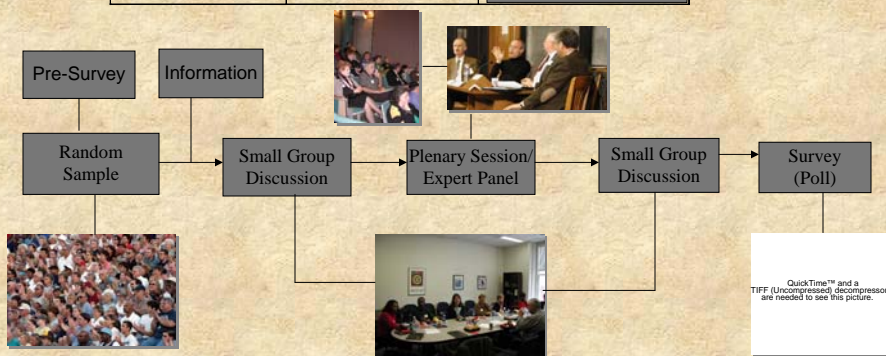
A strong, liberal Democracy

Methods of Selection for Ascertaining Public Opinion

	Raw	Refined
Self-Selection	Open-end call for votes	Discussion Groups
Random Selection	Public Opinion Polls	Deliberative Polls

Methods of Selection for Ascertaining Public Opinion

	Raw	Refined
Self-Selection	Open-end call for votes	Discussion Groups
Random Selection	Public Opinion Polls	Deliberative Polls



DP on Issue of Marriage In America

Recruitment: Voter Registration rolls from counties surrounding Slippery Rock, Carnegie Mellon, Shippensburg, and Community of College of Philadelphia

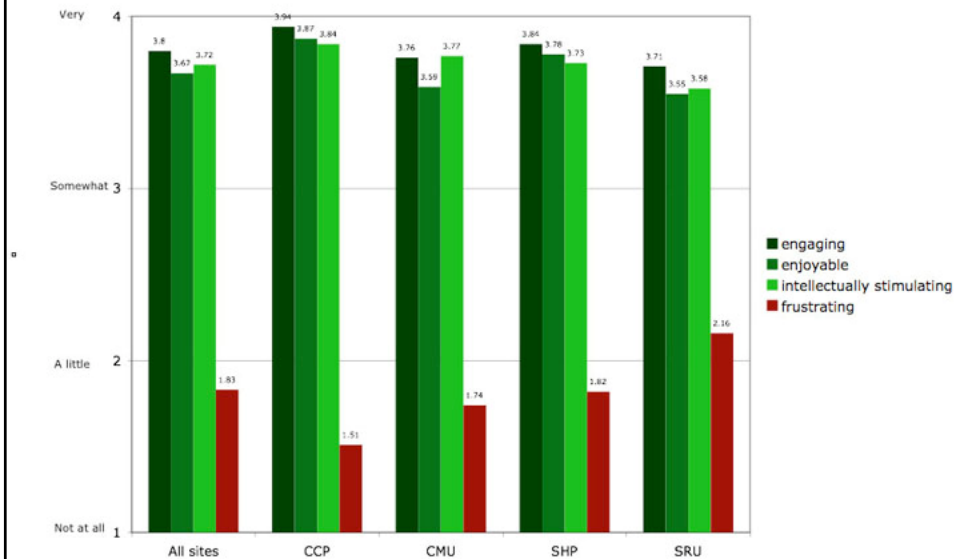


	All Sites	CCP	CMU	SHU	SRU
Form of recognition of same-sex relationships (%)					
Legal marriage	38.0	53.1	46.8	32.0	17.6
Civil unions, but not legal Marriage	32.4	34.7	25.8	38.0	35.1
No legal recognition	22.8	2.0	19.4	28.0	40.5
Unsure	6.8	10.2	8.1	2.0	6.8

Mean Age: 54



To what extent did you find participating in the Deliberative Poll



Deliberative Polls and Deliberative Loops



Increasing Citizen Engagement: Qualitative Results from Community Conversation

1. How helpful did you find...

	Not at all	A little	Somewhat	Very
the Moving Forward Together background document?	4.3%	4.3%	32.6%	58.7%
the small group discussions?	2.2%	10.9%	13.0%	73.9%
the resource panel discussion?	4.4%	8.9%	26.7%	60.0%

2. How much did the Community Conversation...

	Not at all	A little	Somewhat	Very
give you a better understanding of important issues facing your community?	2.1%	12.8%	44.7%	40.4%
help you identify solutions to important issues?	2.1%	23.4%	46.8%	27.7%
cause you to consider points of view that you had not previously considered?	6.4%	10.6%	53.2%	29.8%

Increasing Citizen Engagement : Qualitative Results from Community Conversation

3. Will you become more engaged in your community as a result of the Community Conversation?

Definitely yes	Probably yes	Probably not	Definitely not
72.0%	16.3%	9.3%	2.3%

4. Given what you know now, would you still have participated in the Community Conversation?

Definitely yes	Probably yes	Probably not	Definitely not
79.5%	18.2%	2.3%	0.0%

Learning Circles and Action Forums



