

# Remediation of Soils Impacted by Organochlorine Pesticides Using the DARAMEND<sup>®</sup> Technology

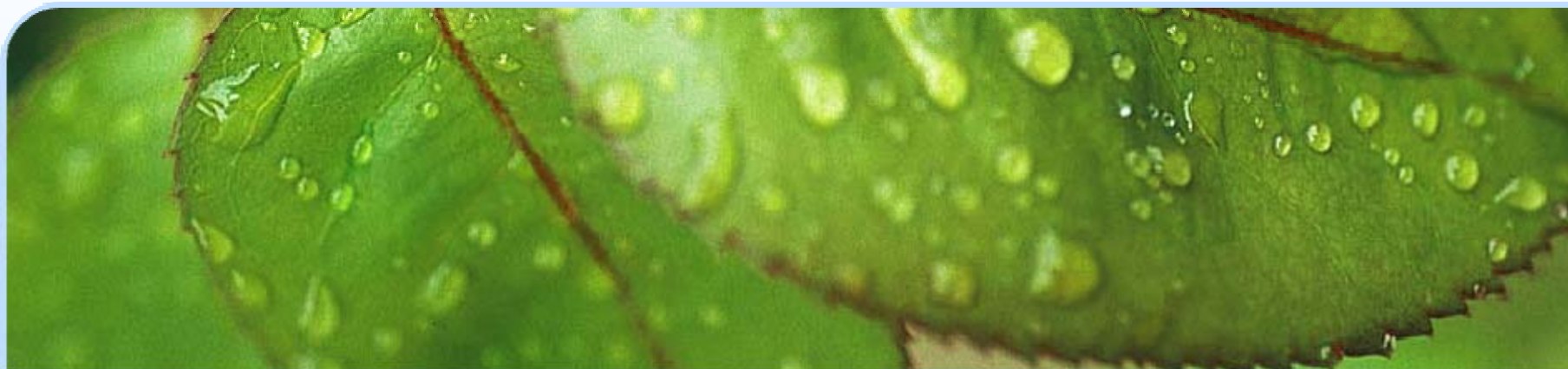
*Andrzej Przepiora, Alan Seech and Jim Mueller - Adventus Group*

10<sup>th</sup> Annual Pesticide & Ag Plastics  
Stewardship Conference  
Savannah, Georgia,  
February 21-23, 2010



## ADVENTUS

*Proven Remediation Technologies for  
Soil, Sediment, and Groundwater*





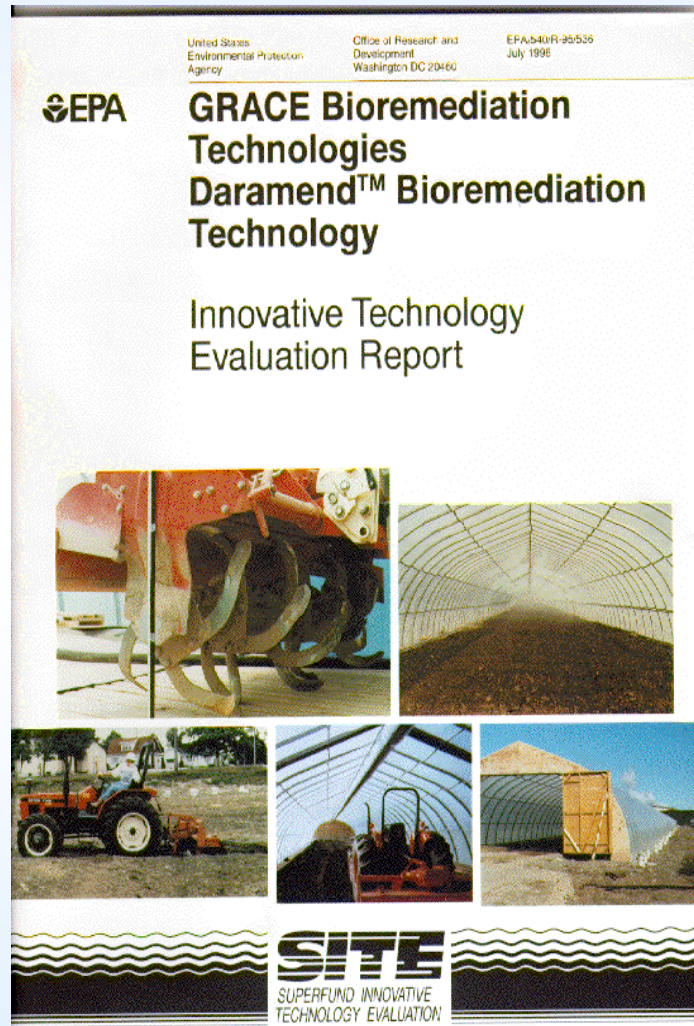
## DARAMEND® Treatment Material

- Particles combining solid controlled-released carbon and nutrients (aerobic) or with micro-scale ZVI (anaerobic)
- Stimulates indigenous bacteria by providing carbon and nutrients
- <5% by volume required to treat most soils
- More than 7,000,000 tons of soil, sediment, and other wastes have been successfully treated to date.





# U.S. EPA SITE Report



EPA/540/R-95/536



## DARAMEND® Fixed Site Treatment Facilities

- Waste Management is a licensee of the patented DARAMEND® ISCR technology and treats contaminated soils at permitted treatment facilities.
- Facilities are located in Lake Charles, LA, Arlington OR, and Calumet City, IL
- More than 3,000,000 tons of soil, sediment, and other wastes have been successfully treated to date.





# DARAMEND Technology Applications

## Cycled Anoxic/Aerobic

- Chlorinated pesticides and herbicides
- Organic explosives
- Chlorinated solvents

## Aerobic

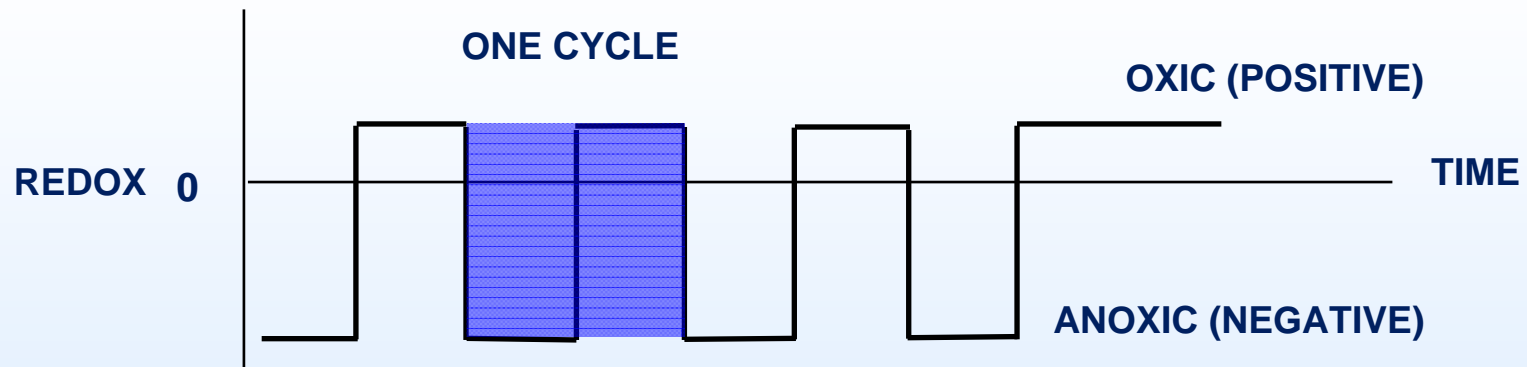
- Wood treatment chemicals (PAHs & PCP)
- Manufactured gas plant PAHs
- Phthalates
- Petroleum hydrocarbons





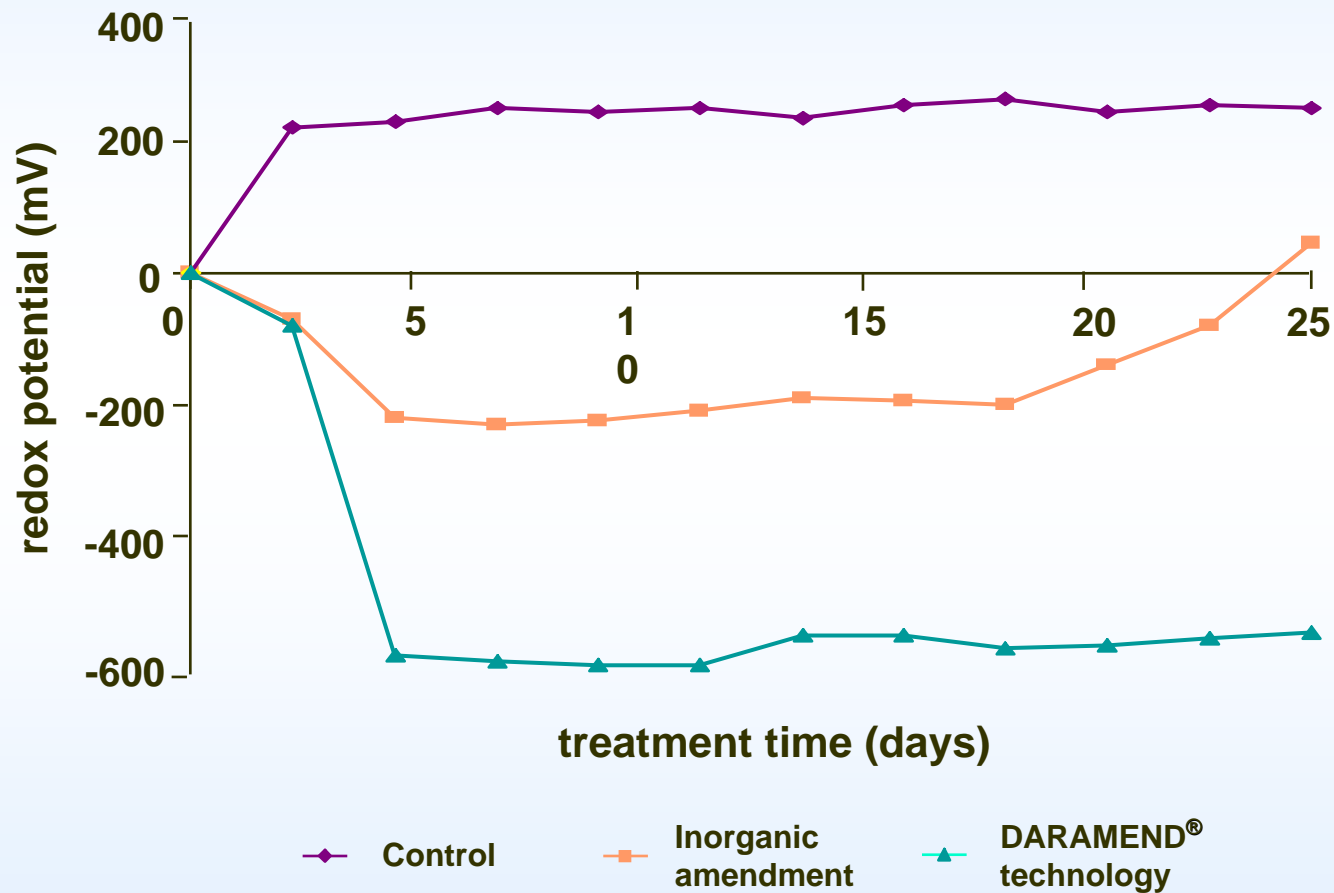
## Cycled Anoxic/Aerobic DARAMEND®

- One 'cycle' consists of a reductive phase and an aerobic phase
- Reductive DARAMEND (fibrous organic carbon with ZVI) tilled into soil and water added to initiate reductive phase
- Soil tilled to initiate aerobic phase
- Amendment composition and dosage soil specific





# Redox Potential in Soil during Reductive Phase





## Treated OCPs

<b>DDT, DDD, DDE</b>	<b>X</b>
<b>Toxaphene</b>	<b>X</b>
<b>Chlordane</b>	<b>X</b>
<b>Dieldrin</b>	<b>X</b>
<b>Lindane &amp; other HCHs</b>	<b>X</b>
<b>2,4-D</b>	<b>X</b>
<b>2,4,5-T</b>	<b>X</b>
<b>Endrin</b>	<b>X</b>
<b>Alachlor, Metolachlor</b>	<b>X</b>
<b>Atrazine</b>	<b>X</b>



DARAMEND<sup>®</sup> Soil Treatment

## CASE STUDY #1

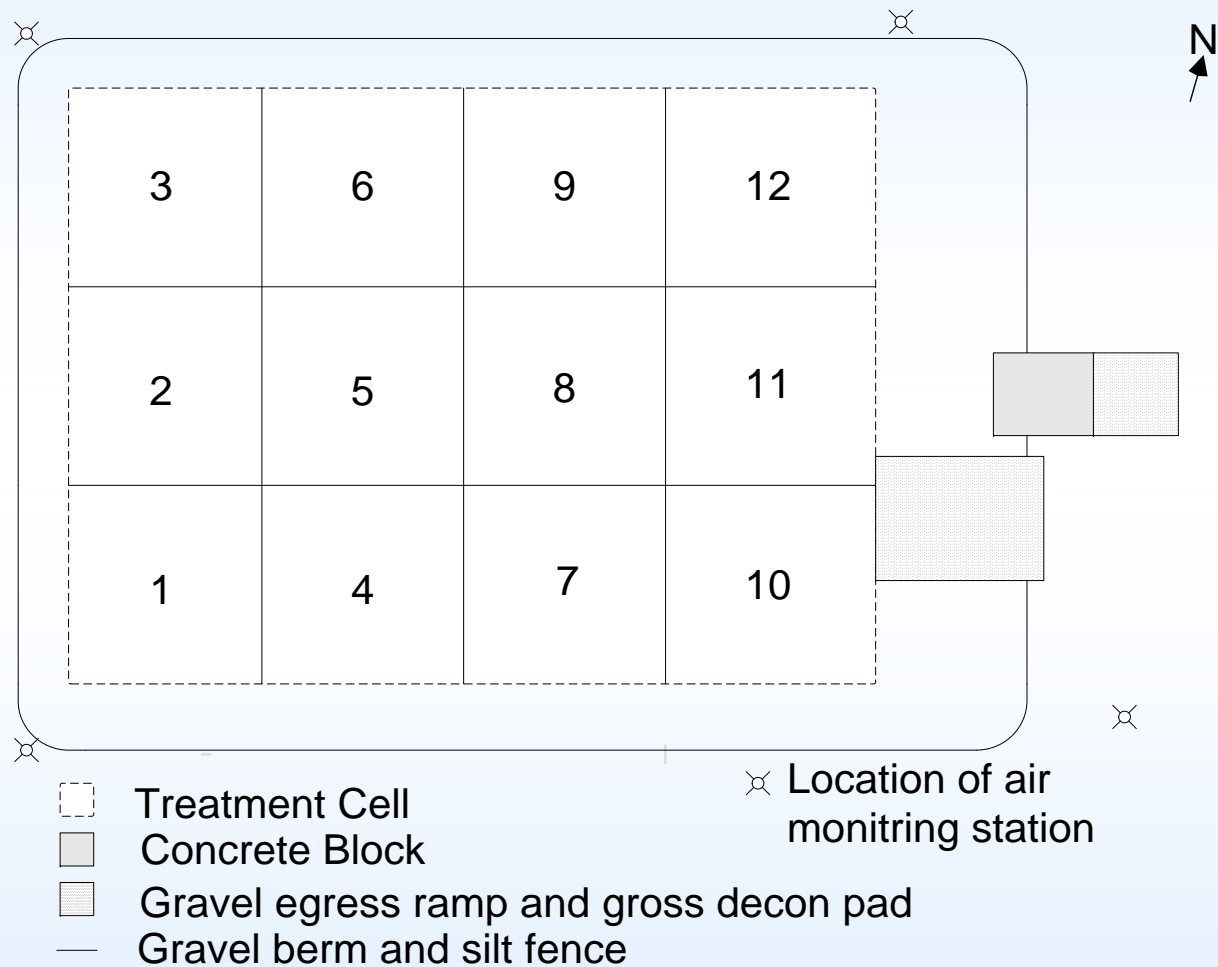


## Treatment of Pesticides - THAN Superfund Site, Montgomery, AL

- T. H. Agriculture and Nutrition Superfund Site in Montgomery, Alabama
- Former agricultural chemical manufacturing facility
- Approximately 4,500 tons of soil and sediment from drainage ditch contaminated with DDT, DDE, DDD, and Toxaphene
- Placed on site into a treatment cell at a depth of approximately 2 ft



# Treatment of Pesticides - THAN Superfund Site, Montgomery, AL





## Treatment of Pesticides - THAN Superfund Site, Montgomery, AL

- Applied and incorporated 2% (w/w) DARAMEND amendments
- Irrigate amended soil to 90% of soil water holding capacity (approx. 30% moisture on a dry weight basis)
- Allow to stand undisturbed for about 7 days (variable dependent on weather)
- Aerate by tilling for 2 or 3 days
- Repeat as required



# Treatment of Pesticides - THAN Superfund Site, Montgomery, AL





## Treatment of Pesticides - THAN Superfund Site, Montgomery, AL





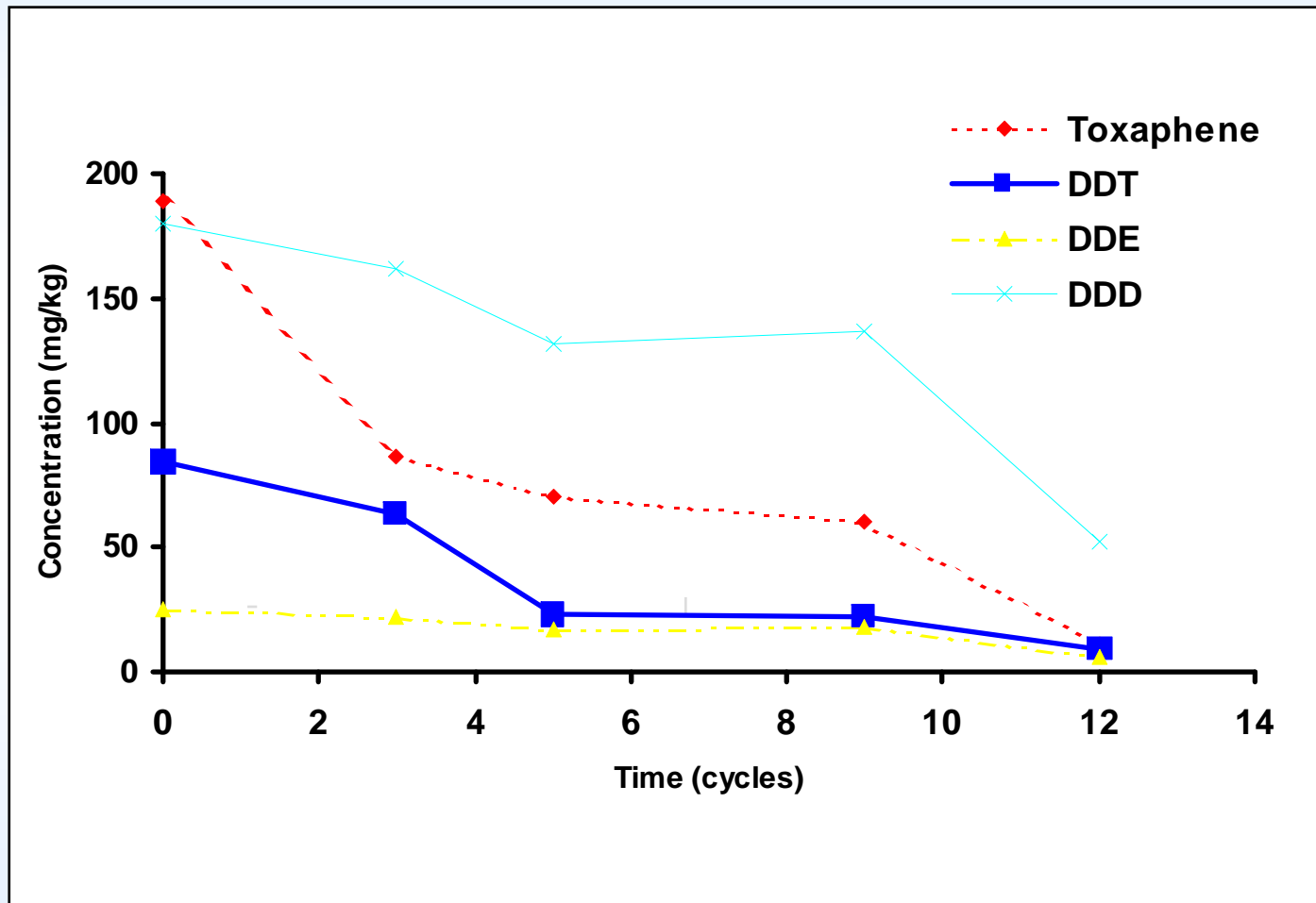
## Treatment of Pesticides - THAN Superfund Site, Montgomery, AL





# Treatment of Pesticides

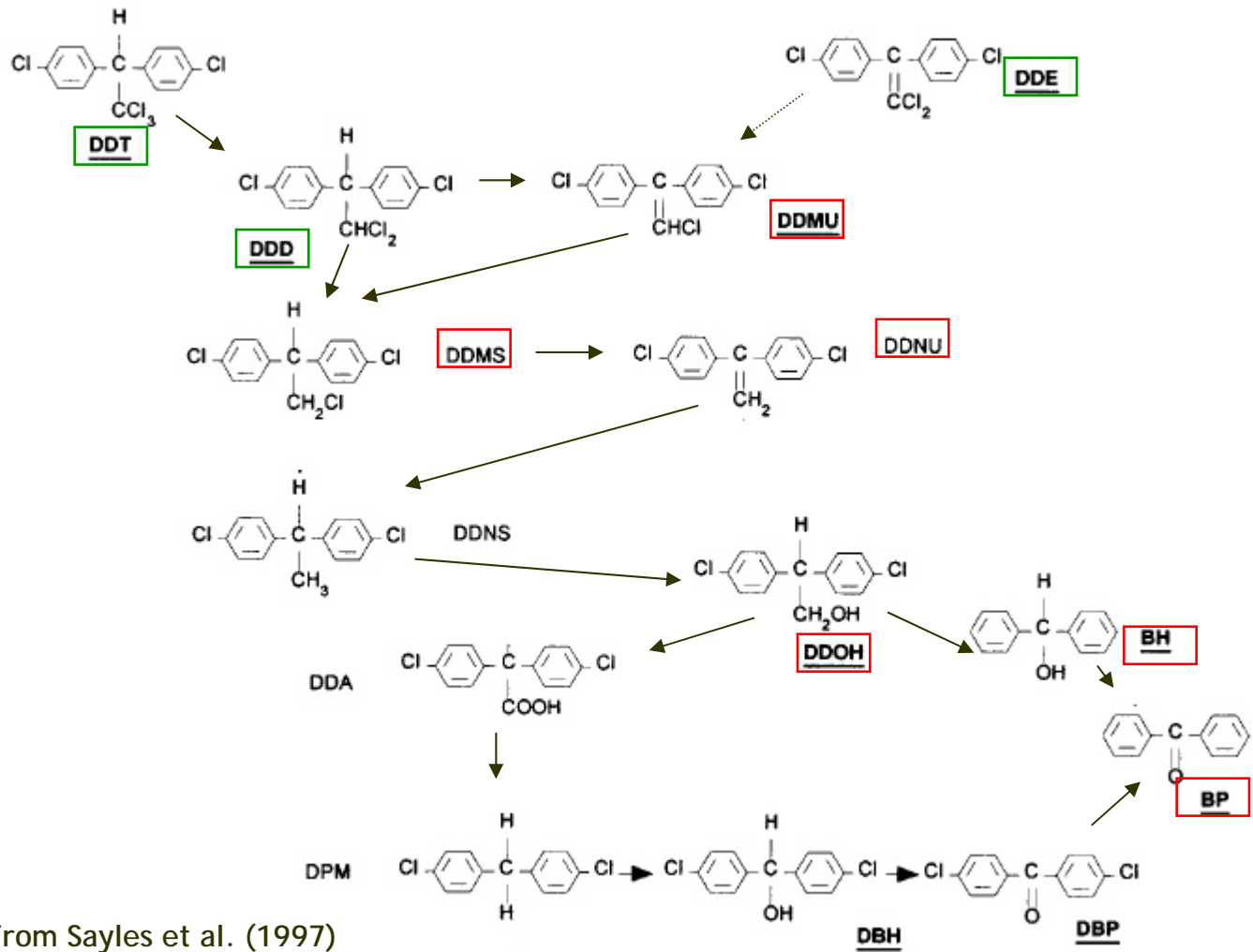
THAN Superfund Site, Montgomery, AL





# What was the fate of the DDT?

## Dechlorination (anaerobic)



From Sayles et al. (1997)



## What was the fate of the DDT?

Ring opening/Mineralization?

- Radioisotope ( $^{14}\text{C}$ -DDT) Fate Studies:
  - Main fate was conversion to carbon dioxide
  - Slow but significant production of  $^{14}\text{C}$ - $\text{CO}_2$
  - Recovery of added  $^{14}\text{C}$  in DDT as carbon dioxide was about 7% in 150 days.
  - After 150 days the rate of  $^{14}\text{C}$ - $\text{CO}_2$  release had decreased to about 1% per month



## What did it cost?

- Variable and dependent on:
  - Excavation requirements
  - Remedial objectives
  - Contaminant type and concentration
- Mean treatment cost was \$55 per ton and ranged between \$30 and \$63 per ton



DARAMEND<sup>®</sup> Soil Treatment

## CASE STUDY #2



# Reductive DARAMEND<sup>®</sup> Treatment Process

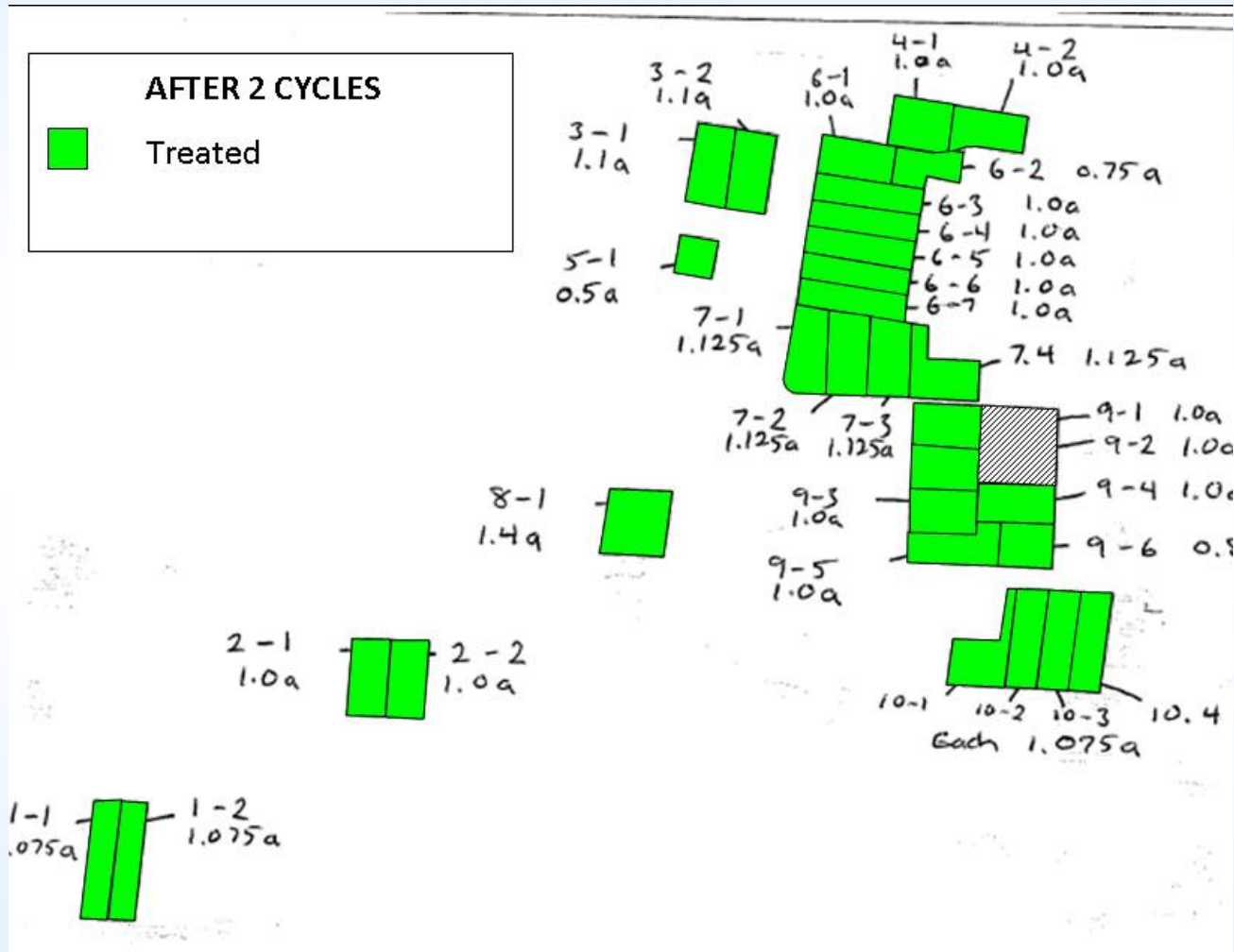
13 ha Agricultural Site: Ontario, Canada (DDT, DDE, Dieldrin)





# Treatment of Pesticides After One Cycle -

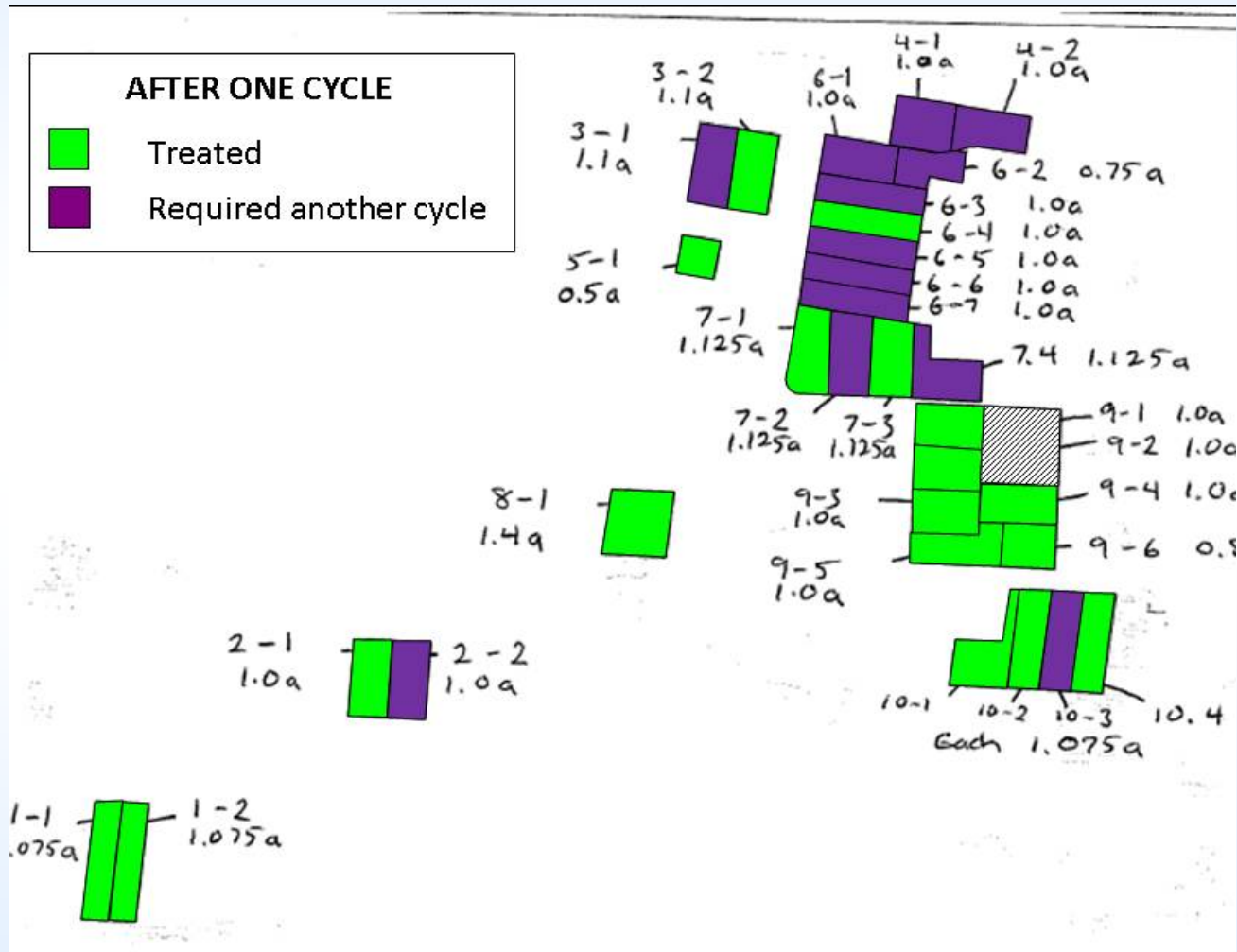
13 ha Agricultural Site: Ontario, Canada





# Treatment of Pesticides After One Cycle -

13 ha Agricultural Site: Ontario, Canada





## Treatment of Pesticides After One Cycle -

13 ha Agricultural Site: Ontario, Canada

Data for plots treated after one cycle

<b>Constituent</b>	<b>Initial Concentration (mg/kg)</b>	<b>Concentration After 1<sup>st</sup> Cycle (mg/kg)</b>	<b>Final % Removal</b>
DDT	1.90	0.98	49%
DDE	2.38	1.11	53%
Dieldrin	0.064	0.040	38%

Data for plots treated after two cycles

<b>Constituent</b>	<b>Initial Concentration (mg/kg)</b>	<b>Concentration After 1<sup>st</sup> Cycle (mg/kg)</b>	<b>Concentration After 2<sup>nd</sup> Cycle (mg/kg)</b>	<b>Final % Removal</b>
DDT	2.05	2.00	0.66	68%
DDE	2.37	1.98	0.80	66%
Dieldrin	0.110	0.080	0.028	65%

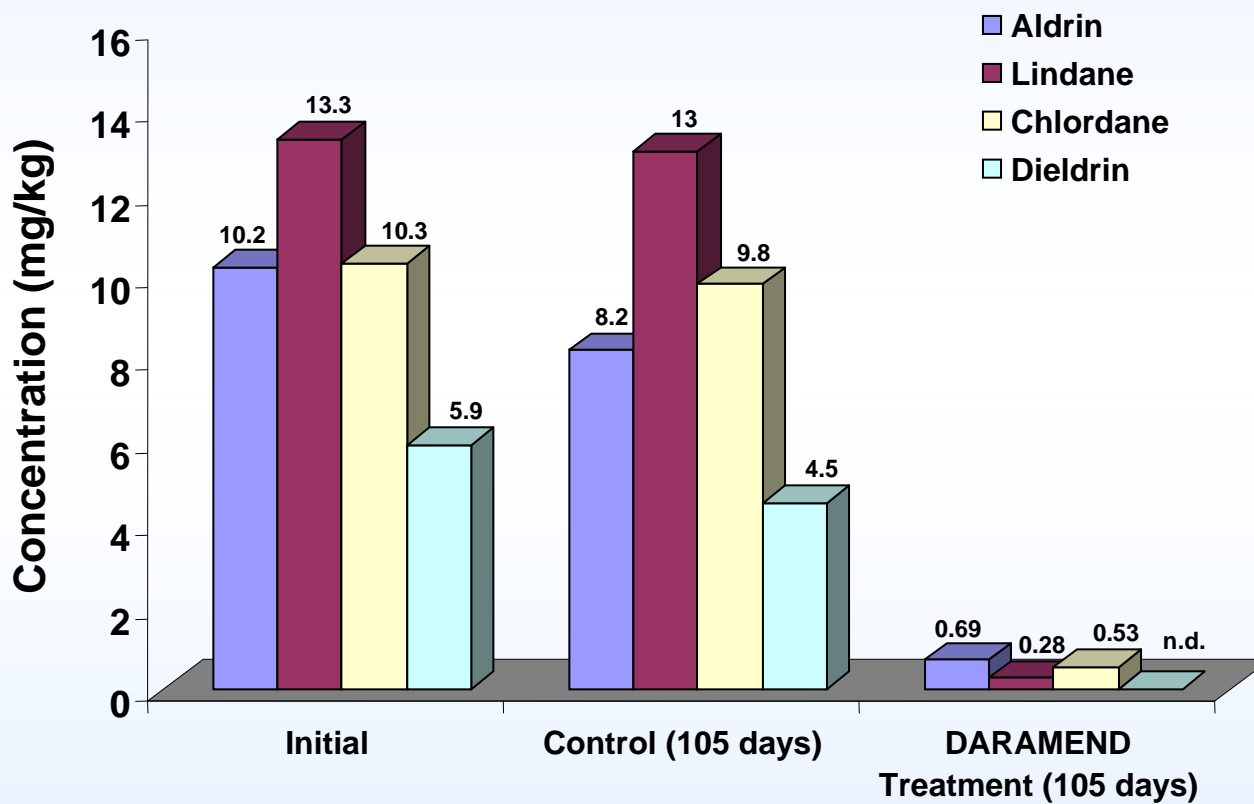


DARAMEND<sup>®</sup> Soil Treatment

## OTHER OCP TREATMENT RESULTS

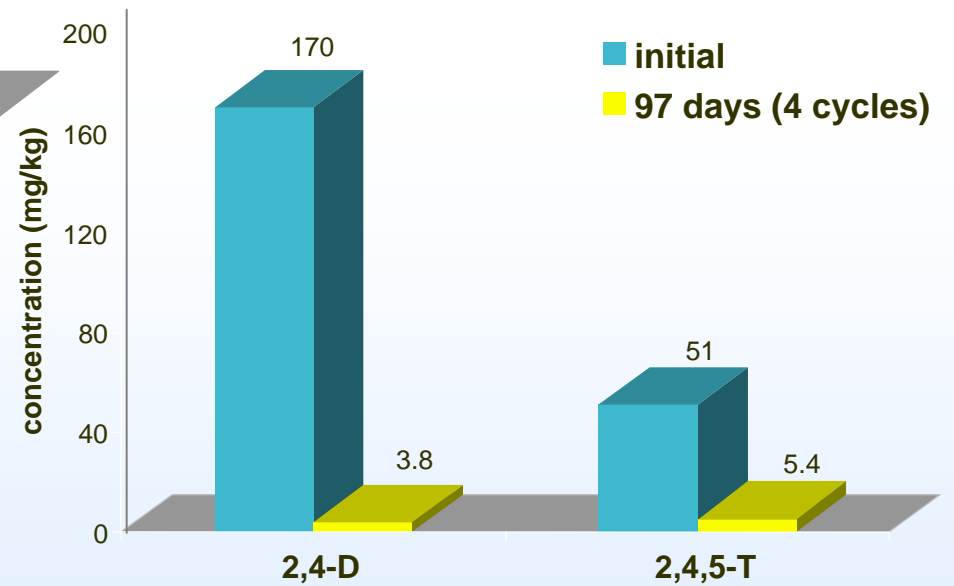
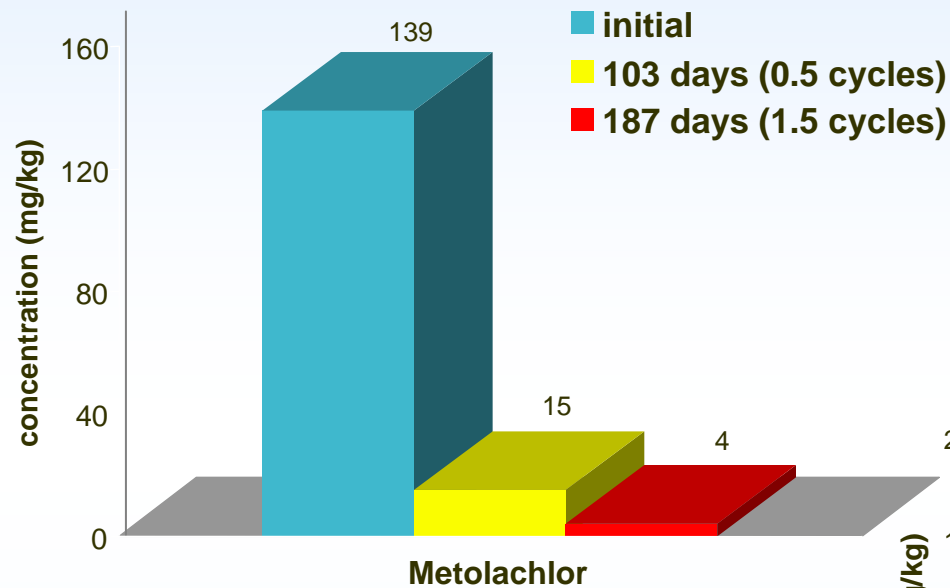


# Treatment of OCPs Southeast US





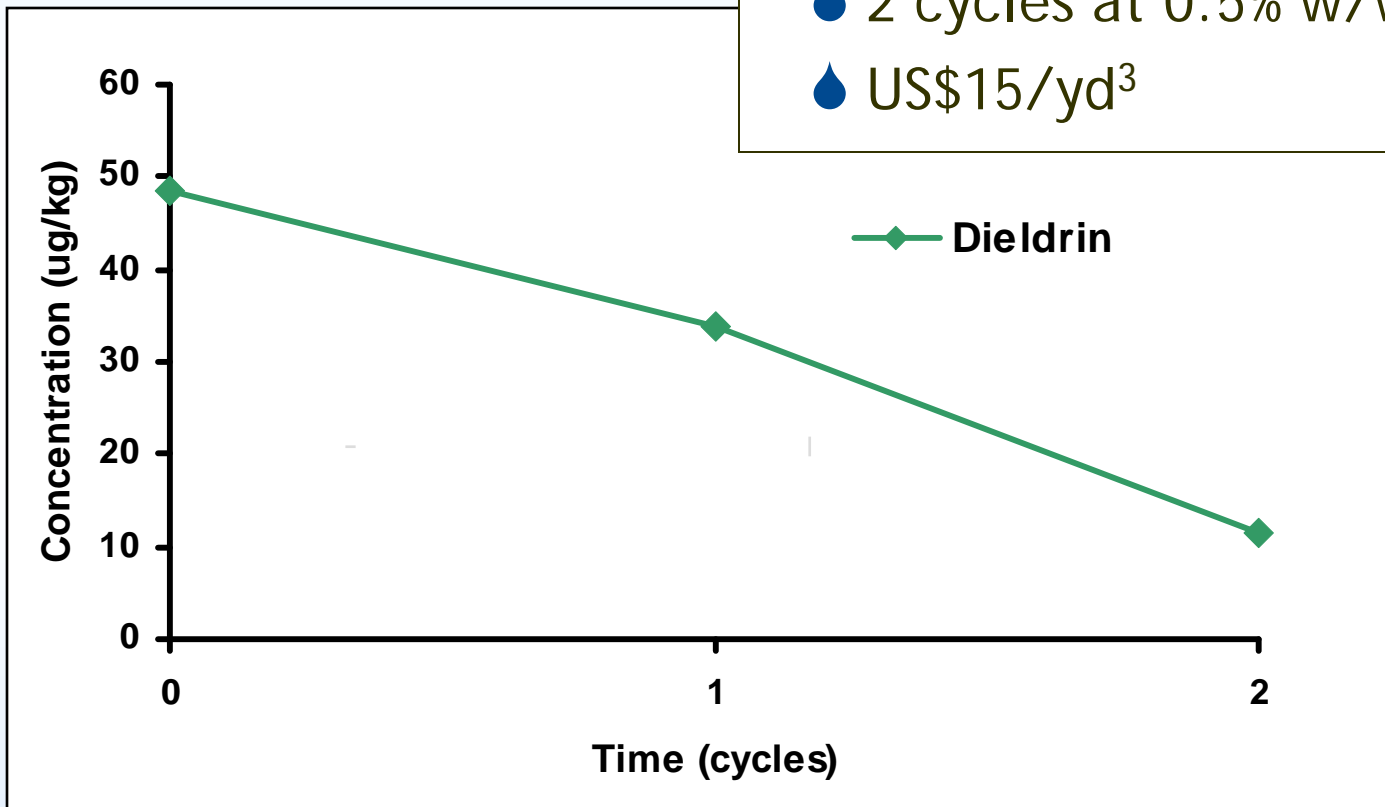
# Treatment of Chlorinated Herbicides - Site in South Carolina





# Treatment of Dieldrin Site in Florida

- 2,130 tons insitu pilot
- 2 cycles at 0.5% w/w DARAMEND
- US\$15/yd<sup>3</sup>





# DARAMEND<sup>®</sup> Bioremediation

## HIGH PERFORMANCE



- Repeated high performance on recalcitrants
- Minimal unwanted intermediate compounds

## RELIABLE AND PREDICTABLE



- Reliable Scale-up
- Use of well-defined, refined amendments

## COST EFFECTIVE



- Low amendment cost/ton
- Low labour requirements
- Money-back warranty of performance

## LOW RISK



# Questions are Welcome!



***For more information please visit: [www.adventusgroup.com](http://www.adventusgroup.com)***