Applications of Sustainability Principles and Metrics at Industrial Sites Undergoing Remediation

Stephanie Fiorenza, BP Remediation Management
Global Perspectives in Green Remediation
California EPA, Sacramento, California
February 4, 2009

Former Terminal, NJ

Sustainable Practices

- Alternative Energy
  - Installed 275-kW solar field; 5880 panels
  - Solar field supports 300 gpm Pump and Treat system
  - Powers six recovery wells, aerators and blowers
- Reuse of Land by Local Organization
- Community Involvement

Results, Former Terminal

- Supplies 350,000 kWh each year
- Meets 20-25% of system demand
- Eliminates 571,000 pounds of CO_2 annually, equivalent of 29,000 gallons of fuel

Former Refinery, NY

Sustainable Practices

- Ecological approach to remediation
  - Constructed wetland treats groundwater before discharge into Genesee River
  - Extracted gw flows 3 days through 3 vertical and 3 horizontal cells
- Community involvement
  - Educational center
- Reuse of land

Constructing the Wetland

Genesee River, NY

Retail Site Case Studies

- Developed 2- & 3D models of petroleum impacts at 10 NJ retail sites
- Scoped tasks required for site closure by NJDEP
- Estimated the associated carbon footprint
- Evaluated COC degradation and carbon footprint over 4 years

Carbon Footprint Inputs

- Energy consumption (fuels and electricity) estimated for closure activities including:
  - Field investigation
  - Sample collection
  - Laboratory analysis
  - Remediation processes
  - Administrative activities
- Risks were not calculated for field personnel traveling/working at sites

Carbon Footprint Assessment (Activity Totals By Task)

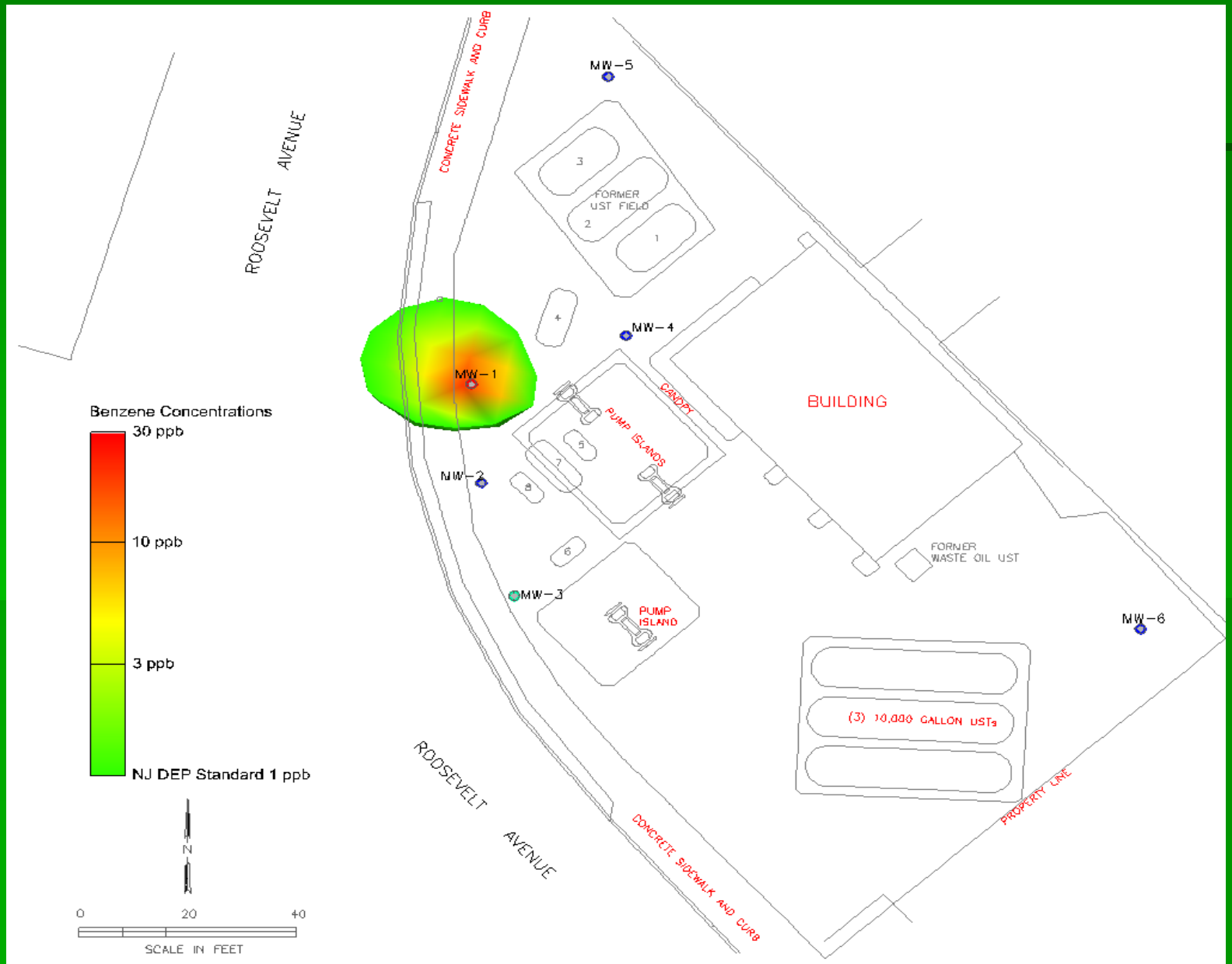
Activity totals	Units	Total Resources Required for Activity	Units	Total CO_2 Emissions (Pounds)
Task Total - task 1 - Groundwater Monitoring				
1805.7	light miles	85.86	gallons of gasoline	1,680
423	kW hours	423.00	kW hours	453
	Pounds of CO_2 Task 1			**2,133**
Task Total - task 2 - Remediation				
MNA	**Pounds of CO_2 Task 2**			**0**
Task Total - task 3 - Reporting				
480	kW hours	480.00	kW hours	514
16	Ccf natural gas consumption	16.00	Ccf	193
	Pounds of CO_2 Task 3			**707**
Task Total - task 4 - Additional Activities				
34.0	light miles	1.62	gallons of gasoline	32
40	heavy miles	5.71	gallons of diesel	128
8	heavy machine hours	160.00	gallons of diesel	3,581
	Pounds of CO_2 Task 4			**3,741**

Overall Study Results

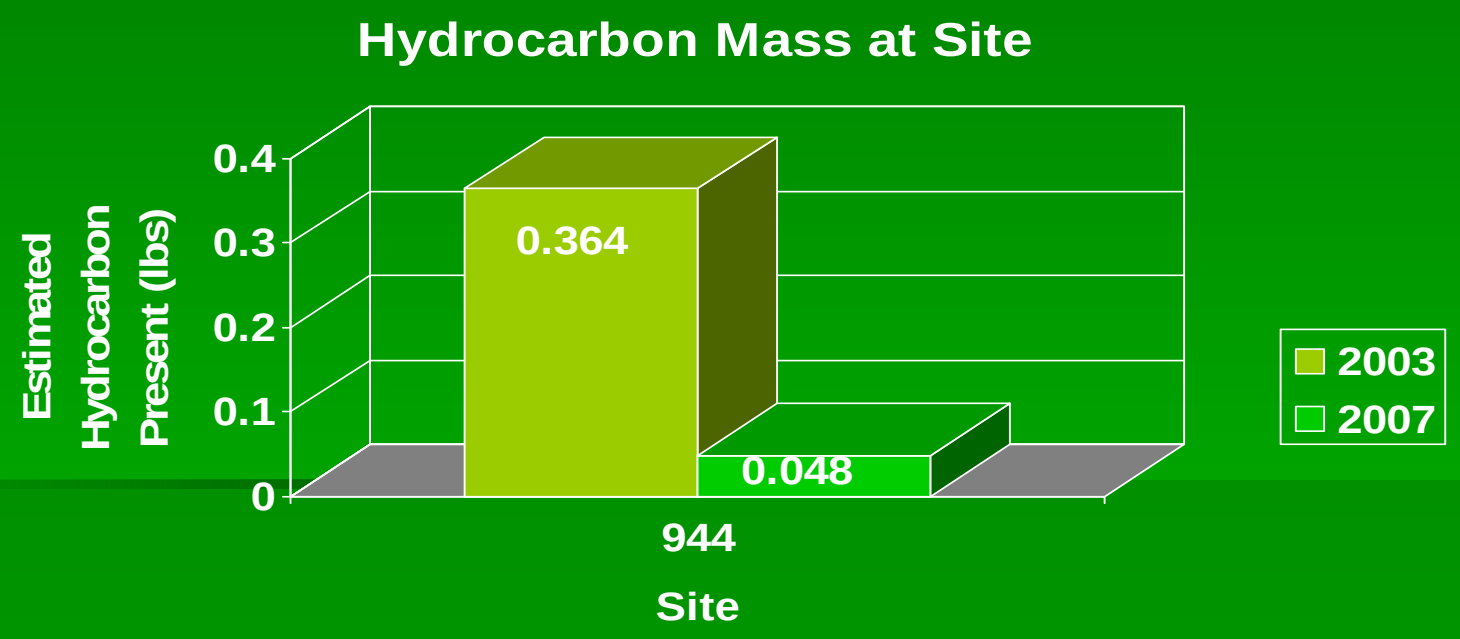
For the 10 sites:

- **Hydrocarbon mass at site ranged 0.05 lb to 7.5 lb (average 1.5 lb)**
- **Gasoline vol equivalent of 0.04 gal to 9 gal (average 1.8 gal)**
- **CO_2 produced to meet closure ranged 1600 to 6800 lb per site (average 4600)**
- **CO_2 produced equals burning 81-349 gal of gasoline (average 240 gal gas)**

Site # 944 Map


ROOSEVELT AVENUE
CONCRETE SIDEWALK AND CURB
MW-5
FORMER UST FIELD
3
2
1
4
MW-4
MW-1
CANOPY
PUMP ISLANDS
BUILDING
5
7
8
MW-2
6
MW-3
PUMP ISLAND
FORMER WASTE OIL UST
MW-6
(3) 10,000 GALLON USTs
PROPERTY LINE
ROOSEVELT AVENUE
CONCRETE SIDEWALK AND CURB
Benzene Concentrations
30 ppb
10 ppb
3 ppb
NJ DEP Standard 1 ppb
N
0
20
40
SCALE IN FEET

Site # 944



MNA with additional monitoring wells required for closure

Site # 944 Results

- Minimum carbon footprint = **6600 lb CO_2**
  - Assumes optimal attenuation rates, 4 years
  - Assumes current regulatory requirements for site
  - **132,000 lb CO_2 produced per lb HC present**
- Likely carbon footprint , lower rate = **10,000 lb CO_2**
- If monitoring/reporting reduced **quarterly to annually**,
  - **Carbon footprint reduced by 1,950 lb or 30%**
  - **Closure goals are still achieved**
- Reduction is equivalent to 100 gal of gasoline, 87 gal of diesel, 16,300 cubic feet of natural gas, or 1,825 kilowatt hours.

Site # 944 Conclusions

- Evaluating sustainable remediation at all sites provides information about the total impact of ongoing or proposed remediation.

- Implementing sustainable practices into site cleanups can lead to significant reductions in the carbon footprint and other environmental impacts associated with remediation requirements.

- By implementing sustainable practices in a manner consistent with the intent of requirements, closure can be reached within reasonable timeframes, while being protective of human health and the environment.

Retail Site Comparison

944	60757	4098
0.05 lb HC	8.8 lb HC	0.77 lb HC
MNA + wells	ISCO	MNA only
6600 lb CO_2	6030 lb CO_2	2200 lb CO_2
132,000 lb CO_2/ lb HC*	690 lb CO_2/ lb HC*	2800 lb CO_2/ lb HC*

*Assumes all mass remediated

Other Examples

Retrospective:

- **Vacuum truck removal of product**
  - 1.75 Million lb CO_2/lb COC (1 yr, 12 events)
- **P & T-** 4000 lb CO_2/lb COC (lifetime, 4 yrs)

Prospective:

- **ISCO** - 6000 lb CO_2; 700 lb CO_2 /lb COC*
- **MNA** + BR wells – 6600 lb CO_2; 28K lb CO_2 /lb COC; 63% CO_2 from well installation
- **SVE** – 200 T CO_2; excavation – 300 T

Closing Thoughts

- Goals – site strategy, remedy selection, remedy optimization
- Comparisons of technologies
- Boundaries and Impacts
  - Local vs global
  - Environmental, Social, Economic
- Time frame - annual, multi-year
- Screening vs. detailed assessments
- Framework

Recommendations

- Explicit assumptions
- Factors and impacts vary in priority depending on site
- Stakeholder involvement

Can there be one tool?

Could one metric serve as a surrogate for all environmental impacts?

Acknowledgments

- Walt Hufford, BP
- Shaun Gilroy and James Arthur, Environmental Standards
- SURF membership, especially White Paper chapter facilitators and metrics chapter co-authors