ASTM STANDARD GUIDE
FOR GREENER CLEANUPS

QUANTITATIVE EVALUATION
(SECTION 7)

Karen Scheuermann, US EPA Region 9
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Section 7
Quantitative Evaluation

Goal of this segment of the training

Most of us will not conduct a Quantitative Evaluation ourselves

However, we may be in a position to review and interpret Quantitative Evaluations at our sites

Become familiar with the Quantitative Evaluation described in the ASTM Standard Guide

Know how to review a Quantitative Evaluation

Know how to interpret the results

This segment provides context and tips
### Topics

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<td>1</td>
<td>Overview/Protocol for Quantitative Evaluation</td>
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<td>Footprint Analyses and Life Cycle Assessments</td>
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<td>Real-life Example</td>
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<td>Resources and Q/A</td>
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</table>

Quantitative Evaluation

Section 7

Quantitative Evaluation
Overview of Quantitative Evaluation

Reminder

Two Paths in the ASTM Standard Guide

One Path
- Apply the Best Management Practices (BMPs)

Another Path
- Conduct a Quantitative Evaluation then Apply the BMPs

The user chooses whether to do a Quantitative Evaluation. The choice will depend on the complexity of the site and the reasons for using the ASTM Standard.
Overview of Quantitative Evaluation

Purpose of a Quantitative Evaluation

Provide information on the most significant contributions to a cleanup’s environmental footprint

Estimate potential footprint reductions to be achieved by specific BMPs

What do we mean by “environmental footprint”?

The emissions, resource use, and waste generation associated with cleanup activities
Overview of Quantitative Evaluation

Quantitative Evaluation in the context of Greener Cleanups

Before

Quantitative Evaluation

Conduct Quantitative Evaluation → Identify Areas for Reduction → Select and Apply BMPs → Achieve Footprint Reductions

After

original clean-up → greener clean-up
Protocol for Quantitative Evaluation

**Goals and Scope Definition**

**Boundary Definition**

**Core Elements**

**Collection and Organization of Information**

**Calculations for Quantitative Evaluation**

**Sensitivity and Uncertainty Analysis**

**Documentation**

There are 7 steps in a Quantitative Evaluation as described in the ASTM Standard Guide.
Protocol for Quantitative Evaluation

**Step 1**
Goals and Scope Definition

User identifies the goal of the study (i.e., questions to be answered)

Similar Sites *may have* Different Goals

**Testing Options / BMPs**
- Pump and Treat
- Pump and Treat + *UV*
- Pump and Treat + *Re-injected GW*
- Pump and Treat + *Solar Power*

**One Site**

**Another Site**

Evaluate Year to Year
- Pump and Treat – Years 1 - 5
- Pump and Treat – Years 6 - 10
- Pump and Treat – Years 11 - 15
- Close-out Year 16
Step 1
Goals and Scope Definition

User establishes the scope (i.e., how to conduct the evaluation)

Choose One of Two Approaches

Footprint Analysis

OR

Life Cycle Assessment

We will discuss the differences between a footprint analysis and a Life Cycle Assessment in the next section.
Step 2
Boundary Definition

User determines the boundaries of the study

Activity Boundary
- Pump and treat activities
  - but
  - bioremediation activities not included

Geographic Boundary
- Areas within fence line of site
  - and
  - areas outside fence line (e.g., aspects of off-site support)

Temporal Boundary
- First 10 years of the pump and treat operations
  - but
  - possible continued operations after 10 years not included
**Step 3**  
Core Elements

User determines which core elements to include in the evaluation

Evaluate all core elements that are expected to be of importance to the clean-up

Document reasons for any core elements that are not included

Identify environmental trade-offs across core elements

Recall our Core Elements

- Materials & Waste
- Energy
- Air & Atmosphere
- Land & Ecosystems
- Water
Step 3
Core Elements

In some cases, we may apply a BMP that decreases the footprint in one core element but increases the footprint in another core element.

What do we mean by trade-offs across core elements?

We select a new treatment reagent with a smaller greenhouse gas footprint.

But this may...

... increase the volume of water used in the process...

... and increase the amount of waste generated by the process.
Protocol for Quantitative Evaluation

“Number Crunching”

**Step 4**
Collect and Organize Information

**Step 5**
Perform Calculations

- Identify appropriate sources of data
- Use either footprint analysis tool or Life Cycle Assessment software

**Step 6**
Perform Sensitivity Analyses

- Assess the confidence and uncertainty of the results

The user collects data and crunches the numbers in a manner consistent with:

- **goals and scope**
- **boundary conditions**
- **core elements**

Appendix X4 in the ASTM Standard Guide provides background and details.
Protocol for Quantitative Evaluation

**Example of Number Crunching**

20,000 lbs HDPE

\[ \times \]

1.9 lbs CO2e emitted per lb HDPE manufactured

\[ = \]

38,000 lbs CO2e

Footprint Conversion Factor for CO2e emissions

20,000 lbs PM emitted per lb HDPE manufactured

\[ \times \]

0.00064 lbs PM

\[ = \]

13 lbs PM

Footprint Conversion Factor for PM emissions

*same type of calculation for energy, NOx, SOx, and HAPs* 

*same set of calculations for all materials and services related to the remedy*

*very simple calculations ...*

*... but there will be a lot of them!*
Protocol for Quantitative Evaluation

**Step 7**
Documentation

- Present and interpret results of the quantitative evaluation
  - Summarize all steps in the evaluation
  - Identify significant contributors to the core elements
  - Recommend actions to reduce the environmental footprint

**Documentation of the Quantitative Evaluation at the Green Hills Site**

Make the documentation publicly available
Step 7
Documentation

→ identify contributors to the core elements
→ recommend BMPs for footprint reduction

Protocol for Quantitative Evaluation

Greenhouse gas emissions

- Diesel used in transportation

Tons CO2e

Example

Onsite grid electricity use
Onsite diesel use
Onsite biodiesel use
Generation of grid electricity
Transportation diesel use
Transportation biodiesel use
Transportation gasoline use
HDPE
Lime
Clean fill
Drain rock
Diesel produced
Biodiesel produced
Gasoline produced
Public water
Offsite solid waste disposal
Offsite haz. waste disposal
Offsite laboratory analysis
The user of the ASTM Standard chooses whether to do a Quantitative Evaluation. The user should:

- Clearly identify the goal, scope, and boundaries of the evaluation
- Determine which core elements to include in the evaluation
- Crunch the numbers
- Present and interpret the results in a publicly available report

Key Messages:

- Wrapping Up the Overview/Protocol

Overview/Protocol of Quantitative Evaluation
### Topics

1. Overview/Protocol for Quantitative Evaluation  
2. Footprint Analyses and Life Cycle Assessments  
3. Key Topics in Quantitative Evaluation  
4. What to Do When You See One  
5. Real-life Example  
6. Resources and Q/A
Footprint Analyses and LCAs

Two approaches to Quantitative Evaluation

Footprint Analyses
- Includes less of the life-cycle
- Input databases are less comprehensive
- Output metrics are less comprehensive
- NO

Life Cycle Assessment (LCA)
- Includes more of the life-cycle
- Input databases are more comprehensive
- Output metrics are more comprehensive
- YES

Data gathering
- Develop output metrics
- Report impact results

As a general rule...
Section 7: Quantitative Evaluation

Footprint Analyses and LCAs

What do we mean by “report impact results”?

Example

Metric
12 lbs HAPs emitted to the air

But what are the impacts from the HAPs?

Ecotoxicity
Ozone Depletion
Acidification
Human Health

HAPs = Hazardous Air Pollutants
LCA = Life-Cycle Assessment
Footprint Analyses and LCAs

Footprint Analyses
- Sustainable Remediation Tool (SRT)
- SiteWise
- Consultant’s In-House Worksheets
- Spreadsheets for Environmental Footprint Analysis (SEFA)

Life Cycle Assessment (LCA)
- SimaPro
- GaBi

Developed by EPA

- Generally quicker and easier to conduct
- Generally more involved and requires specialized training and expertise

Different tools and software will give different results, due to different built-in scopes and boundaries.

The user should choose the calculator/tool/software that best suits the goals, scope, and boundaries identified for the site.
Quantitative Evaluation

**Topics**

1) Overview/Protocol for Quantitative Evaluation 15 min
2) Footprint Analyses and Life Cycle Assessments 5 min
3) Key Topics in Quantitative Evaluation 5 min
4) What to Do When You See One 5 min
5) Real-life Example 10 min
6) Resources and Q/A 10 min
Key Topics in Quantitative Evaluation

Quantitative Evaluation is Most Useful for Complex Sites and Remedies

As a general rule...

Relatively complex site...
- multiple activities
- long time frame
- unique technologies

Quantitative Evaluation usually can help to:
- Find “hidden” contributors
- Prioritize BMPs
- Identify “trade-offs”

Relatively simple site...
- single activity
- short time frame
- standard technologies

Quantitative Evaluation generally not needed:
- Hidden contributors are unlikely
- BMP selection is easy
- “Trade-offs” unlikely
Identifying Core Elements to Include in the Quantitative Evaluation

The default should be to include all five Core Elements. However, some Core Elements may be more important than others at your site.

- PARTICULATE EMISSIONS MAY BE IMPORTANT FOR A REGION IN NON-ATTAINMENT.
- GREENHOUSE GAS EMISSIONS MAY BE IMPORTANT TO A MUNICIPALITY WITH GREENHOUSE GAS REDUCTION GOALS.
- THE WATER FOOTPRINT MAY BE IMPORTANT IN ARID LANDS.
- WASTE GENERATION MAY BE IMPORTANT FOR A COMMUNITY WITH CONCERNS REGARDING LANDFILL SPACE.
- MATERIALS & WASTE
Key Topics in Quantitative Evaluation

Be Careful When Evaluating an Array of Remedy Options

A. Be sure that the Alternatives have the same endpoints regarding effectiveness of the cleanup remedy.

B. Remember that the various Alternatives may have large vs small footprints in different core elements.

C. The environmental footprint of the remedy is not the driver in decision making. But it can give a preview of opportunities for footprint reduction.

Be careful how you interpret footprint results when asking for a footprint analysis at your site.

Be alert for improper use of results by PRPs or site owners.
The Quantitative Evaluation can be conducted at any phase of the cleanup.

With feedback loops for selecting BMPs.
Quantitative Evaluation

Topics

1) Overview/Protocol for Quantitative Evaluation 15 min
2) Footprint Analyses and Life Cycle Assessments 5 min
3) Key Topics in Quantitative Evaluation 5 min
4) What to Do When You See One 5 min
5) Real-life Example 10 min
6) Resources and Q/A 10 min
When you see a Quantitative Evaluation ...

... ask the following general questions:

- Are the goals, scope, and boundaries clearly defined?
- Are all five core elements addressed?
- Have trade-offs across core elements been described?
- Have the significant contributors to the footprint been identified?
- Have recommendations been made for footprint reduction?

If not addressed, has a rationale been provided?
What to Do When You See One

When you see a Quantitative Evaluation ...

... ask a few key questions on specifics:

If there is large grid electricity demand at your site ...
Has the local grid mix been used in the calculations?

If there are a lot of off-site support activities for your site ...
Have the off-site activities been included in the evaluation?

If there are unique technologies at your site ...
Have the technologies been modeled accurately?

lab analyses waste disposal POTW

wind turbine engineered wetlands landfill gas combustion
When you see a Quantitative Evaluation ...

... be curious. What is driving the results?

My site has only a pump and treat system ...

... so why is transport diesel fuel such a big contributor?

The pump and treat system at my site uses a lot of grid electricity ...

... so why isn’t the greenhouse gas footprint bigger?

Perhaps treatment reagents and treatment wastes are being trucked great distances, resulting in large diesel fuel usage.

Perhaps the local grid electricity is based primarily on hydropower, resulting in a smaller greenhouse gas footprint.
# Quantitative Evaluation

## Topics

1. Overview/Protocol for Quantitative Evaluation  
   - Duration: 15 min  
2. Footprint Analyses and Life Cycle Assessments  
   - Duration: 5 min  
3. Key Topics in Quantitative Evaluation  
   - Duration: 5 min  
4. What to Do When You See One  
   - Duration: 5 min  
5. Real-life Example  
   - Duration: 10 min  
6. Resources and Q/A  
   - Duration: 10 min
Example of Quantitative Evaluation

Section 7
Quantitative Evaluation

Recall our approach to quantitative evaluation

Set Up

Number Crunch

Results

Site Description
- Slag pile on shoreline
- Slag is sinking into water

Remedy Design
- Dredge slag out of shoreline area
- Place on top of pile
- Asphalt cover
- Build containment walls
- Groundwater extraction
**Example of Quantitative Evaluation**

**Section 7 Quantitative Evaluation**

**Step 1: Goals and Scope**

**Goal:**
Identify opportunities for Greener Cleanup BMPs

**Scope:**
Conduct footprint analysis using EPA’s SEFA worksheets

**Step 2: Boundary Definition**

**Activity Boundary:**
- dredging & construction
- gw extraction & cap maintenance
  `<exclude site investigation and pilot testing>`

**Geographic Boundary:**
- within fence line
- off-site support

**Temporal Boundary:**
- 100 years of O&M

**Step 3: Core Elements**

- Quantitative metrics for 4 core elements
- Qualitative description for land & ecosystems
### Example of Quantitative Evaluation

We are using quantitative metrics based on EPA’s Footprint Methodology ...

<table>
<thead>
<tr>
<th>Category</th>
<th>Metric Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy</strong></td>
<td>• Total energy used&lt;br&gt;• Energy from renewable resources</td>
</tr>
<tr>
<td><strong>Air</strong></td>
<td>• Greenhouse gases&lt;br&gt;• Criteria pollutants (NO$_x$ / SO$_x$ / PM)&lt;br&gt;• Hazardous air pollutants (HAPs)</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>• On-site water use&lt;br&gt;  – Quantity, quality, source</td>
</tr>
<tr>
<td><strong>Materials &amp; Waste</strong></td>
<td>• Materials used on-site&lt;br&gt;  – Percent from recycled materials&lt;br&gt;• Waste generated on-site&lt;br&gt;  – Percent recycled or reused</td>
</tr>
</tbody>
</table>
Step 4 Collect and Organize Information

Step 5 Perform Calculations

Step 6 Perform Sensitivity Analyses

→ Inputs based on Feasibility Study

→ Make assumptions where data is lacking
  → Ratio of cement to water in slurry
  → Type of precipitant used for gw treatment
  → Components in “fish mix”
  → Dimensions of earthen dock
  → Density of slag
  → Transport distances for personnel, materials, and waste

→ Establish intermediate inputs
  → Equipment hours for operation of excavators and dredging machines
  → Amount of materials needed, such as steel sheet pile and asphalt

→ Screen out minor inputs
  → Materials and equipment for sampling events
  → Miscellaneous materials used in well construction
Example of Quantitative Evaluation

**Section 7**

**Quantitative Evaluation**

**Step 4**

Collect and Organize Information

**Data entry in EPA’s SEFA worksheets for footprint analysis**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Crew Size</th>
<th>Number of Days Worked</th>
<th>Hours Worked Per Day</th>
<th>Total Hours Worked</th>
<th>Number of Roundtrips to Site*</th>
<th>Roundtrip Miles to Site</th>
<th>Mode of Transport</th>
<th>Fuel Type</th>
<th>Total Miles **</th>
<th>Fuel Usage Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredging</td>
<td>2</td>
<td>104</td>
<td>8</td>
<td>2948.3822</td>
<td>184</td>
<td>40</td>
<td>Light-Duty Truck</td>
<td>Diesel</td>
<td>7972.220075</td>
<td>20</td>
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<tr>
<td>Slag Transport</td>
<td>3</td>
<td>343</td>
<td>8</td>
<td>2843.3822</td>
<td>184</td>
<td>40</td>
<td>Light-Duty Truck</td>
<td>Diesel</td>
<td>7972.220075</td>
<td>20</td>
</tr>
<tr>
<td>Shoreline Stabilization</td>
<td>3</td>
<td>308</td>
<td>8</td>
<td>2526.9438</td>
<td>184</td>
<td>40</td>
<td>Light-Duty Truck</td>
<td>Diesel</td>
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<tr>
<td>Slag Crusher Operation</td>
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<td>3,208</td>
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<td>40</td>
<td>Light-Duty Truck</td>
<td>Diesel</td>
<td>7972.220075</td>
<td>20</td>
</tr>
<tr>
<td>Capping Engineered Slag</td>
<td>7</td>
<td>365</td>
<td>8</td>
<td>2046.135</td>
<td>184</td>
<td>40</td>
<td>Light-Duty Truck</td>
<td>Diesel</td>
<td>7972.220075</td>
<td>20</td>
</tr>
</tbody>
</table>

* Trips to site are vehicle trips for cars and trucks and "person-trips" for airplanes, buses, and trains.

**Step 5**

Perform Calculations

**Footprint calculations in EPA’s SEFA worksheets**

<table>
<thead>
<tr>
<th>Equipment Type*</th>
<th>HP</th>
<th>Load Factor **</th>
<th>Equip. Fuel Type</th>
<th>Total Hours Operated</th>
<th>Fuel Use</th>
<th>Total Miles</th>
<th>Transport Fuel Type</th>
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<tr>
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<td>250</td>
<td>75%</td>
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<td>1,105</td>
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</tr>
<tr>
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<td>75%</td>
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<tr>
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<td>369</td>
<td>2863.247174</td>
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</table>

**Step 6**

Perform Sensitivity Analyses

**Data entry in EPA’s SEFA worksheets for footprint analysis**

<table>
<thead>
<tr>
<th>Contributors to Footprint</th>
<th>Units</th>
<th>Conc. Factor</th>
<th>MADB</th>
<th>Conc. Factor</th>
<th>lbs CO2s</th>
<th>Conc. Factor</th>
<th>lbs</th>
<th>Conc. Factor</th>
<th>lbs</th>
<th>Conc. Factor</th>
<th>lbs</th>
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<tr>
<td>On-Site</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>Landfill gas combusted</td>
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<td>2.25</td>
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<td>Other onsite fossil fuel</td>
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<td>Other onsite fossil fuel</td>
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<td>Other onsite fossil fuel</td>
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<td>0.000024</td>
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<td>0.000184</td>
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<td>0.000084</td>
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**Number Crunch**
### Example of Quantitative Evaluation

#### Step 4
**Collect and Organize Information**

#### Step 5
**Perform Calculations**

#### Step 6
**Perform Sensitivity Analyses**

---

<table>
<thead>
<tr>
<th></th>
<th>CO2e (lbs)</th>
<th>CO2e (tons)</th>
<th>Nox (lbs)</th>
<th>Sox (lbs)</th>
<th>PM (lbs)</th>
<th>HAPs (lbs)</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>Totals</td>
<td></td>
<td></td>
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<td>41,105</td>
<td>287,840</td>
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<td>Amount of Slag Being Excavated +25%</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>65,000 CY Slag</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CO2e (lbs)</td>
<td>CO2e (tons)</td>
<td>Nox (lbs)</td>
<td>Sox (lbs)</td>
<td>PM (lbs)</td>
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<td>334,514</td>
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<td>50,027</td>
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<td>8</td>
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<td>(420)</td>
<td>(7,256)</td>
<td>(174)</td>
<td>(167)</td>
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<tr>
<td>9</td>
<td>% Change</td>
<td>-3%</td>
<td>-3%</td>
<td>-2%</td>
<td>0%</td>
<td>-1%</td>
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<td>12</td>
<td>Scenario 1a.</td>
<td>Amount of Slag Being Excavated -25%</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>65,000 CY Slag</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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Section 7
Quantitative Evaluation

Example of Quantitative Evaluation

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The quantitative evaluation can generate very detailed results...

... ... ... ...

The key is to interpret the results for Greener Cleanup BMPs.
We used the results to:

- Look for Greener Cleanup BMPs in all core elements
- Identify opportunities for footprint reduction
- Estimate the footprint reductions that could be achieved with the BMPs

Remember:
The quantitative evaluation is based in part on assumptions.

All results are estimates!
Example of Quantitative Evaluation

Opportunity for Greener Cleanup BMP: Materials

Remedy uses large amount of bulk materials (armor rock, gravel, fill)

BMP
Use materials with recycled content

Obtain ½ of the armor rock, gravel, and fill from reused sources.

Proportion of materials from virgin sources decreases from 100% to 62%.
GHG emissions decrease by 300 tons.
Opportunity for Greener Cleanup BMP: Waste

Remedy produces large amount of waste due to removal of structures during O&M.

BMP
Arrange for reuse of clean salvaged materials

Send ½ of O&M demolition materials for recycle or re-use.

Proportion of waste sent to off-site landfills decreases from 85% to 44%.

GHG emissions decrease by 800 tons.

Footprint Reductions
Opportunity for Greener Cleanup BMP: Water

Nearly all of public water in the remedy is used in slurry mixture for containment walls.

**BMP**

Use treated wastewater in place of fresh water

Replace ½ of public water in slurry walls with reclaimed water from nearby treatment system.

Fresh public water usage decreases by 50%.

GHG emissions increase by 200 tons.
Opportunity for Greener Cleanup BMP: Particulates

Operation of diesel equipment is a key contributor to on-site particulate emissions.

**BMP**
Minimize diesel emissions through use of filter devices

Retrofit old equipment or replace with equipment meeting “Tier 2” standards.

Reduce on-site particulate emissions by 60%.
Minimal increase to greenhouse gas emissions.
Opportunity for Greener Cleanup BMP: Greenhouse Gas

Cement used in the slurry wall causes 40% of the greenhouse gas emissions from the remedy.

**BMP**
Substitute Portland cement with fly ash

Replace ½ of cement in the slurry walls with fly ash.

GHG emissions decrease by 12,400 tons.
Proportion of materials from virgin sources decreases from 62% to 56%.
Using Quantitative Evaluation to help select BMPs:

1. **Materials**: Obtain armor rock, gravel, and fill from reused sources.

2. **Waste**: Send O&M demolition materials for recycle or re-use.

3. **Water**: Replace public water in slurry walls with reclaimed water.

4. **Particulates**: Retrofit old equipment or replace with “Tier 2” equipment.

5. **GHG**: Replace cement in the slurry walls with fly ash.

Footprint reductions can be achieved in four core elements. And ...

... estimated reduction in greenhouse gas footprint from all five BMP opportunities combined:

- 13,300 tons
- 22% reduction
Example of Quantitative Evaluation

Other ideas from the BMP checklist ...

Plant trees for ecosystem improvements around edge of the site

Use open space on the cap for generation of renewable energy

66-acre site
<table>
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<tr>
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<tr>
<td>2) Footprint Analyses and Life Cycle Assessments</td>
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<tr>
<td>3) Key Topics in Quantitative Evaluation</td>
<td>5 min</td>
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<td>4) What to Do When You See One</td>
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<tr>
<td>5) Real-life Example</td>
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<tr>
<td>6) Resources and Q/A</td>
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Wrap-Up

**We hope this has provided basic information about Quantitative Evaluations**

**You can find specific information in the ASTM Standard Guide**

*If you receive a Quantitative Evaluation for your site ...*

... we think you will find the results very useful ..."... and it should help you gain a better understanding of your site and remedy!*
Footprint Assessment

Methodology

EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint supplements EPA's 2008 green remediation primer (EPA 542-f) an approach to quantify energy, air, and waste that comprise the environment remedy. It also provides suggestions on how to during the remedy selection, design, implement phases. After finalizing the methodology in 2012, publically released the Spreadsheets for Environmental Footprint Analysis (SEFA), which are designed to help user methodology's metrics on a site-specific basis.

Click here to view the archived webinar.

A Standard Guide for Greener Cleanups

EPA representatives worked with ASTM International to develop a consensus-based standard intended to encourage property owners, responsible parties, developers, and communities to voluntarily use greener practices for contaminated site cleanup. As a part of the standard development process, EPA's Office of Solid Waste and Emergency Response (OSWER), EPA regional offices and stakeholders, developed a framework outlining the desired outcomes of a potential standard for greener cleanups. The framework reflected EPA's Green Remediation Focus, which focuses on five core elements associated with a cleanup project's environmental footprint.

ASTM International issued the final Standard Guide for Greener Cleanups (E2893-13) in November 2013. The guide includes:

- A systematic protocol to identify, prioritize, select, implement, and report on the use of best management practices (BMPs) to reduce the environmental footprint of cleanup activities
- A list outlining more than 160 greener cleanup BMPs that are linked to the core elements of a greener cleanup and to relevant cleanup technologies
- Guidelines to quantify the environmental footprint of cleanup activities

Cluin.org/greenremediation
Thank you for your interest in Greener Cleanups!

**Resources**

**EPA’s Footprint Methodology (full document)**
www.clu-in.org/greenremediation/subtab_b3.cfm

**EPA’s Footprint Methodology (2-page fact sheet)**

**EPA’s SEFA Worksheets (for footprint analysis)**
www.clu-in.org/greenremediation/subtab_b3.cfm

**SEFA Webinar (archived Oct 28, 2014)**
http://www.clu-in.org/conf/tio/SEFA_102814/

**Contacts**

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

Thank you for your interest in Greener Cleanups!
Quantitative Evaluation

ASTM STANDARD GUIDE FOR GREENER CLEANUPS

QUANTITATIVE EVALUATION (SECTION 7)

Contact for questions on this presentation →

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scheuermann.karen@epa.gov