

Greening Response Actions

OSC Readiness

February 12, 2009



2009 OSC READINESS TRAINING PROGRAM
SAN DIEGO, CALIFORNIA ■ FEBRUARY 9–12, 2009

Greening Response Actions & You

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EPA/OSRTI



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What is “Green Remediation”?

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

Opportunities to Increase Sustainability in Site Cleanups

- Apply to all cleanup programs
- Exist throughout site investigation, design, construction, response operations, and monitoring
- Help meet requirements of federal mandates, e.g. E.O. 13423 and Energy Policy Act



Core Elements: Energy Requirements

- Optimized passive-energy technologies (with little or no demand for external utility power) to treat low levels of contamination
- Energy efficient equipment operating at peak performance
- Renewable energy systems in remote locations or to offset grid electricity

PV array for pumping 2-3 gpm of water through a low-energy mulch bioreactor at Altus AFB



Portable PV system for 5-month SVE operations after oil pipeline break at Rocky Mountain House air base in Alberta, Canada



Core Elements: Air Emissions

- Use of cleaner fuel and retrofit diesel engines
- Modified operations to reduce operating and idle time
- Minimized dust export of contaminants
- Alternatives to off-site T&D of contaminated soil

Air compressors mounted on windmills to power hydraulic skimming pumps for recovery of petroleum from ground water at former St. Croix Alumina Plant



Paved bike path constructed above waste left in place in high-altitude California Gulch mining area



Core Elements: Water Requirements and Resources

- Minimum fresh water use and maximum reuse
- Reclaimed treated or storm water for beneficial use or storage
- Native vegetation requiring little or no irrigation
- Prevention of water quality impacts, e.g. nutrient-loading or disruption of natural hydraulics

Stormwater channels and erosion control blankets for excavation and backfilling at Port Deposit



Low impact development strategies restoring original conditions after Poudre River excavation



Core Elements: Land and Ecosystems

- Minimal habitat disturbance such as noise and lighting
- Soil and sediment protection from compaction, decon, or uncontrolled traffic
- Ecorestoration practices
- Use of local byproducts such as fly ash or ag waste
- Minimally invasive in situ technologies

Metal salt crust along Upper AK River prior to Superfund removal



Ten years after applying municipal biosolids and assorted nutrients



Core Elements: Material Consumption and Waste Generation

- Minimized extraction and disposal of natural resources
- Reuse and recycling of materials, including C&D debris and clean metal
- Passive sampling devices and cleanup technologies producing minimal waste

Salvaged concrete during response actions at Barksdale AFB, as part of federal "greening the government" goals



Single ten-day mobilization for investigations and removal actions at Paducah GDP, needing only 23 lab samples through use of Triad



Core Elements: Long-Term Stewardship

- Reduced emission of CO₂, methane, and other GHGs
- Adaptive management approach reflecting local priorities and state-of-the-art technologies
- Leverage of response action infrastructure into future site use

Environmentally friendly brownfield cleanup converting illegal "Grove Landfill" into environmental education facility



Community involvement in environmental monitoring of Re-Solve, Inc. Superfund site



Is It Your Job?

EPA Strategic Plan: Goal 5

Compliance and Environmental Stewardship

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

FEMA Post-Disaster Sustainability Mission Statement

To promote and facilitate sustainable redevelopment at the local level by integrating the principles and practices of sustainable development into the broader goals of the post-disaster recovery process. EPA support to FEMA sustainability planners includes determining whether major environmental issues could be partially addressed through a sustainability initiative. Immediate disaster recovery processes (described in "Rebuilding for a More Sustainable Future: An Operational Framework") address sustainable public infrastructure including water, sewer, and energy systems. The guidance also may be used as a reference during non-disaster time.

What About the NCP?

- Section 300.415(i) requires on-site CERCLA removal actions to comply with ARARs to the extent practicable
- Federal ARARs may include new “greening” requirements
- Location-specific ARARs may include new energy, waste management, and construction requirements of local agencies

Core Elements of Green Remediation		Energy	Air	Water	Land & Ecosystems	Materials & Waste	Long-Term Stewardship							
NCP Criteria	Sub-Criteria	Remedial Process Optimization	Renewable Energy	GHG	PM10	Water Conservation	Water Quality Enhancement	Land Use	Ecosystems	Transfer vs. Destruction	Waste Reduction	Recycling and Reclaiming	Adaptive Management	Community Involvement
		Protection of Human Health and the Environment	Protection of the Human Health and the Environment	x	x	x	x	x	x	x	x	x	x	x
Compliance with ARARs	Compliance with Chemical-Specific ARARs													
	Compliance with Action-Specific ARARs													
	Compliance with Location-Specific ARARs													
Long-Term Effectiveness	Compliance with Other Criteria, Advisories, and Guidances	x	x	x		x	x							
	Magnitude of Residual Risk													
	Adequacy and Reliability of Controls													
Reduction in Toxicity, Mobility, and Volume	Treatment Process Used and Materials Treated													
	Amount of Hazardous Materials Destroyed, Treated, or Recycled													
	Degree of Expected Reductions in Toxicity, Mobility, and Volume													
Short-Term Effectiveness	Degree to Which Treatment is Irreversible													
	Does the Alternative Satisfy Statutory Preference for Treatment													
	Type and Quantity of Residual Remaining After													
Implementability	Protection of Community During Remedial Actions													
	Protection of Workers During Remedial Actions													
	Environmental Impacts	x	x	x	x	x	x	x	x	x	x	x	x	x
Cost	Time Until Remedial Action Objectives are Achieved													
	Ability to Construct and Operate the Technology													
	Reliability of the Technology													
State Acceptance	Ease of Undertaking Additional Remedial Actions, if Necessary	x												
	Ability to Monitor Effectiveness of Remedy	x												
	Ability to Obtain Approvals From Other Agencies	x	x											
Community Acceptance	Coordination with Other Agencies													
	Availability of Offsite Treatment, Storage, and Disposal Services/Capacity													
	Availability of Necessary Equipment and Specialists													
Community Acceptance	Availability of Innovative Technologies	x	x											
	Capital Cost													
	Operating and Maintenance Costs													
Community Acceptance	Present Worth Cost													
	State Acceptance													
	Community Acceptance													

x = potential intersection with National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria (40 CFR Part 300)

Adapted from CDM presentation at the "Battelle" Sixth International Conference on Remediation of Chlorinated and Recalcitrant Compounds Conference 2008

Greening Your Projects: Strategies

- Two step process:
 1. Be aware of the options you have at your projects
 2. Use the authorities you have to put them in place (more under toolkit presentation)
- Network with fellow OSCs
- Include language in your performance standards
- Keep an eye on other programs (BF, RCRA-CA, Superfund Remedial, UST, etc). Different programs, but similar activities

Partners in Green Response Actions

Technology Innovation Program Green Remediation (GR) Effort

Superfund GR Workgroup

Technical Support Project (TSP) Green Committee

Green Remediation, Revitalization, and Reuse (GRRR) Team

Climate Change and Contaminated Lands (CCCL) Workgroup

Climate Change Coordinating Committee (C4)

ASTSWMO Greener Cleanups Task Force

ITRC Green and Sustainable Remediation (GSR) Project

Federal Remediation Technologies Roundtable (FRTR) GR Focus

EPA Partnerships with Other Federal Agencies

Department of Defense (USACE IAG & MOU)

Department of Energy (NREL IAG & MOU)

State Initiatives (Cal/EPA GR Team, Illinois Greener Cleanups, Wisconsin Initiative on Sustainable Cleanups (WISC)

Brownfields Sustainability Pilots: Green Redevelopment

Tribal Initiatives

EPA Regional Initiatives:

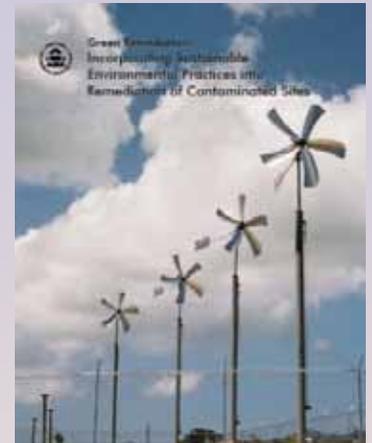
Region 3 Pilot Project on Green Cleanup Standards

Region 9 Cleanup-Clean Air Initiative

Sustainable Remediation Forum (SuRF)

Green Response Action Resources

- OSWER “green remediation primer”
- Contracts toolkit for ERRS and RACs
- GR Web
www.clu-in.org/greenremediation
- Webinars and archived discussions
www.cluin.org
- Tech support for federal and state project managers



Developing Resources

- Green Remediation Analyses and Development of Methodology (Region 9)
- Remedy- and issue-specific “cheat sheets”
- Site cleanup energy audit tool
- Profiles of green removal projects
- Engineering Forum “GR review and technical support” capability
- Green cleanup voluntary standards project

For More Information

www.clu-in.org/greenremediation

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CLU-IN.ORG | Green Remediation | Overview

EPA United States Environmental Protection Agency

Technology Innovation Program

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Green Remediation

Overview

EPA's Office of Solid Waste and Emergency Response (OSWER) is working with private and public partners to foster the use of best management practices (BMPs) for green remediation at contaminated sites throughout the United States. OSWER is documenting the state of BMPs, identifying opportunities for improvement, establishing a community of BMP practitioners, and developing mechanisms and tools to help site cleanup and reuse stakeholders make informed decisions about "green cleanup" strategies.

Green Remediation: The practice of considering all environmental effects of remedy implementation and incorporating options to maximize the net environmental benefit of cleanup actions.

In the News

- EPA issues Green Remediation: Best Practices for Excavation and Surface Restoration quick-reference fact sheet.
- California Department of Toxic Substances Control hosts Symposium on Green Remediation on February 4.
- Elements of EPA's recently proposed guidelines for controlling pollutant discharge from construction sites can apply to remedy construction for green cleanups.
- EPA offers a Green Remediation Tools and Examples Webinar on January 13.
- Wisconsin's Department of Natural Resources embarks on its new *Wisconsin Initiative for Sustainable Cleanups (WISC) Initiative*.
- Federal agencies focus on green remediation at the December 2008 meeting of the *Federal Remediation Technologies Roundtable*.

The Green Remediation Toolbox provides materials on core elements and BMPs of green remediation, contracting and administrative toolkits, decision-making tools, and links to initiatives involving green remediation applications.

Technical Information targets related documents concerning "whole cleanup" sustainability, guidance and policy, renewable energy, design, construction, and operations, and system optimization.

Profiles & Case Studies of Green Remediation illustrate BMP applications during project planning or in the field at 22 Superfund, RCRA, federal facility, brownfield, or state/voluntary cleanup sites.

Additional Resources are available from other federal and state agencies, industry and advisory groups, and related EPA programs or issue arenas.

New Site-Specific Profile of Green Remediation in Action
Cleanup at the Former Ferdula Landfill in Frankfort, NY, relies on wind-driven vacuum

ERRS Contract Toolkit

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ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
Pre-Award Activities	Planning the Procurement	Get group of OSCs, Project Officers (POs) and Contracting Officers (COs) together 18 months before RFP is issued to discuss how to craft contract to encourage innovative strategies. Consider additional conversations with other Regions, OSRTI, USACE, BLM, DOT, and other agencies. Compare notes and share ideas.	OSRTI ERRS Designated Lead. The OAM SRRPOD Service Center Manager in charge of ERRS. Advisory group of OSCs, POs, and COs to be established.	Users of the contract will have direct influence on how the contract is structured. OSCs can bring back field experiences for ideas to encourage the use of innovative approaches.
		Establish cross program Superfund team as an advisory group for all pre-award activities, for all contracts.	Same as Above	Same as Above
		Review contracts in other Regions and other agencies for similar work to see how they are written. Talk to peers in other regions and other agencies (USACE, DOD, Interior, etc.) to get ideas.	Same as Above	Same as Above

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
Pre-Award Activities	Planning the Procurement	Prepare new statement of work (SOW) language which suggests recommended innovative technologies that can be used during the removal action. This may be incorporated at the contract level, and may also be done at the Task Order (TO) level. Given the time sensitive nature of the tasks, opportunities for innovative approaches may be more appropriate at the overall SOW level. Be sure to include sustainability reporting requirements.	OSRTI ERRS Designated Lead. The OAM SRRPOD Service Center Manager in charge of ERRS. Advisory group of OSCs, POs, and COs to be established.	Users of the contract will have direct influence on how the contract is structured. Field personnel can suggest ideas for encouraging the use of innovative approaches.
Pre-Award Activities	Establishing Contract Type	Consider contracts which allow performance based task orders to provide incentives (positive or negative). True performance-based contracts permit contractor to decide on approach. Structure incentives to focus in part on use of innovative strategies. Consider use of Award Fee contracts and establish Award Term contracts, if the Region is willing to commit the resources needed to manage such contracts.	Same as above.	Contracts will have built-in incentives for suggesting and utilizing innovative strategies.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
Pre-Award Activities	Establishing Contract Type	Consider site-specific contracts where such vehicles will enable and incentivize innovative approaches. (NOTE: It may not be possible in all situations to make these performance-based, since contractor may need to comply with design specifications.)	OSRTI ERRS Designated Lead. The OAM SRRPOD Service Center Manager in charge of ERRS. Advisory group of OSCs, POs, and COs to be established.	Contracts will have built-in incentives for suggesting and utilizing innovative strategies.
Pre-Award Activities	Writing the Contract SOW	Clearly establish requirements in TO for contractor to consider or utilize innovative approaches where appropriate. Given the time sensitive nature of the tasks, opportunities for these innovative approaches are more appropriate at the overall SOW level.	Same as above.	Contracts will contain specific provisions for alternative approaches in each area of SOW.
		Consider using a Work Breakdown Structure for removal actions. Go through SOW task by task to identify areas where using innovative strategies is feasible. Write specific language under each task, as appropriate. (NOTE: This can also be used at the TO level.)	Same as above.	Contracts will contain specific provisions for alternative approaches in each area of SOW.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
Pre-Award Activities	Writing the Contract SOW	Provide an attachment showing possible innovative technologies that can be used during the removal action or emergency response.	OSRTI ERRS Designated Lead. The OAM SRRPOD Service Center Manager in charge of ERRS. Advisory group of OSCs, POs, and COs to be established.	Contracts will contain specific provisions for alternative approaches in each area of SOW.
	Establishing Contract Terms and Conditions	Provide for reduced burdens on contractor if they utilize innovative approaches (e.g., relieve them from some contractual requirements, like certain reporting requirements, if possible and appropriate). There should be specific limits on these allowances.	Same as above, plus OGC advice for liability language.	Contracts will have built-in incentives. Contractors will be more willing to take risks. EPA will have data on alternative strategies.
		Relieve contractors from legal liability, if possible, when using new, untested technology. (NOTE: OGC must be consulted.)	Same as above.	Same as above.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
Pre-Award Activities	Establishing Contract Terms and Conditions	Establish standard reporting requirements for proposed innovative strategies. Include a requirement to evaluate the success of each new strategy.	OSRTI ERRS Designated Lead. The OAM SRRPOD Service Center Manager in charge of ERRS. Advisory group of OSCs, POs, and COs to be established.	Contracts will have built-in incentives. Contractors will be more willing to take risks. EPA will have data on alternative strategies.
		Provide contingencies affecting the exercise of optional periods of performance or increases in levels of effort that address the contractor's willingness to use innovative strategies (Award Term Options).	Same as above.	Same as above.
	Developing Evaluation Criteria and Selecting Contractors	Request that technical proposals include various approaches for evaluating and utilizing innovative cleanup strategies. Develop evaluation criteria that consider an offeror's use of innovative technologies. Assign higher scores to contractors who have a proven track record in this area and are willing to continue to try new approaches to the work. Base selection, in part, on a firm's commitment to environmental sustainability, including the implementation of an Environmental Management System. Recognize that higher costs may be a result of alternative strategies.	Same as above, plus experts for various innovative strategies.	Higher scores will be possible for offerors that have experience, expertise, and willingness to consider alternative approaches. EPA will have a cadre of contractors who are experienced in these areas and willing to take some risks.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
Pre-Award Activities	Developing Evaluation Criteria and Selecting Contractors	When evaluating past performance, require specific references from officials who have direct knowledge of offerors' experience with innovative approaches.	Same as above, plus experts for various innovative strategies.	Higher scores will be possible for offerors that have experience, expertise, and willingness to consider alternative approaches. EPA will have a cadre of contractors who are experienced in these areas and willing to take some risks.
		Use OSCs or other specialists who can evaluate innovative approaches as members of TEP or advisors to help evaluate this part of proposal.	Same as above.	Same as above.
During Contract Performance	Writing the Task Order	Clearly establish a preference for contractors that consider or utilize innovative approaches.	OSCs are generally responsible for writing TOs and developing the independent government cost estimates (IGCEs). The advisory group of OSCs, POs, and COs to be established could be useful resources to help identify the latest innovative strategies.	The individual TOs will provide the most detailed information and requirements on site level activities and can be used to outline specific requirements or state preferences for the use of innovative cleanup strategies.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
During Contract Performance	Writing the Task Order	Request a section in the contractor's work plan to demonstrate how the contractor will use innovative technologies such as green cleanup during the various stages of the removal action.	OSCs are generally responsible for writing TOs and developing the independent government cost estimates (IGCEs). The advisory group of OSCs, POs, and COs to be established could be useful resources to help identify the latest innovative strategies.	The individual TOs will provide the most detailed information and requirements on site level activities and can be used to outline specific requirements or state preferences for the use of innovative cleanup strategies.
		Request that contractors propose alternative approaches, where appropriate.	Same as above.	Same as above.
		Be prepared to modify the TO, if necessary, once an approach has been selected.	Same as above.	Same as above.
		Using a work-breakdown-structure approach, go through TO to identify areas where using innovative strategies is feasible. Write specific language under each task, as appropriate.	Same as above.	Same as above.
		Given flexibility in the contract, develop specific monetary bonus/award terms to seek out and implement/use green approaches.	Same as above.	Same as above.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
During Contract Performance	Writing the Task Order	Require that contractor prepare a section in the final report for the site that highlights any innovative technologies that were used during the removal action; these highlights can be shared with other OSCs to be implemented at other sites.	OSCs are generally responsible for writing TOs and developing the independent government cost estimates (IGCEs). The advisory group of OSCs, POs, and COs to be established could be useful resources to help identify the latest innovative strategies.	The individual TOs will provide the most detailed information and requirements on site level activities and can be used to outline specific requirements or state preferences for the use of innovative cleanup strategies.
	Onsite Activities	Encourage contractor to solicit bids from subcontractors that have implemented green approaches at other removal sites or promote the use of innovative technologies.	Same as above.	Same as above.
		Promote the use of "green" vehicles and the use of clean fuels, beyond required legal minimums, for ERRS vehicle and heavy machinery fleets. The Smart Energy Resources Guide (EPA/600/R-08/049) provides information on available mechanisms to reduce these emissions at cleanup sites.	Same as above.	Same as above.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
During Contract Performance	Onsite Activities	Encourage contractor to solicit cost effective treatment options for wastes on site.	OSCs are generally responsible for writing TOs and developing the independent government cost estimates (IGCEs). The advisory group of OSCs, POs, and COs to be established could be useful resources to help identify the latest innovative strategies.	The individual TOs will provide the most detailed information and requirements on site level activities and can be used to outline specific requirements or state preferences for the use of innovative cleanup strategies.
		Encourage recycling of materials onsite including aluminum, paper, and scrap where appropriate.	Same as above.	Same as above.
	Reviewing and Approving Work Plan	Evaluate any alternative approaches. Request that contractors state how they plan to use innovative technologies, such as green cleanup, during removal action. Have them present the pros and cons of utilizing various approaches, as well as documenting additional costs, scheduling impacts, and potential contingencies.	OSCs are responsible for reviewing the technical approaches contained in work plans but the PO/COs must be intimately involved to facilitate any negotiations.	Negotiation on technical approach and cost allows refinement and EPA approval of innovative approaches.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
During Contract Performance	Reviewing and Approving Work Plan	Negotiate with the contractor if their approach is not acceptable. Focus on the need for the contractor to be cost efficient and practical when proposing innovative technologies.	OSCs are responsible for reviewing the technical approaches contained in work plans but the PO/COs must be intimately involved to facilitate any negotiations.	Negotiation on technical approach and cost allows refinement and EPA approval of innovative approaches.
		Evaluate any tradeoffs with traditional approaches before approving.	Same as above.	Same as above.
		Ensure, after negotiations, that the final work plan documents all agreements and understandings in implementing the work while using practical innovative technologies.	Same as above.	Same as above.
	Evaluating Performance	Provide recognition of contractors that use innovative strategies during the annual evaluation in the NIH Contractor Performance System or any other performance evaluations. (There is no separate NIH category for this, but the PO can include this in the overall performance ratings.) If a contractor's score is borderline between two levels, this may push them into a higher bracket.	OSCs complete monthly review and PO and COs are involved in annual review.	Financial incentives are persuasive way to encourage innovation.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
During Contract Performance	Evaluating Performance	If the contract is performance-based, measure performance and apply rewards accordingly.	OSCs complete monthly review and PO and COs are involved in annual review.	Financial incentives are persuasive way to encourage innovation.
		If the contract is Award Fee type, evaluate the performance in accordance with established criteria, which can include the use of innovative strategies. (NOTE: Award Fee criteria can be changed unilaterally by the Government for future periods, pursuant to the clause set forth in EPAAR 1552.216-70).	Same as above.	Same as above.

ERRS Toolkit

Stage of Contract Development		Potential Opportunity	Who to work with to develop contract language	Results/ Outcome
During Contract Performance	Recognition of Contractors	Exercise contract options contingent upon satisfactory performance, which may include willingness to use innovative strategies.	Process for individual contractor recognition differs in each Region. National recognition would be granted by advisory group of OSCs, POs, and COs.	Recognition will encourage use and provide reference for contractors' subsequent bids.
		Establish an annual Contractor's Innovation Award for contractors that implement innovative cleanup strategies use on a regional or national basis.	Same as above.	Same as above.
		Write letters to contractor corporate officers commending them on their use of innovative approaches.	Same as above.	Same as above.
		Send report cards to all contractors on how well the Government considers they have performed in this area.	Same as above.	Same as above.

Dig and Haul Case Study

Sean Sheldrake
EPA Region 10



Why Transportation?

- Transportation/heavy duty diesel equipment is often the biggest energy consumer for site response.
- Transportation and other vehicles used can be the biggest polluters for each unit of energy required to do the cleanup at your site, increasing short term risks.

West Coast Collaborative Goals

- **Protect/Improve Public Health by:**
 - Helping to meet National Ambient Air Quality Standards (PM2.5, Ozone)
 - Meeting air toxics goals (both federal and state/local partners)
 - Nonattainment / EJ areas
- **Support Energy Security and Green House Gas Reductions by:**
 - Using cleaner fuels (biodiesel, biogas/natural gas, electric...) relative to total diesel fuel
 - Advance regional/local production of renewable fuels supporting local agriculture and forestry sectors
 - Utilize SmartWay and other programs to virtually eliminate on-road, locomotive, and non-road HDD idling (ports, corridors, distribution locations)

Why is Reducing Emissions Important?

Degrades Air Quality

- Particulate Matter (PM)
- Ozone precursors

Energy and Climate Change

- Over 40% of green house gas emissions from mobile sources
- Over 90% of fuel imported petroleum

Serious Health Effects

- Diesel exhaust is a “likely human carcinogen” and respiratory irritant
- Harmful diesel PM
- Diesel exhaust contains “likely” and “known” (e.g., benzene) human carcinogens, and also have respiratory, neurological, developmental, and immunological health effects.

Why is Reducing Emissions Important?

(continued)

Costs for Society

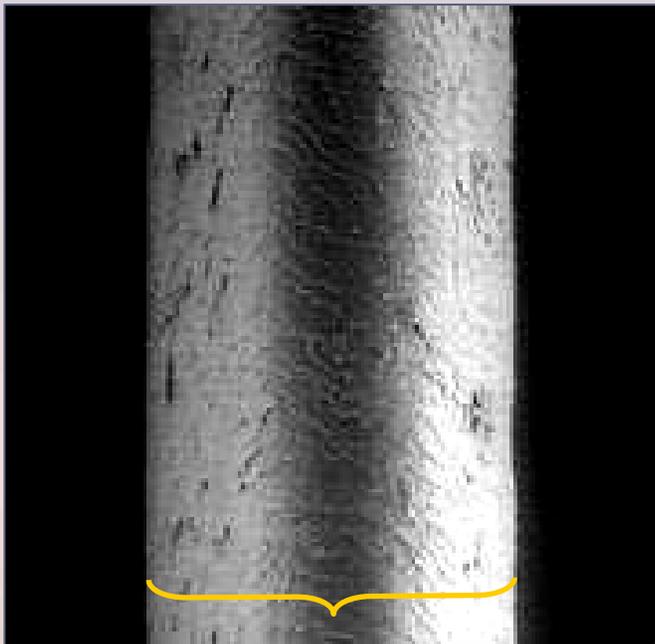
- \$Billions in healthcare per year related to PM exposure
- \$5 million/year spent on health care in California

What Are The Benefits?

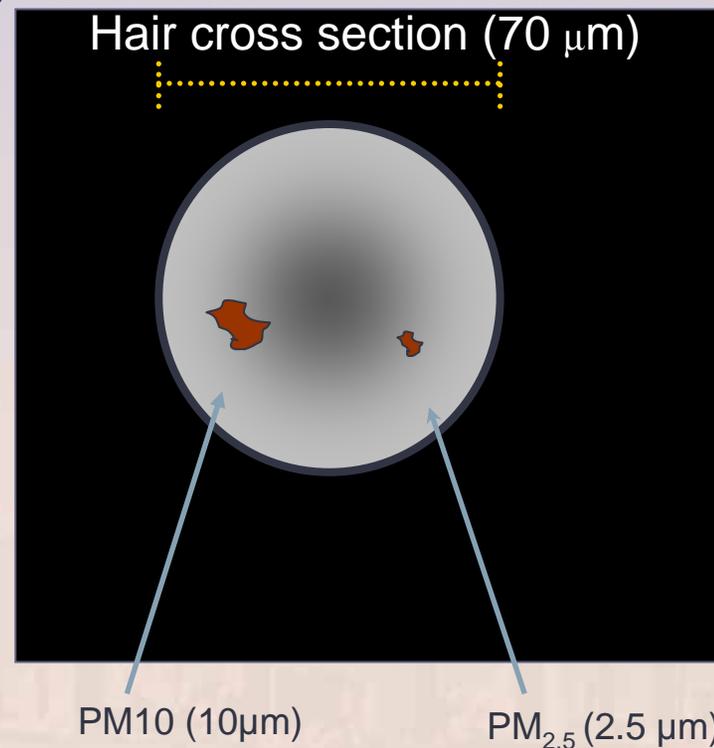
- Significantly reduces harmful particulate matter and ground-level ozone precursors
 - Reduces exposure in communities and sensitive populations nearby Superfund & redevelopment sites
 - \$1 invested in diesel emissions reductions → \$13 in health benefits
 - Decrease in hospital admissions (Asthma attacks, heart attacks, cardiopulmonary illnesses)
 - Fewer lost work and school days
- See: www.epa.gov/region09/cleanup-clean-air/index.html for more details

Particulate Matter (PM) In Diesel Exhaust Is The Driver Of Risk

- Mix of particles and liquid droplets
- Considerably smaller in size than human hair
- Penetrates deeply into the lungs



Human Hair (70 μm diameter)



Avoiding Or Substantially Reducing Emissions

- Switch from truck to rail transport
- Integrate diesel emissions issues into response planning

What If Rail Transport Isn't Practical? What Now?

- Diesel emissions controls may be a viable and cost effective option at your site.

Diesel Oxidation Catalyst (DOC)

Emissions Reductions

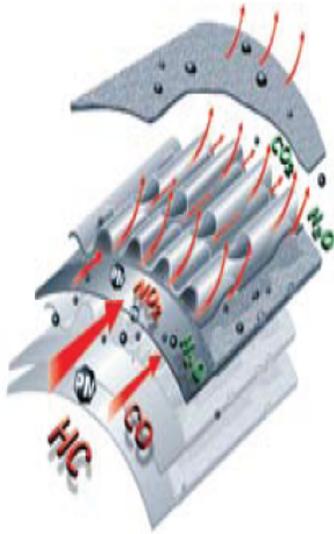
- 20% - 50% reduction in PM
- 60% - 90% reduction in HC
- >90% reduction in CO
- DOC: \$2,000 - \$4,000



Diesel Multistage Filters (DMFs)

High Efficiency Filtration *with* No Maintenance

... DMF Mufflers DO NOT require routine ash cleaning



The DMF Muffler uses a two-stage metallic filter to trap and reduce diesel particulate matter (PM). Each filter stage consists of alternating layers of a corrugated metal and a porous sintered metal fleece. The unique catalyst coating reduces PM, HC and CO, while minimizing NO_x emissions (<20% increase).

Broad Engine Coverage

- Approved for four-stroke diesel engine on-road applications with engine horsepower ranges of 150-600 hp
 - 1991-1993 model year engines (0.25 g/bhp-hr PM or less) with exhaust temperatures above 230° C at least 40% of the time.
 - 1994-2002 model engines (0.10 g/bhp-hr PM or less) with exhaust temperatures above less than 210° C at least 40% of the time.

Maintenance-Free

NO_x - 0%

PM - 50%

HC - 75%

CO - 75%

CO₂ - 0%

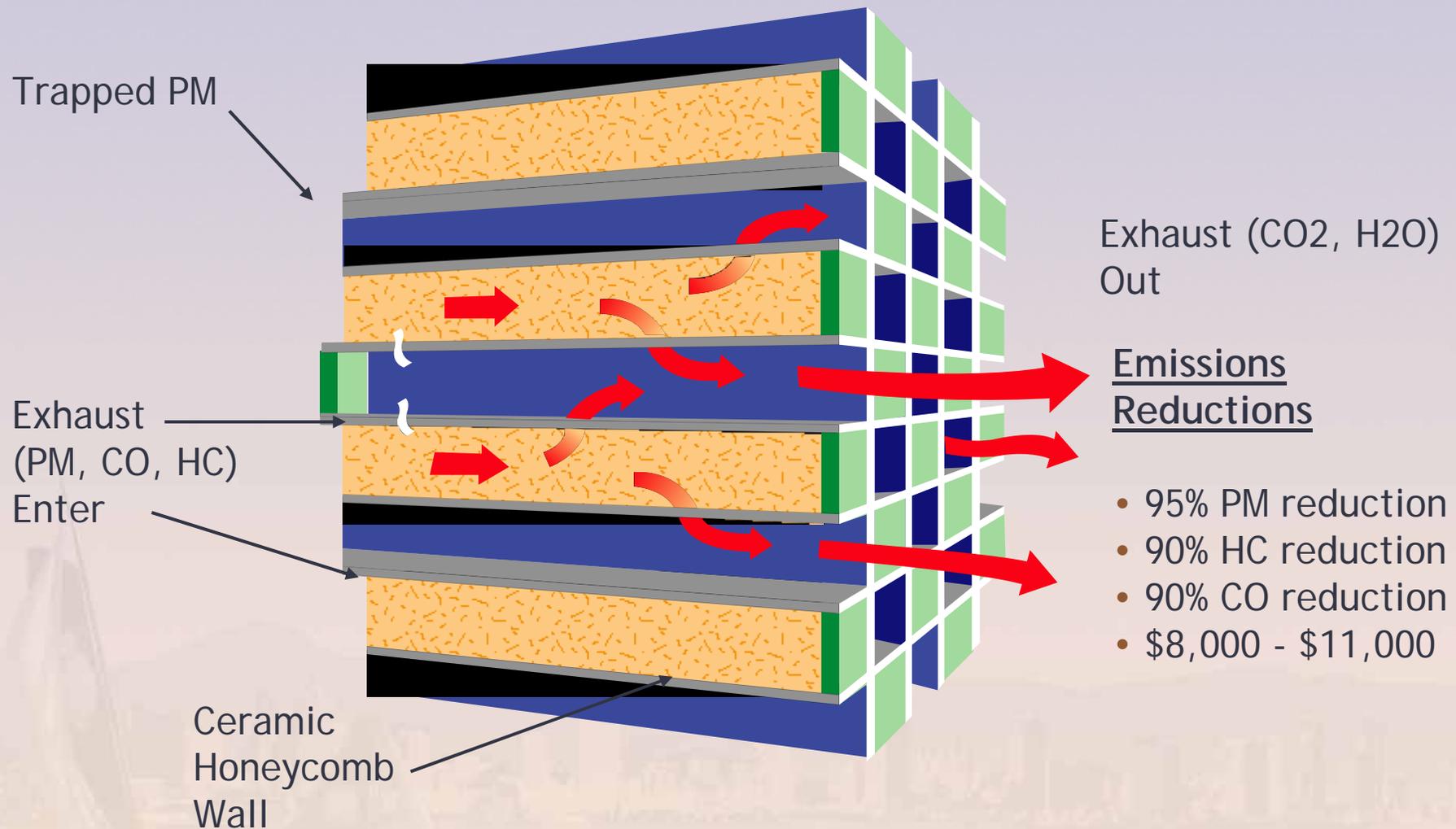
DMF: \$6,000 - \$8,000

For more information, see:

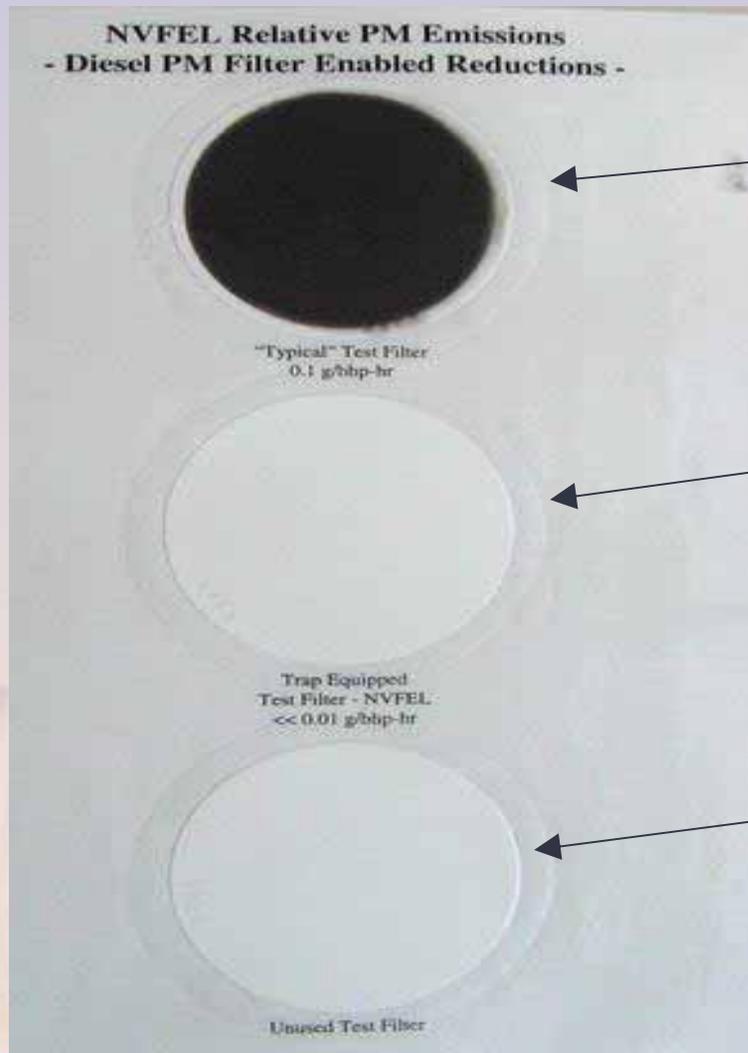
www.donaldson.com/en/exhaust/support/datalibrary/042722.pdf

www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Diesel Particulate Filter



Diesel Particulate Filter Emissions Reductions



Typical test filter - no DPF

Test filter - with DPF

Unused test filter

Other Emissions Control Technologies & Cleaner Fuels

- Selective Catalytic Reduction (SCRs)
 - 20% - 50% reduction in PM
 - 60% - 90% reduction in HC
 - >90% reduction in CO
 - 25% - 50% reduction in NOx
- Biodiesel - Neet or blends (~\$5/gallon - virgin biodiesel)
 - 10% to 50 % reduction in PM, Sulfates, & HC
- Ultra Low Sulfur Diesel (ULSD), PM 13% NOx 3% CO 6% HC 13%

See: www.epa.gov/otaq/retrofit/verif-list.htm

www.epa.gov/region09/cleanup-clean-air/index.html

www.cfpub.epa.gov/quantifier/view/index.cfm for more details



Front
Loader



Hauler



Dredging



Earth Mover



Back Hoe

Region 10 Success Stories

- ERRS contract now includes emission reduction language
- On the way—biodiesel usage in some field EPA owned and GSA vehicles
- Use of rail transport instead of trucks for soils disposal at Boomsnub removal site, Vancouver, WA



Port of Portland Terminal 4
dredging with ULSD—
reducing emissions: PM 13%,
NOx 3%, CO 6%, HC 13%



Divers Will Breathe Cleaner Air

40% less carbon monoxide



EPA dive boat in Puget Sound



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2007 Volvo Penta



1997 Yanmar

Pollutant	2007 Volvo Penta (Tier 2 emissions)	vs.	1997 Yanmar (pre-controlled)	Pounds/Year Reduced i *
	% Reduction of emissions *			
PM		77.8		10.5
NOx		39.0		93.5
CO		43.8		16.9
HC		22.0		2.0

* Emission reductions are estimates based on Tier 2 standards and emission factor calculations for pre-controlled marine engines. Wayne Elson, September 2007

ERU Truck Retrofits / Alternative Fuels

- B100 usage where available, average B50 usage reducing SO_x, CO, HC, PM by approximately 50% overall
- DMFs added to ERU trucks to reduce the remaining output of PM by another 50%



Taylor Lumber, Sheridan, OR

B20/ULSD used at the Taylor site,
reducing overall emissions substantially:
PM 13%, NOx 3%, CO 6%, HC 21%, Sulfates 20%, CO₂ 15%

H.33 CLEAN TECHNOLOGIES

The contractor will use clean technologies and/or fuels on all diesel equipment to the extent practicable and/or feasible. The preference is for clean diesel technologies, but alternative fuels, such as biodiesel or natural gas-powered vehicles are also acceptable. These alternative fuels will be used where they are available and within a reasonable distance to sites. For equipment retrofits, the contractor will employ the Best Available Control Technology (BACT) on non-road and on-road diesel powered equipment used at a site. Examples of clean diesel technologies include diesel particulate filters (DPFs), and diesel oxidation catalysis (DOCs). For alternative fuel usage, the contractor will use at least a B20 blend (i.e., 20% biodiesel and 80% petrodiesel) or higher in the equipment engines that are used at a site.

Mechanisms

- Addition of greener contract/statement of work (SOW) language in ERRS contracts
- Include language in AOCs/CDs (PRP lead), and Action Memos
- Retrofit diesel ER equipment used regularly on response actions
- Voluntary use on PRP sites

Questions?

Region 10:

Sean Sheldrake - (206) 553-1220

Wayne Elson - (206) 553-1463

On the Web:

Region 9:

www.epa.gov/region09/cleanup-clean-air/index.html

West Coast Collaborative:

www.westcoastcollaborative.org/

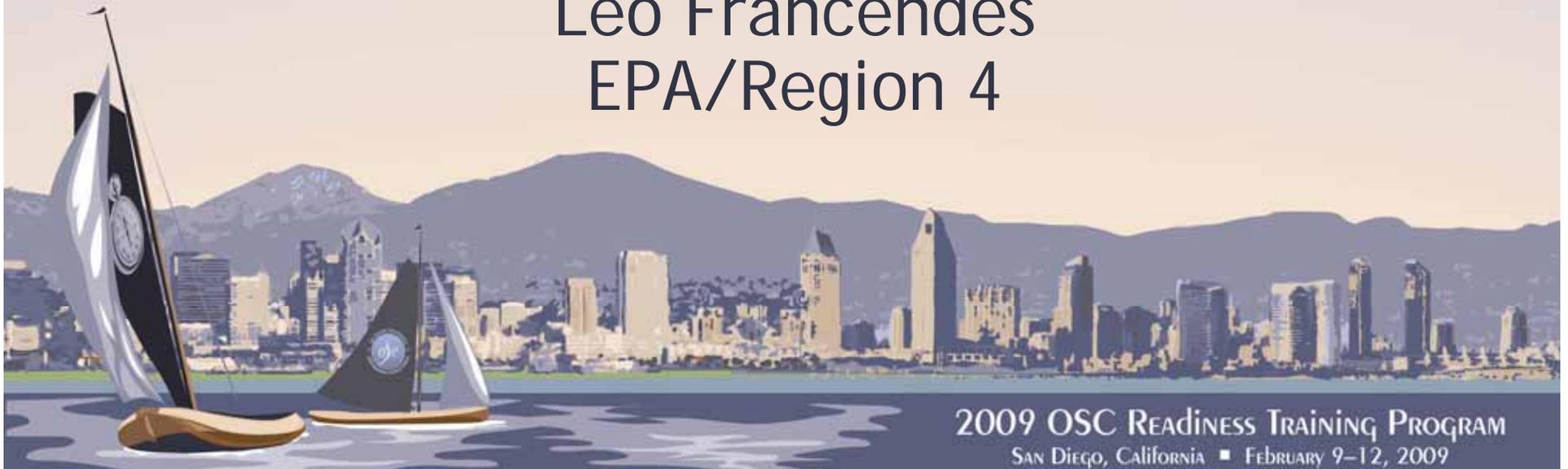


Camilla Wood Preserving Removal to Reuse

\$ 3.5 million Removal Action FY 08

Camilla, Georgia
5000ish folks

Leo Francendes
EPA/Region 4



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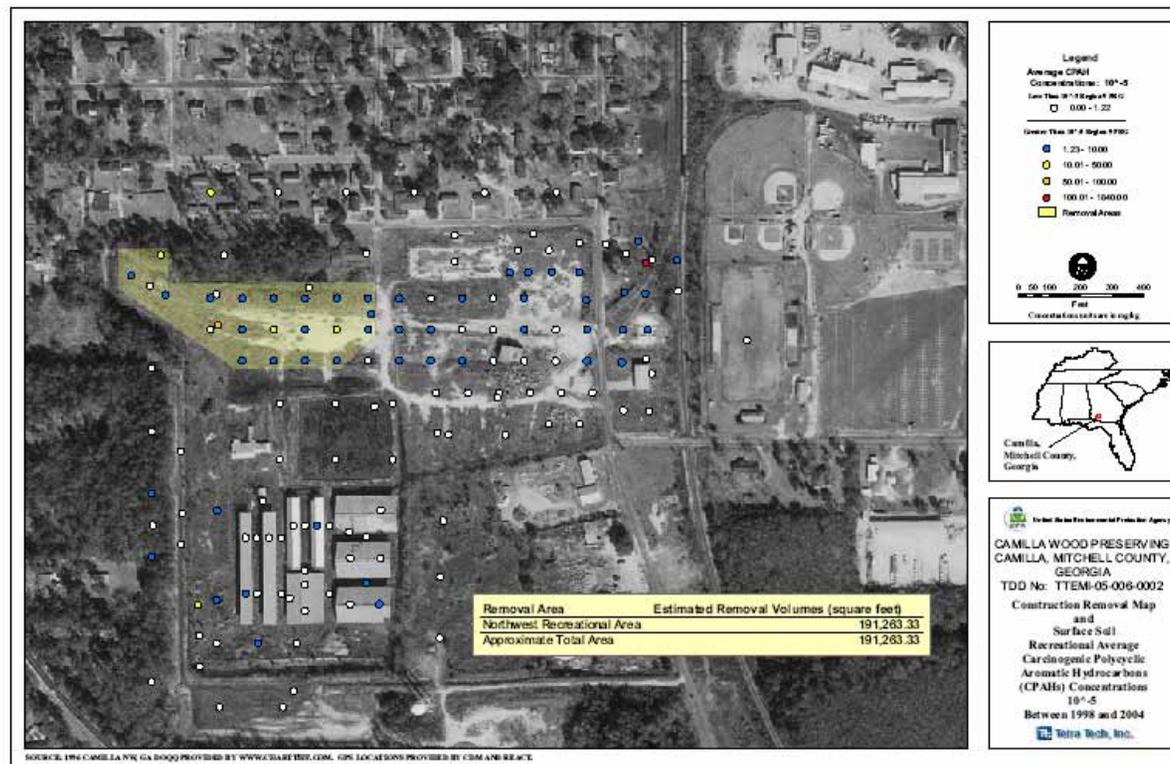
Camilla Wood Site Boundaries



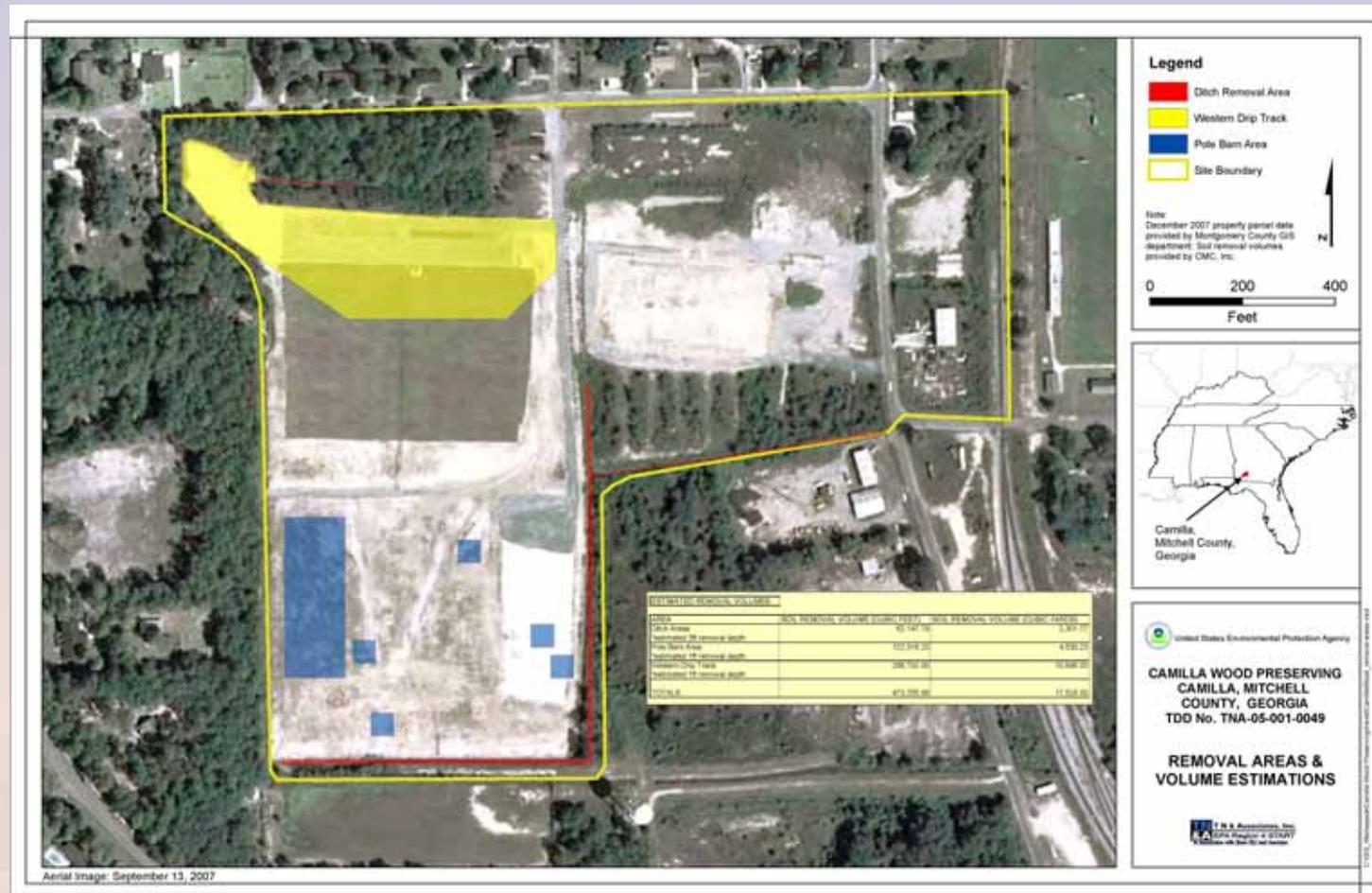
Beaver Heaven



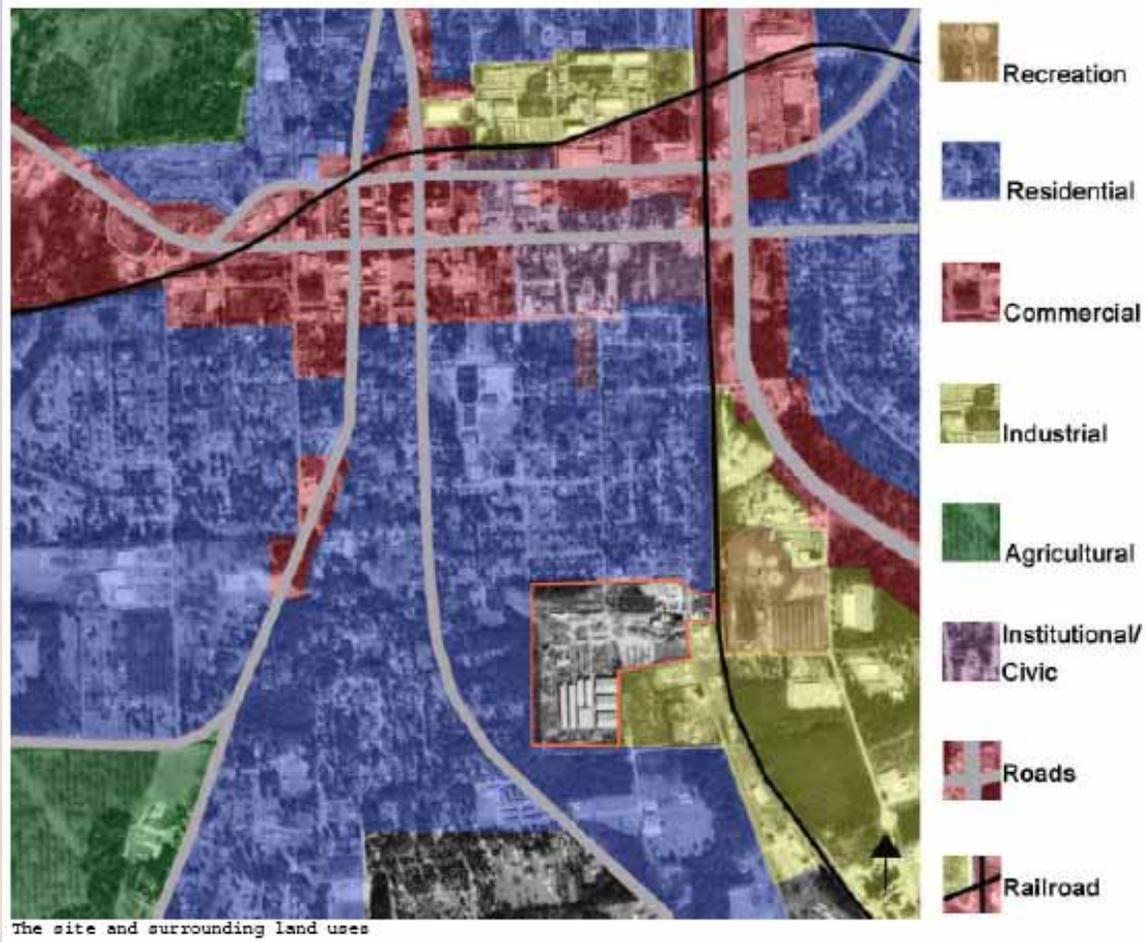
CPAH Driven Surface Soil Map



Basically a Big Ole Surgical Dirt Job



Surrounding Land Use



A Very Wet Dig



And it Rained and Rained and....



The Moments We Enjoy the Most



10,000 CYS Gone 10,000 left Behind



Millions Saved as the Community Concurs



The community wanted a low profile, capped pile while it awaits the remedial remedy.

Recycling Metals...Something We All Do



279.70 tons of
scrap steel
58.42 tons of tin

Timing, Marketing, Luck ?



Nobody wanted the poles...until they were gone

Relocating the Wildlife



I Promise I'll Walk Him and Feed Him



Mentoring Moments 😊



Over 100 Adult Turtles Released



ERT guidance and support in coordination with USFWS

No Longer the Swampland



Taking Shape



Aerial Photo of the Site
3/4/2007

The Value of the Planned Reuse Document



Planning for the Future:

A Revised Recreational Reuse Framework for the Camilla Wood Preserving Company Superfund Site
Camilla, Georgia

June 2007

EPA Region 4
Superfund Redevelopment Initiative

funded by
United States Environmental Protection Agency

prepared for
City of Camilla, GA

prepared by
Camilla Wood Preserving Company Site Land Use Committee
E² Inc.

Key Reuse and Regulatory Groups

Land Use Committee Members:

Bryant Campbell	City Council - Land Use Committee Chair
Shan Daniels	Recreation Director for Camilla and Pelham
D.F. Irwin	Camilla Fire Chief
Marilyn Royal	Mitchell County Development Authority
Michael Scott	City Manager
Alice Shelton	Resident
James Shelton	Resident

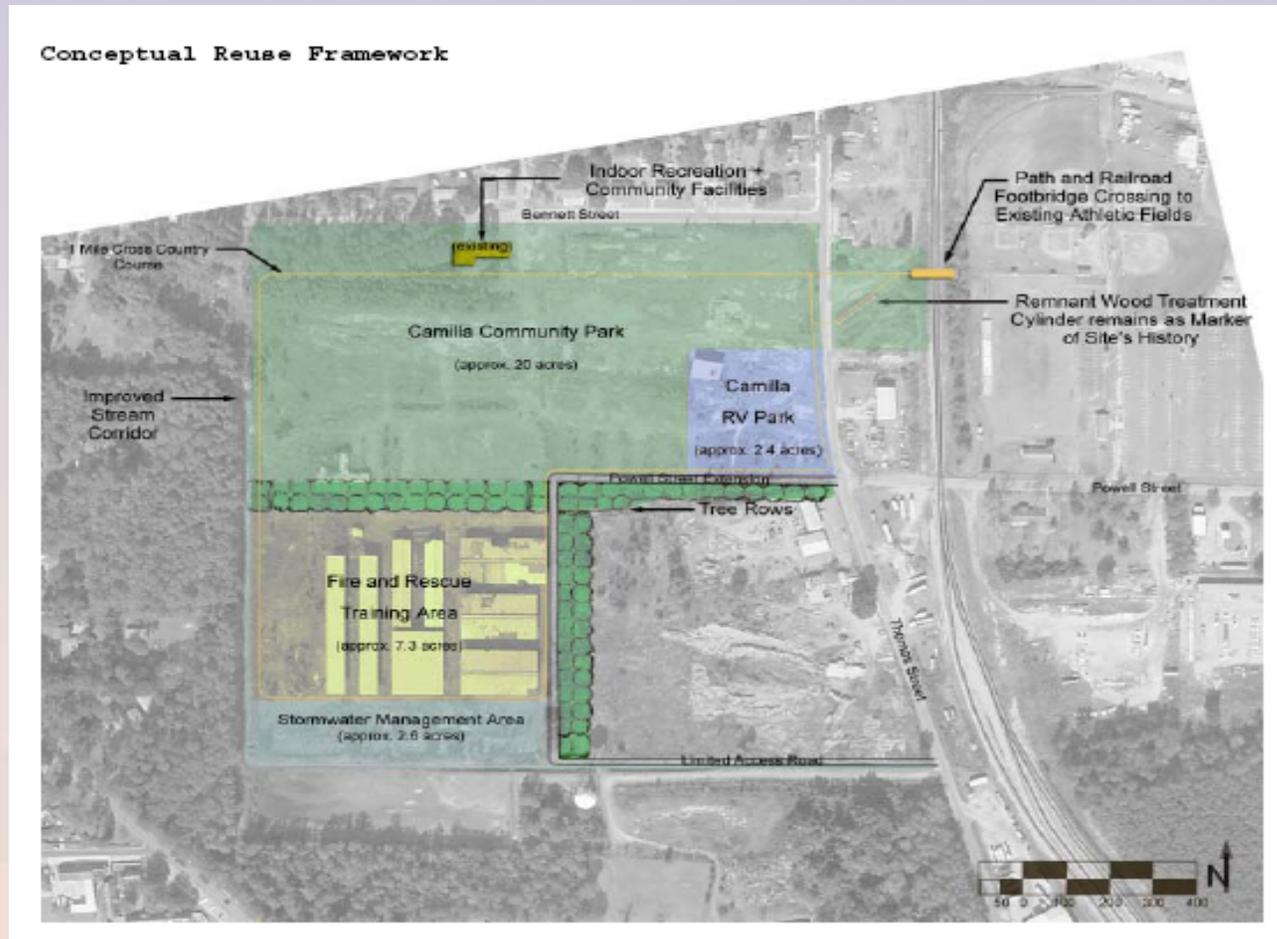
Local Officials:

Alfred J. Powell, Jr.	Mayor
Zelda Collier	City Council
Phillip Kelson	City Council
Oberia Mills	City Council
W.D. Palmer, III	City Council
Vernon Twitty, Jr	City Council
Michael Bankston	City Attorney

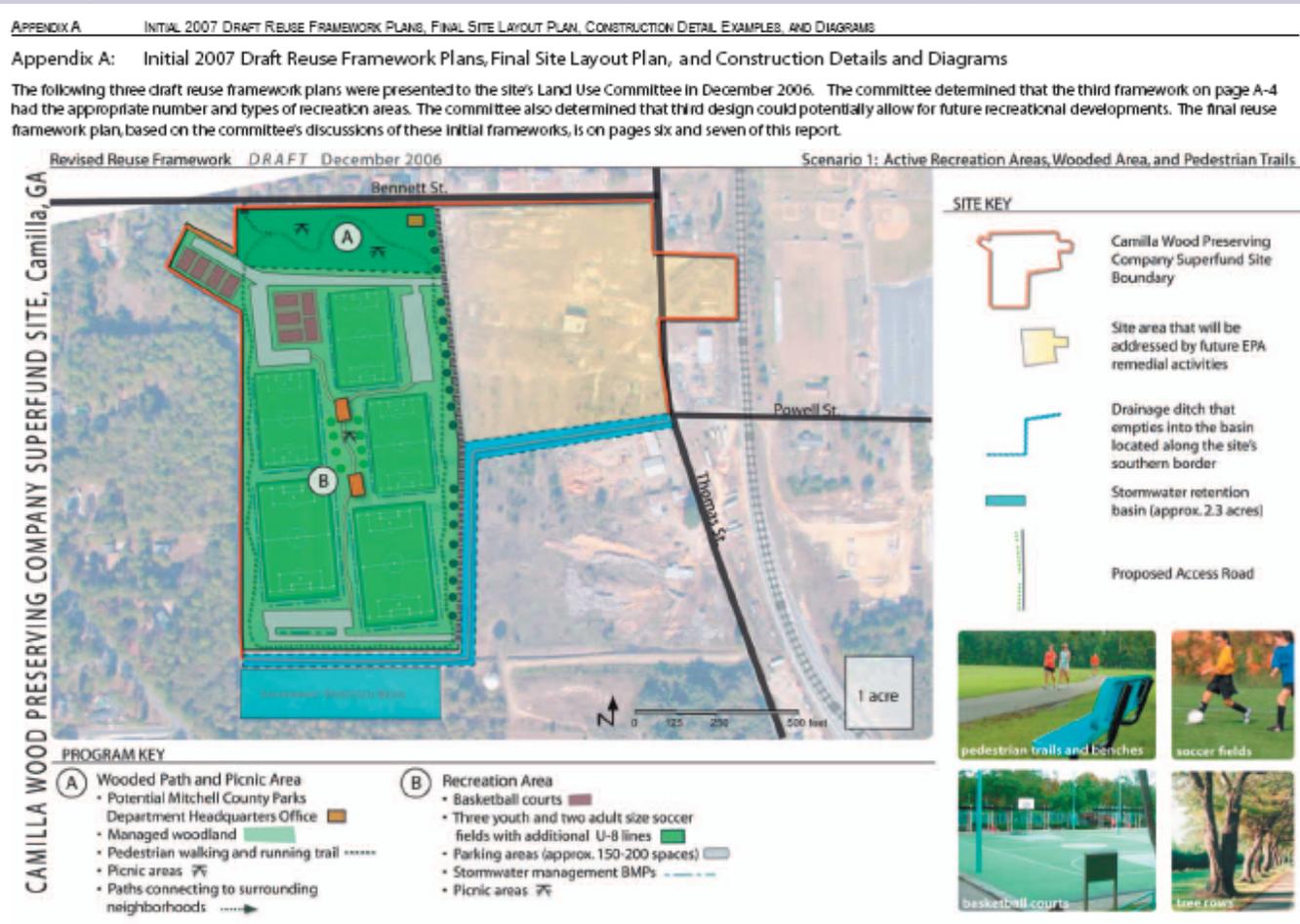
US EPA and Georgia Department of Natural Resources:

Edward Bates	US EPA, Cincinnati
Jill Clark	Georgia Department of Natural Resources
Mark Fite	Regional Reuse Coordinator, US EPA Region IV

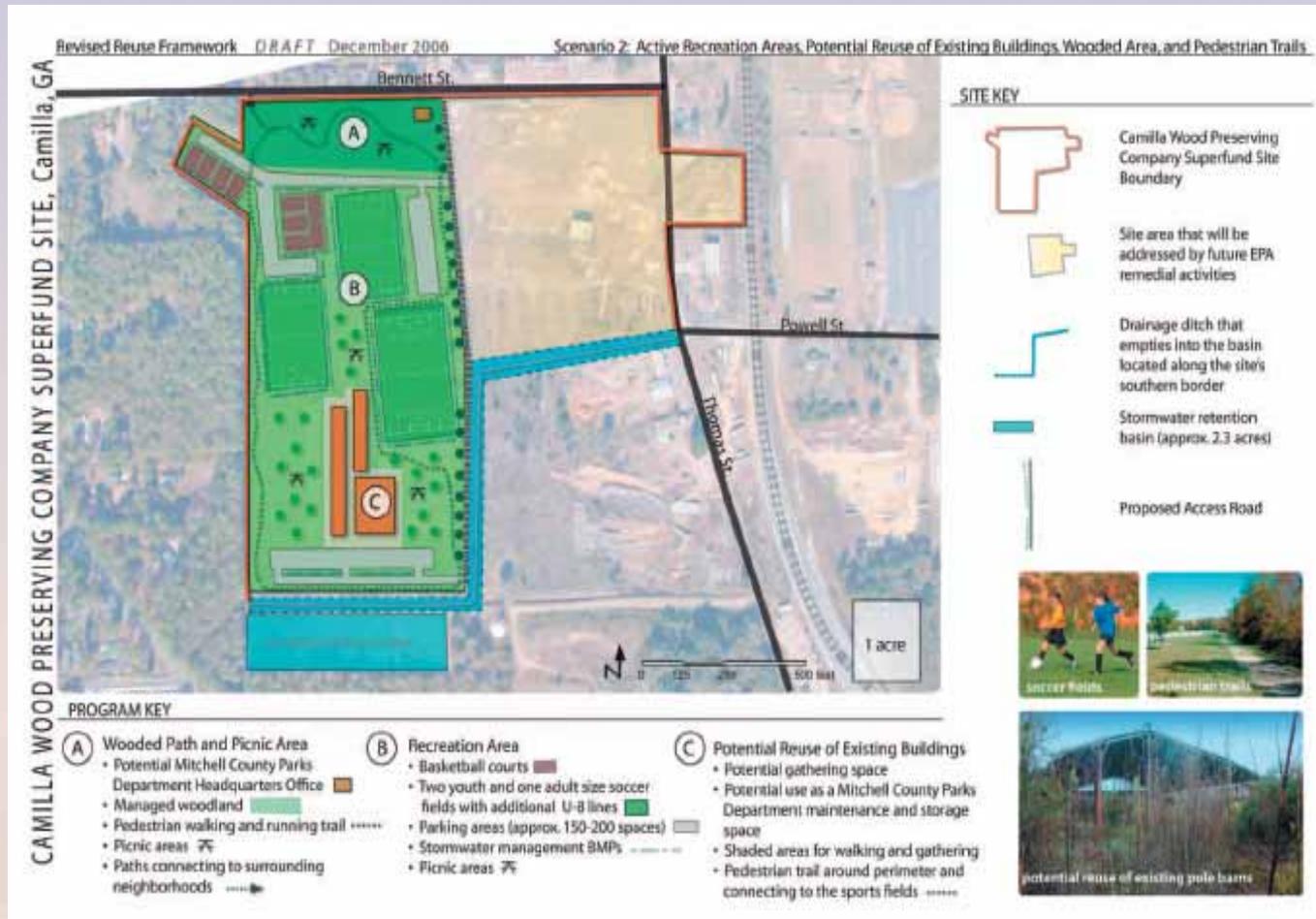
Brain Storming in 2003



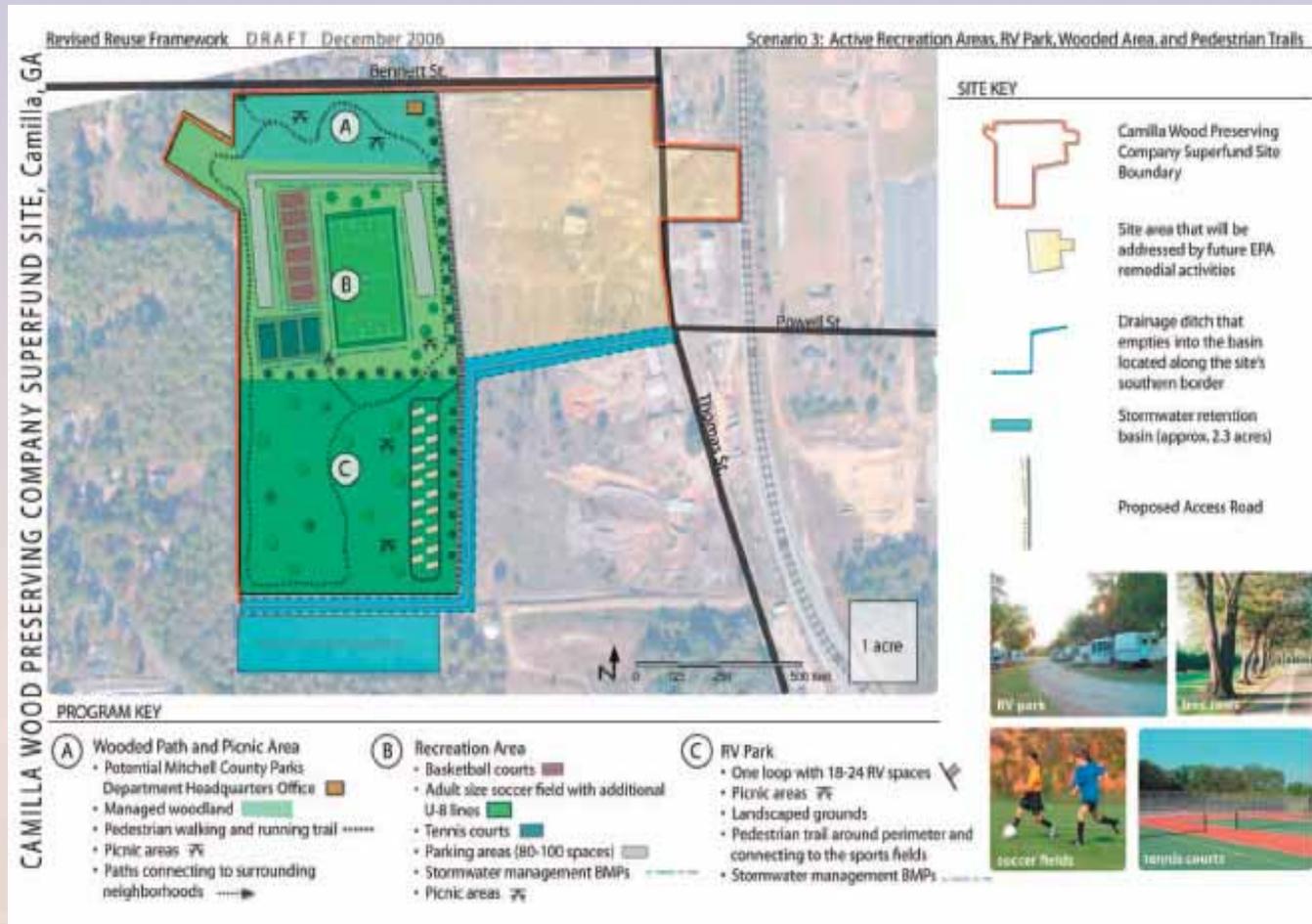
Soccer Soccer Soccer!!!



RV Park vs The Structures



Structures Gotta Go...RV Park Emerges



We Have Agreement!!!

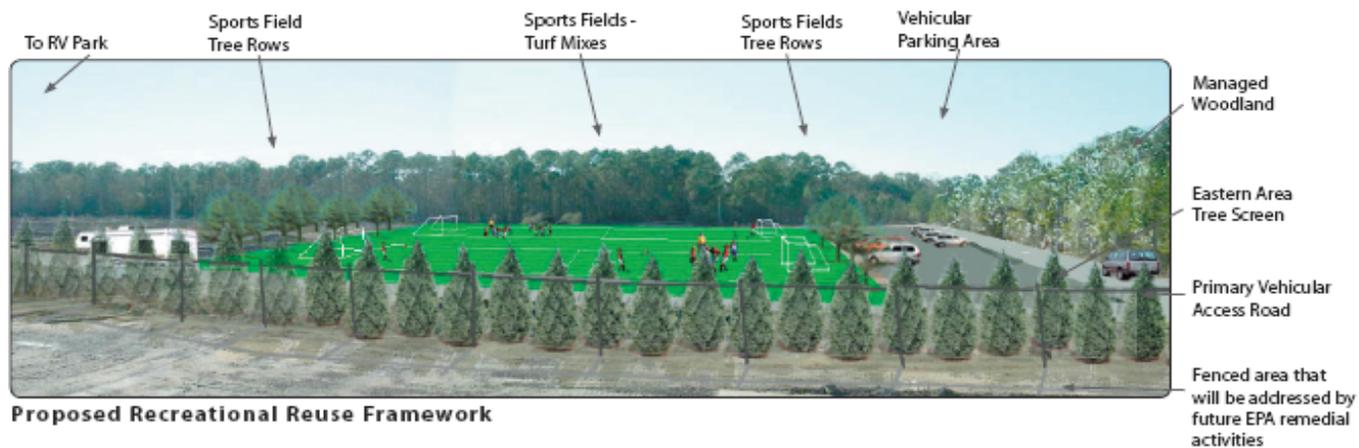


This Rendition got em Going

CAMILLA WOOD PRESERVING COMPANY SUPERFUND SITE REVISED REUSE FRAMEWORK

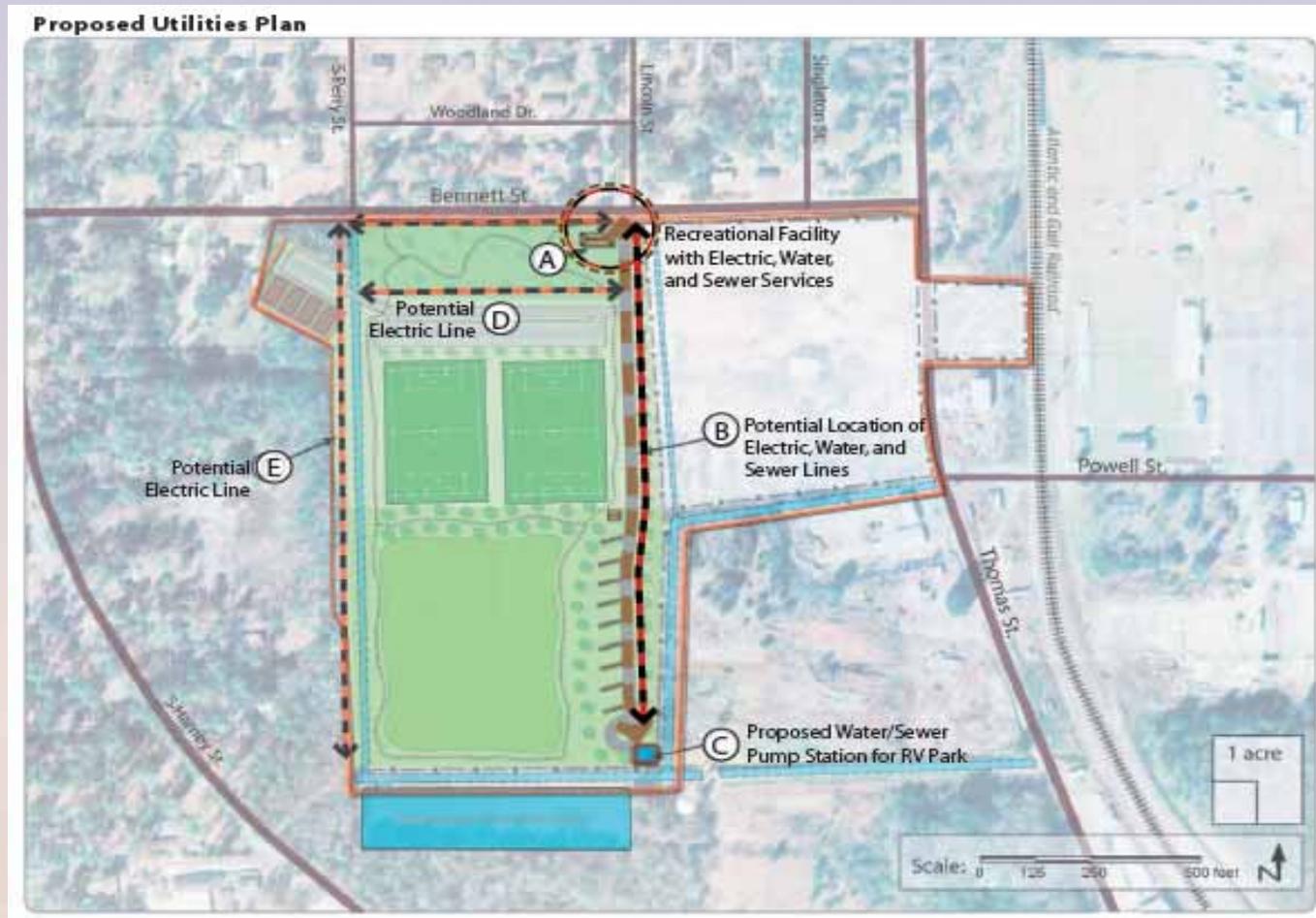


Existing Camilla Wood Preserving Company Site



Proposed Recreational Reuse Framework

You Want Utilities Too?



We Dug and Certified Clean Trenches



The City Provided and Installed Utilities



How to Build an RV Campground

RV Campground



RV PARK EXAMPLES

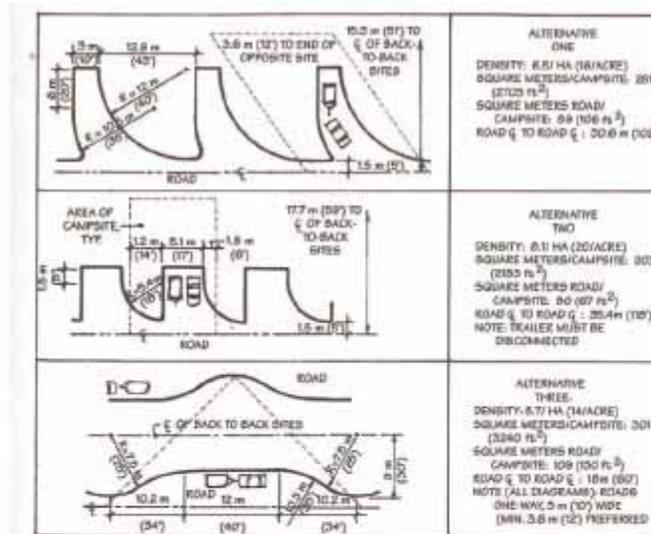
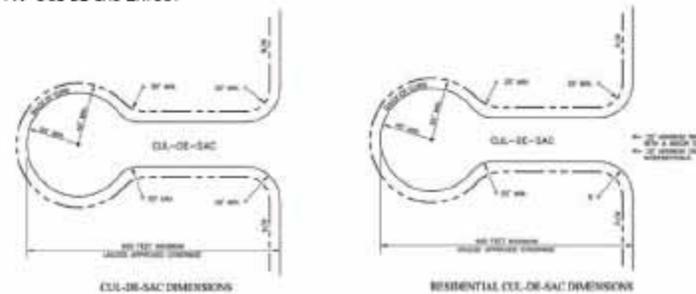


Figure 4.13. Sample motor camping layouts.

RV CUL-DE-SAC LAYOUT



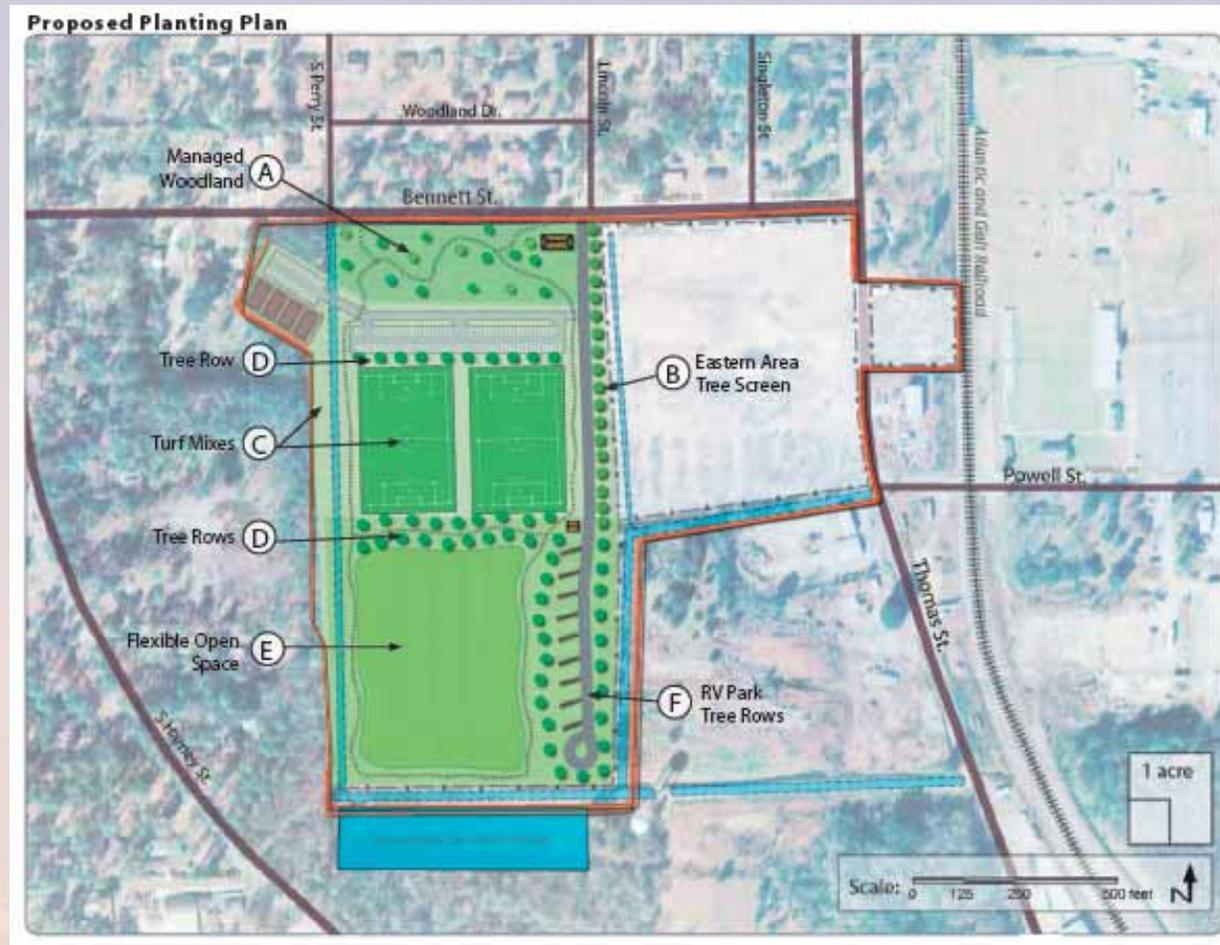
The Mess



Doesn't Look Like Much But...



The Plants...Don't Forget the Plants



Native Grasses and Invasive Plants

Wildflower Meadow Mixes

Latin Name

Centaurea cyanus
Chamaecrista fasciculata
Coreopsis lanceolata
Coreopsis tinctoria
Cosmos sulphureus
Echinacea purpurea
Gaillardia puchella
Gaura lindheimeri
Gypsophila elegans
Ipomopsis rubra
Lavatera trimestris
Linum grandiflorum rubrum
Lupinus perennis
Mirabilis jalapa
Monarda citrodora
Papaver rhoeas
Phlox drummondii
Rudbeckia amplexicaulis
Rudbeckia hirta
Salvia coccinea
Verbena tenuisecta

Common Name

Dwarf Cornflower
 Partridge Pea
 Lance-Lanced Coreopsis
 Plains Coreopsis
 Sulphur Cosmos
 Purple Coneflower
 Annual Gaillardia
 Gaura
 Annual Baby's Breath
 Gilia
 Tree Mallow
 Scarlet Flax
 Perennial Flax
 Four-O'Clock
 Lemong Mint
 Corn Poppy
 Annual Phlox
 Clasping Coneflower
 Black-eyed Susan
 Scarlet Sage
 Moss Verbena



Switchgrass
 (*Panicum virgatum*)



View of a Grassy Meadow

Native Grass Mixes

Latin Name

Andropogon gerardii
Schizachyrium scoparium
Sorghastrum nutans
Panicum virgatum
Tripsacum dactyloides

Common Name

Big bluestem
 Little bluestem
 Indiangrass
 Switchgrass*
 Eastern gamagrass**

* Switchgrass and eastern gamagrass should not be pre-mixed with fluffy-seeded species

** Eastern gamagrass is best when used alone for these applications

Turf Grasses

Latin Name

Festuca arundinacea
Lolium perenne
Poa pratensis
Lolium multiflorum

Common Name

Turf-Type Tall Fescue
 Turf-Type Perennial Ryegrass
 Kentucky Bluegrass
 Annual Ryegrass

Invasive Plants -- NOT Recommended

Latin Name

Elaeagnus umbellata
Hedera Helix
Imperata cylindrica (L.) Beauv.
Ligustrum sinense
Lonicera japonica
Paulownia tomentosa
Pueraria lobata
Rosa multiflora

Common Name

Autumn Olive
 English Ivy
 Cogongrass
 Chinese privet
 Japanese Honeysuckle
 Empress or Paulownia Tree
 Kudzu
 Multiflora Rose

Making Mounds for Topographic Variety





Sod From a
Local Vendor
at No Extra
Cost Versus
Hydroseeding



Its Corny, but True...Build It and



County provided labor for the installation of the irrigation system bought at cost

County Labor also Laid the Sod



Remember the Contaminated Swampland?



Camilla took possession under involuntary acquisition with no liability.

Well Fed and Proud



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Tri County Complex in Under a Year



2008 National
Notable
Achievement
Award for
Cross
Program Land
Revitalization

Solid Waste Management Case Study

Matthew Monsees
EPA/Region 4



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Today's Material

- WARM Model
- "Typical" Removal Site, < \$1M
- Extension to 100 "Sites" per year
- Baseline and Alternative Model Calculations
- Energy Summaries
- Data Reduction to Show What Your Results Can Be

Waste Reduction Model - WARM

- WARM calculates and totals GHG emissions of baseline and alternative waste management practices and energy savings.
 - (Source reduction)
 - Recycling
 - Combustion
 - Combustion
 - Composting
 - Land filling

Case Study - Your Typical, <\$1M Removal

- 8 weeks on site, 8 persons on site, 6 days a week
- Baseline Solid Waste
 - Office paper: $\frac{1}{4}$ ream/day = 1 $\frac{1}{2}$ wk, 8 wks = 66 #s
 - Cardboard: 18 boxes/week = 18 #s, 8 wks = 144 #s
 - Plastic Bottles: 120/week = 30 #s, 8 wks = 240 #s
 - Cans: 72/week = 6.75 #s, 8 wks = 54 #s
 - Mixed Paper: 4 #s/wk, 8 wks = 32 #s
 - Lumber Scraps: 50 pounds for job

Expand to 10 Regions

- 100 typical removals per year
- Baseline Solid Waste per Year
 - Office Paper: 3.3 tons
 - Cardboard: 7.2 tons
 - Plastic Bottles: 12 tons
 - Cans: 2.7 tons
 - Mixed Paper: 1.6 tons
 - Lumber Scraps: 2.5 tons

Case Study - Exclusions

- Does not include
 - Leaves, branches, lawn clippings
 - Glass
 - Other solid wastes
 - WARM includes 34 waste streams

WARM Calculations

- Baseline and Alternative Waste Management
- Lifecycle GHG Emissions
- Energy Consumption

Baseline Solid Waste - Tons

Material	Generated	Recycled	Landfill	Combusted	Composted
Aluminum Cans	8	0	8	0	0
HDPE	12	0	12	0	0
Cardboard	7	0	7	0	0
Office Paper	3	0	3	0	0
Mixed Paper	2	0	2	0	0
Mixed Organics	3	0	3	0	0

Alternative Waste Management - Tons

Material	Baseline	Source Reduced	Recycled	Landfill	Combusted	Composted
Aluminum Cans	8	0	8	0	0	0
HDPE	12	0	12	0	0	0
Cardboard	7	0	7	0	0	0
Office Paper	3	0	3	0	0	0
Mixed Paper	2	0	2	0	0	0
Mixed Organics	3	0	0	0	0	3

GHG Emissions Analysis - MTCE

GHG Emissions from Baseline Waste Management (MTCE):

3

Commodity	Tons Recycled	Tons Land filled	Tons Combusted	Tons Composted	Total MTCE
Aluminum Cans	0	8	0	0	0
HDPE	0	12	0	0	0
Corrugated Cardboard	0	7	0	0	1
Office Paper	0	3	0	0	2
Mixed Paper, Broad	0	2	0	0	0
Mixed Organics	0	3	0	0	0

GHG Emissions Analysis

GHG Emissions from Alternative Waste Management (MTCE): (47)

Commodity	Tons Recycled	Tons Land filled	Tons Combusted	Tons Composted	Total MTCE
Aluminum Cans	8	0	0	0	(30)
HDPE	12	0	0	0	(5)
Corrugated Cardboard	7	0	0	0	(6)
Office Paper	2	0	0	0	(3)
Mixed Paper, Broad	2	0	0	0	(2)
Mixed Organics	0	0	0	3	(1)

Energy Analysis - MBTU

- Total Energy Use from Baseline = 14
- Total Energy Use from Alternative = (2,441)
- Incremental Energy Use = (2,455)

Energy Use Summary - 2,455 MBTU

- This is equivalent to:
 - 23 Households' Annual Energy Consumption
 - 423 Barrels of Oil
 - 19,755 Gallons of gasoline

Energy Use Per OSC Decision

- Assume 1 site per year for an OSC
- Equivalent to:
 - 3 Months of a Household's Energy Consumption Saved
 - ½ Barrel of Oil Saved
 - 200 Gallons of Gasoline Saved

Remember

- Does not include major source reuse/recyclables - trees, scrap metal, product diverted from disposal, reusable fly ash, etc.

Simple to Institute

- During RSE, assess potentials
- During Removal Planning, refine assessments
- Use START or ERRS to assist in location of vendors, sites, and local methods
- Include alternative solid waste management in Task Order SOWs/SOOs

Solid Waste Management Case Study

OSC Readiness

- WARM can be found at:
www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html
- For explanation of methodology, see the EPA report: Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks (EPA530-R-06-004). It is available on the Internet at www.epa.gov/climatechange/wycd/waste/downloads/fullreport.pdf (5.6 Mb PDF file).

ESF #14 / Long-Term Community Recovery: EPA Emergency Response Coordination with Long-Term Recovery

Joseph Vescio
EPA/OEM



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What is ESF #14?

- Part of the National Response Framework, it...“provides a mechanism for coordinating Federal support to enable community recovery from the long-term consequences of extraordinary disasters.”

EPA's ESF #14 Responsibilities

- Provide technical assistance in contaminated debris management, environmental remediation, and watershed protection, planning, management and restoration.
- Provide technical assistance in developing appropriate drinking water and wastewater infrastructure projects and in identifying financial assistance options.
- Provide technical assistance on using environmentally sound and sustainable approaches in rebuilding businesses and communities.

How is ESF #14 Related to a Response Effort?

- FEMA currently places an ESF #14 representative in the JFO during the initial response phase of an incident, mainly to observe.
- Response issues that will affect long-term recovery are noted.
- When appropriate, ESF #14 kicks in to begin addressing LTR issues.

FEMA's Requests for EPA

- FEMA has requested that EPA play a larger role in forming strategies for long-term community recovery.
- Consulting on Smart Growth, sustainability, and water infrastructure.
- Identifying financial assistance options for communities.
- Decisions made during recovery phase that will affect long-term recovery.

EPA's Latest ESF #14 Efforts

- Greensburg, Kansas
 - Participated in numerous meetings, workshops, and a rebuilding fair to provide consultation and technical assistance
 - Led the effort in developing the Greensburg Green Home Program Guide

EPA's Latest ESF #14 Efforts

- Iowa Flood Disaster
 - Part of Inter-Agency Coordination Team
 - Cedar Rapids Smart Growth audit
 - Sustainable building symposium
 - Technical assistance for waste water treatment
 - Sustainable landscaping practices
 - Solid waste management and recycling

EPA's Latest ESF #14 Efforts

- Hurricane Ike Recovery
 - EPA Presence at JFO under ESF #14 following the disaster
 - Mission Assignment for \$25K, to identify challenges to recovery in environmental remediation, watershed protection, etc.
 - MOU for longer term support, including:
 - Drafting Smart Growth template for community
 - Assist in sustainable reuse of Brownfields
 - Planning assistance for water and wastewater infrastructure

EPA's Latest ESF #14 Efforts

- Windsor, Colorado
 - Tornado recovery efforts
 - Attended and promoted Rebuild Green workshop for community
 - Connected FEMA and State to National Renewable Energy Lab for Tech Assistance program grant

Final Points

- FEMA is looking to EPA to provide strong assistance in sustainability, environmental remediation, watershed protection and restoration, and drinking water and wastewater infrastructure
- EPA is currently developing internal guidelines to make sure that staff is clear on EPA's responsibilities—we need to “stay in our lane”

Final Points (continued)

- OSCs should attempt to coordinate with the Regional ESF #14 representative—if appropriate. Make sure the representative knows what decisions were made during response.
- Keep in mind the requests FEMA is making to EPA in terms of long-term recovery—they could affect response decisions. ESF #14 is not the driver, but keep the lines of communication open.

Contacts

EPA HQ:	Joe Vescio	(202) 564-2522
Region 1:	Cosmo Caterino	(617) 918-1264
Region 2:	Steve Touw	(732) 906-6900
Region 3:	Michael Zickler	(215) 814-2792
Region 4:	Stallings Howell	(404) 562-9329
Region 5:	Glenn Cekus	(312) 353-6449

Contacts (continued)

Region 6:	Olivia Balandran	(214) 665-7257
Region 7:	David Williams	(913) 551-7625
Region 8:	David Ostrander	(303) 312-6827
Region 9:	Rich Martyn	(415) 972-3038
Region 10:	Mary Goolie	(907) 271-3414

Greening Response Actions:

An Exercise in Applying
the Strategies

Carlos Pachon
EPA/OSRTI

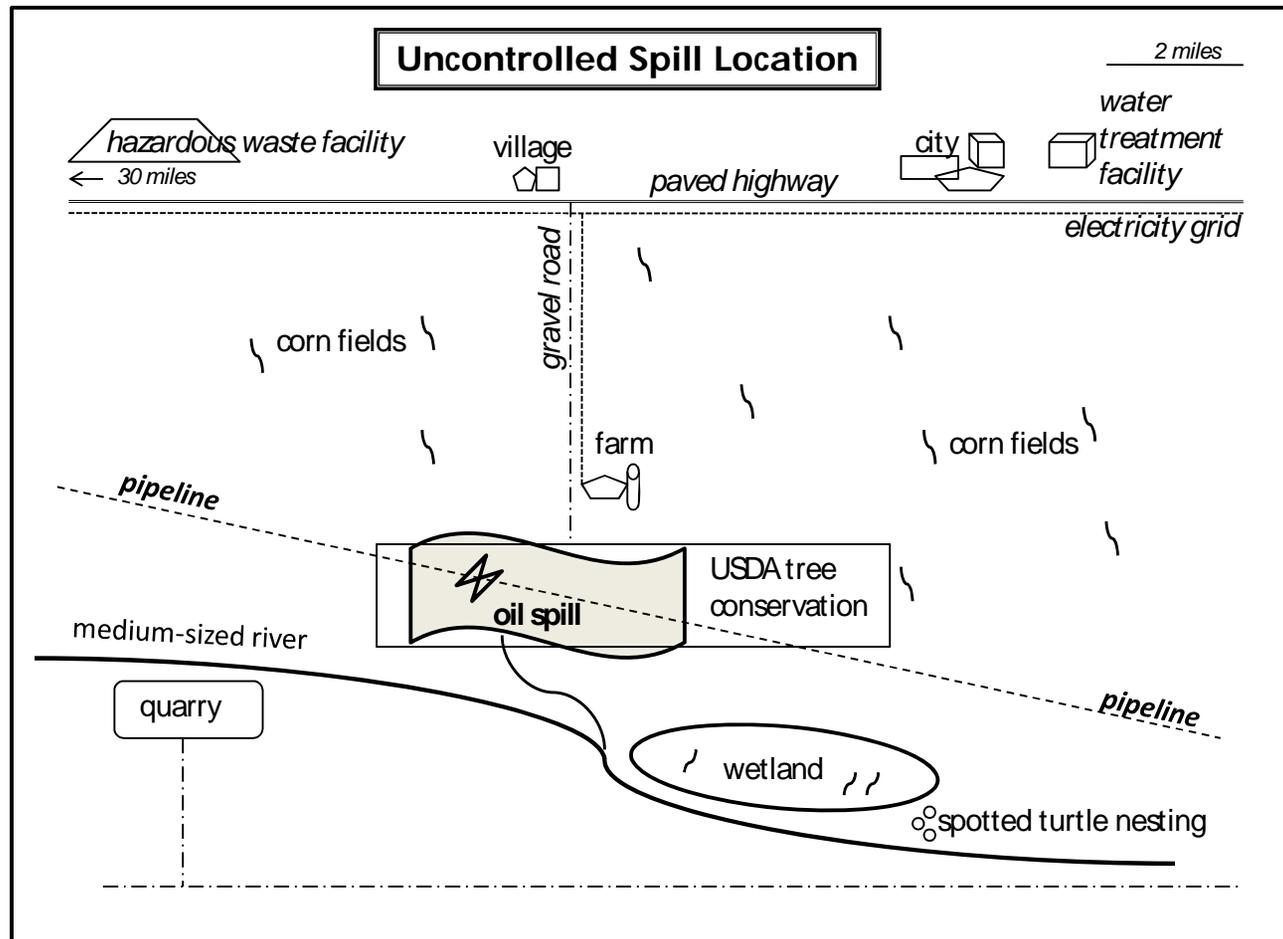


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Study Site Scenario: Inland Oil Spill

- Event: rupture of 20-inch crude oil pipeline situated 5 feet bgs in former creek channel
- Immediate impact: oil release reported at 210,000 gallons
- Setting: wooded area along river and near wetland hosting endangered turtle species
- Surrounding properties: agricultural
- Nearest city: 22,000 population, 16 miles away

Local Infrastructure & Environment



Early Findings

- 45- by 60-foot crater left by rupture
- Friable asbestos covering the pipeline
- 20 acres under federal tree conservation program directly impacted
- Turtle, bird, and fish mortality in river tributary and wetland
- No apparent contamination of private wells
- Benzene vapor concentrations of 2 ppm during first week
- Clogged drain tiles in nearby agricultural fields

Response Activities

- Established an air monitoring network and began collecting surface soil and water samples
- Constructed a 1.5-mile access road
- Cleared a 5-acre staging area in cornfield for machinery and equipment/lab trailers 0.5 miles from the gravel road
- Placed booms and seep mopped
- Deployed up to 20 vacuum trailers at once and 2-3 frac tanks from various parties
- Constructed downgradient interception trenches to pump captured oil

Response Activities (continued)

- Excavated 3 siphon dams on creek for periodic vacuum pumping
- Used air sparging units to aerate portions of the creek and wetland
- Excavated a test pit to evaluate subsurface conditions
- Removed 30 oil-laden trees on or adjacent to the spill site
- Began removing estimated 10,000 tons of contaminated soil

In Your Role as OSC...

Which of the green strategies discussed today could apply to these activities?

What other strategies have you tried or thought about, that could work here?

Which team members also might have good ideas or innovative resources?

What can you do to equip the field contractors for a greener response?

Sample Strategies for Greening a Response Activity

Response Activity:

Constructed a 1.5-mile access road

Green Strategy

Use machinery and vehicles upgraded with tailpipe emission controls

Adaptation Approach

Include an emissions control requirement in ERRS or site-specific contracts and subcontracts

Success Measures

Increased percentage of light and heavy machinery operating with emission controls

Response Activity:

Placed booms and seep mopped

Green Strategy

Choose equipment and related expendable products with recycled material contents

Adaptation Approach

Provide a listing of confirmed vendors to ERRS or site-specific contractors and subcontractors

Success Measures

Increased volume (%) of expendable materials with recycled content

Results of Exercise

Incorporated into technical assistance
and decision tools

Segregated into planning approaches
versus field decisions

Built into mechanisms for regional
information sharing

Used to illustrate “ready to roll”
strategies or remaining barriers

*disclaimer



- **ICS** (not just for breakfast anymore)
- **IMT**
- **INS**
- **“Getting to 5”**
- **Homeland Security**
- **Pointsec** (no one got my already public polrep!...not even me)
- **ECMS**
- **ACMIS**
- **Peopleminus** (saved and attested 5 days early because it's a holiday weekend)
- **CORE ER**
- **Quickplace**
- **HQ**
- **Ethics Training**



Crozet Arsenic

- Former Apple Orchard Area(s) that have historically applied a variety of chemicals including:
 - Lead Arsenates
 - 4,4'-DDT
 - 4, 4'-DDD
 - 4,4'-DDE
 - * Mostly top 6-8 inches
- Many of the areas are now developed



Removal Action

- No cost recovery
- Potential problem across America
- Action level of 58 ppm
- Traditional dig and dispose
- *Phytoremediation*
- *Solar Power*



Two Areas

- Community Area
 - 13 homes out of 150
 - All dig and dispose
- Larger Property Area *
 - 27 acres
 - Hillside
 - Access issues



Phytoremediation

- Researched by the University of Florida
- *Pteris Vittata* (Chinese Brake Fern)
- Hyper-Accumulate Arsenic in the fronds
- Licensed to Edenspace Systems Corporation through University of Florida.
- The use of arsenic accumulating ferns belonging to the *Pteris* genus for phytoremediation is protected under US Patent 6280500 ***

EDENFERN®

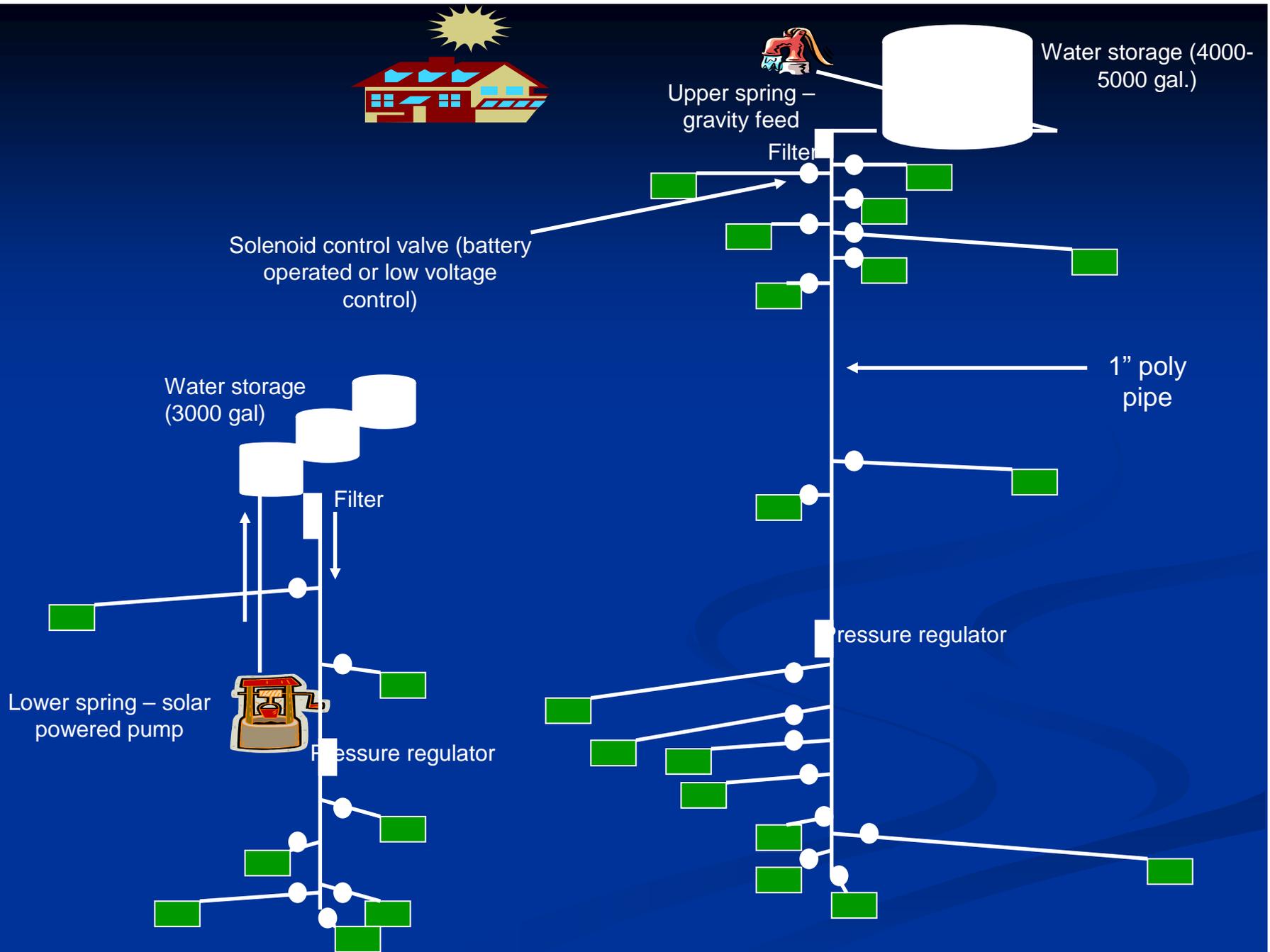
- Can extract 20-50 ppm per growing season
- Extracts arsenic through the roots system and stores it in the fronds.

The Numbers

- 20,000 ferns (a tractor trailer load)
- 24 plots (about 900 square feet each)
- 12 cubic yards of disposal (harvested ferns) per year vs. 400-528 cubic yards for soil removal....
Plus backfilling.

Irrigation

- Water Water everywhere (but not a drop to drink)
- 2 springs (holding tanks)
- 390 W solar panel array (3, 12volt panels)
- Solar pump
 - 30 gallons/min
 - 30 feet of elevation capacity
 - 10k gallons/day (6 hours full sun)



Not to scale



Contracting Issues

- Rent...
- GSA purchase (excessed equipment)
- Purchase Card Purchase (\$4000)
- ERRS...
- Fern Patent
- Alternative Energy Store
 - “Making Renewable... Do-able”

**And That's How I am Helping to
Save the World**

Questions?