Air National Guard

LARGE-SCALE LACTATE INJECTION IN A MILDLY-REDUCING AQUIFER FOR PCE/TCE DECHLORINATION

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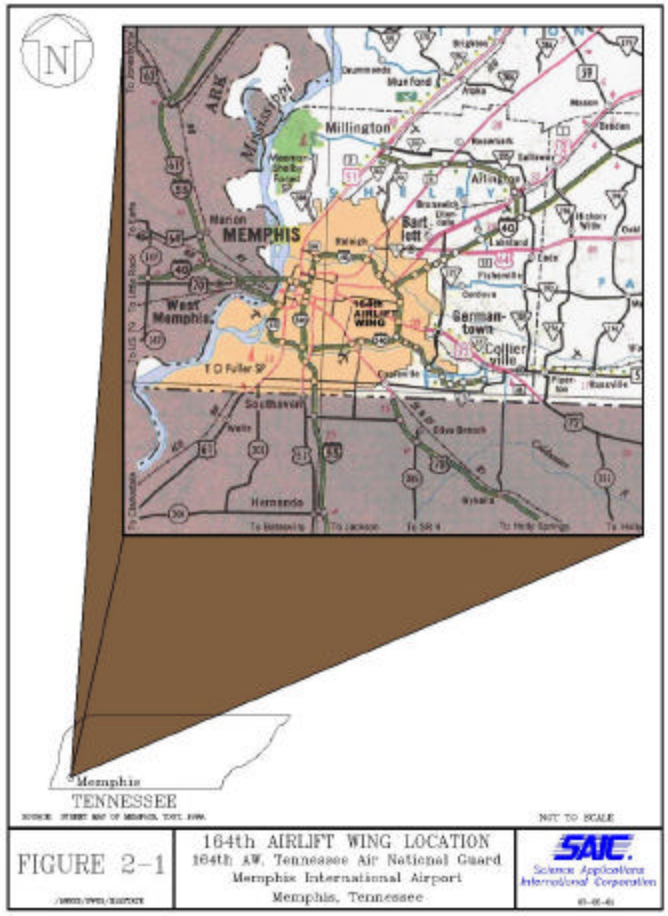
Bounded to the West and North by Memphis International Airport



Bounded to the South and East by Federal Express

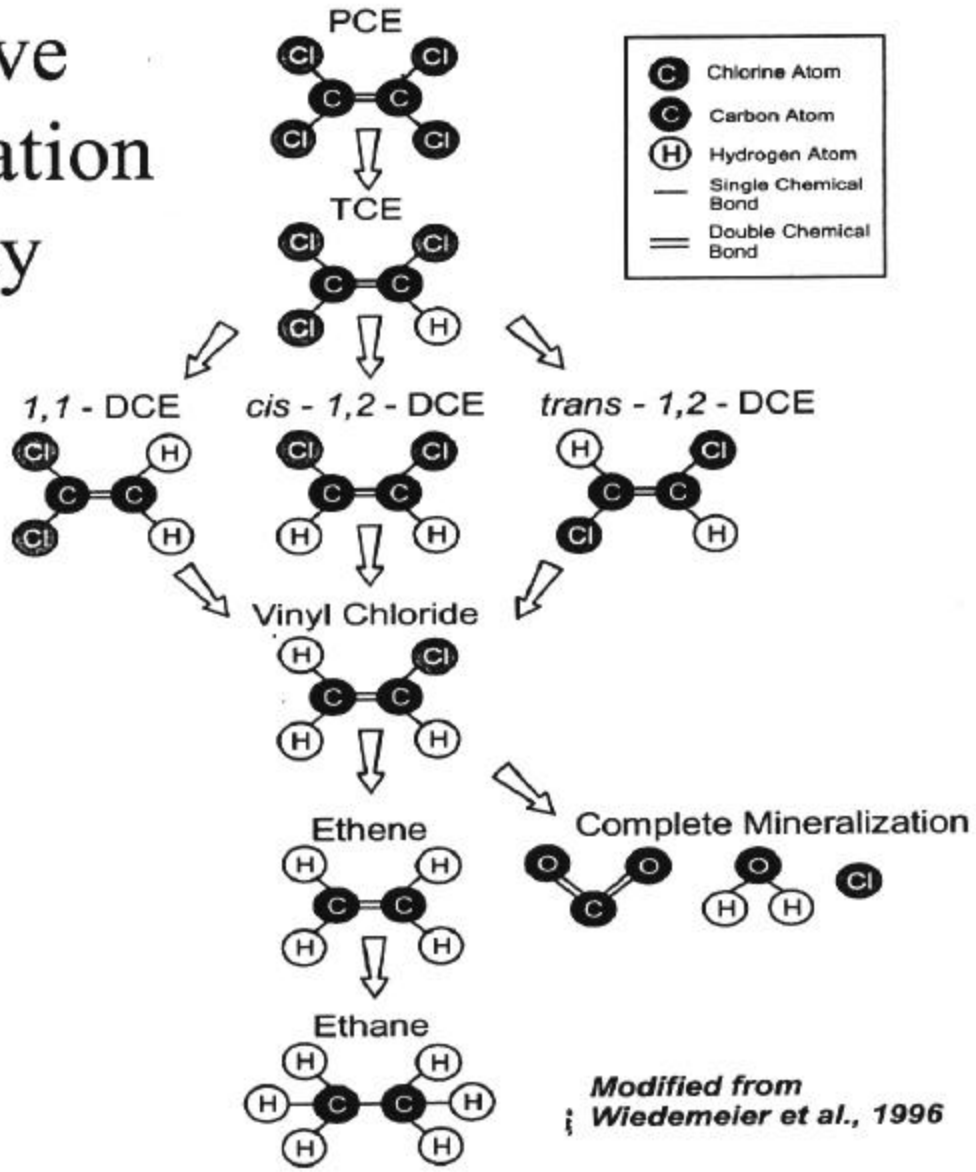
TCE Concentrations In Groundwater

PROJECT OBJECTIVES

- To provide low cost, low maintenance reduction in chlorinated solvents at the source

- To provide supplemental data through the pilot study for inclusion in the FS currently being conducted

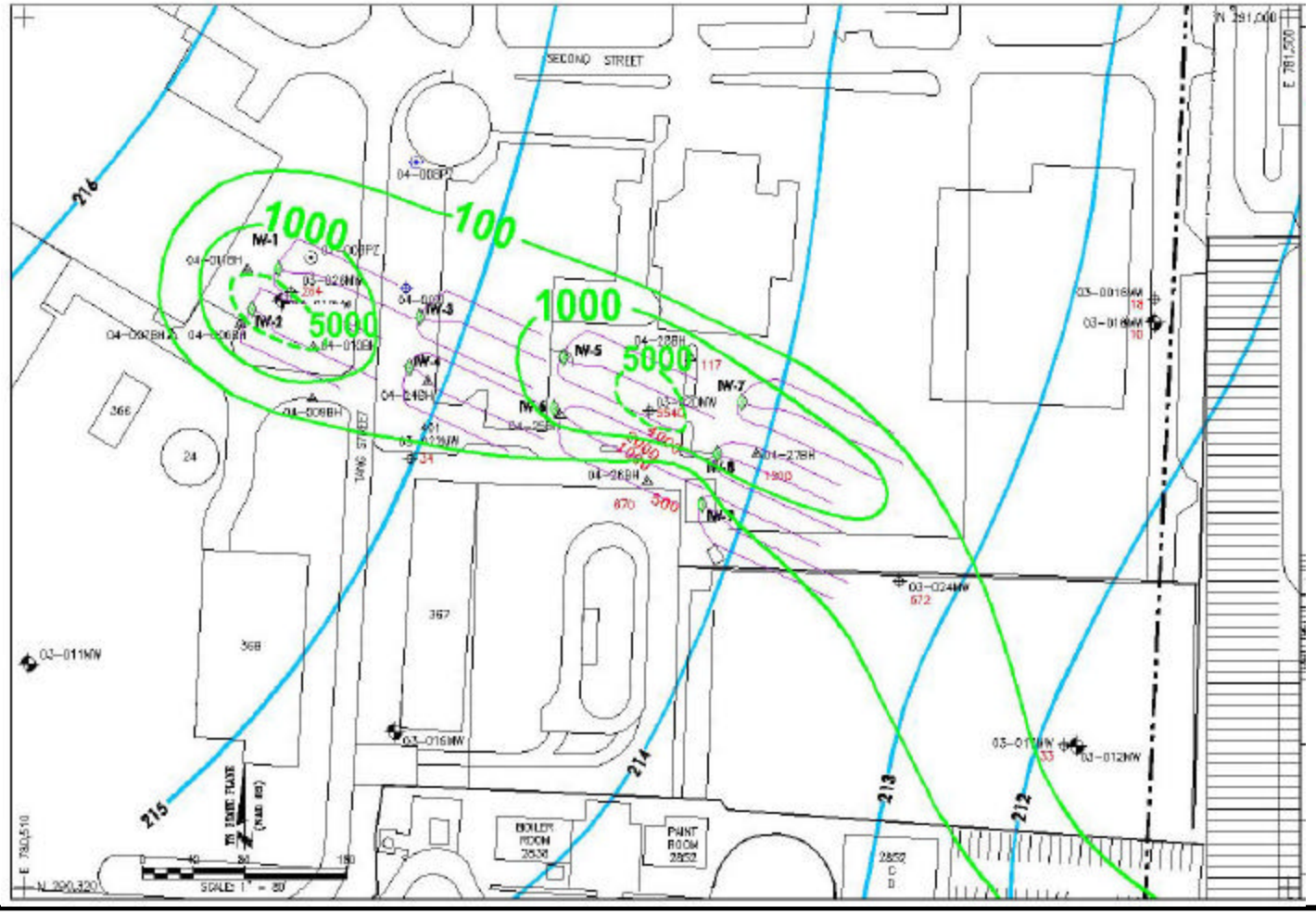
Reductive Dechlorination Pathway



Specifications

Specification	Typical	
Sodium Lactate, % by wt.	60 ± 1.2	60 ± 0.5
H_2O	40 ± 1.2	40 ± 0.5
pH	70 ± 0.5	6.8 – 7.2
Color, APHA	25 max	10
Iron, ppm	2 max	<5
Heavy Metals, ppm	10 max	<1
Specific Gravity	1.3100-1.3400	
Specific Gravity of Injected Material (4%)	1.02	
Chloride, ppm	500 max	
Citrate, Oxalate, Phosphate, Tartrate	none detected	
Sulfate	none detected	
Sugars	none detected	
Methanol, Methyl Esters (ppm)	250 max	
Sodium, %	12.3 ± 0.2	
Odor	Practically odorless	

Optimized Well Locations With 3-D Model



Pull-Technique HDPE Burial

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Heat Fusion Coupling

Na Lactate Drop Tube

Potable Water Source

Mixers for Homogenous 1% Solution

Distribution Header For Optimal System Control

Food-grade Na Lactate

First Injection

- Confirmation of mixing
- Calibration of pumping rates for each well
- Monitoring of Mounding
  - Injection wells (9 to 19 ft) 38 ft
  - Monitoring wells (0.75 to 6.25 ft)

Anticipated Schedule

First injection – May, 2002

Post completion technical memorandum – June 20, 2002

Second injection – July, 2002

Third injection – September, 2002

Fourth injection – November, 2002

Post-treatment sampling– January, 2003

Follow up sampling – March, 2003

End of 1-yr pilot study – May, 2003

End of year report – June, 2003

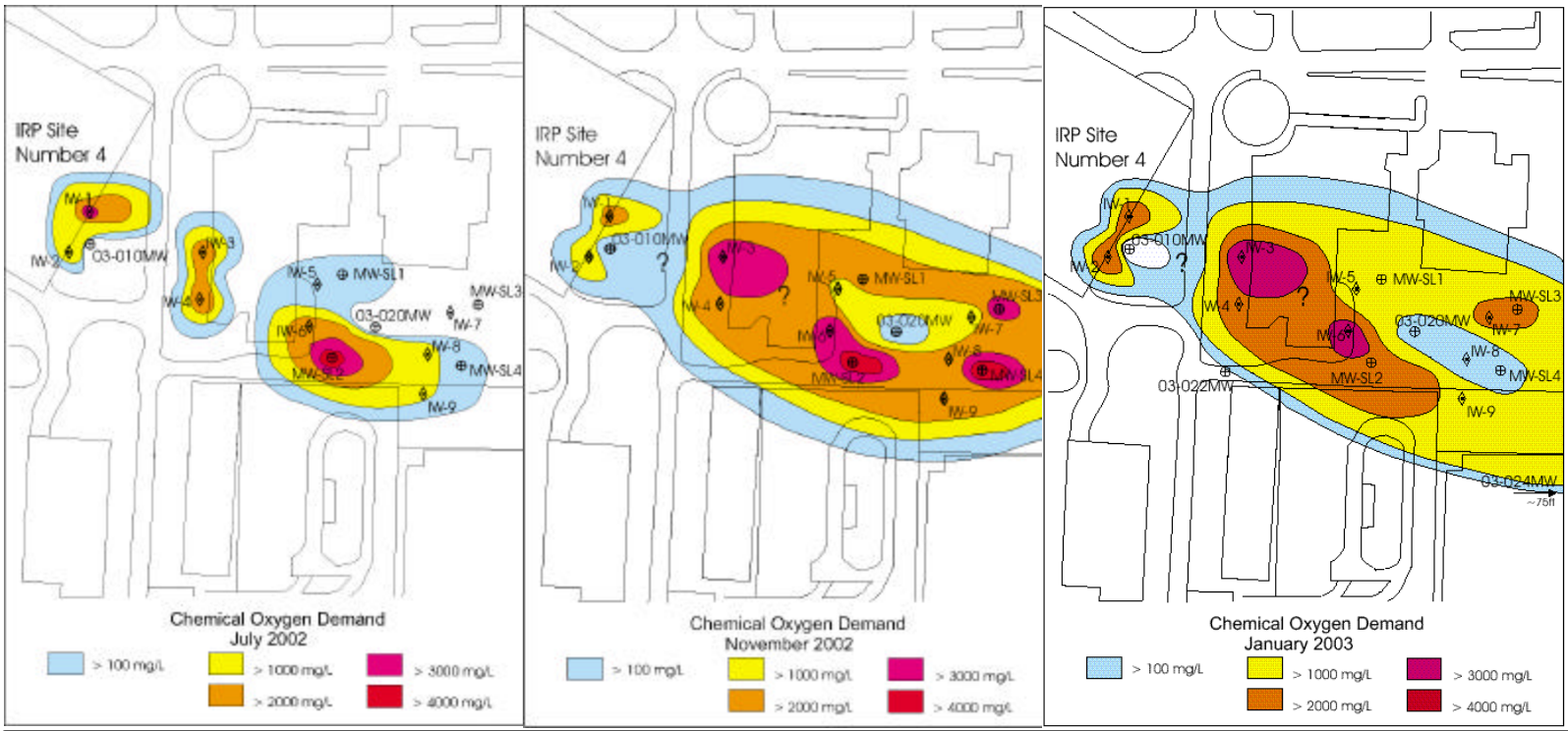
*Pre-injection sampling will be conducted 1wk prior to each injection

System Monitoring Sampling

- 9 injection wells and 6 monitoring wells sampled (2 additional MW side- and down-gradient for Sept. sampling)
- Distribution, Chemical Reduction, & Redox
- Analyses
  - Field measured
    - Ferrous Iron, alkalinity, temperature, pH, specific conductance, diss. oxygen, oxidation reduction potential
  - Laboratory
    - Chlorinated ethenes, ethene/ethane/methane, chemical oxygen demand, lactate, acetate/propionate/butyrate, sulfate, phosphate, ammonia as nitrogen, carbon dioxide

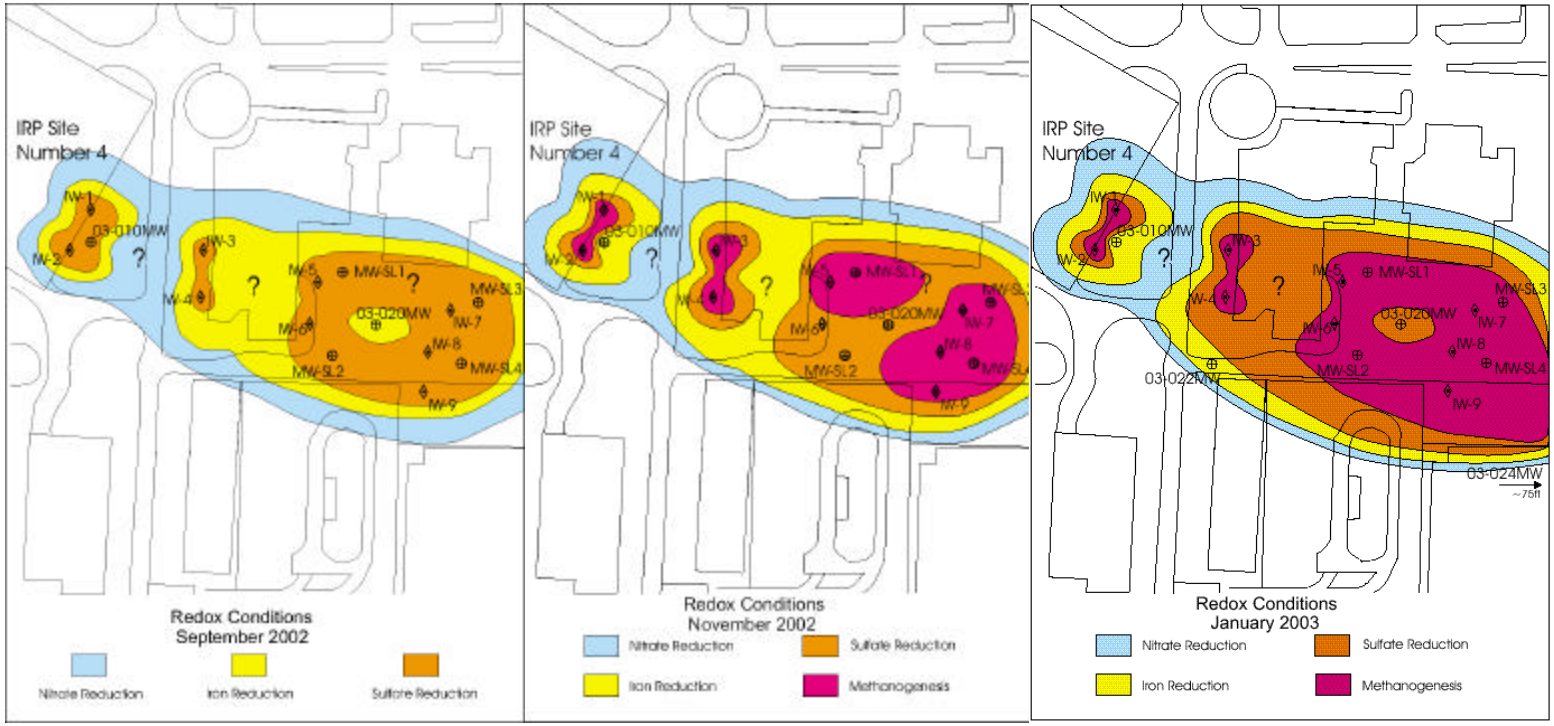
COD Distribution

July 2002 Nov. 2002 Jan. 2003

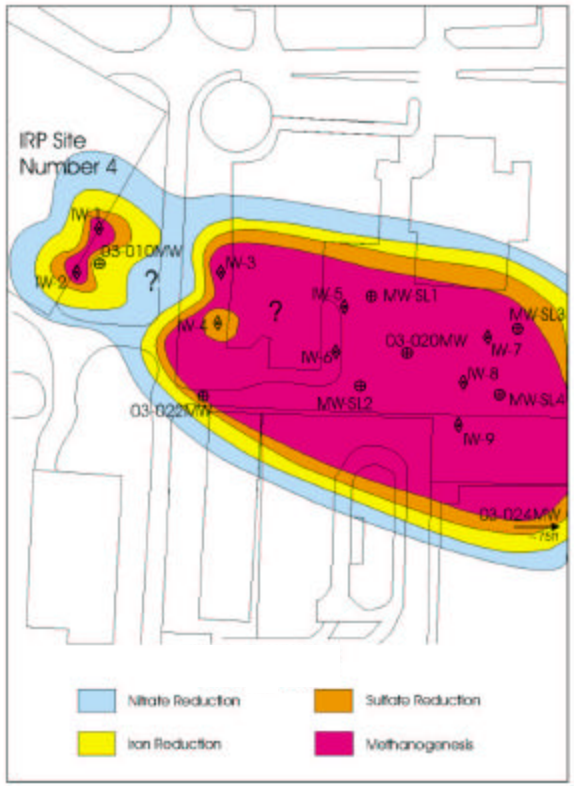


Redox Conditions

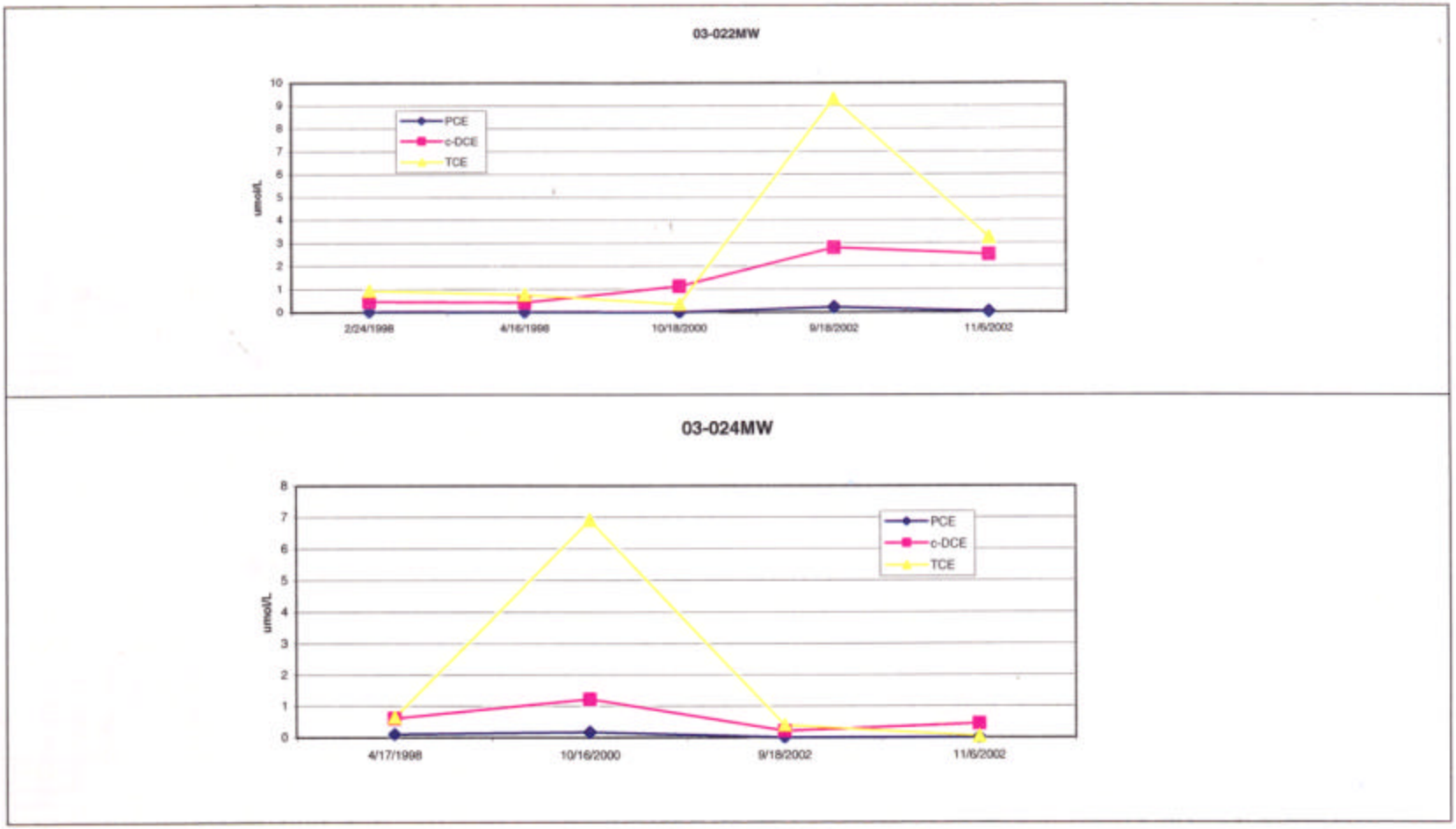
Sept. 2002 Nov. 2002 Jan. 2003



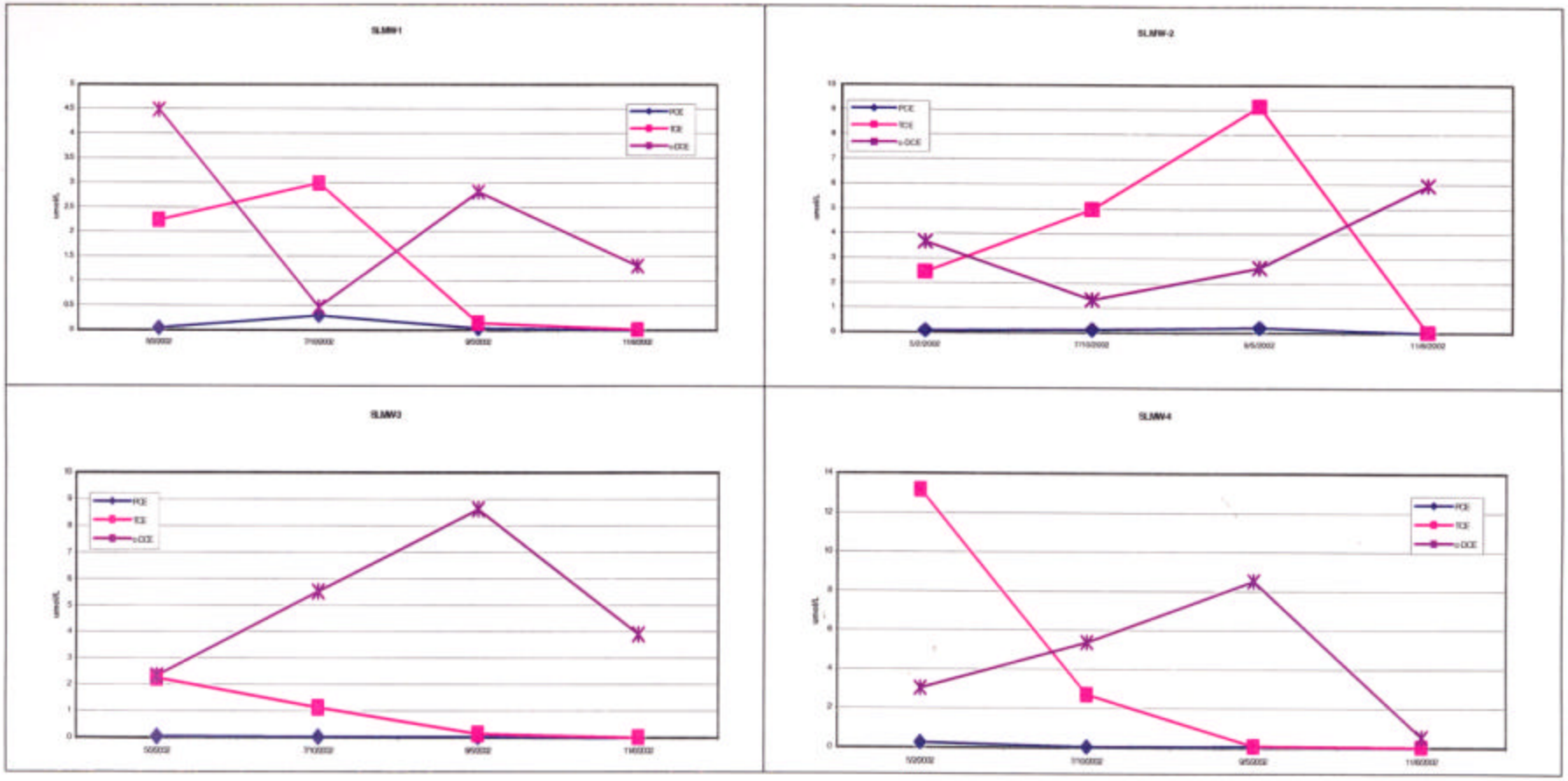
Redox Conditions, March 2003



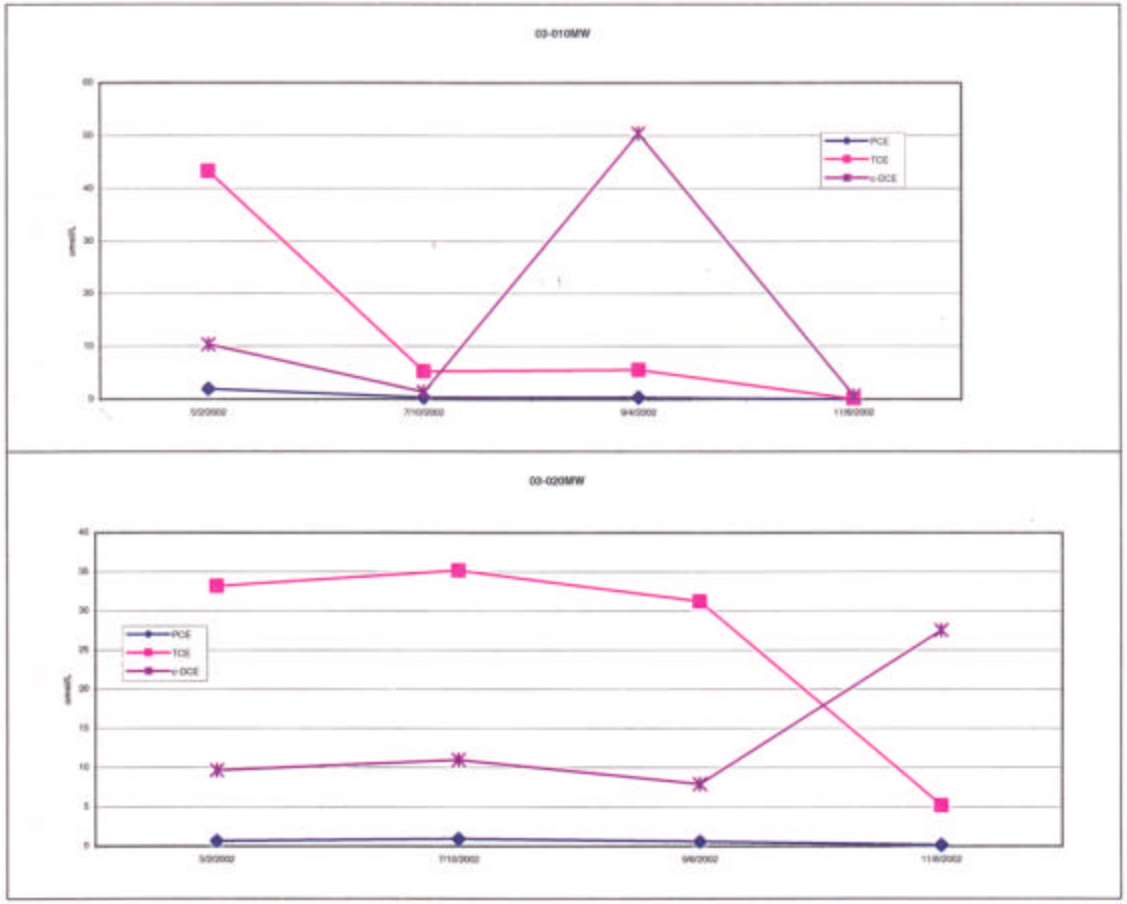
Analytical Results for Monitoring Wells Outside the Target Treatment Area



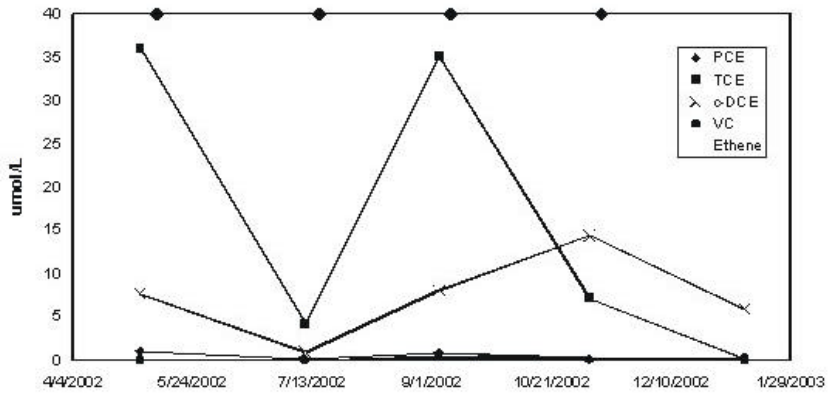
Molar Concentrations in System Monitoring Wells



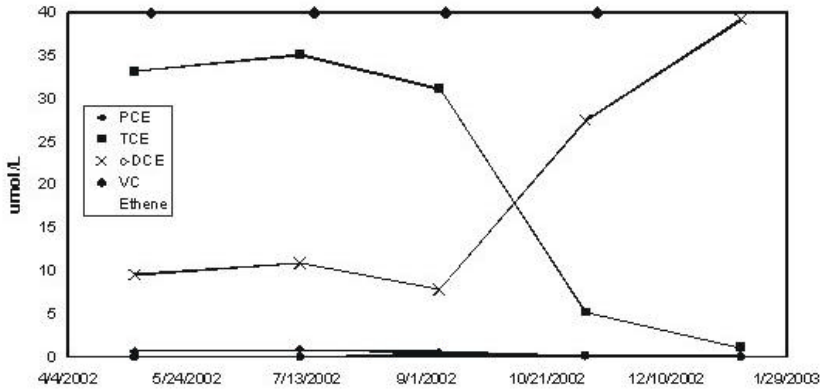
Molar Concentrations from Pre-injection Hot Spots in the Shallow and Deep Portions of the Water Table Aquifer



VOCs in IW-5 (a) and 03-020mw (b)



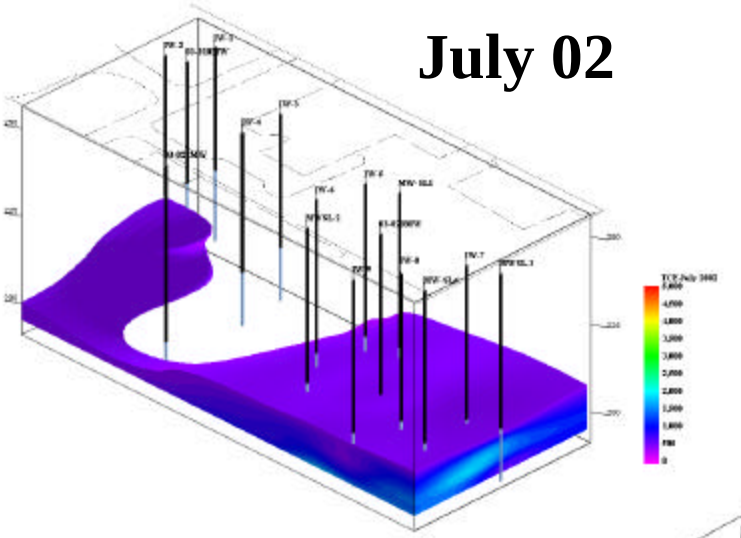
(A)



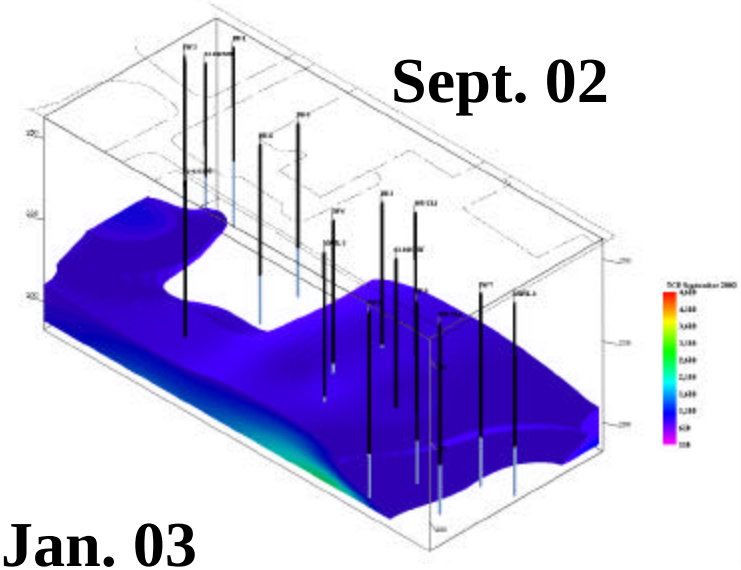
(B)

Injection Area TCE Concentrations >500 ug/L

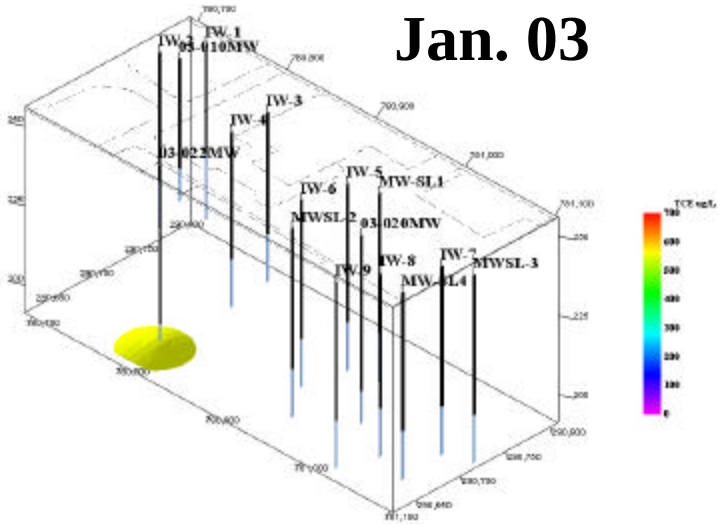
July 02



Sept. 02



Jan. 03



Conclusions

Nine months of monitoring during lactate injection in a large-scale mildly reducing aquifer indicate that

- **The injection system successfully delivered significant quantities of an electron donor throughout the treatment area.**
- **Methanogenic conditions were achieved throughout the treatment area.**
- **Stoichiometric ARD to *cis*-DCE was observed throughout the treatment area.**
- **Baseline DNA screening indicated the absence of DHE in site groundwater prior to electron donor injection.**
- **The absence of advanced ARD beyond *cis*-DCE may be a result of insufficient time for biomass growth, or may be due to the absence of the organisms required for advanced ARD. Future activities include continued monitoring (including DHE monitoring) to determine if bioaugmentation is required in order to achieve complete ARD to ethene.**