



# Department of the Navy Green and Sustainable Remediation

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# New Executive Order and DoD Guidance

- **EO 13514 – October 5, 2009 Federal Leadership in Environmental, Energy, and Economic Performance**
  - GSR related major elements: Improve energy efficiency; reduce GHG emissions, water consumption, & waste generation; promote renewable energy, recycling, & community enhancements
  
- **DoD Memorandum August 10, 2009 - Consideration of Green and Sustainable Remediation (GSR) practices in the Defense Environmental Restoration Program**
  - Evaluate opportunities for GSR during all phases of remediation
  - Implement these opportunities when and where these make sense
  - Track and report progress



# What is GSR?

- GSR employs strategies for cleanups that:
  - Use natural resources and energy efficiently
  - Reduce negative impacts on the environment
  - Minimize or eliminate pollution at its source
  - Protect and benefit the community at large
  - Reduce waste to the greatest extent possible
- GSR minimizes the environmental “footprint” of cleanup actions
- Environmental footprint refers to the impacts on environmental media and society



# Green and Sustainable Remediation

## DON Programmatic Approach

- DON remains focused on conducting cleanups in accordance with CERCLA and the NCP
  - GSR considerations bring a more holistic approach to site cleanup while remaining endpoint focused
  - Environmental, social, and economic impacts considered during remedy selection are rolled into existing NCP criteria
- Implementing GSR as part of the DON's existing optimization program
  - Optimization reviews (required by DON policy) are opportune times to evaluate green/sustainable methods
  - Consider GSR throughout the cleanup process: Key points include Remedy Selection, Remedial Design, and System Operation
  - Consider sustainability when developing performance objectives and exit strategies



# Green and Sustainable Remediation

## DON Programmatic Approach

- DON Optimization Workgroup tasked to develop and promote GSR approach, implementation, and information
- Emphasized in NAVFAC Technology Transfer Plan for Environmental Restoration 2010 – 2014
  - “Incorporating Optimization and Sustainable Environmental Remediation Practices” is one of the top 8 technical challenges
- Communicating efforts with other Federal partners, state regulators, and industry through FRTR, ITRC, SuRF, & ASTM



# Where does a Sustainability Evaluation Fit in the CERCLA Process?

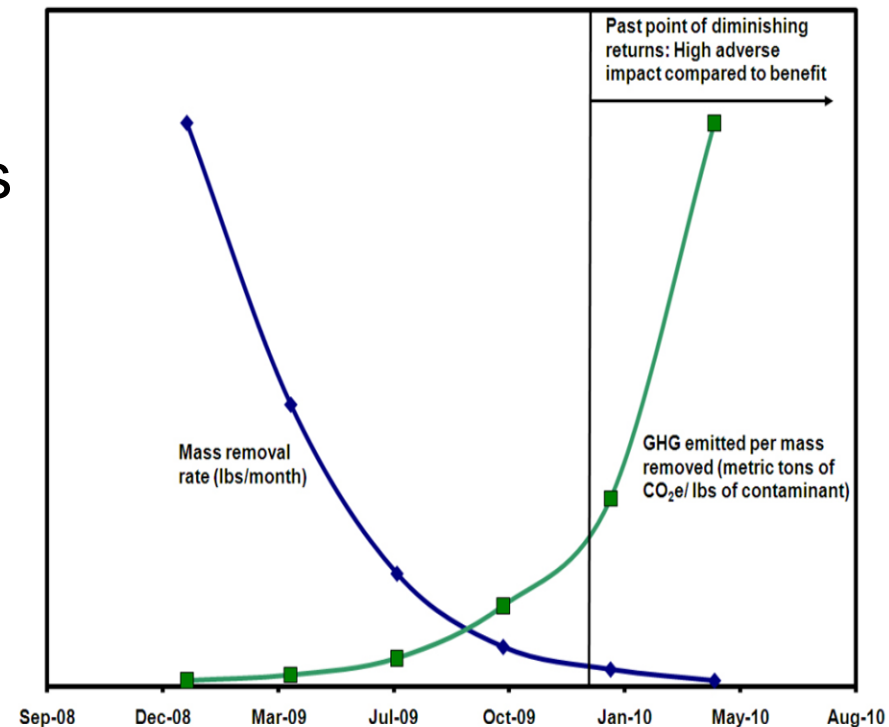
- **Nine criteria for detailed analysis of remedial alternatives**
  - Overall protection of human health and the environment
  - Compliance with ARARs
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility or volume through treatment
  - **Short-term effectiveness**
  - Implementability
  - Cost
  - State acceptance
  - Community acceptance

- Adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy
- Time for remedy implementation



# Incorporating GSR into the Cleanup Process

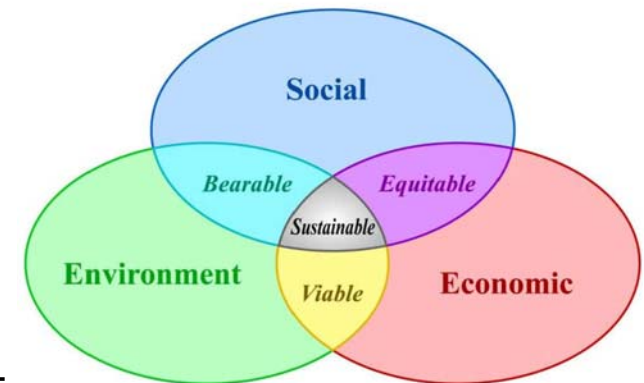
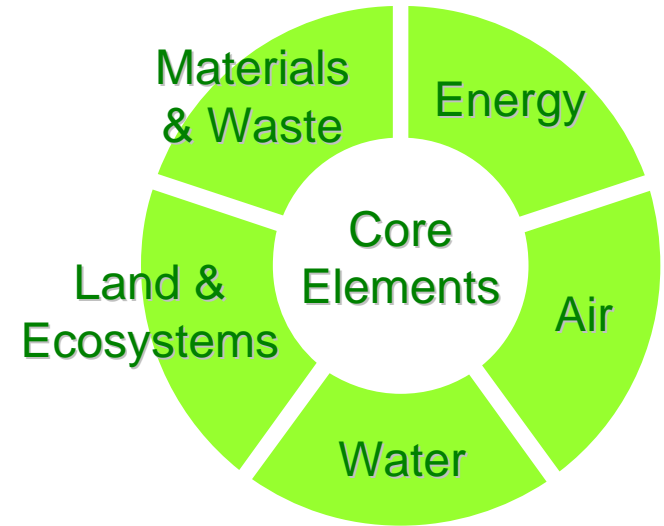
- Minimize environmental footprint of site cleanups
- Most effective stages to apply GSR is during remedy selection and implementation of exit strategies
- Avoid operating remedial systems beyond point of diminishing returns as this increases environmental footprint with little remedial benefit





# GSR Evaluation Metrics

- DON Optimization Workgroup decided on the following metrics:
  - Energy Consumption
  - GHG Emissions
  - Criteria Pollutant Emissions
  - Water Usage
  - Worker Safety
  - Resource Consumption
    - Waste Generation
  - Ecological Impacts
  - Community Impacts
- For operating remedies, include Kwh used and GHG emission per lb contaminant removed
  - Could also include other relevant metrics





# Project Approach

1. Determine which sustainability metrics should be considered for the site;
2. Establish and apply a methodology to quantify or characterize each metric;
3. Obtain consensus regarding how metrics are weighed against each other and against traditional criteria in selecting the remedial approach;
4. Identify methods to reduce environmental footprint of remedy components; and
5. Prioritize, select, and document what footprint reduction methods should be implemented with consideration of the overall net environmental benefit and available funding.



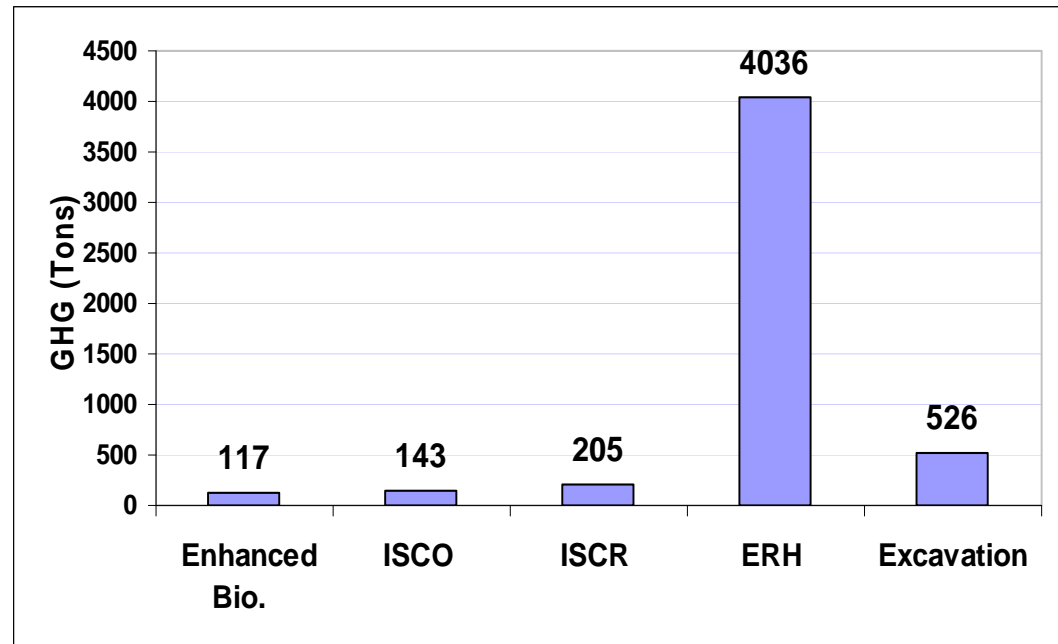
# Navy GSR Evaluation Case Studies

- Case studies for lessons learned - completed 6, 1 in progress
  - Former Naval Air Station (NAS) Alameda, CA (two OUs)
  - NAS Meridian, MS
  - Marine Corps (MC) Recruit Training Center, Parris Island, SC
  - MC Logistics Base, Albany, GA
  - Naval Aviation Depot, Norfolk, VA
  - Yorktown Fuel Depot, Yorktown, VA (in progress)
- Two case studies in remedial action operation phase
- Five case studies in remedy selection phase



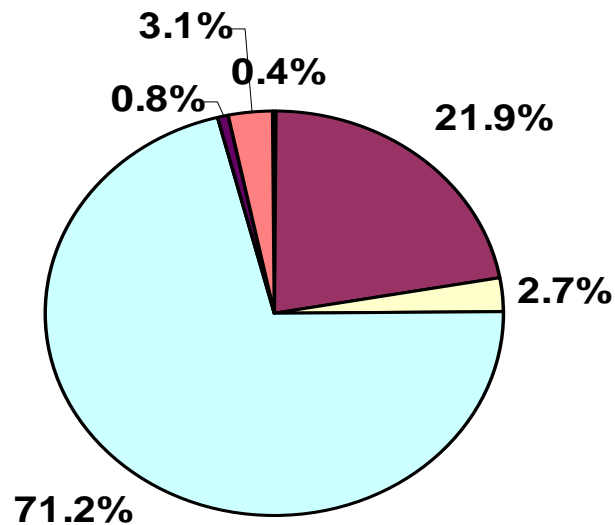
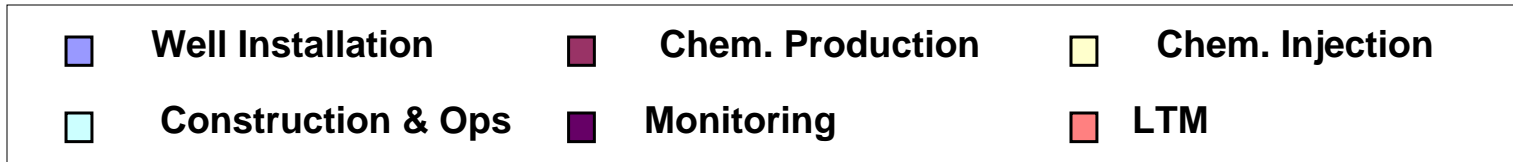
# Observations from Case Studies - GHG Emissions

- All case studies included GHG emissions - CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O
- Reported as CO<sub>2</sub>e
- Mostly related to energy consumption
- For commonly used in situ remedies (active), In situ bio tends to have low GHG emissions





# ISCO - GHG Emissions from Various Activities



➤ Production of chemicals / supplies used at remediation sites could have significant contribution for GHG footprint

➤ Two case studies did not include GHG emissions from production of chemicals / supplies



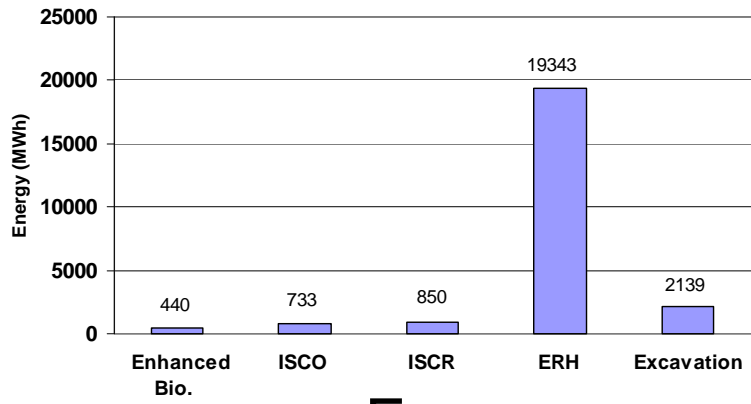
# What is Included in GHG Calculation for each Activity?

■ Well Installation	■ Chem. Production	■ Chem. Injection
■ Construction & Ops	■ Monitoring	■ LTM

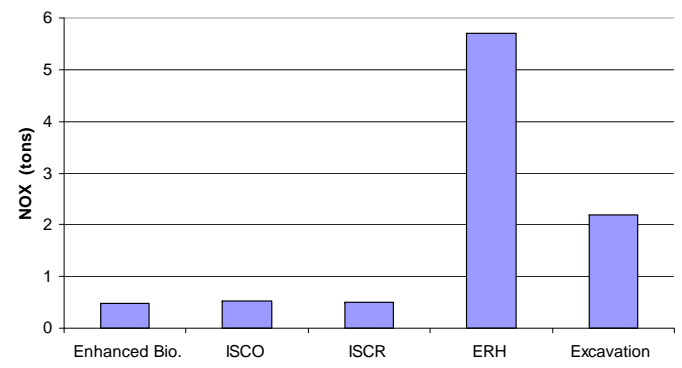
- Consumables
- Transportation Personnel
- Transportation Equipment / Materials
- Equipment Use - earthwork, pumps, compressors
- Residual Handling - soil, water, sludge



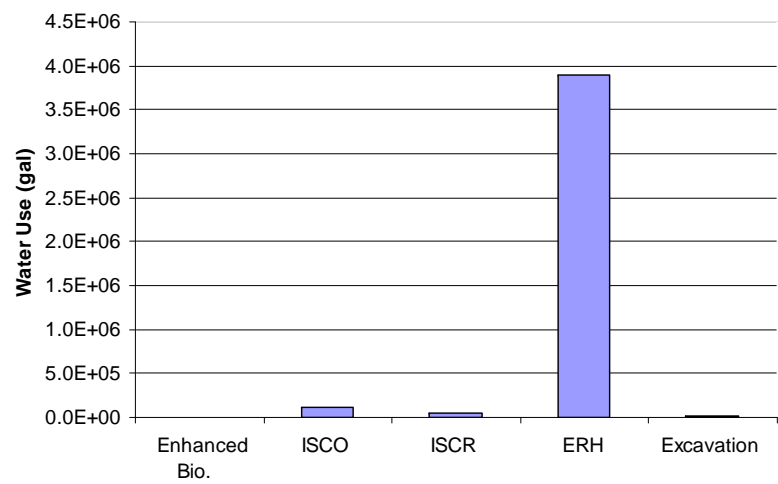
# Other Metrics from Case Studies



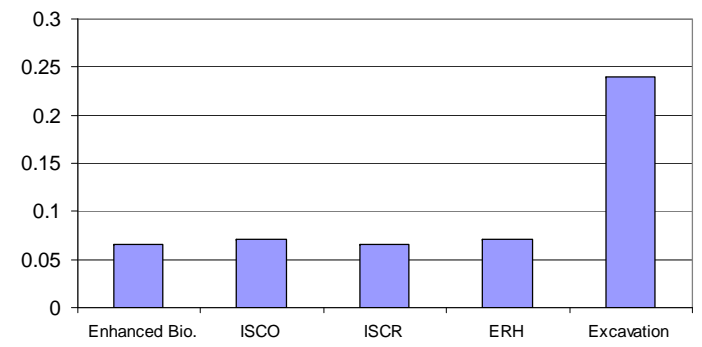
Energy



Air Pollutants



Water Usage

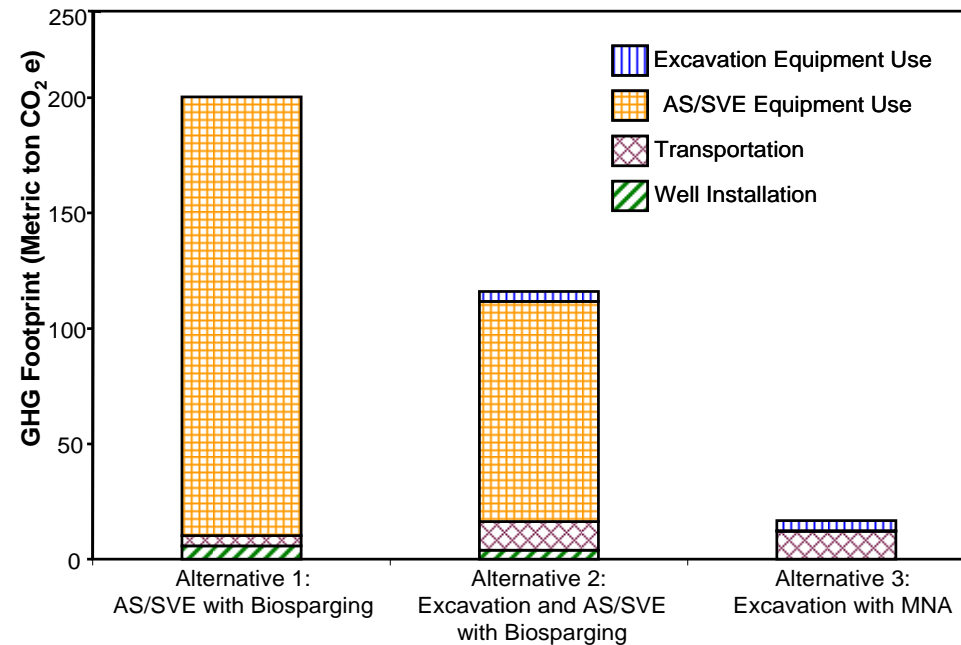


Injury



- SiteWise™ Tool - released May 2010
- Collaborative effort between Army, Navy, and Battelle
- Calculates the environmental footprint of remedial alternatives
- MS Excel-based
- Metrics evaluated:
  - Greenhouse gases
  - Air quality parameters
  - Energy consumption
  - Water consumption
  - Worker accident risk
- No cost for use
- Available to the public at

<http://www.ert2.org/t2gsportal>



**GHG Footprint of the Remedial Alternatives  
Considered at NAS Meridian**



# SiteWise™ Data Input Sheet

This Workbook alerts the user to define material production, transportation, equipment size, and disposal handling materials.

**Yellow cells** require the user to choose an input from a drop down menu

**White cells** require the user to type in a value

## MATERIAL PRODUCTION

For inputting data for other options in Material Production, please check this box.

WELL MATERIALS	Well Type 1	Well Type 2
Input number of wells		
Input depth of wells (ft)		
Choose well diameter (in) from drop down menu	1/2	1/2
Choose material type from drop down menu	Steel	Steel
Choose specific material schedule from drop down menu	Schedule 40 Steel	Schedule 40 Steel
TREATMENT CHEMICALS	Treatment 1	Treatment 2



# SiteWise™ Calculation

<b>PUMP OPERATION</b> - For each pump, select only one of the three methods to calculate energy and GHG emissions					
Enter "0" for all user input values for unused pumps or unused methods					
<b>USER INPUT</b>		<b>Pump 1</b>	<b>Pump 2</b>	<b>Pump 3</b>	<b>Pump 4</b>
<b>Method 1 - IF NAME PLATE SPECIFICATIONS ARE KNOWN</b>					
<b>USER INPUT</b>	<b>Input Pump horsepower (hp)</b>	0	0	1	5
<b>USER INPUT</b>	<b>Input Number of pumps operating</b>	1	0	2	6
<b>USER INPUT</b>	<b>Input Operating Time for each pump (hrs)</b>	10	0	3	7
	<b>Input Pump Load</b>	0.8	0.8	0.8	0.8
	<b>Input Pump Motor Efficiency</b>	0.9	0.9	0.9	0.9
<b>Method 2 - IF PUMP HEAD IS KNOWN</b>					
<b>USER INPUT</b>	<b>Input flow rate (gpm)</b>	0	0	0	0
<b>USER INPUT</b>	<b>Input total head (ft)</b>	0	25	0	0
<b>USER INPUT</b>	<b>Input Number of pumps operating</b>	0	1	0	0
<b>USER INPUT</b>	<b>Input Operating Time for each pump (hrs)</b>	0	4	0	0
	<b>Input pump Efficiency</b>	0.6	0.6	0.6	0.6
	<b>Input specific gravity</b>	1	1	1	1
	<b>Pump horsepower (hp)</b>	0.00	0.00	0.00	0.00
<b>Method 3 - IF ELECTRICAL USAGE IS KNOWN</b>					
<b>USER INPUT</b>	<b>Input Pump Electrical Usage (KWh)</b>	1000	0	0	0
<b>Select Region</b>					
<b>USER INPUT</b>	<b>Choose Region from Figure 1</b>	AKGD	AKMS	AZNM	CAMX
	CO <sub>2</sub> emission factor (lb/MWH)	1232	499	1311	724
	CH <sub>4</sub> emission factor (lb/MWH)	0.0256	0.02075	0.01745	0.03024
	N <sub>2</sub> O emission factor (lb/MWH)	0.00651	0.00408	0.01794	0.00808
	NO <sub>x</sub> emission factor (lb/MWH)	2.480	6.791	2.111	0.618
	SO <sub>x</sub> emission factor (lb/MWH)	1.214	0.526	1.081	0.531
<b>ENERGY OUTPUT</b>					
	Energy Usage (KWh)	1.0E+03	0.0E+00	4.0E+00	1.4E+02
	Energy Usage (MWH)	1.0E+00	0.0E+00	4.0E-03	1.4E-01
	Energy Usage (BTU)	8.5E+06	0.0E+00	3.4E+04	1.2E+06
<b>CO<sub>2</sub> OUTPUT</b>					
	CO <sub>2</sub> emission (metric ton)	5.6E-01	0.0E+00	2.4E-03	4.6E-02
	N <sub>2</sub> O emission (metric ton CO <sub>2</sub> e)	9.2E-04	0.0E+00	1.0E-05	1.6E-04
	CH <sub>4</sub> emission (metric ton CO <sub>2</sub> e)	2.4E-04	0.0E+00	6.6E-07	4.0E-05
<b>NO<sub>x</sub> and SO<sub>x</sub> OUTPUT</b>					
	NO <sub>x</sub> emission (metric ton)	1.1E-03	0.0E+00	3.8E-06	3.9E-05
	SO <sub>x</sub> emission (metric ton)	5.5E-04	0.0E+00	2.0E-06	3.4E-05
<b>TOTAL FROM PUMP OPERATION</b>					
	CO <sub>2</sub> Emission (metric ton)	6.1E-01			
	Energy Used (MWh)	1.1E+00			
	Energy Used (MMBTU)	9.8E+00			
	Water Usage (gal)	5.8E+02			
	NO <sub>x</sub> Emission (metric ton)	1.2E-03			
	SO <sub>x</sub> Emission (metric ton)	5.9E-04			



# Major Information Sources

- EPA climate leaders GHG inventory protocol core module guidance
- World Resources Institute
- World Business Council for Sustainable Development
- EPA Mobile 6
- EPA non-road model
- EPA eGRID
- GaBi LCA software
- Eco Profiles from various European industry sources
  - Various groups are developing additional information
  - Need to frequently update emission factors used in GSR evaluations



# Typical High Footprint Activities

<b>Activity</b>	<b>Metrics Most Impacted</b>
Transportation for materials and waste as well as personnel during RA-O & LTMgt	Emissions of GHGs, criteria pollutants, consumption of energy, accident risk (particularly death)
Operation of mechanical equipment (e.g. pumps, blowers, compressors)	Emissions of GHGs, criteria pollutants, consumption of energy
Drilling/Well installation	Emissions of GHGs, criteria pollutants, consumption of energy, accident risk (particularly injury)
Consumption of chemicals or other materials (e.g. oxidants, ZVI, biostimulants, GAC)	Emissions of GHGs, consumption of energy



# DON GSR Web Portal



## Green and Sustainable Remediation

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Welcome to the Navy's Web site on green and sustainable remediation. This Web site provides useful links on available information, case studies, and Web tools on sustainable practices for remediation.

**Web Tool:** A Web-based multi-media tool on green and sustainable remediation that discusses sustainability, sustainable remediation, and regulatory drivers for considering green and sustainable remediation. The Web tool available at this location also discusses sustainable remediation metrics, tools, and environmental footprint reduction methodologies.

**Fact Sheet:** In August 2009, the NAVFAC Optimization Workgroup issued a fact sheet on sustainable environmental remediation. The fact sheet summarizes the need for considering sustainable practices by Navy Remedial Project Managers (RPMs) and lays out the metrics of green and sustainable remediation as per the Workgroup. The fact sheet also discusses methodologies to conduct baseline environmental footprint of remedial technologies and ways to reduce the footprint.

**Case Studies:** NAVFAC has applied sustainability concepts on several existing and planned remedial systems. The case studies on this Web page provide a few examples.

**Drivers:** There are several regulations and incentives that are driving the industry towards green and sustainable remediation. This Web page discusses some of the regulations and executive orders that mandate federal agencies to conserve energy and to be more sustainable.

**Resources:** There are guidance documents, case studies, and standards available on green and sustainable remediation on several federal, state, and other organizations. This Web page contains links to many of these informational sites.

**Tools:** There are several tools available in the public domain for conducting a baseline environmental footprint of a remedial technology. SiteWise™ being developed jointly by the Navy, Army Corps, and Battelle is one of such tools and will be available on this site soon.

HOME · WEB TOOL · FACT SHEET · CASE STUDIES · DRIVERS · RESOURCES · TOOLS · CONTACT

Available at [www.ert2.org](http://www.ert2.org)



# Green and Sustainable Remediation Fact Sheet and Web Training Tool

- Issued August 2009 by the DON Optimization Workgroup
- Sustainability metrics
- Footprint assessment methods
- Incorporating GSR into the Environmental Restoration Process
- Footprint reduction methods

Fact sheet available from:

<http://www.ert2.org/t2gsrportal>





# Green and Sustainable Remediation

## Additional DON Products

### Training

- Spring 2010 RITS (7 locations)
  - GSR Overview and SiteWise™ Tool
- CECOS Remedy Optimization and Site Closeout Course (2 per yr)
  - Being updated to include GSR considerations

### Guidance

- Guidance for Optimizing Remedy Evaluation, Selection, and Design (updated March 2010)
- Guidance for Optimizing Remedial Action Operations (planned update to include GSR in 2011)
- New guidance for GSR
  - Underway with planned completion by EOY 2010

### Case Studies

- Completed six case studies and one underway
- Lessoned learned to be included in guidance, training, and other resources



# Summary

- DON aggressively taking actions to integrate green and sustainable practices within all phases of remediation
- DON Optimization workgroup developing resources
- SiteWise™ is a valuable tool for quantifying the environmental footprint of remedial alternatives
- DON metrics include GHG emissions, energy usage, criteria air pollutants, ecological impacts, water usage, resource consumption, worker safety, and community impacts
- DON working with other agencies for sharing lessons learned and developing consistent approaches

