Welcome to the CLU-IN Internet Seminar

EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint

Sponsored by: EPA Office of Superfund Remediation and Technology Innovation

Delivered: May 22, 2013, 1:00 PM - 3:00 PM, EDT (17:00-19:00 GMT)

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

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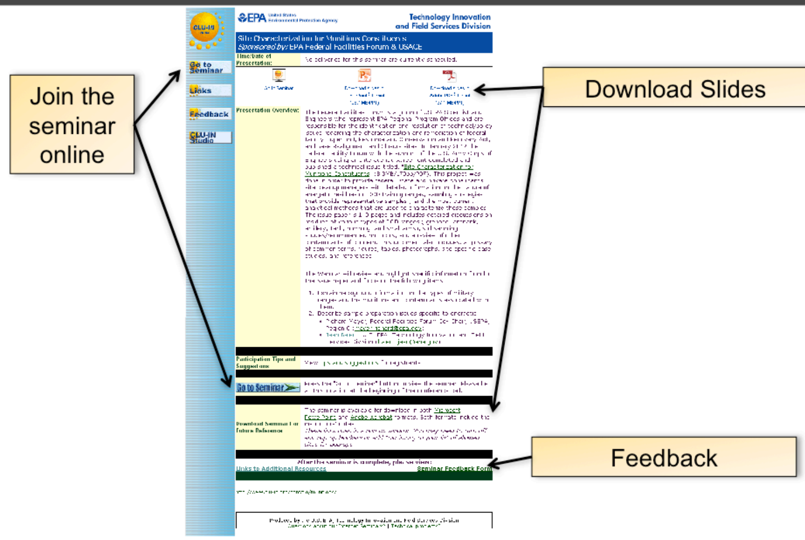
Seminar Homepage



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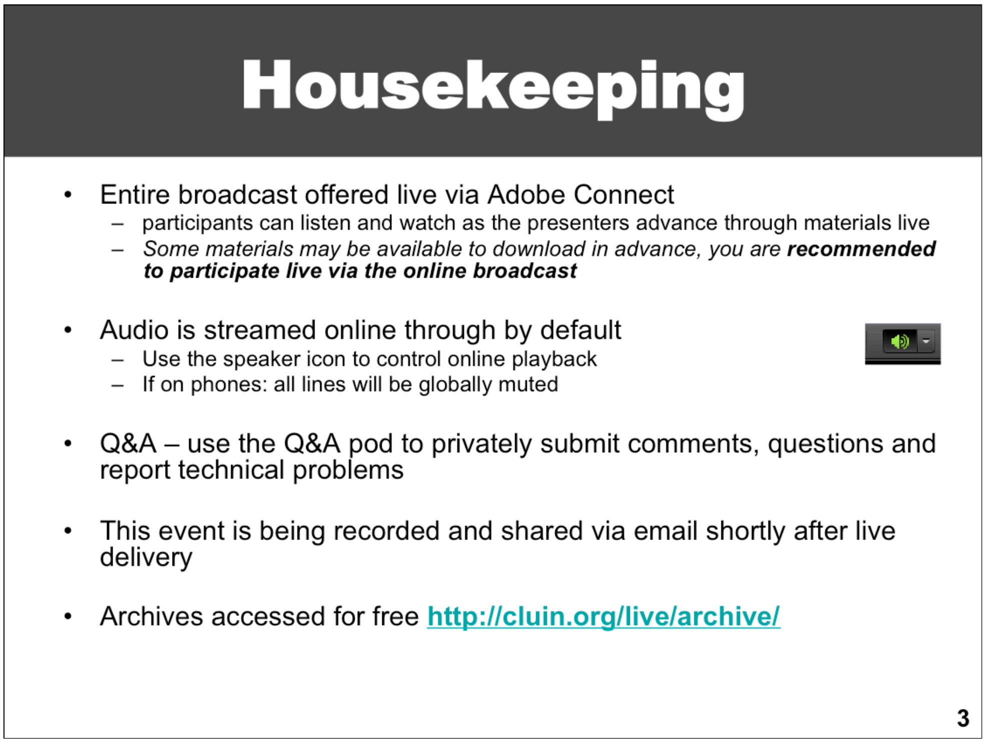


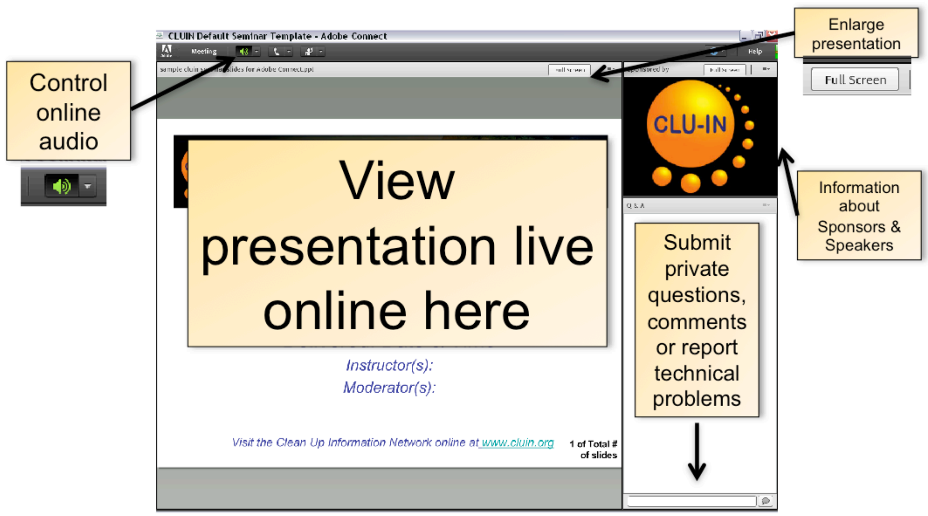
♦ Although I'm sure that some of you have these rules memorized from previous CLU-IN events, let's run through them quickly for our new participants.

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

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

♦ With that, please move to slide 3.

New online broadcast screenshot



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Methods and Tools for Environmental Footprint Assessment

United States
Environmental Protection
Agency

Carlos Pachon
Hilary Thornton
Stephanie Vaughn
CLU-IN Webinar

May 22, 2013

Workshop Overview

- ♦ **Module 1: EPA's Green Remediation Policy and Core Elements**
- ♦ **Module 2: EPA's Environmental Footprint Evaluation Methodology**
- ♦ **Module 3: Performing an Environmental Footprint Analysis**
- ♦ **Module 4: Green Remediation Application Case Studies**
- ♦ **Module 5: Spreadsheets for Environmental Footprint Analysis**
- ♦ **Module 6: Lessons Learned & Discussion Questions**
- ♦ **Information and Resources**

Module 1: EPA's Green Remediation Policy and Core Elements

EPA United States Environmental Protection Agency

EPA's Definition of "Green Remediation"*

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

*aka greening response actions, greener cleanups, etc.

Policy Drivers at Many Levels

- **Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance**

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

- **EPA Strategic Plan 2011-2015: Goal 3: Cleaning Up Communities and Advancing Sustainable Development**

  EPA's Superfund program will implement its green remediation strategy to reduce the energy, water, and materials used during site cleanups while ensuring that protective remedies are implemented (Administrator Lisa Jackson).

- **EPA Office of Solid Waste & Emergency Response Policy (OSWER): Principles for Greener Cleanups**

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

- **Superfund Green Remediation Strategy**

Sustainability in Superfund Site Remediation

- **Social:**
  - » Engaging communities in site cleanup decisions
  - » Turning contaminated sites into community assets
- **Economic:**
  - » Redevelopment in blighted areas (aligns with smart growth goals)
  - » Fostering employment opportunities in communities where sites are cleaned up
  - » Rising property values in communities
  - » Remediation in the U.S.: A $7billion/year economic engine
- **Environmental:**
  - » Protecting Human Health and the Environment
  - » Liberating contaminated sites for reuse (1 remediated acre redeveloped = 4 acres of green field development)
- **Challenge: A smaller footprint in cleaning up sites**

EPA 10

Community Involvement (CI): Robust "Social" Leg in Superfund

- By Law, Superfund requires community input in remedy decisions and implementation
- EPA parallels the International Association for Public Participation 7 "core values of public participation"
- EPA has a CI policy since 1981, and nearly 100 CI Coordinators across the 10 regional offices
- Technical assistance (grants and services) are provided to ensure communities are independently advised on challenging technical issues
- Our experience shows good CI results in better remedies
- Environmental justice link

> *…members of the public affected by a Superfund site have a right to know what the Agency is doing in their community and to have a say in the decision-making process. (Superfund Community Involvement Handbook).*

EPA 11

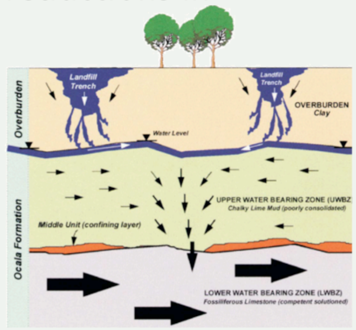
Fostering Redevelopment and Economic Opportunities

- In Superfund, Remedial Action Objectives factor *reasonably anticipated future land use**.
- EPA serves as an active partner in helping to return sites to productive uses
  - Funding reuse assessments and redevelopment planning
  - Removing reuse barriers, real or perceived
  - Partnering with local governments, communities, developers, and other interested stakeholders
- Beyond cleanup: Sites ready for anticipated reuse is a key Superfund "GPRA" goal
- Annually 300 businesses at 142 Superfund sites with redevelopment has taken place generate $8.8 billion in sales, 25,000 jobs and $1.6 billion in employment income

EPA *www.epa.gov/superfund/programs/recycle/pdf/reusedirective.pdf 12

Footprint Reduction in Remedies

- **Consistent with science and engineering principles**
- **Minimizing footprints and large reductions in footprints come from…**
  - » Accurate conceptual site model (CSM)
  - » Well-characterized source areas and contaminant plumes
  - » Appropriate remedy selection
  - » Sound engineering
  - » Streamlined performance monitoring



- **…then, focus on greening the resulting remedy**

Core Elements of Green Remediation

Energy and Air Emissions

- **Reduced emissions of criteria pollutants (PM, SOx, NOx) and greenhouse gases (GHG)**
  - Maintaining, repowering, or retrofitting diesel engines
- **Energy efficiency practices**
  - High-efficiency equipment
  - Variable frequency drives
  - Low-emission vehicles and carpooling
  - Use of local materials and services
  - Combined heat and power
- **Renewable energy**
  - On-site renewable energy
  - Purchased renewable energy

An off-grid, 770-watt PV system at Brooks Camp, AK, powered an air sparging pump used for treating groundwater contaminated by former underground storage tanks.

EPA 15

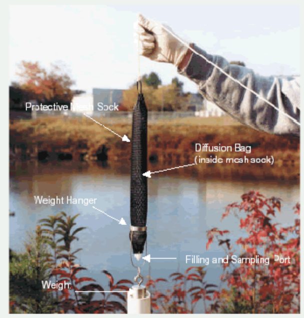
Water Use and Conservation

- Seek beneficial use of extracted and treated water
- Optimize capture zones of groundwater pump & treat (P&T) systems
- Divert clean water around impacted areas
- Use less-refined water resources when possible
- Manage stormwater runoff to protect surface water quality
- Infiltrate diverted stormwater for aquifer storage

Portable closed-loop wheel washing systems for reducing onsite and offsite trackout during construction

Materials & Waste

- **Reduce Material Use**
  - Alternative materials or chemicals
  - Materials with recycled content
  - Materials from waste products
- **Source unrefined materials locally and/or from recycled sources**
- **Minimize hazardous and non-hazardous waste generated on site**
- **Reuse or recycle waste generated on site**



Use of passive diffusion bag samplers reduces or eliminates purge water associated with well sampling.

Land & Ecosystems

- **Protection of valuable "ecosystem services" at sites during cleanup**
- **Metrics are under development; examples may include:**
  - Soil erosion control
  - Nutrient uptake and water quality protection
  - Wildlife habitat

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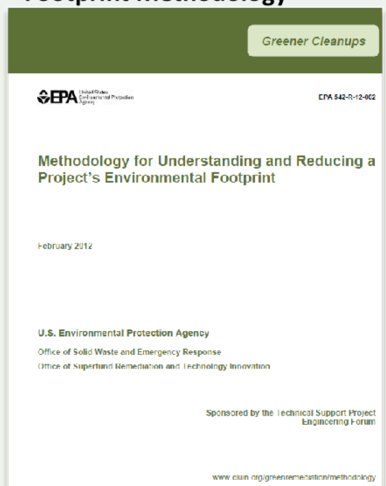
Options for Implementing Green Remediation

- **Direct Use of Best Management Practices (BMP)**
  - Excavation and Surface Restoration
  - Site Investigation
  - Pump and Treat Technologies
  - Bioremediation
  - Soil Vapor Extraction & Air Sparging
  - Clean Fuel & Emission Technologies for Site Cleanup
  - Integrating Renewable Energy into Site Cleanup
  - Sites with Leaking Underground Storage Tank Systems
  - Landfill Cover Systems & Energy Production
  - Mining Sites
  - Implementing In Situ Thermal Technologies
  - Overview of EPA's Methodology to Address the Environmental Footprint of Site Cleanup

www.cluin.org/greenremediation/

- **For Complex Projects – Apply Footprint Methodology**


Greener Cleanups

EPA 542-R-12-002

Methodology for Understanding and Reducing a Project's Environmental Footprint

February 2012

U.S. Environmental Protection Agency

Office of Solid Waste and Emergency Response

Office of Superfund Remediation and Technology Innovation

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www.cluin.org/greenremediation/methodology

Module 2:
EPA's Environmental Footprint Evaluation Methodology

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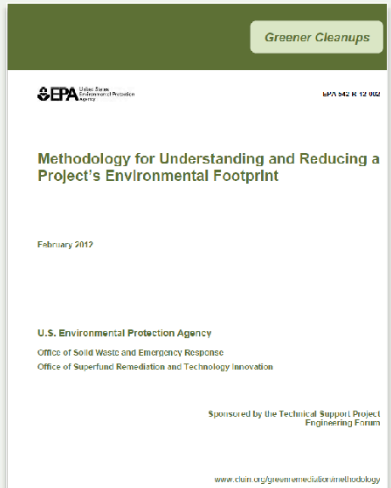
Methodology for Understanding and Reducing a Project's Environmental Footprint

- ♦ **Goal of an evaluation – Identify the most significant contributors to a project's environmental footprint and better focus efforts to reduce it**
- ♦ **Footprint evaluations are not required for cleanup, but if conducted, this is the preferred methodology**
- ♦ **Remedy selection process remains unchanged in all cleanup programs**



Greener Cleanups

EPA 542 R 12 002

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(continued)

Methodology for Understanding and Reducing a Project's Environmental Footprint

- **Built around five core elements**
- **Provides common footprint metrics and a process to quantify them**
- **Designed to be generally compatible with existing "footprinting" tools**
- **Based on lessons learned from multiple projects**
- **Includes practical assistance such as:**
  - conversion factors for commonly used materials
  - screening out small contributors
  - establishing grid electricity footprints

Methodology Overview

- Based on pilot projects, the cost of a footprint analysis ranges from $5,000 to $15,000 ($US)
- Footprint analysis costs can be lower when performed with other site activities
- Applies to all cleanup projects at any stage
  - Investigation, design, construction, operation
- Applies to all remedy and site types

Methodology is available at www.cluin.org/greenremediation

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Methodology Document Contents

- **Main Text: The basics of a footprint analysis**
  - Introduction
  - Metrics
  - Footprint methodology
  - Considerations for interpreting the footprint
  - Approaches to reducing the footprint
- **Appendices: The "mechanics" of a footprint analysis**
  - A. Exhibits
  - B. Data presentation formats
  - C. Footprint reduction scenarios
    - Materials and Waste (3)
    - Water (3)
    - Energy and Air (2)

Information Flow

- **Exhibits (17) provide practical assistance and help manage the flow of information**
  - contents of materials used in cleanups
  - energy demands of field equipment
- **Data presentation formats (9 Tables) organize the information collected and summarize the results**
  - Table B1 includes all suggested footprint metrics

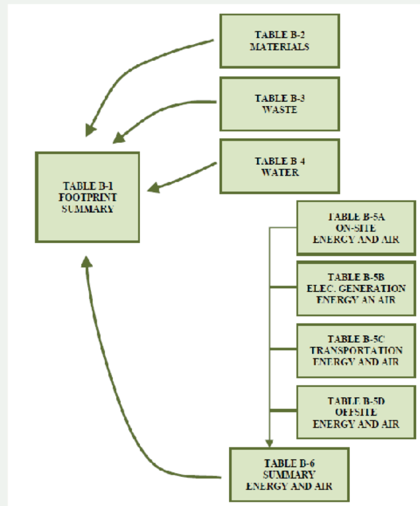
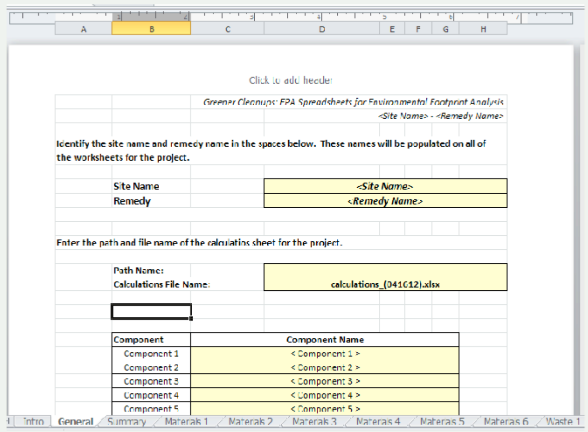


Figure from Appendix B, Page 74

Spreadsheets for Environmental Footprint Analysis (SEFA)

- **Available online, with the methodology**
- **Consistent with the methodology**
- **Use is optional**
- **Example tutorial provided on-line**
- **Microsoft® Excel based**
- **See Section 6 of briefing**



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Green Remediation Metrics

Energy

- **Total energy used**
- **Total energy voluntarily derived from renewable resources**

Air

- **GHGs**
- **Criteria Pollutant (NOx, SOx, PM)**
  - On-site emissions
  - Total emissions
- **Hazardous air pollutants (HAPs)**
  - On-site emissions
  - Total emissions

Water

- **On-site water use (including public/potable water)**
  - Quantity
  - Source of water
  - Fate of used and treated water

(continued)

Green Remediation Metrics

Materials & Waste

- **Refined (including manufactured) materials used on site**
  - Quantity and percent from recycled materials
- **Bulk, unrefined materials used on site**
  - Quantity and percent from recycled materials
- **Waste**
  - Hazardous waste generated on site
  - Non-hazardous waste generated on site
  - Percent of total potential waste generated on site that is recycled or reused

Land & Ecosystems

- **Qualitative evaluation**

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How will EPA use the Methodology?

- Train EPA technical staff on ways to understand and reduce the footprint
- Conduct footprint analyses at its own sites when and where appropriate
- Facilitate the evaluation of environmental footprint studies submitted to EPA by outside parties
- Recommend to PRPs to follow Methodology
- On-line training under development
- Document environmental footprint reductions at our clean-up sites

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Module 3:
Performing an Environmental Footprint Analysis

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Methodology Steps

Seven Steps

1. Set Goals and Scope of Analysis
2. Gather Remedy Information
3. Quantify Onsite Materials and Waste Metrics
4. Quantify Onsite Water Metrics
5. Quantify Energy and Air Metrics
6. Qualitatively Describe Affected Ecosystem Services
7. Present Results

① Set Goals and Scope of Analysis

- **Goal of analysis**
  - » What we hope to accomplish by the footprint analysis
  - » For example, the goal may be to identify remedy activities that are key contributors to the footprint and to recommend reductions
- **Scope of analysis**
  - » The aspects of the remedy to be included in the analysis
  - » As one example, the scope may include system O&M and performance monitoring, but not system construction
  - » As another example, the scope may include the ground water remedy, but not the soil remedy
- **Also define the boundaries of the analysis, and the functional unit**
  - » EPA Footprint Methodology provides guidance on these topics

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2.1 Gather Remedy Information

Remedy Item/Activity	Quantity/Information
Number, Depth, and Design of Extraction Wells	6-inch wells, 600 ft total
Length, Size, and Type of Piping	3,000 ft of 6-inch high-density polyethylene
Extraction Rate	700 gpm
Treatment Plant Construction	80 ft x 100 ft x 30 ft
Information for Estimating Utility Use	Pumps, mixers, heating, ventilation, and air-conditioning (HVAC), lighting
Information for Estimating Waste Generation	Influent loading
Information for Estimating Chemical Use	Influent loading
Monitoring Program (Frequency, Locations, Parameters)	Annual, 100 wells, arsenic
Transportation Distances	Various

Typical information from Feasibility Study, Design, Implementation/O&M, and Optimization

2.2 Screening Inputs

Based on professional judgment, exclude items with a footprint smaller than "screening limits"

- **Follow suggested methodology protocol to establish screening limits**
- **Apply screening limits to each major metric or set of metrics**
  - Refined materials
  - Unrefined materials
  - Non-hazardous waste
  - Hazardous waste
  - On-site water
  - On-site NOx, SOx, and PM10
  - On-site HAPs
  - Total energy use
- **Exclude items with estimated footprint contribution smaller than the screening limits**

Document items that are excluded

EPA

Quantify Footprint Metrics

3 **Quantify Materials and Waste Metrics**

4 **Quantify Onsite Water Metrics**

5 **Quantify Energy and Air Metrics**

Reminder: SEFA is designed to process Steps 3, 4 & 5, once goals and scope have been identified, and information has been gathered.

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3 Quantify Onsite Materials & Waste Metrics – Refined Materials

Material and Use	Units	Quantity	Conversion to lbs	% Recycled or Reused Content	Material Quantity (lbs) Recycled	Material Quantity (lbs) Virgin
Refined Materials (lbs)						
Building steel	ft^3	240,000	1 lbs/ft^3	55%	132,000	108,000
Concrete reinforcing steel	ft^2	40,000	1.3 lbs/ft^2	55%	28,600	23,400
Cement portion of concrete	ft^3	20,000	22 lbs/ft^3	0%	0	440,000
Sodium hydroxide (20%)	gal	3,011,250	2.04 lbs/gal	0%	0	6,144,000
Hydrogen peroxide (50%)	gal	295,650	4.96 lbs/gal	0%	0	1,467,000
Ferric chloride (37%)	gal	1,368,750	4.33 lbs/gal	0%	0	5,928,000
Refined Materials Subtotals (lbs):					**160,600**	**15,179,900**
Refined Materials Total (lbs):					**15,340,500**	
Refined Materials Total (tons):					**7,670**	
% of Refined Materials that is Recycled or Reused Content:					**~1%**	

Provided by User

Provided by Methodology

Calculated

Metric Results

3 Quantify Onsite Materials & Waste Metrics – Waste

Waste or Used Material	Quantity
Recycled or Reused Waste (tons)	
Reused On-Site: None	**3,000**
Recycled or Reused Off-Site: None	**0**
Total Recycled or Reused Waste:	**3,000**
Landfilled Waste (tons)	
Hazardous Waste Disposed	
7,800 tons of dewatered, precipitated metal sludge	**7,800**
Non-Hazardous Waste Disposed: None	**0**
Disposed Waste Total:	**7,800**
Total Waste:	**10,800**
% of Total Waste Recycled or Reused:	**28%**

Metric Results

EPA

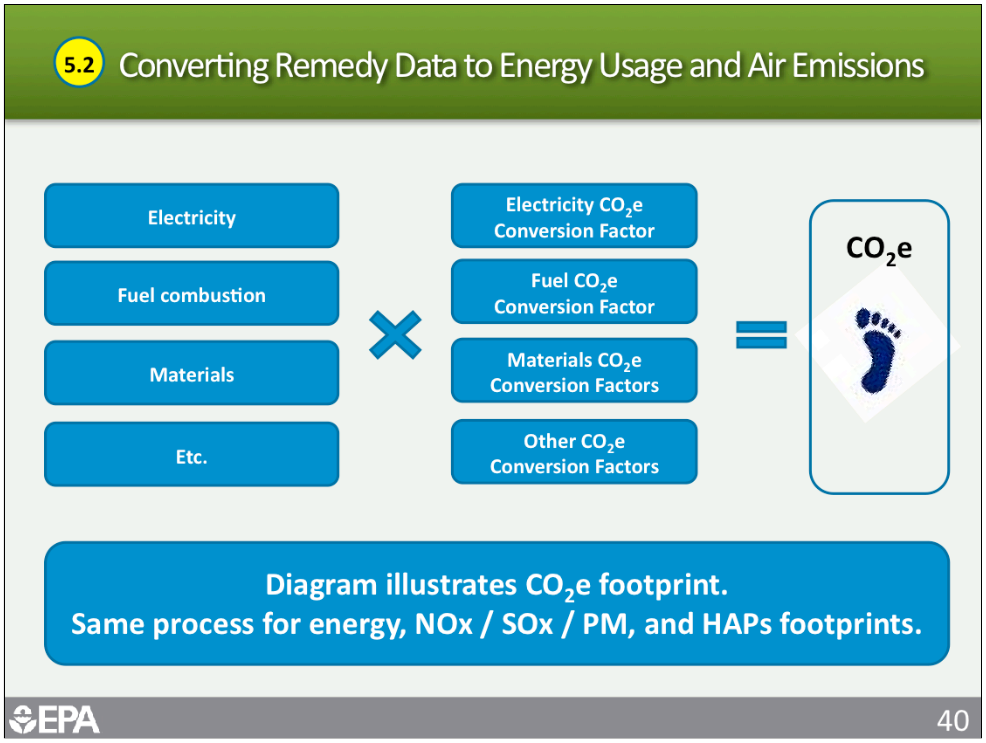
4 Quantify Onsite Water Metrics

Water Resource	Description of Quality of Water Used	Volume Used (1000's gallons)	Uses	Fate of Used Water
Public water supply	Potable	360,000	Blending polymer	Creek
Extracted groundwater Aquifer: **"Shallow"**	Marginal quality	11,000,000	Treatment	Creek
Surface water Intake Location: **None**	**None**			
Reclaimed water Source: **None**	**None**			
Collected/diverted storm water	**None**			
Other water resource	**None**			

5.1 Quantify Energy and Air Metrics – Energy Usage

- Electrical equipment → Electricity usage
- Natural gas equipment → Natural gas usage
- Transportation and equipment → Fuel usage

Remedy Item/Activity	Energy Usage
Electrical use for extraction and treatment	33,000,000 kWh
Electrical use for lighting and HVAC	6,000,000 kWh
Natural gas use (building heat)	710,000 therms
Fuel use for materials transportation	491,510 gallons diesel


5.2 Converting Remedy Data to Energy Usage and Air Emissions
Electricity
Fuel combustion
Materials
Etc.
Electricity CO_2e Conversion Factor
Fuel CO_2e Conversion Factor
Materials CO_2e Conversion Factors
Other CO_2e Conversion Factors
CO_2e
Diagram illustrates CO_2e footprint.
Same process for energy, NOx / SOx / PM, and HAPs footprints.
EPA
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6 Qualitatively Describe Affected Ecosystem Services

In its current form, the methodology suggests the use of qualitative descriptions of the effects of a remedy on land and ecosystem services such as nutrient uptake and erosion control.

Concepts related to ecosystem services are available online from EPA's Ecosystem Services Research Program at www.epa.gov/research/ecoscience/.

7 Present Results - Environmental Footprint Summary

How to interpret these metrics?

How to use them to improve our cleanup site?

Parameter	Footprint
Refined Materials Use (% from recycled material)	15.3 million lbs (1%)
Unrefined Materials Use (% from recycled material)	1,150 tons (0%)
Hazardous Waste	7,800 tons
Non-Hazardous Waste	0 tons
% of Total On-site Waste Recycled or Reused	0%
Public Water Use	360,000,000 gallons
Other On-site Water Use	Marginal amount
Total Energy	853,000 MMBtu
Total Energy Voluntarily from Renewable Resources	0 MMBtu
On-site NOx, SOx, PM Emissions	7,800 lbs
On-site HAP Emissions	6 lbs
Total NOx, SOx, PM Emissions	637,000 lbs
Total HAP Emissions	4,100 lbs
Total GHG Emissions	45,710 tons

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Keep in Mind when Interpreting the Results …

- How accurate are the results? — 1 2 3
- What is a big footprint?
- What parameters are of greatest importance? — haz waste, PM, H_2O, GHG
- Can I use the results to target areas for improvement? — YES!!

EPA

How Accurate are the Results?

1 — Think about uncertainties in key remedy parameters.
- years of P&T required
- amount of soil removal

2 — Uncertainty in major contributors to the footprint.

For GHG emissions…
- electricity use
- chemical use
- natural gas for building heat

3 — Be aware of estimates in the calculations.
- footprint conversion factors
- fuel usage estimates
- transportation distances

Keep in mind…. The results of footprint analyses are estimates to help guide future footprint reduction actions, and are not exact numbers!

What Parameters are of Greatest Importance?

This will depend on the conditions specific to the site and on the values important to site stakeholders.

Particulate emissions may be important for a region in non-attainment.

The water footprint may be important in arid lands.

Waste generation may be important for a community with concerns regarding landfill space.

GHG emissions may be important to a municipality with GHG reduction goals.

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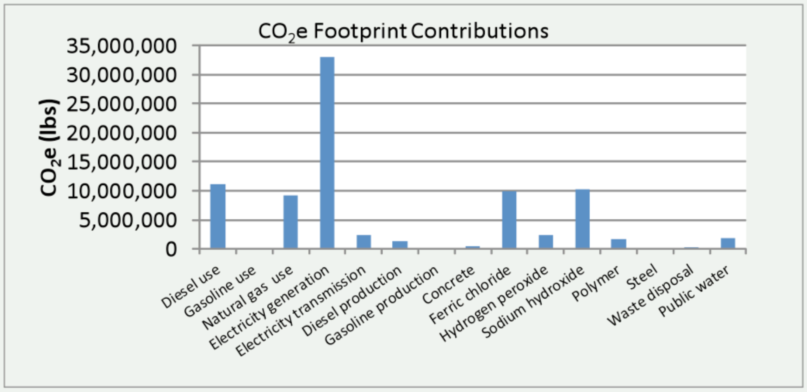
Can I Use the Results to Target Areas for Improvement?

YES!!

A footprint analysis can provide results that highlight the key contributors.



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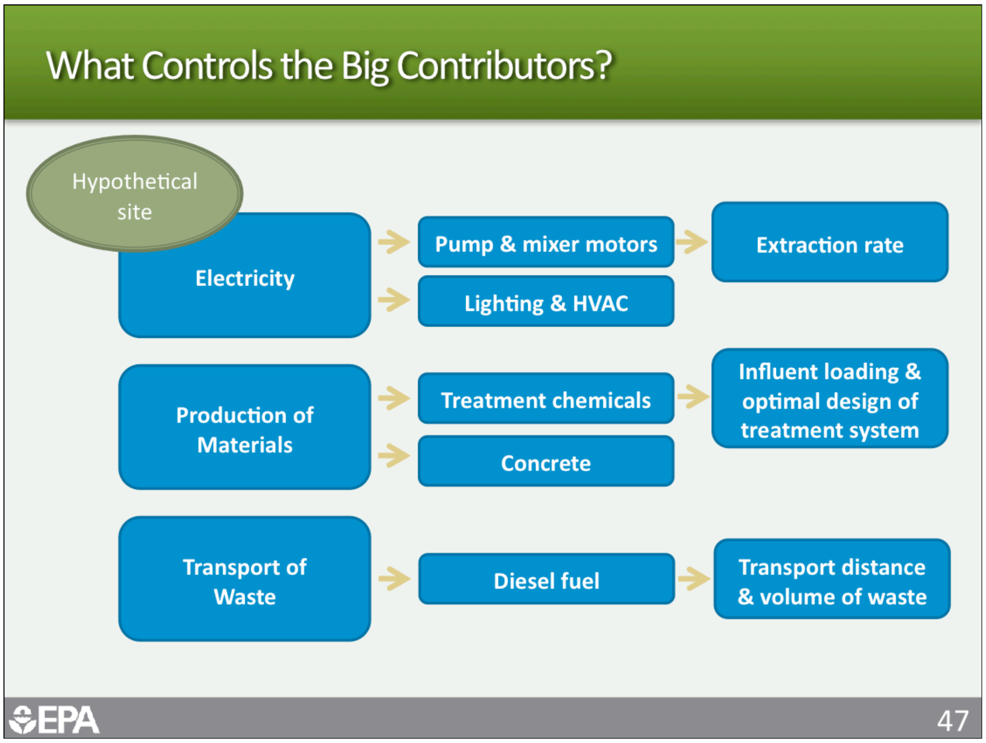
What Controls the Big Contributors?
Hypothetical site
Electricity
Pump & mixer motors
Lighting & HVAC
Extraction rate
Production of Materials
Treatment chemicals
Concrete
Influent loading & optimal design of treatment system
Transport of Waste
Diesel fuel
Transport distance & volume of waste
EPA
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Module 4: Green Remediation Application Case Studies

United States Environmental Protection Agency

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Case Study #1

- **Site with volatile organic compound (VOC) contamination in groundwater**
- **Interim P&T system operating for many years**
- **Considerations derived from Green Remediation evaluation:**
  - Air stripping is more successful than GAC at removing the specific VOCs at this site
  - Increase air stripping and eliminate GAC for water treatment and discharge to sewer
  - Purchase Renewable Energy Certificates (RECs) to offset all electricity usage

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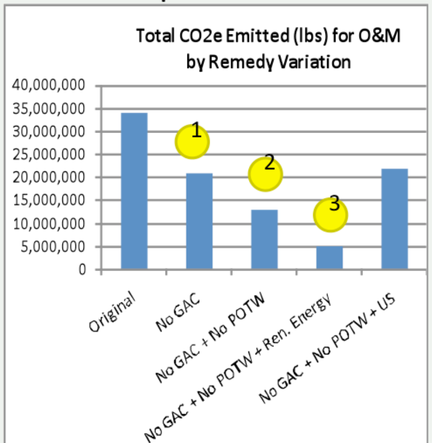
Case Study #1

Using GHG Emissions as an Example Parameter



Air stripping is enhanced to allow elimination of GAC and publicly owned treatment works (POTW)

♦ **Lessons learned**

» Understanding the environmental footprint can inform the decisions that result in greener remedies

» Optimizing remedy would result in less energy use and less energy to offset with renewable electricity

» Optimizing remedy can lead to most substantial footprint reductions

Case Study #2

- **Example Green Remediation application for an UST removal**

Footprint for Baseline Approach (Dig & Haul + Backfill)

Metric	Unit	Value
Total Energy	MMBtus	**0.084**
% of Energy from Renewable Resources	%	**0%**
CO_2e Emissions	lbs	**13,200**
NOx, SOx, PM Emissions	lbs	**166**
Hazardous Air Pollutants Emissions	lbs	**<1**
Water	**500 gallons potable water**	
Refined Materials Used & % from Recycled Material	lbs & %	**0 & 0%**
Unrefined Materials Used & % from Recycled Material	tons & %	**225 & 0%**
Tons of Hazardous Waste	tons	**0**
Tons of Non-Hazardous Waste	tons	**150**
% of Total Potential Waste Recycled or Reused	%	**2.6%**
Ecosystem Services	**Not Applicable**	

(continued)

Case Study #2

- **Energy and emissions findings**
  - 10% for backhoe
  - 35% from transportation of waste and fill
  - 30% from landfill activities for soil disposal
  - 17% from laboratory analysis
  - 8% other
- **Potentially applicable green practices**
  - Segregate clean and impacted soil; use clean soil for backfill
  - Identify closest facility for disposal and source of backfill
  - Avoid return trips of empty trucks by coordinating waste hauling and backfill deliveries
  - Nutrient and microbe addition for on-site, *in situ* treatment
  - Use biodiesel fuels in place of diesel

(continued)

Case Study #2

- **Consider identifying on-site source of clean fill that would otherwise be hauled offsite**
  - Provides opportunity to reuse materials
  - Reduces or eliminates:
    - Energy and emission footprints for transport of backfill
    - Cost for transport of backfill
  - Does not change remedial approach
  - Does not delay remediation
  - Does not increase cost

(continued)

Case Study #2

- **Example application at UST removal – Using footprint reduction practices**

Parameter	Change
Total Energy	**26% decrease**
% of Energy from Renewable Resources	**No change**
CO_2e Emissions	**26% decrease**
NOx, SOx, PM Emissions	**16% decrease**
Hazardous Air Pollutant Emissions	**No change**
Water	**No change**
Refined Materials Used and % from Recycled Material	**No change**
Unrefined Materials Used	**225 to 0**
% of Unrefined Materials from Recycled Material	**No change**
Tons of Hazardous Waste	**No change**
Tons of Non-Hazardous Waste	**No change**
% of Total Potential Waste Recycled or Reused	**No change**
Ecosystem Services	**Not applicable**

Module 5

Spreadsheets for Environmental Footprint Analysis

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Spreadsheets for Environmental Footprint Analysis

SEFA

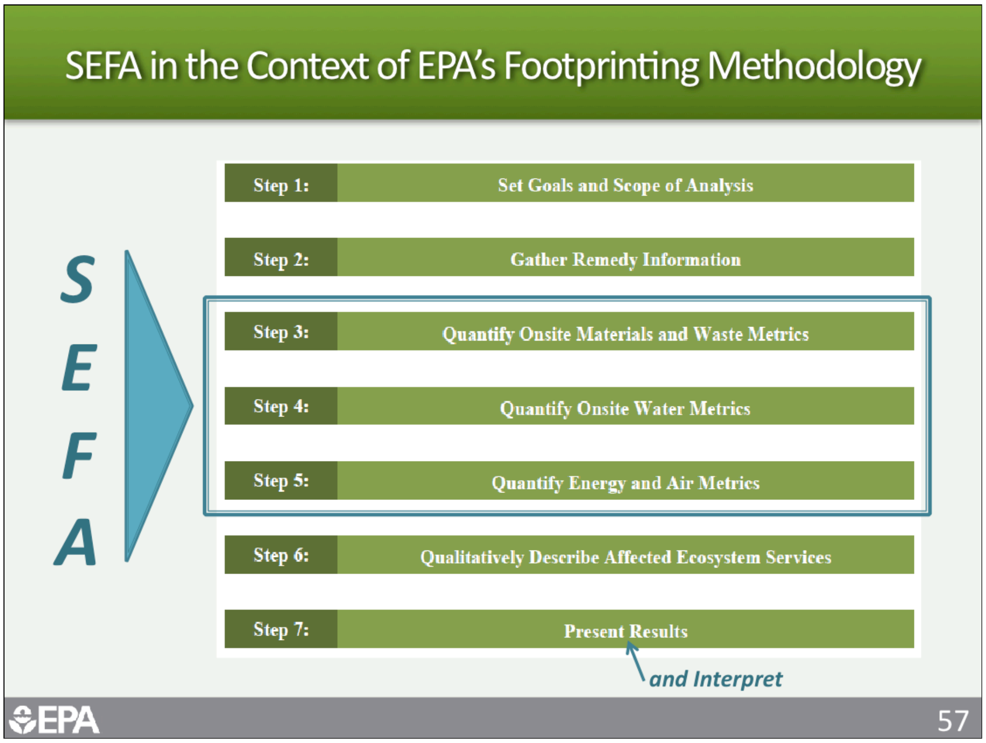
SEFA is…

- → a set of Excel workbooks developed by EPA
- → designed for conducting environmental footprint analys
- → compatible with EPA's Footprinting Methodology
- → set up in "blank slate" template format
- → structured for inputting data, running calculations, and organizing outputs

originally designed for internal EPA use

placed on EPA web page for public access

SEFA and EPA's Footprinting Methodology are publicly available and posted at: www.cluin.org/greenremediation/methodology/index.cfm


SEFA in the Context of EPA's Footprinting Methodology
S
E
F
A
Step 1: Set Goals and Scope of Analysis
Step 2: Gather Remedy Information
Step 3: Quantify Onsite Materials and Waste Metrics
Step 4: Quantify Onsite Water Metrics
Step 5: Quantify Energy and Air Metrics
Step 6: Qualitatively Describe Affected Ecosystem Services
Step 7: Present Results
and Interpret
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Inside SEFA – Three Excel Workbooks

Main Workbook

→ User enters basic site information

→ User enters data for materials, waste, and water

Workbook provides summary of results

Energy Workbook

→ User sets up analytic structure

→ User enters data for on-site and off-site activities

Workbook compiles the activities

Calculations Workbook

→ No data entry by user in this workbook

Workbook makes the footprint calculations

The user sets up the analytic structure

The user enters information about the remedy

The workbooks exchange data and process the results

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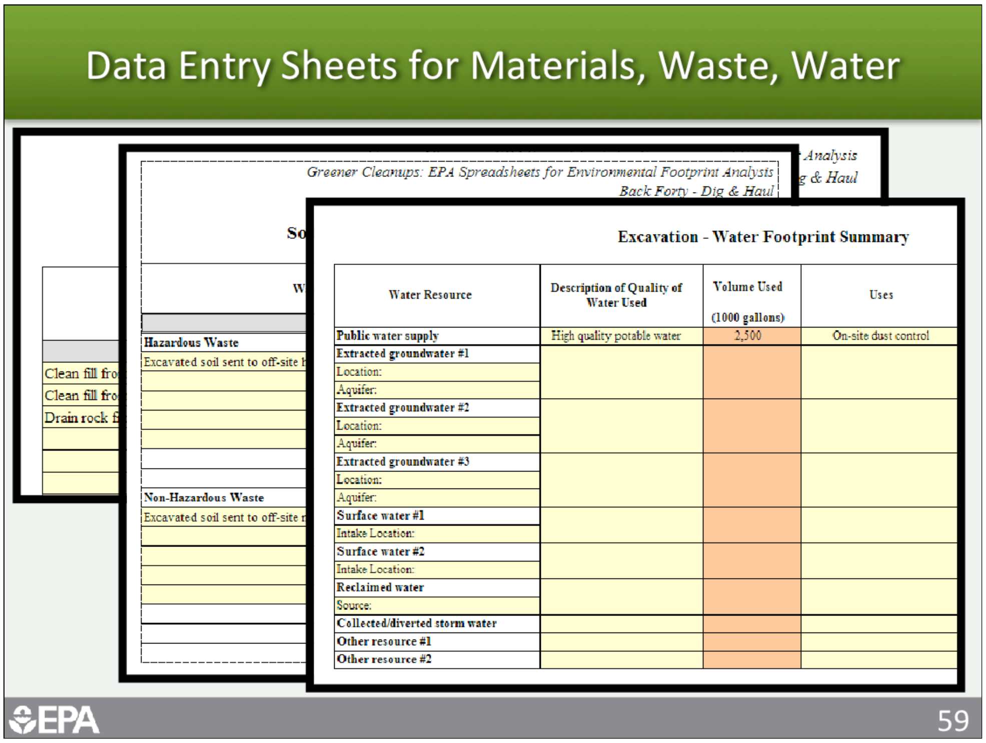
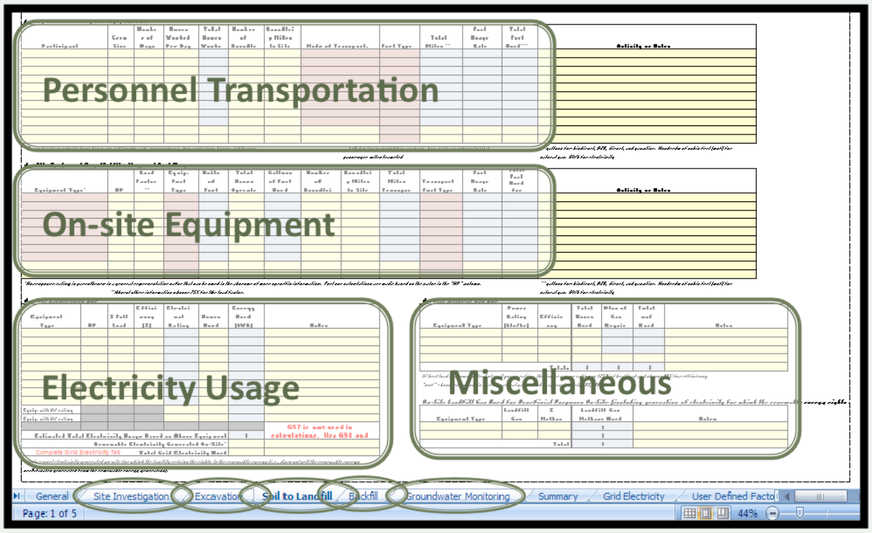


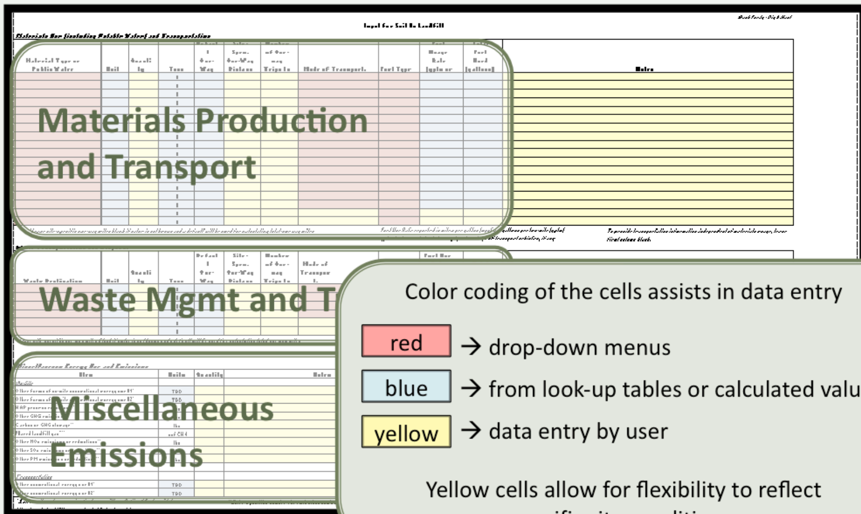
Excavation - Water Footprint Summary

Water Resource	Description of Quality of Water Used	Volume Used (1000 gallons)	Uses
Public water supply	High quality potable water	2,500	On-site dust control
Extracted groundwater #1			
Location:			
Aquifer:			
Extracted groundwater #2			
Location:			
Aquifer:			
Extracted groundwater #3			
Location:			
Aquifer:			
Surface water #1			
Intake Location:			
Surface water #2			
Intake Location:			
Reclaimed water			
Source:			
Collected/diverted storm water			
Other resource #1			
Other resource #2			

Data Entry Sheets for Energy and Activities



Data Entry Sheets for Energy and Activities *(continued)*



Color coding of the cells assists in data entry

- red → drop-down menus
- blue → from look-up tables or calculated values
- yellow → data entry by user

Yellow cells allow for flexibility to reflect specific site conditions.

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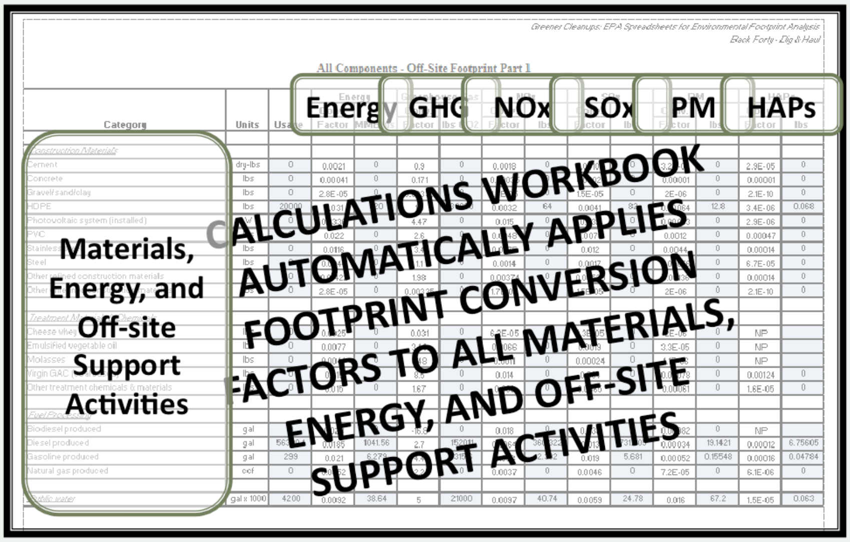
Worksheets Apply Footprint Conversion Factors



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Metrics Are Presented as Suggested in Methodology

Core Element	Metric	Unit of Measure	Footprint					
			Site Investigation	Excavation	Soil to Landfill	Backfill	Groundwater Monitoring	Total
Materials & Waste	Refined materials used on-site	Tons	0	10	0	0	0	10
	% of refined materials from recycled or waste material	%		0%				0%
	Unrefined materials used on-site	Tons	0	1500	0	7000	0	8,500
	[illegible]	%		0%		20%		[illegible]
	On-site hazardous waste disposed of off-site	Tons	10	0	3500	0	0	3,510
	On-site non-hazardous waste [illegible]	Tons	0	500	7500	0	0	8,000
	% of total potential waste recycled or reused	%	0%	30%	0%			15%
Water	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Energy	Total energy used	MMBtu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Total energy voluntarily derived from renewable resources							
	- Biodiesel use and onsite [illegible]	MMBtu	0	0	0	0	0	-
	- Voluntary purchase of renewable electricity	MWh	0	0	0	0	0	-
	- Voluntary purchase of RECs	MWh	0	0	0	0	0	-
Air	On-site NOx, SOx, and PM emissions	Pounds	117	939	0	411	1	1,467
	On-site HAP emissions	Pounds	0	0	0	0	0	0
	Total NOx, SOx, [illegible]	Pounds	738	2017	0	962	305	4,021
	Total HAP emissions	Pounds	8	3	0	1	4	16
	Total greenhouse gas emissions	Tons CO2e	43	125	0	62	17	247

Materials
Waste
Water
Energy
Air Emissions

Additional Features in SEFA

SEFA has additional features such as:

- **Tracking renewable energy sources**
- **Specifying local power mix for grid electricity**
- **Establishing unique footprint conversion factors**
- **Modeling carbon storage (e.g. from planting trees)**

These and other features in SEFA allow flexibility for accurately modeling specific site and remedy conditions.

Overview of SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

Flexible

- *any site and any remedy*
- *any level of detail*
- *any set of comparisons*

Requires Experience to Run

- *should be run by experienced staff*
- *steep learning curve*
- *easy to run once you know how*

"Hands-on"

- *user sets up structure of analysis to reflect site*
- *enter data directly into excel spreadsheets*
- *not equipped with user interface*

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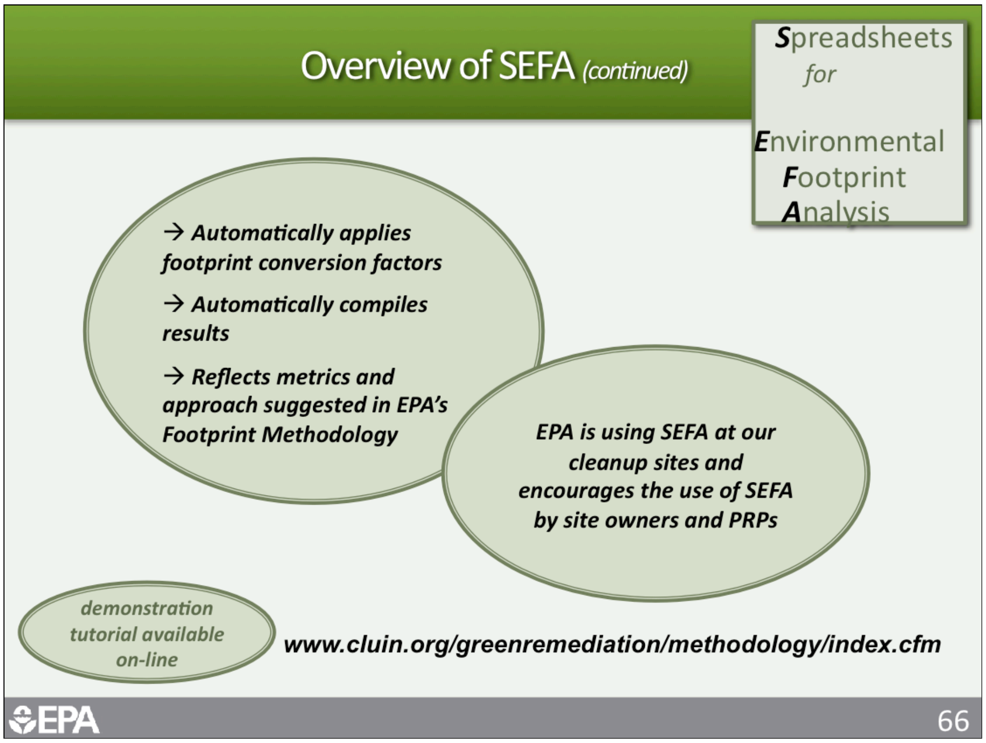
Overview of SEFA (continued)
Spreadsheets for Environmental Footprint Analysis
→ Automatically applies footprint conversion factors
→ Automatically compiles results
→ Reflects metrics and approach suggested in EPA's Footprint Methodology
EPA is using SEFA at our cleanup sites and encourages the use of SEFA by site owners and PRPs
demonstration tutorial available on-line
www.cluin.org/greenremediation/methodology/index.cfm
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Module 6: Lessons Learned & Discussion Questions

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Technical Lessons Learned

- Apply science and engineering principles
- Environmental footprint evaluations and BMPs complement optimization and should accompany typical remedial activities
- Energy use and off-site support activities are significant contributors to many footprints
- Remedy footprints are site dependent
  - Remedy type
  - Location
  - Contaminant type
  - Geologic setting and hydrogeologic conditions

(continued)

Technical Lessons Learned

- **Footprint analyses typically identify a few large contributors for each remedy type, for example:**

Remedy	Primary Contributors
In situ bioremediation and *in situ* chemical oxidation (ISCO)	- Nutrient production and transportation - Performance monitoring - *Drilling or injection can be smaller than expected*
Excavation	- Waste transportation (esp. for hazardous waste) - Waste disposal - *System construction may be smaller than expected*
P&T, vapor intrusion mitigation (VIM), and soil vapor extraction (SVE)	- Electricity - Treatment chemicals/materials (for example, GAC) - *Construction is quite small*

(continued)

Technical Lessons Learned

- Most green remediation BMPs can be identified from BMP fact sheets
- For more complex remedies, environmental footprint calculations provide quantitative data to guide footprint reduction efforts
- Understanding the remedy and gathering information are the most labor intensive part of a footprint analysis
- Opportunities exist to significantly reduce the environmental footprint of short-term, aggressive remediation

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Discussion Questions

- My P&T system is generating 7,800 tons of hazardous waste per year. Why is it considered part of the footprint?

Discussion Questions

- I hear that I can buy RECs to off-set the carbon footprint of the cleanup. Is that OK?

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Discussion Questions

- **Using a different reagent in the treatment system will reduce the total CO_2e footprint by 5%. However, the footprint analysis margin of error is about 20%. Should I go ahead and try to replace the old reagent with the new?**

Discussion Questions

- If I put a fence around the site instead of treating the contaminated soil, I will minimize the environmental footprint and still be protective. Is that what we are trying to achieve?

Discussion Questions

- **The project contractor used the EPA Footprint Evaluation Methodology; that means their footprint is correctly done, right?**

Discussion Questions

- **Phytoremediation has a lower footprint than *in situ* thermal remediation. Does that mean it is greener?**

Discussion Questions

- My footprint evaluation is complete and GHG has the largest numbers. Should I prioritize efforts to reduce GHG before other elements?

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Discussion Questions

- I am in the design phase of a remediation project. Should I go straight to proposing footprint reduction or do I need a quantitative evaluation?

Information and Resources

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Information and Resources

- Guidance Documents
- Special Issues Primers
- Technical Bulletins
- Fact Sheets
- Case Studies and Project Profiles
- Technology Descriptions
- Vendor Support
- Current and In-depth Information
  - BMPs for common cleanup approaches
  - Policy information at Federal and State level
  - Assessing a project's environmental footprint
  - Technical support

Hazardous Waste Clean-Up Information (CLU-IN)
www.clu-in.org

CLU-IN Green Remediation Focus Area
www.cluin.org/greenremediation

CLU-IN Global Efforts to Advance Remediation at Contaminated Sites
www.cluin.org/global

Brownfields and Land Revitalization Technology Support Center
www.brownfieldstsc.org

Triad Resource Center
www.triadcentral.org

Sustainability
www.epa.gov/sustainability

EPA Regional Points of Contact

Region	Superfund Green Remediation Regional Coordinators	Engineering Forum Environmental Footprint Methodology Points of Contact
1	Ginny Lombardo, John Podgurski	Kimberly White
2	Nicoletta Diforte, Kristin Giacalone	Stephanie Vaughn
3	Chris Corbett, Mickey Young	Josh Barber
4	Diedre Lloyd	Hilary Thornton, Candice Teichert
5	Brad Bradley	Brad Bradley
6	Sairam Appaji, Raji Josiam	Raji Josiam
7	Craig Smith	Matthew Jefferson
8	Timothy Rehder	Frances Costanzi
9	Jeff Dhont, Michael Gill	Julie Santiago-Ocasio, Karen Scheuermann
10	Beth Sheldrake, Sean Sheldrake	Kira Lynch

New Ways to stay connected!

- www.cluin.org
- Follow CLU-IN on Facebook, LinkedIn, or Twitter

https://www.facebook.com/EPACleanUpTech

https://twitter.com/#!/EPACleanUpTech

http://www.linkedin.com/groups/Clean-Up-Information-Network-CLUIN-4405740

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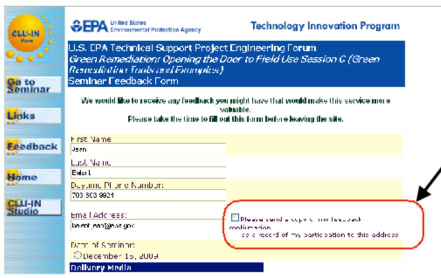
Resources & Feedback

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



Need confirmation of your participation today?

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

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