



# **Treatment Technologies for Site Cleanup: Annual Status Report (12th Edition)**

**Internet Seminar  
<http://clu.in.org>  
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## OSRTI & The Superfund Technology Innovation Program

- Interpret and supply information on technologies and markets
- Partner with agencies, states and private companies to develop and evaluate technologies
- Increase acceptance of innovative options by regulators, consulting engineers, and purchasers of technologies and services
- Develop policy tools that help foster acceptance of innovative technologies
- Disseminate information - conferences, direct mail, electronic mail, home pages and bulletin boards

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## Objectives of the Report


- Goal is to document the selection and implementation of remedies in Superfund
- Data serves as a “benchmark” of the state of the practice, it informs program management and supports remedy evaluations
- Reports on “as built” remedies, including their implementation status, and remedy-specific technical data (e.g. contaminant, techniques, treatment components)
- Highlights innovative remediation technology applications

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## ASR Background

- Current edition (12<sup>th</sup>) has ROD data through 2005 and project status information through November 2006
- First edition was produced in 1991, last edition was released in February 2004
- Information extracted from RODs, CERCLIS, 5yr reviews, site specific documents/websites
- Covers 1,536 NPL sites, 2,976 RODs, and 1,915 treatment projects

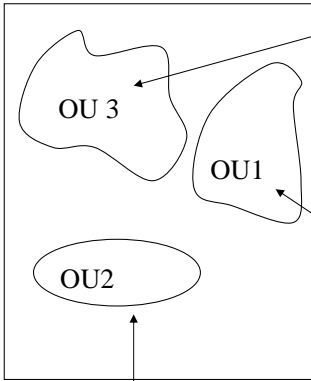


## Background on Identifying Remedies

**Report Focus:**

- Sites, RODs, and projects
- Source and groundwater control (SC & GW)
- Treatment and containment
- Innovative technologies
- Remedial actions only (no removals)

Example of a site



ROD #1

- SVE Soil (completed)
- P&T GW (operational)
- Inst. Control GW

ROD #2

- Landfill cap
- MNA (Design)

No ROD

Site boundary


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## RODs per Site on the NPL

Number of Sites	Number of RODs and Amendments Per Site
697	1
360	2
111	3
46	4
33	5
12	6
7	7
5	8
8	9
25	10-18
4	24-29
1	68

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## Overview of Remedies at Superfund Sites\*

SC Remedy Type	11 <sup>th</sup> Ed # Sites	12 <sup>th</sup> Ed # Sites	GW Remedy Type	11 <sup>th</sup> Ed # Sites	12 <sup>th</sup> Ed # Sites
Treatment of a Source	541	605	Groundwater Pump and Treat	713	728
Containment or Off-Site Disposal of a Source	576	632	In Situ Treatment of Groundwater	135	229
Other Source Control	650	682	Groundwater MNA	201	239
			Other Groundwater	822	854

\*Differences in numbers from one edition to another represent net changes

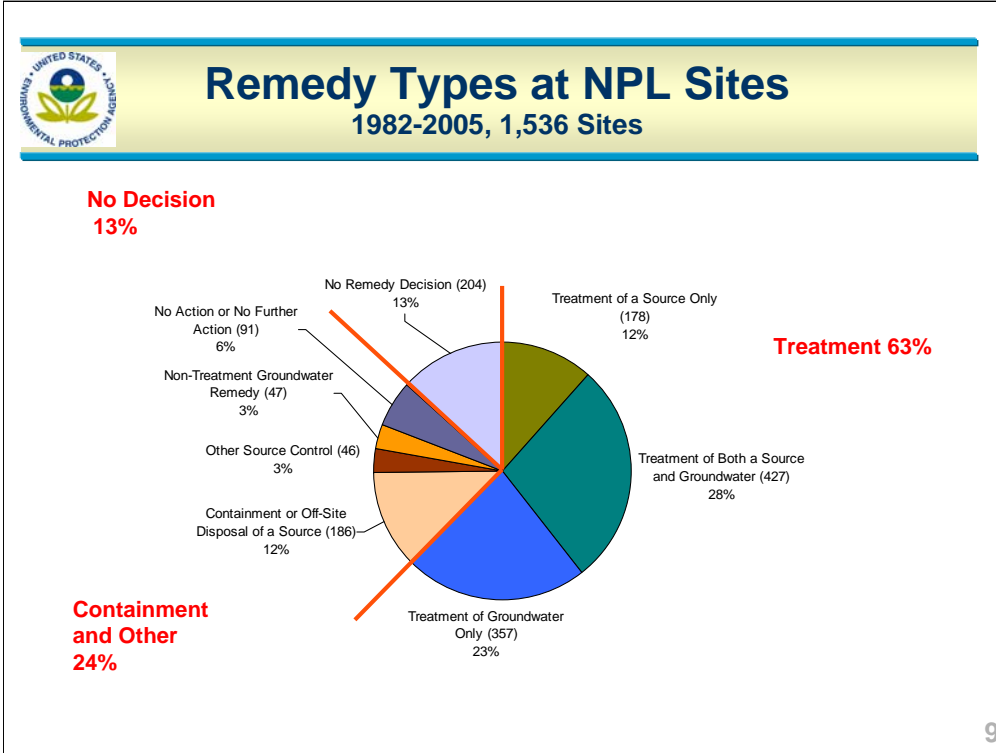
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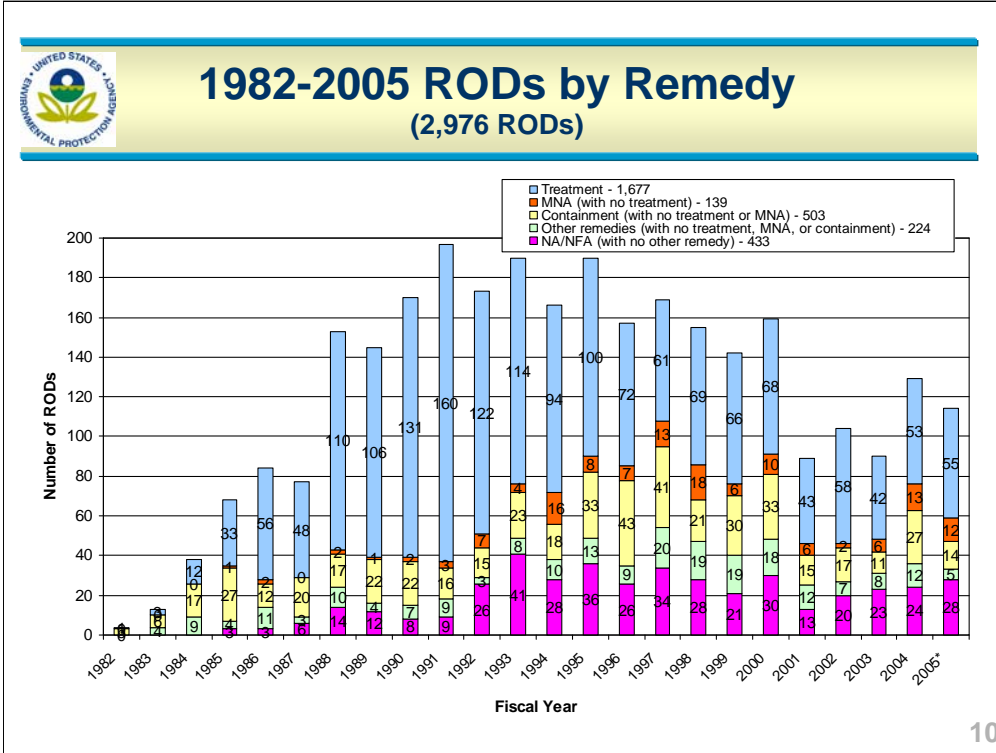


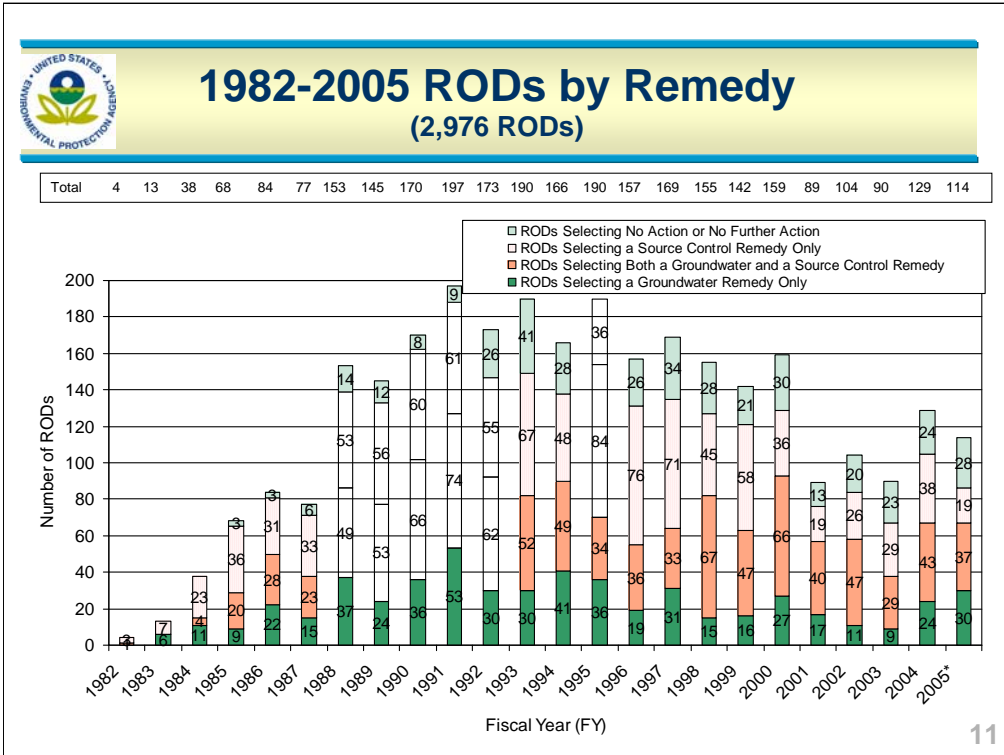
## Summary of Overall Findings


- NPL Sites (1,536):
  - » 62% have some form of treatment.
  - » 28% of sites have both source and groundwater treatment
  - » 27% have containment as the most “aggressive” remedy
  - » 11% have no remedy decision yet
  - » 1,055 sites have a SC remedy, 1,072 have a GW remedy
- RODs (2,976 RODs & ROD Amendments):
  - » In '02-'05 we signed about 100 RODs/year
  - » In '05, 55% had some form of treatment
  - » Percentage of “multimedia” RODs is holding at about 32%
- Remedies (ASR focus is on treatment remedies)
  - » There are 1,915 treatment projects at NPL sites (status varies)
  - » Of these, 977 are SC treatment and 938 GW treatment









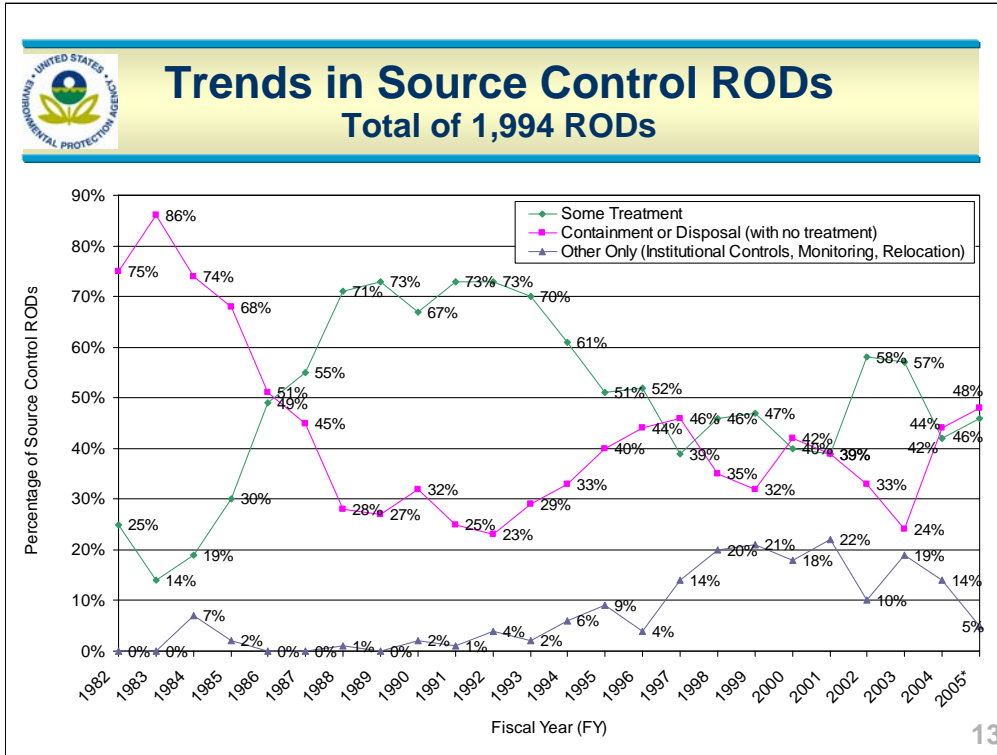


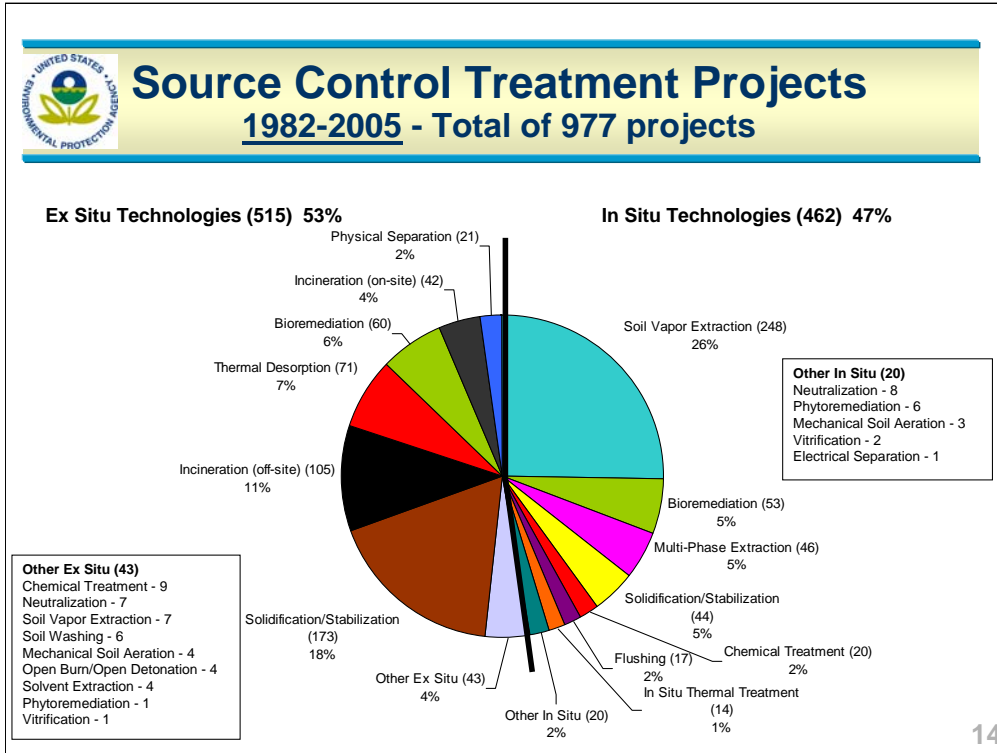
## Summary of Source Control Findings

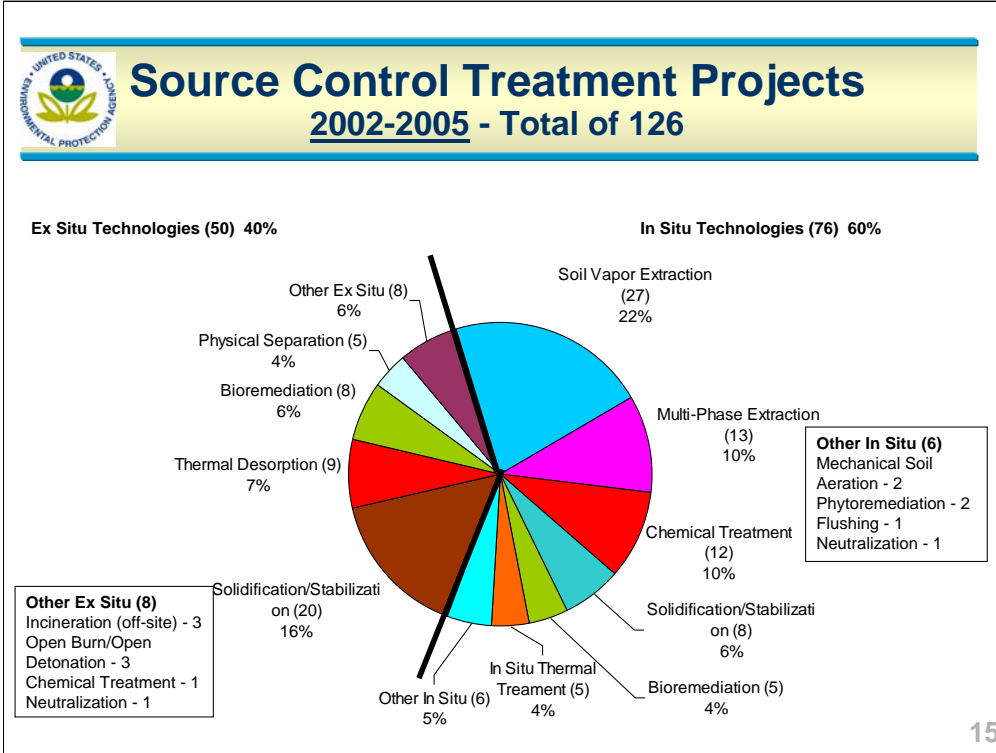
- 1,055 sites (69%) have SC remedies, 1,994 RODs include a source control remedy, 1,105 have treatment
- Selection of treatment and containment in RODs tracks closely in 45% range
- Continued increase in selection of in situ treatment, 75% of SC treatment RODs in 2005
- Most common *in situ* remedies are SVE, multiphase extraction, and bioremediation
- Major *ex situ* remedies are solidification/stabilization, thermal desorption, and bioremediation
- There is continued evidence of the “maturing” status of treatment projects, both *in situ* and *ex situ*.

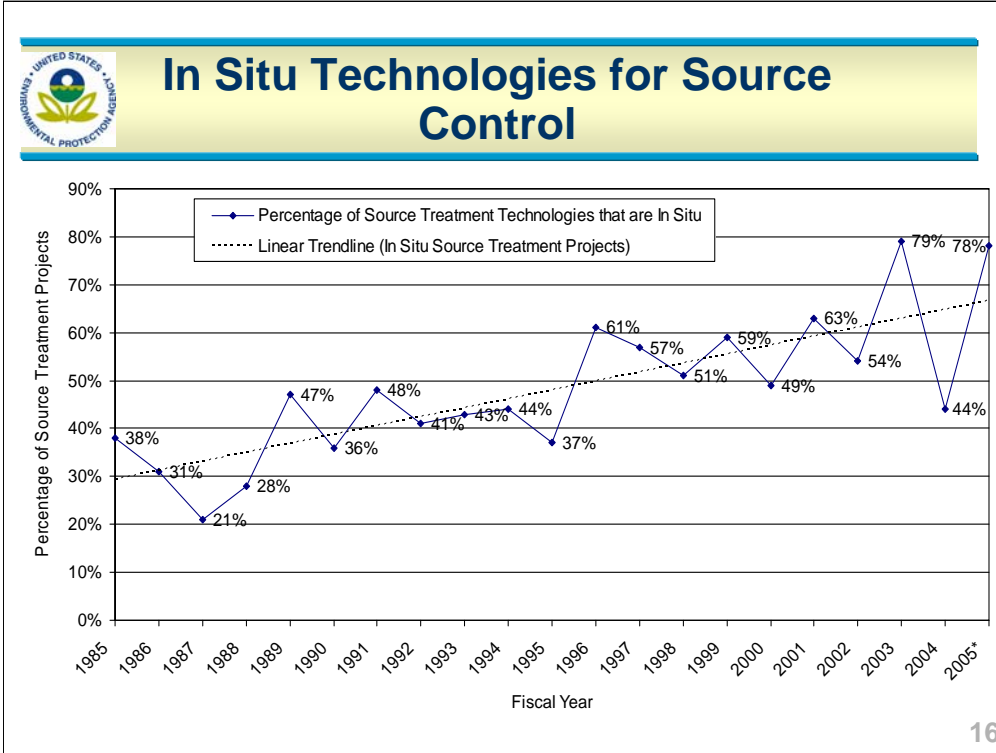
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Implication of the first bullet is that ICs generally are “supplemental” to a containment or treatment remedy.



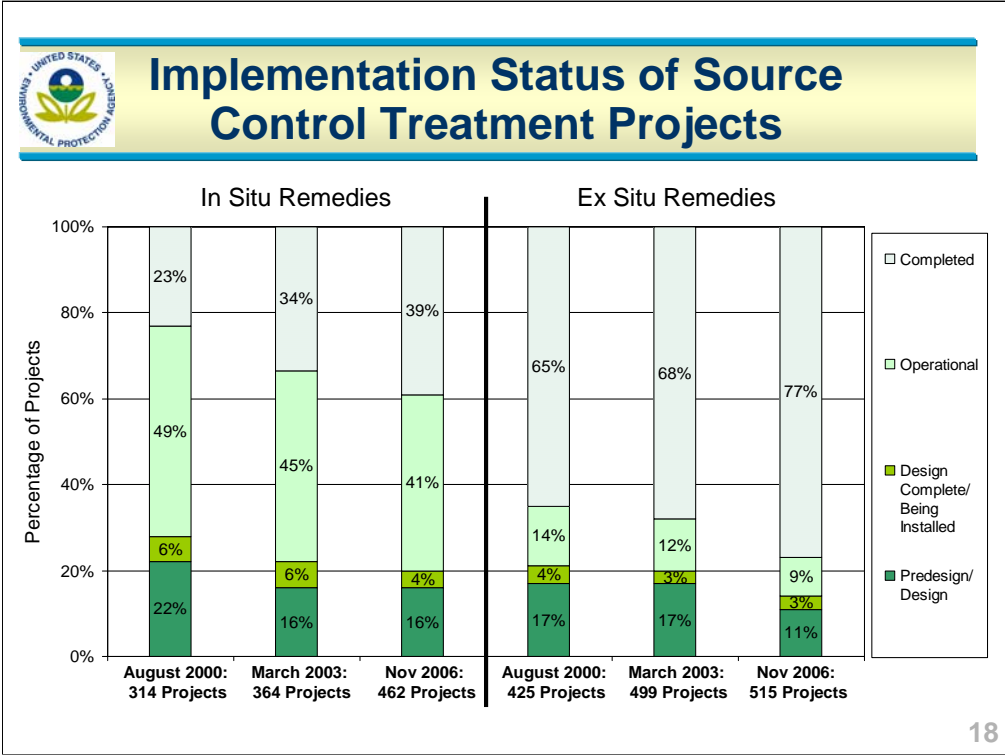








Technology	Total number of projects <sup>a</sup>	Polycyclic aromatic hydrocarbons (PAHs)	Other nonhalogenated semivolatile organic compounds <sup>b</sup>	Benzene-toluene-ethylbenzene-xylene (BTEX)	Other nonhalogenated organic compounds <sup>b</sup>	Organic pesticides and herbicides <sup>c</sup>	Other halogenated volatile organic compounds <sup>d</sup>	Halogenated semivolatile organic compounds <sup>d</sup>	Polychlorinated biphenyls	Metals and metalloids
Bioremediation	113	37	51	33	33	24	17	22	2	5
Chemical Treatment	29	1	2	3	4	1	4	12	4	13
Multi-Phase Extraction	46	9	3	11	6	4	8	18	1	1
Electrical Separation	1	0	0	0	0	0	0	1	0	0
Flushing	17	3	5	5	5	1	3	11	0	5
Incineration	147	27	41	33	23	36	34	52	36	6
Mechanical Soil Aeration	7	0	0	3	1	0	1	7	0	0
Neutralization	15	2	0	0	0	0	0	0	0	6
Open Burn/ Open Detonation	4	0	1	0	0	0	0	0	0	0
Physical Separation	21	4	2	1	0	3	0	0	4	5
Phytoremediation	7	1	2	2	2	1	1	4	0	4
Soil Vapor Extraction	255	15	31	107	51	3	33	217	1	0
Soil Washing	6	1	1	0	0	2	0	0	1	2
Solidification/ Stabilization	217	17	18	13	13	16	7	20	35	180
Solvent Extraction	4	2	1	0	1	1	0	2	2	1
Thermal Desorption	71	21	17	24	15	8	12	33	16	0
In Situ Thermal Treatment	14	5	0	2	0	3	3	8	0	0
Vitrification	3	0	0	1	1	0	1	3	2	1
<b>Total Projects</b>	<b>977</b>	<b>145</b>	<b>175</b>	<b>238</b>	<b>155</b>	<b>103</b>	<b>124</b>	<b>410</b>	<b>104</b>	<b>229</b>

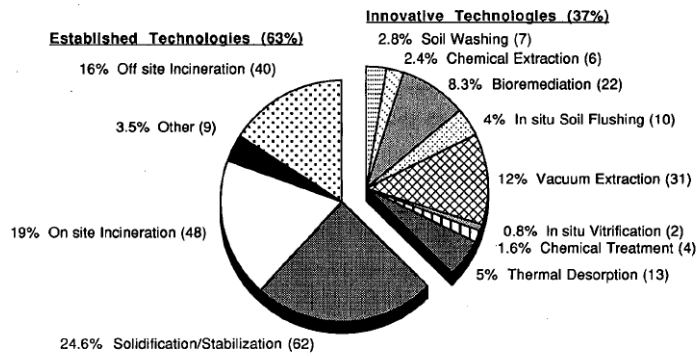




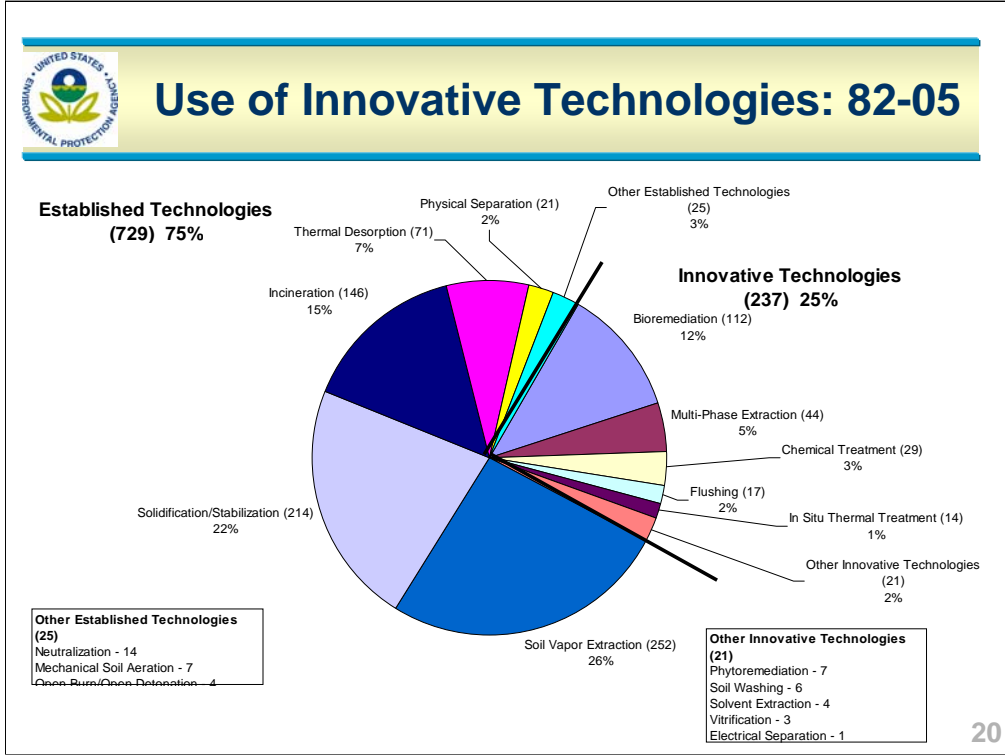
# Use of Innovative Technologies: 82-91


**Figure 1**  
**Summary of Innovative vs. Established Treatment Technologies For Source Control at Superfund Sites\***

January 1991



\* Data are derived from 1982 - 1989 Records of Decision (RODs) and anticipated design and construction activities.  
 The 254 technologies are associated with approximately 211 sites; the difference reflects the use of more than one technology per site.  
 ( ) Number of times this technology was selected or used.



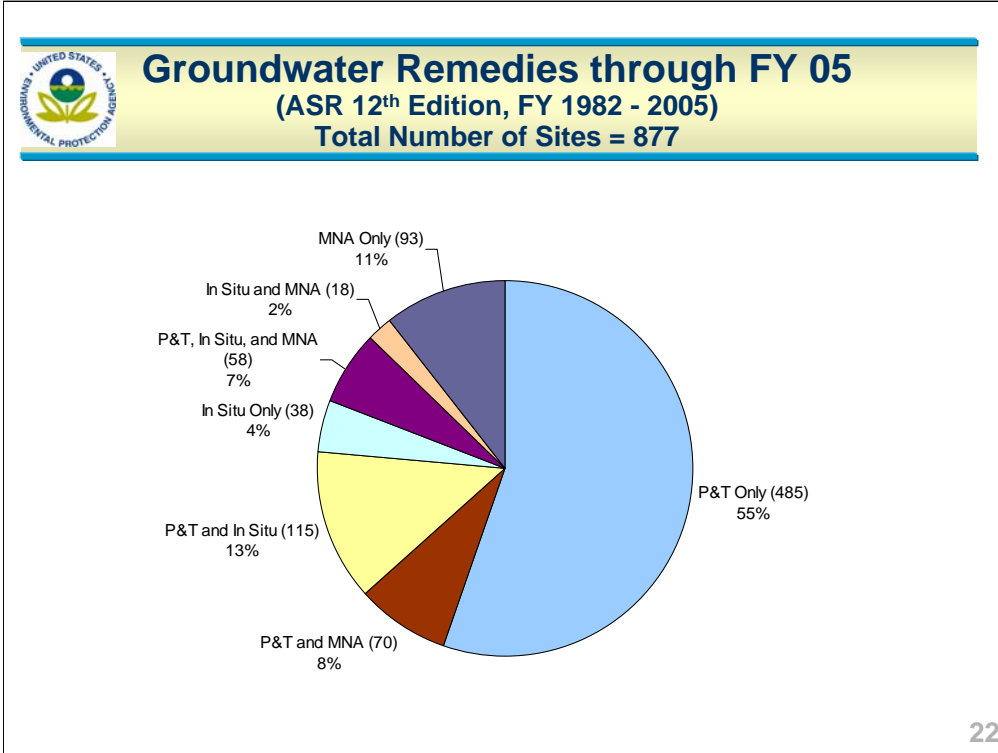


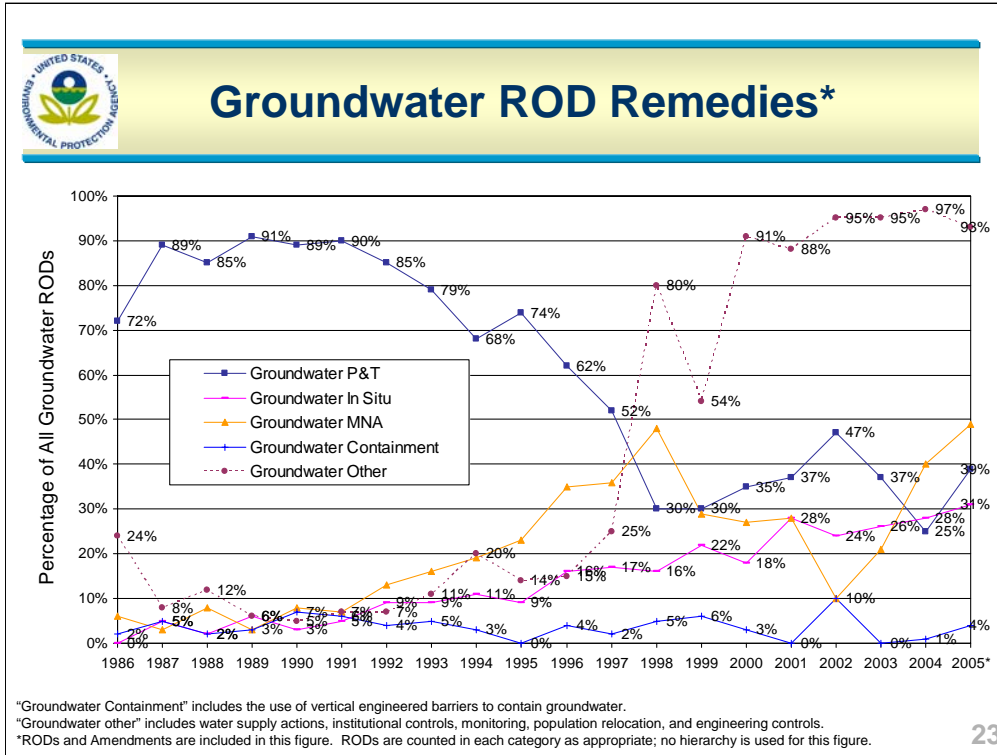
## Summary of Groundwater Control Findings

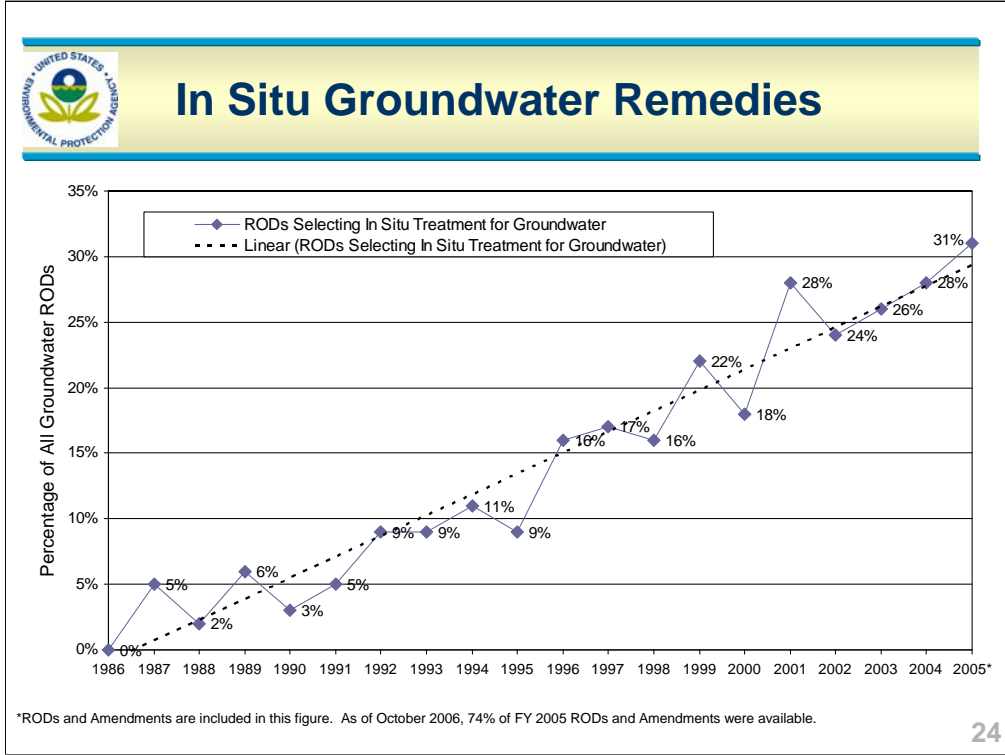
- 1,072 sites (70%) have a GW remedy
- 1,509 RODs have a GW remedy, 958 include P&T, and 195 *in situ* treatment
- However, a new pattern in GW remedy selection that emerged after 1997 is holding, mainly;
  - » In situ treatment continues to climb
  - » GW Remedy mix in RODs has stabilized with P&T, *in situ* and MNA all in the 30-40% range, and...
  - » ICs and “other” remedies are selected in over 90% of GW RODs
- Bioremediation and chemical treatment have eclipsed air sparging as top *in situ* remedies
- 45% of sites with P&T as the sole GW treatment remedy also have a source control remedy.

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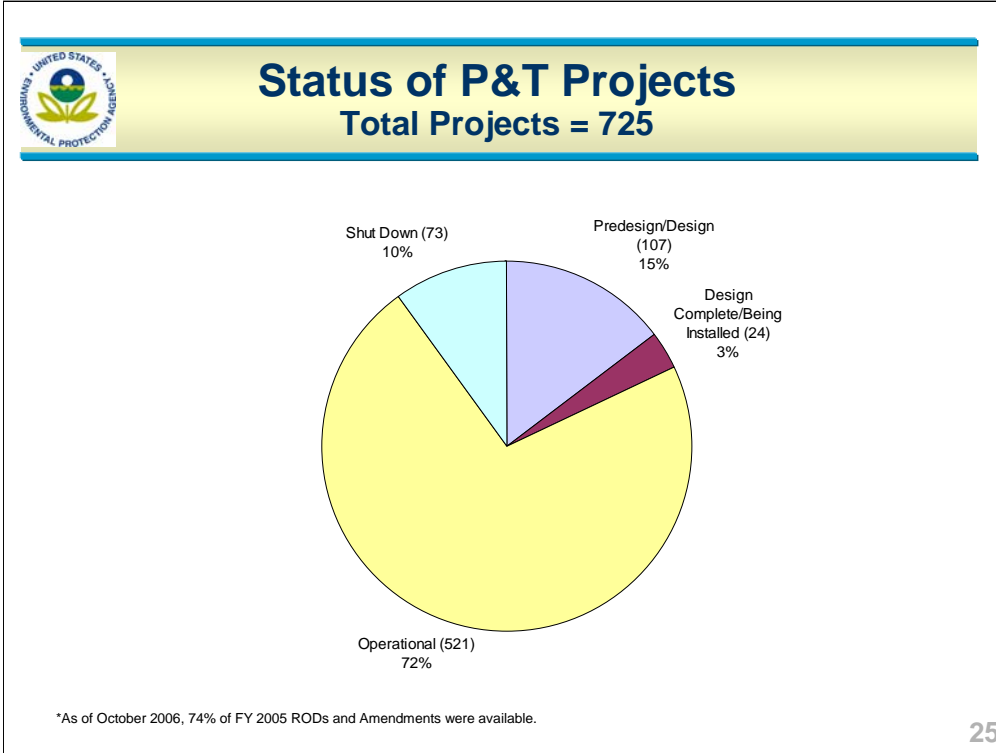
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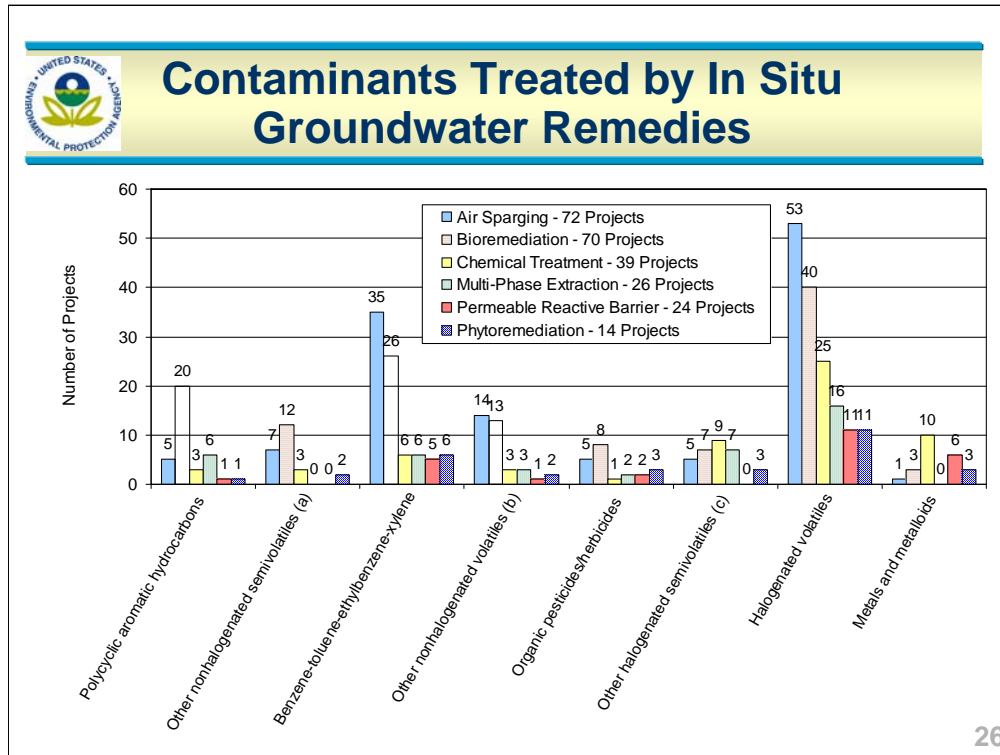












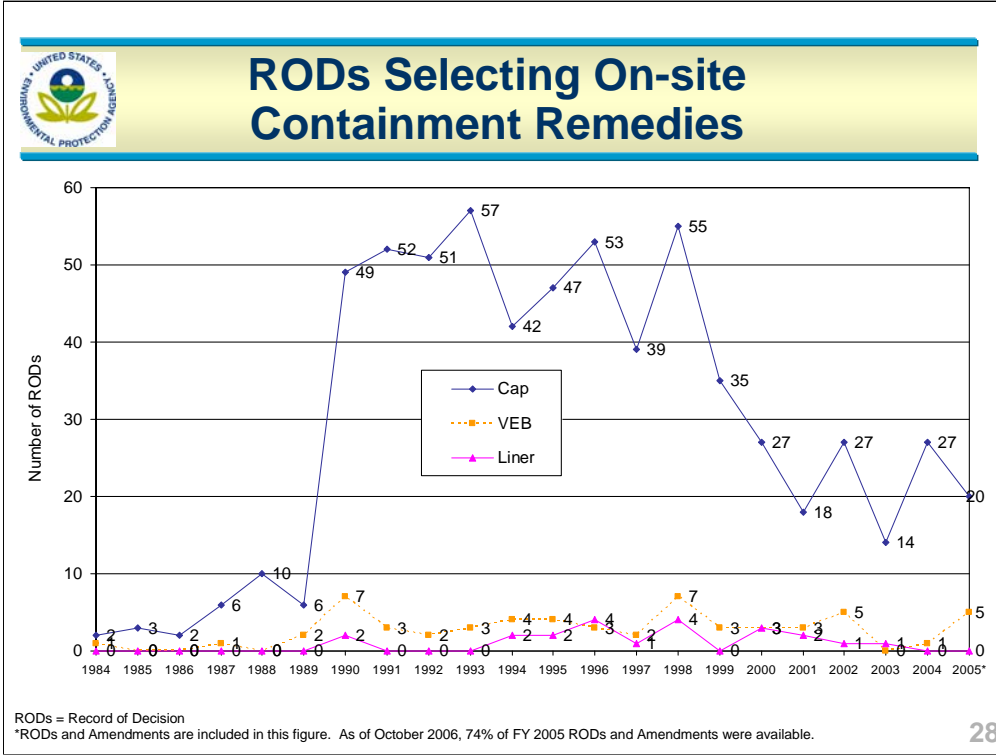
- (a) Does not include polycyclic aromatic hydrocarbons.
- (b) Does not include benzene, toluene, ethylbenzene, and xylene.
- (c) Does not include organic pesticides and herbicides.



## Status of In-site GW Treatment Projects

ASR Category	Predesign/ Design	Design Complete/ Being Installed	Operational	Completed	Total
Air Sparging	7	5	38	19	69
Bioremediation	29	4	27	9	69
Chemical Treatment	19	2	9	8	38
Permeable Reactive Barrier	7	1	14	2	24
Multi-Phase Extraction	6	1	12	5	24
Phytoremediation	3	1	10	0	14
In-Well Air Stripping	1	1	6	0	8
In Situ Thermal Treatment	1	1	2	1	5
Flushing	0	1	0	0	1
<i>Total</i>	73	17	118	44	252
<i>Percentage of In Situ Groundwater Technologies</i>	29%	7%	47%	18%	--

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## Concluding Points

- Solid use of treatment remedies at Superfund sites
- Across the program we are making full use of the remedy tool box.
- The program continues to mature;
  - » Fewer sites with no remedies
  - » The implementation status of selected remedies, more are completed and operational, fewer in design.
  - » Innovative technologies are gaining ground and becoming mainstream
- The prevalence of *in situ* treatment remedies suggests we focus on innovations in *in situ* performance monitoring
- 75% of P&T projects are operational – hold the course on RSE, capture zone analysis, etc.



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