PERFORMANCE MONITORING OF THE SPILL SITE 7 ZVI PERMABLE REACTIVE BARRIER

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RTDF PRB Action Team Meeting
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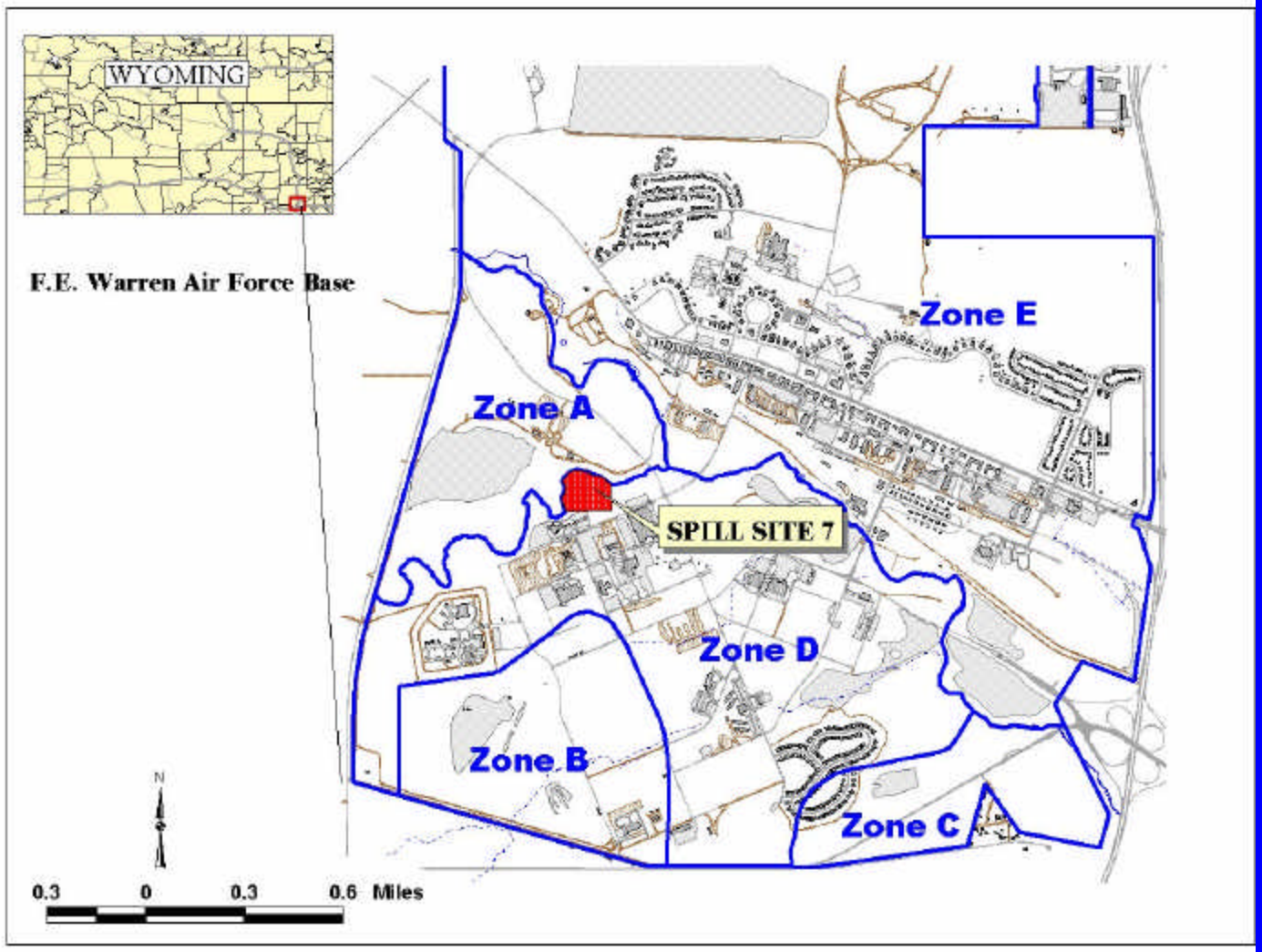
OUTLINE

- Introduction & Background
- Performance Monitoring Objectives
- Performance Monitoring Network
- Performance Monitoring Results
- Future Activities
- Treatability Studies
- Summary of Results

FEW and SS7 Location Map



NATURE of CONTAMINATION

- Liquid Oxygen Production
- Trichloroethene (TCE) used as degreaser
- Discharged to Grease Trap
- Drained to Surface Drainage Ditch
- Infiltrated to Groundwater
- Maximum TCE = 21,000 µg/L
- Groundwater/Surface Water Interaction
- Interim remedial action in **Zone D** (1997)

REMEDIAL ACTION OBJECTIVES

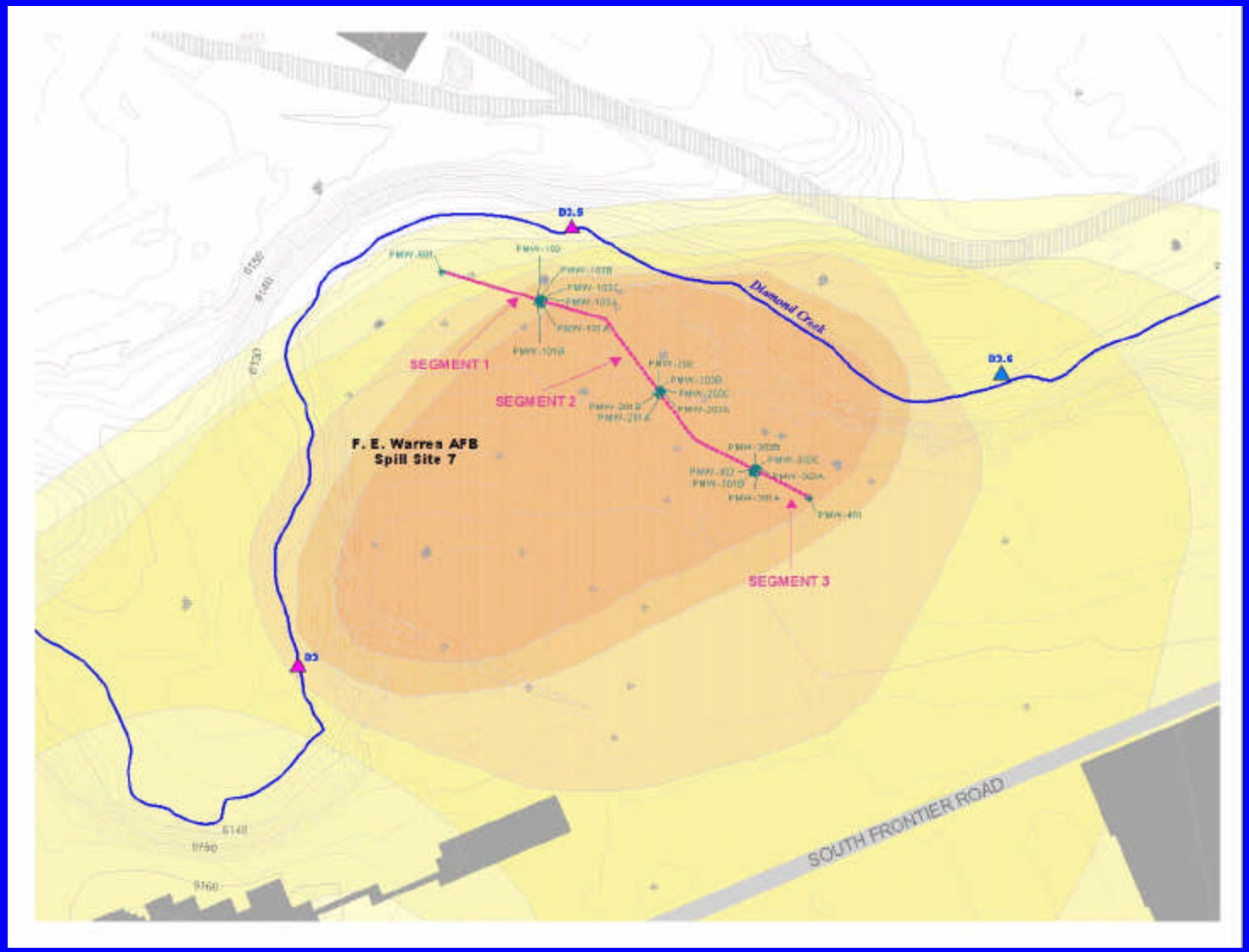
- Minimize future potential to ingest COCs by reducing concentrations in upper 15 feet of groundwater to MCLs
- Minimize COC loading to Diamond Creek

PRB CONSTRUCTION

- Installed during July/August 1999
- Continuous 568 foot Iron-Filings PRB
- 3 Segments
  - COC Concentrations and Distribution
  - Groundwater Velocity (1.3 feet/day)
  - Groundwater Flow Direction
- Performance monitoring network

PRB Construction

SS7 SITE MAP


D3.5
D3.6
D3
Diamond Creek
SEGMENT 1
SEGMENT 2
SEGMENT 3
F. E. Warren AFB
Spill Site 7
SOUTH FRONTIER ROAD

PERFORMANCE MONITORING OBJECTIVES

- COCs reduced to treatment goals
- Effects on groundwater flow paths
- Contaminant loading to Diamond Creek
- Byproducts impacting Diamond Creek

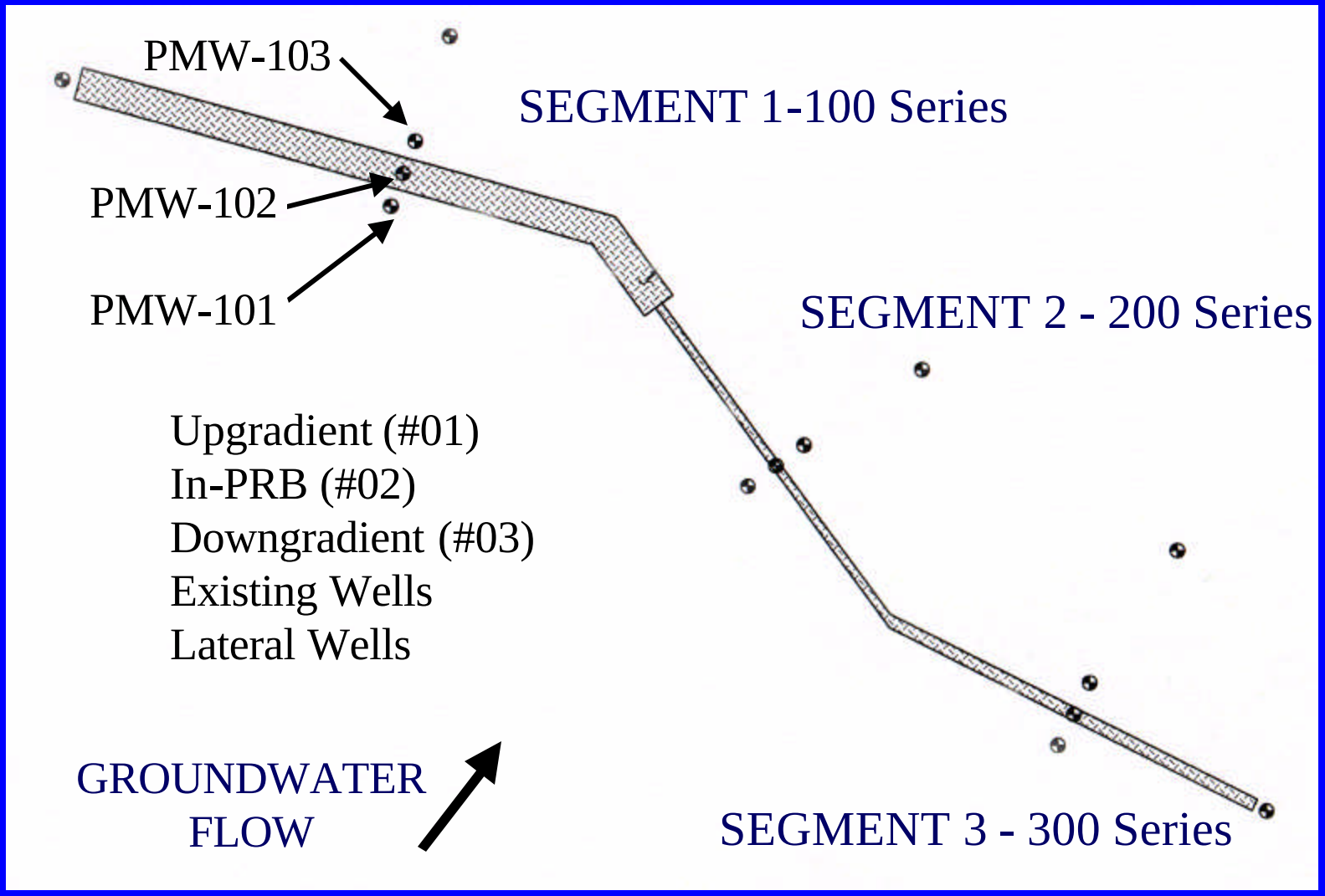
PERFORMANCE MONITORING NETWORK

- Groundwater
  - Monitoring wells: Quarterly then semi-annually
  - Analysis for COCs and water quality parameters
    - pH, ORP (Eh), DO, Conductivity, Metals, Cl, N, SO_4
  - Water-level measurements
- Surface Water
  - SW locations: Quarterly then semi-annually
  - Analysis for COCs and water quality parameters
  - Water-level measurements

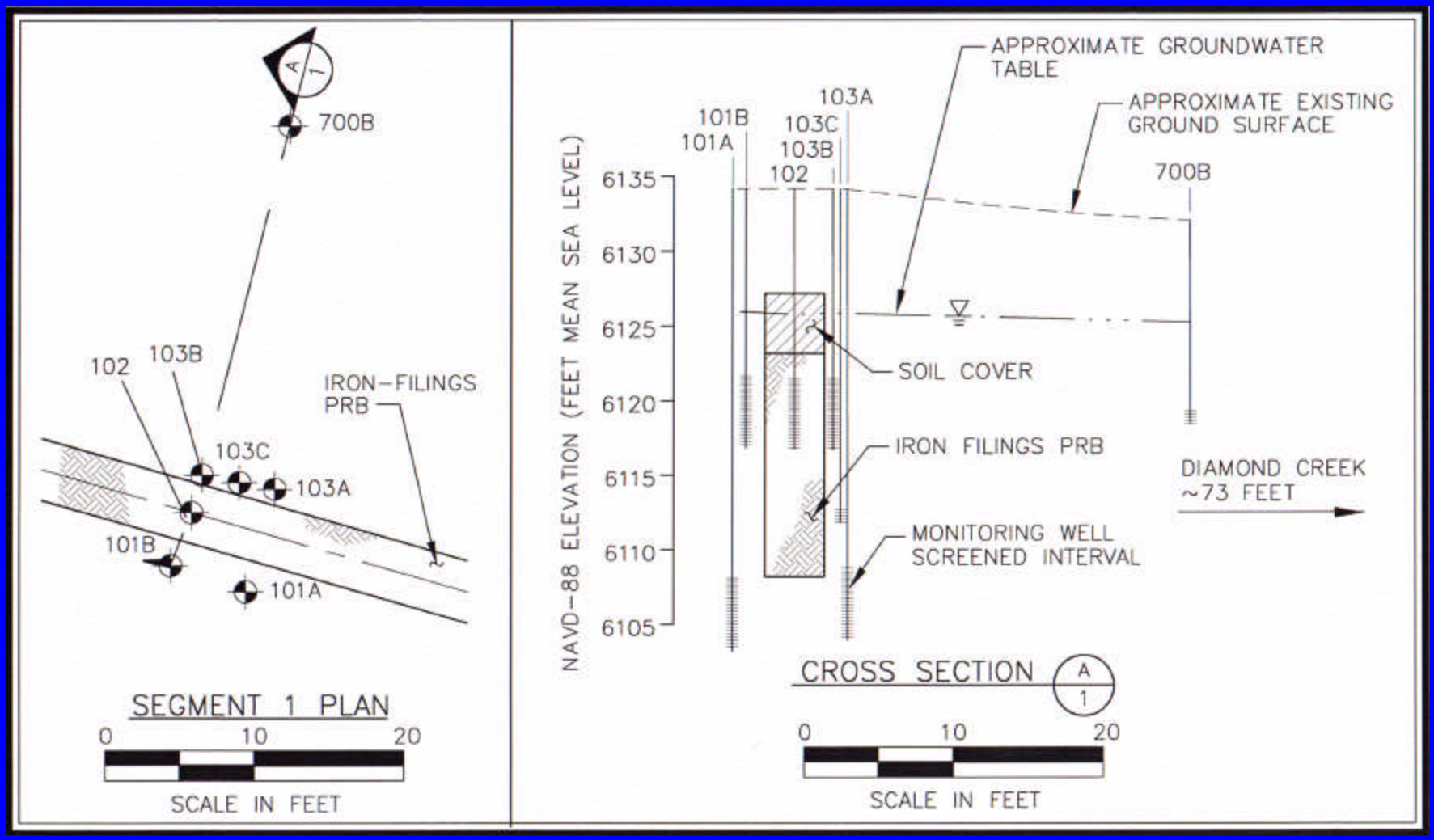
GROUNDWATER MONITORING

- Upgradient of PRB
  - Monitoring wells 1 to 3 feet upgradient
- In-PRB
- Downgradient of PRB
  - 1 to 3 feet downgradient
  - 30 to 50 feet downgradient
- Vertically Stratified: water table, mid-PRB, and below base of PRB

PMW Monitoring Network



PRB SECTIONS

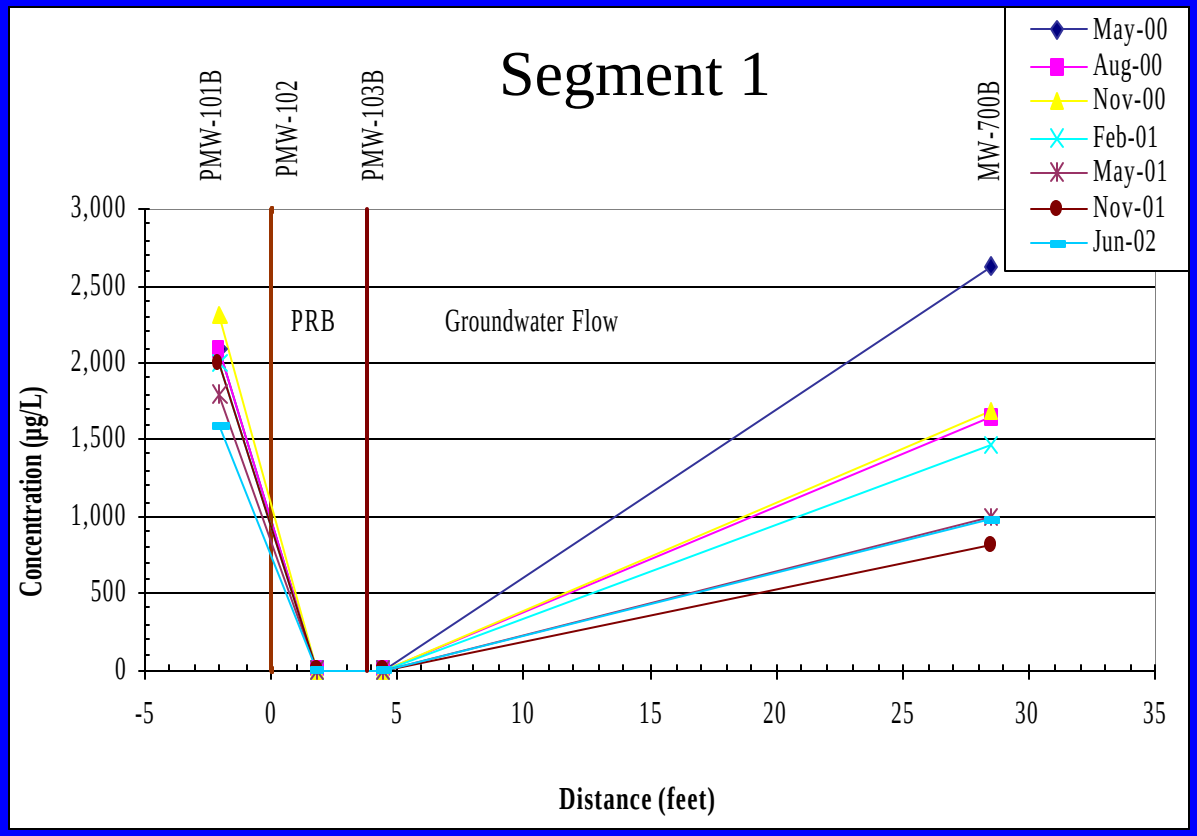


SS7 PMW Cluster

COCs & TREATMENT GOALS

- Trichloroethene (TCE) = 5 µg/L
- *Cis*-1,2-Dichloroethene (DCE) = 70 µg/L
- *Trans*-1,2-DCE = 100 µg/L
- Total DCE = 300 µg/L
- Vinyl Chloride = 2 µg/L

TCE Transects



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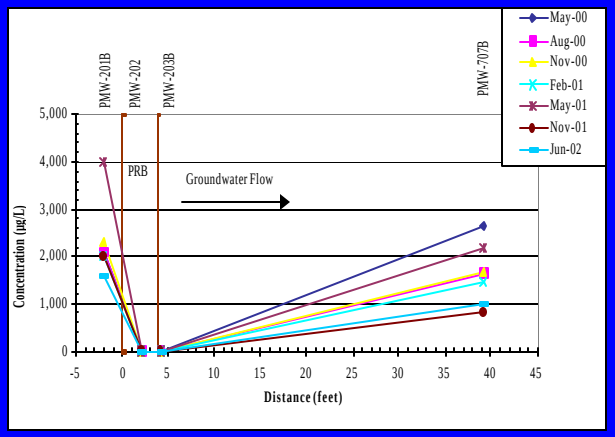

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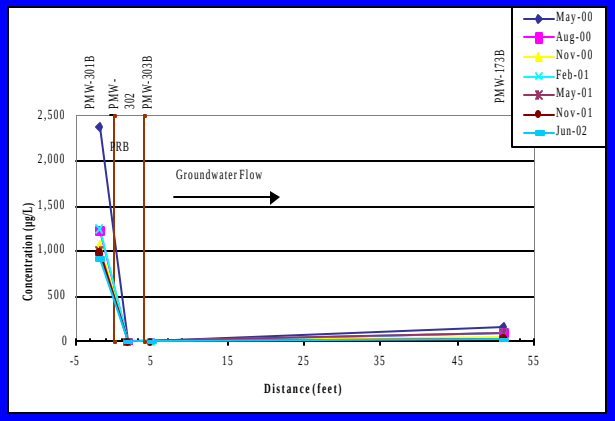
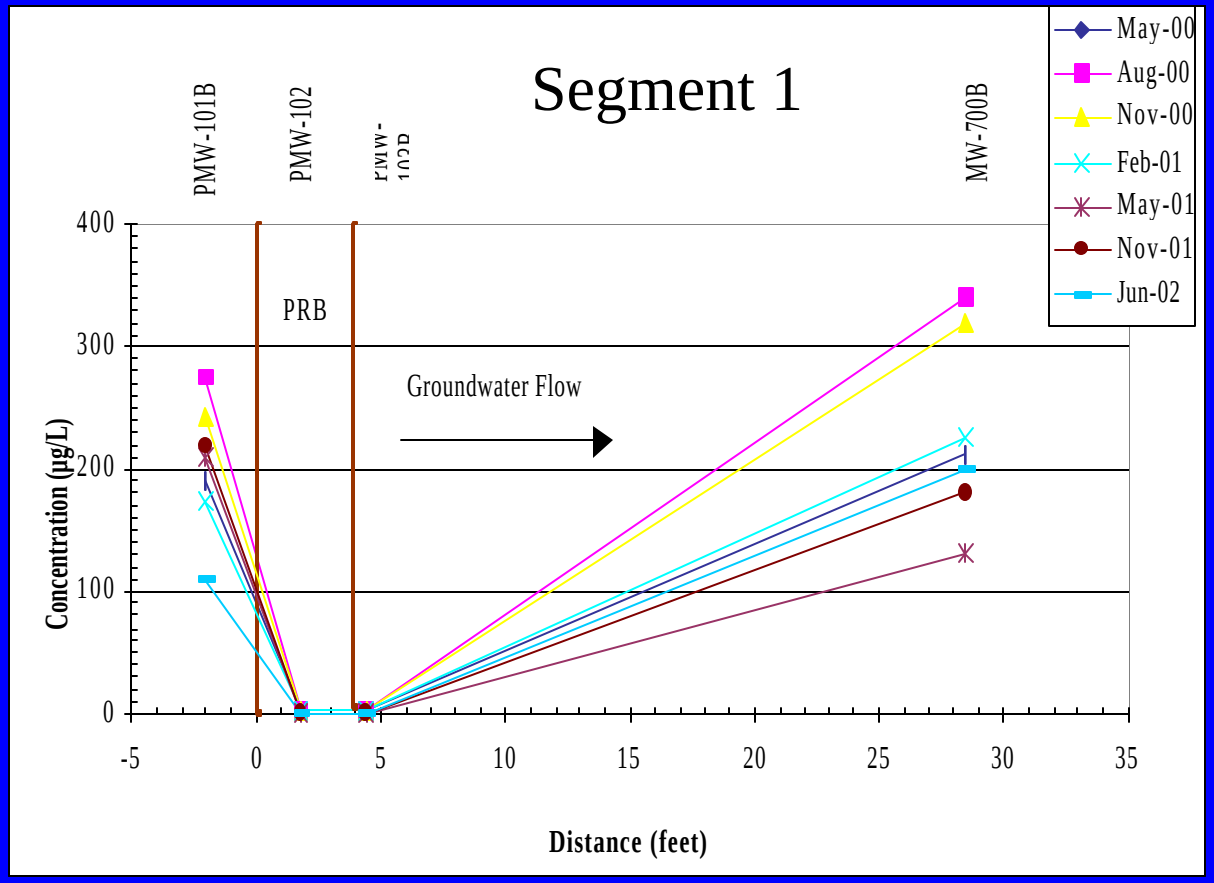


Cis-1,2-DCE Transects



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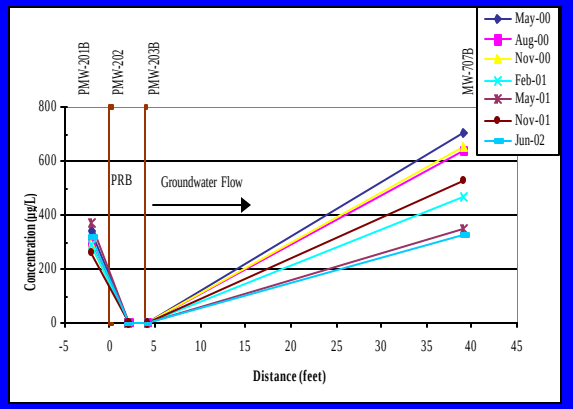

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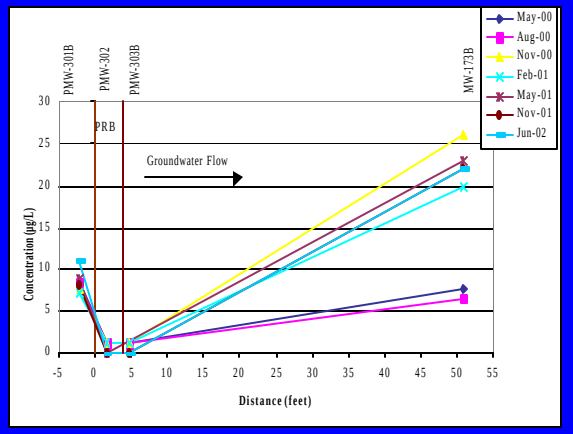
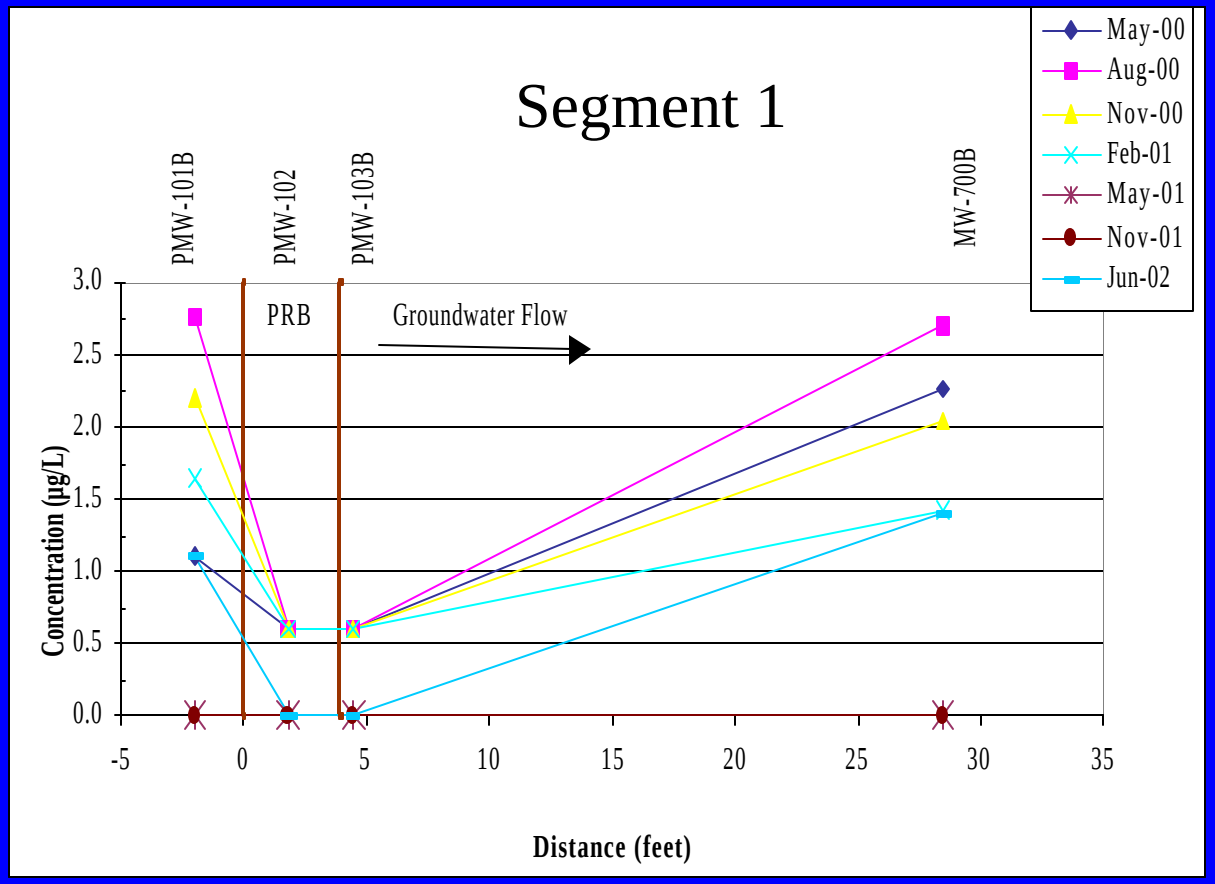


Trans-1,2-DCE Transects



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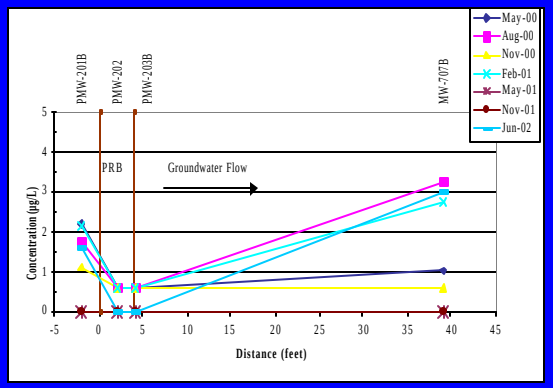

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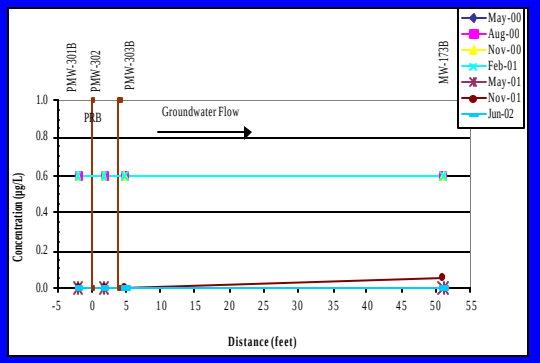
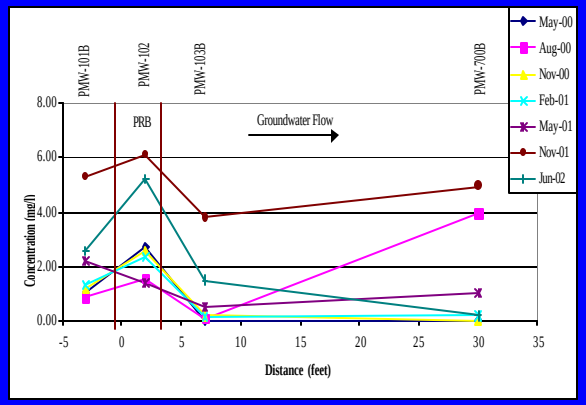
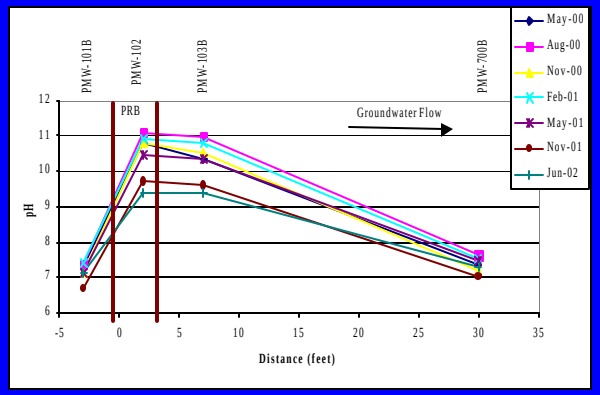


TRENDS in PARAMETERS & METALS

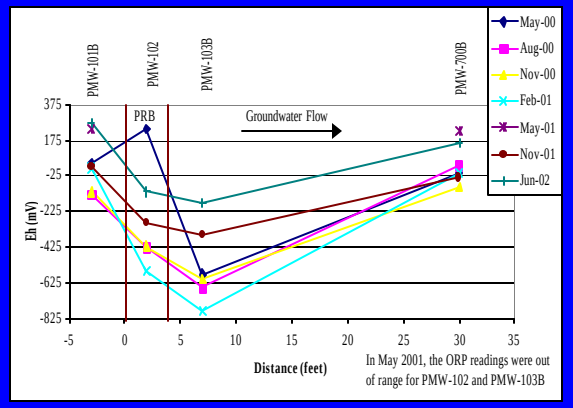
Dissolved Oxygen



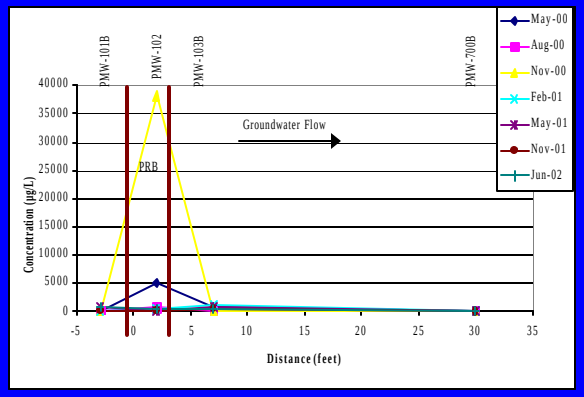
pH



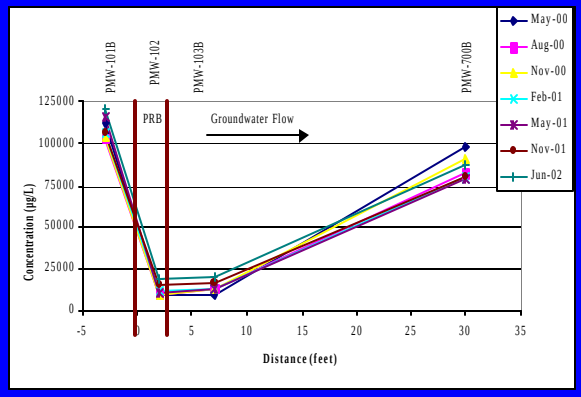
ORP



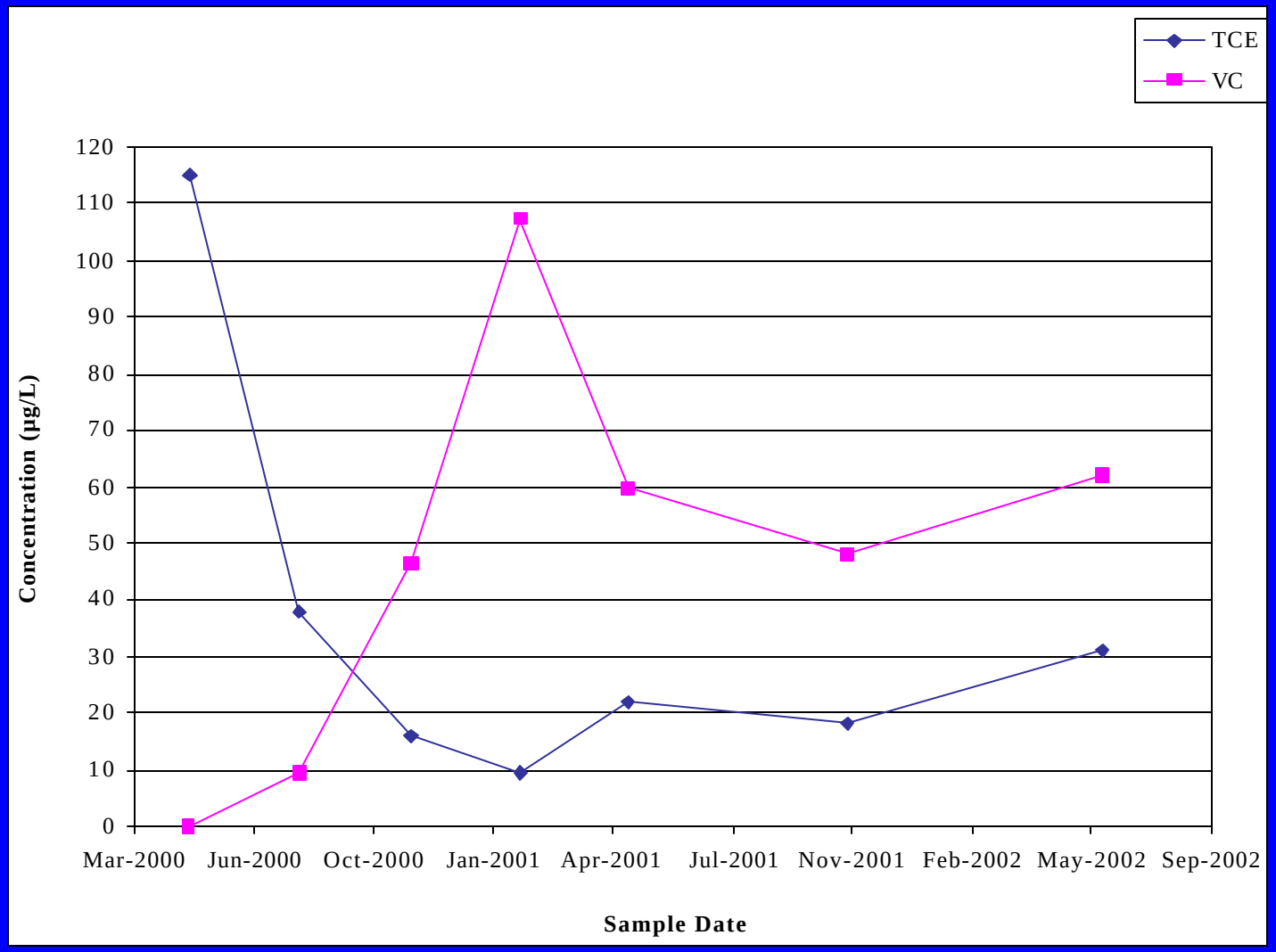
Iron



Calcium



MW-186: TCE & VC


TCE
VC
120
110
100
90
80
70
60
50
40
30
20
10
0
Concentration (µg/L)
Mar-2000
Jun-2000
Oct-2000
Jan-2001
Apr-2001
Jul-2001
Nov-2001
Feb-2002
May-2002
Sep-2002
Sample Date

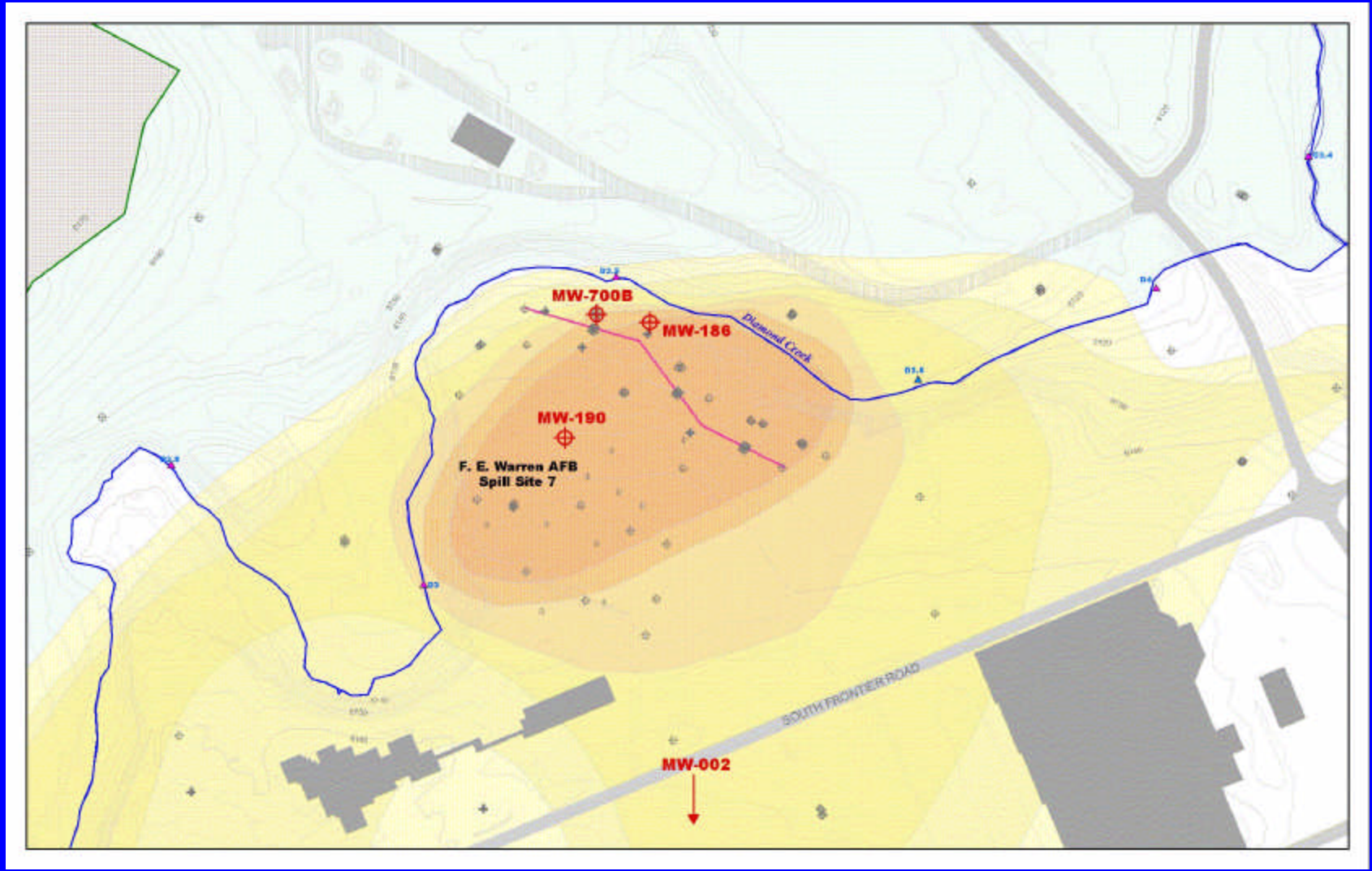
Source of VC in MW-186?

- Product of increased microbial activity
  - biodegradation
- Incomplete degradation of TCE by PRB
  - residence time
  - PRB continuity at junction between segments
- Desorption downgradient of PRB

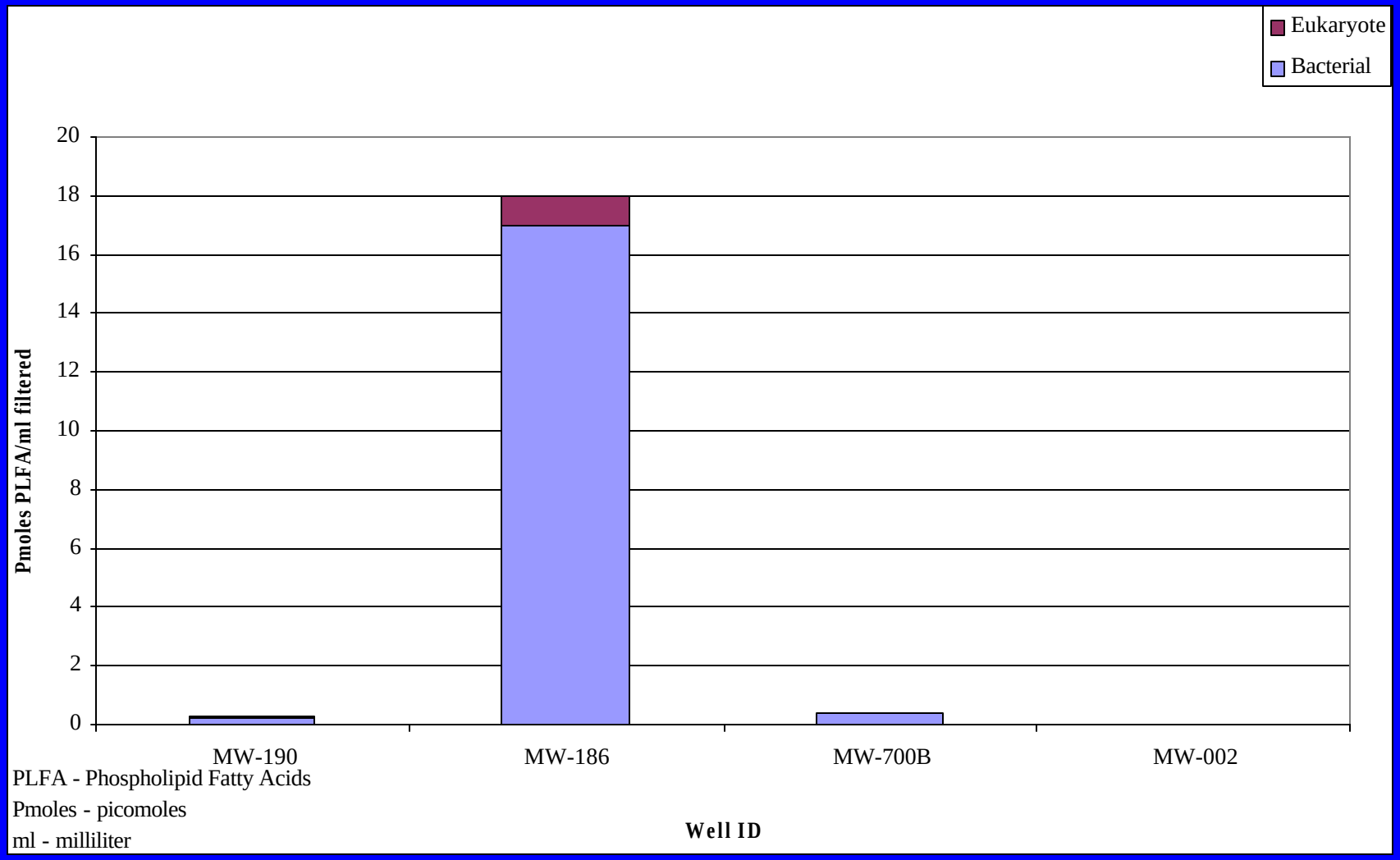
MICROBIAL ACTIVITY

- Phospholipid Fatty Acid (PLFA) Analysis
  - lipids in microbial membrane
  - differ in composition depending on organism and environmental conditions
  - what types of microbes present and how they're reacting to environmental conditions
- Insight to Microbial Communities
  - viable biomass
  - community structure
  - metabolic activity

WELLS for BIO-EVALUATION



BIOMASS in GROUNDWATER



PLFA - Phospholipid Fatty Acids

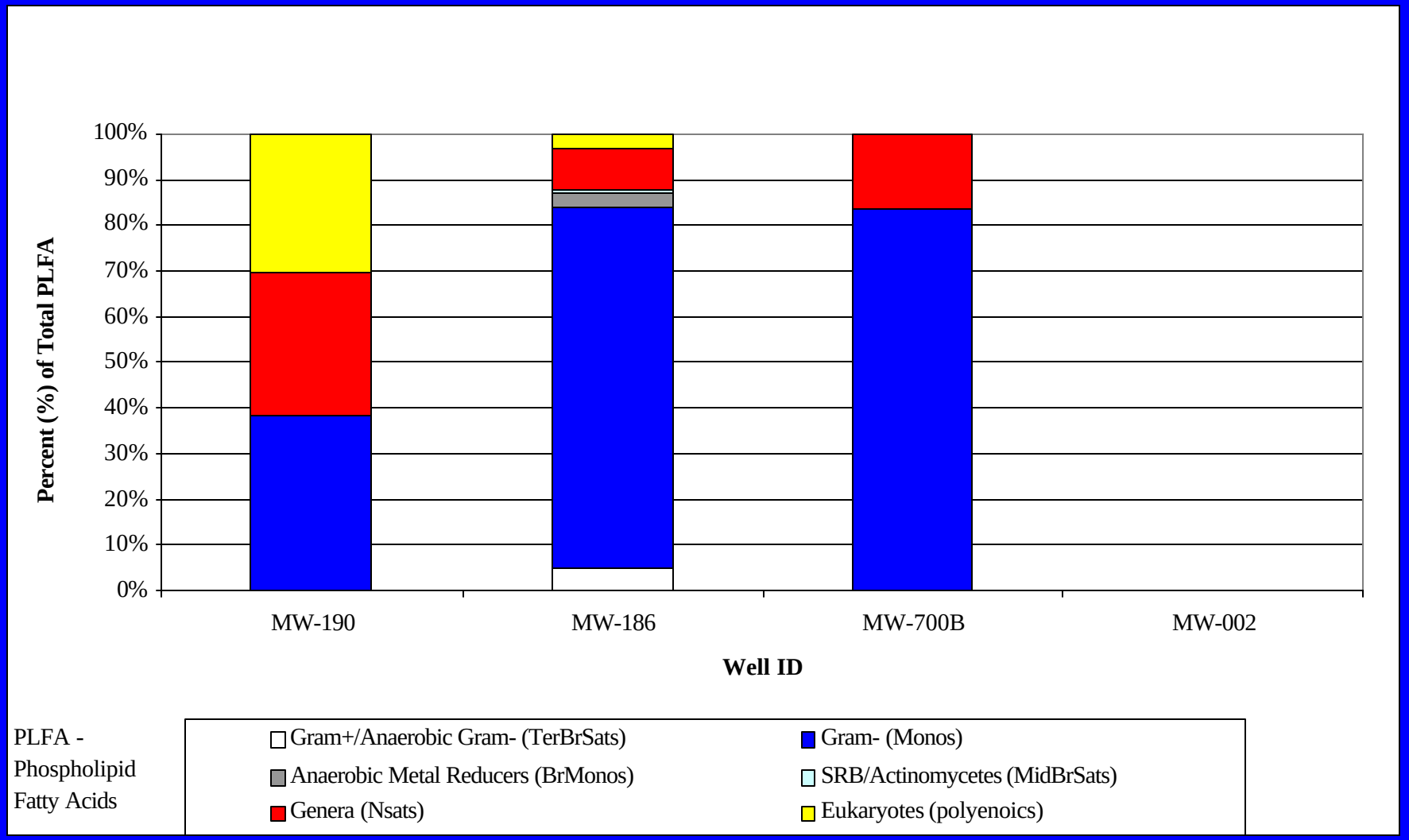
Pmoles - picomoles

ml - milliliter

COMMUNITY STRUCTURE

- PLFA patterns - quantitative profile of microbial populations
- Gram ‘-’ bacteria: ability to utilize wide range of carbon sources and adapt quickly

%'S OF PLFA GROUPS



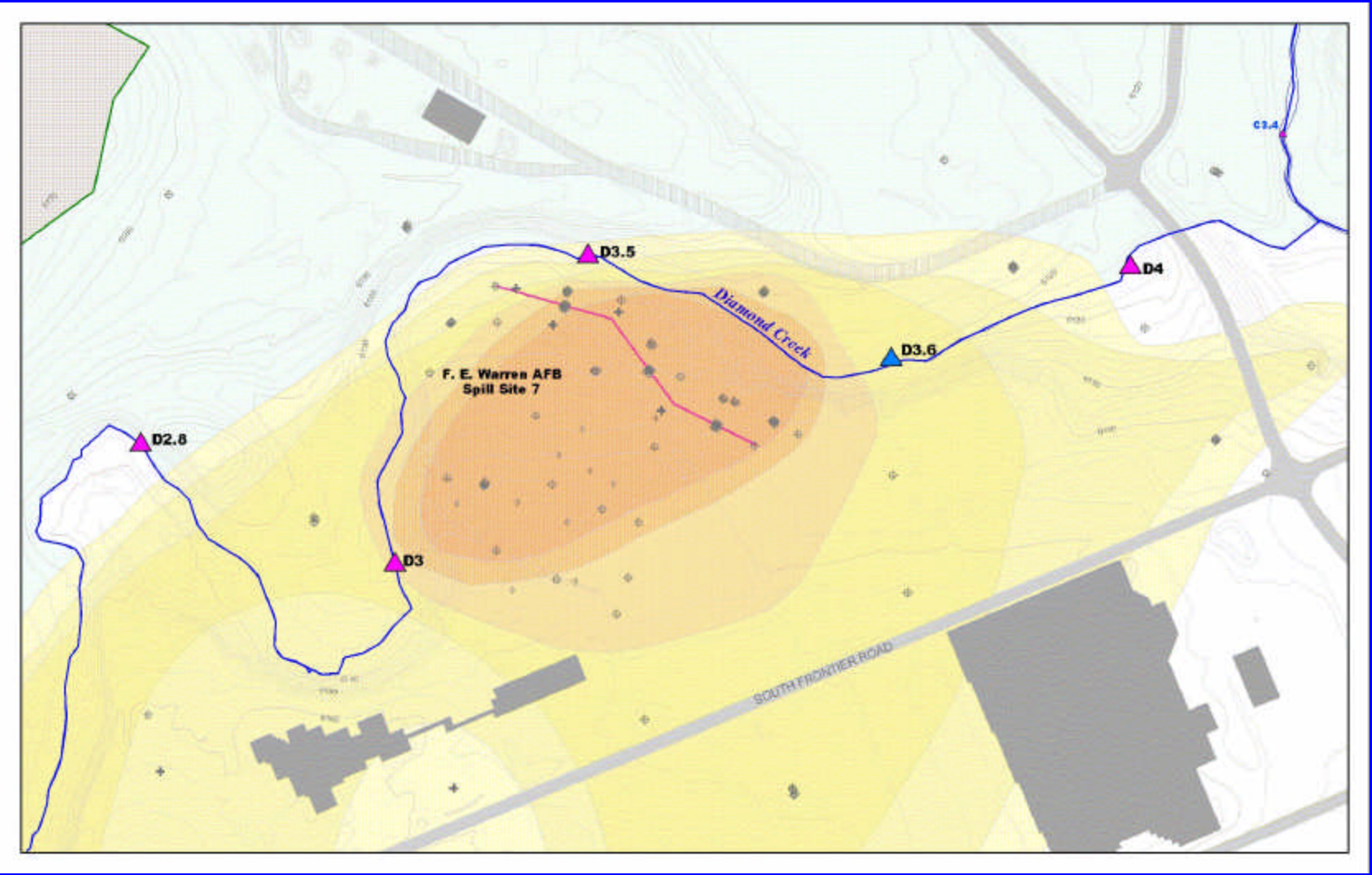
CARBON ISOTOPES

- Desorption or Residence Time?
- Isotopic signatures
  - Ratio of C-12 and C-13 isotopes
  - PRB - reductive dehalogenation - products more depleted in C-13
- Ratios in parents & product
- Distinguish VC produced by degradation in PRB vs.other processes downgradient
- University of Toronto sponsored

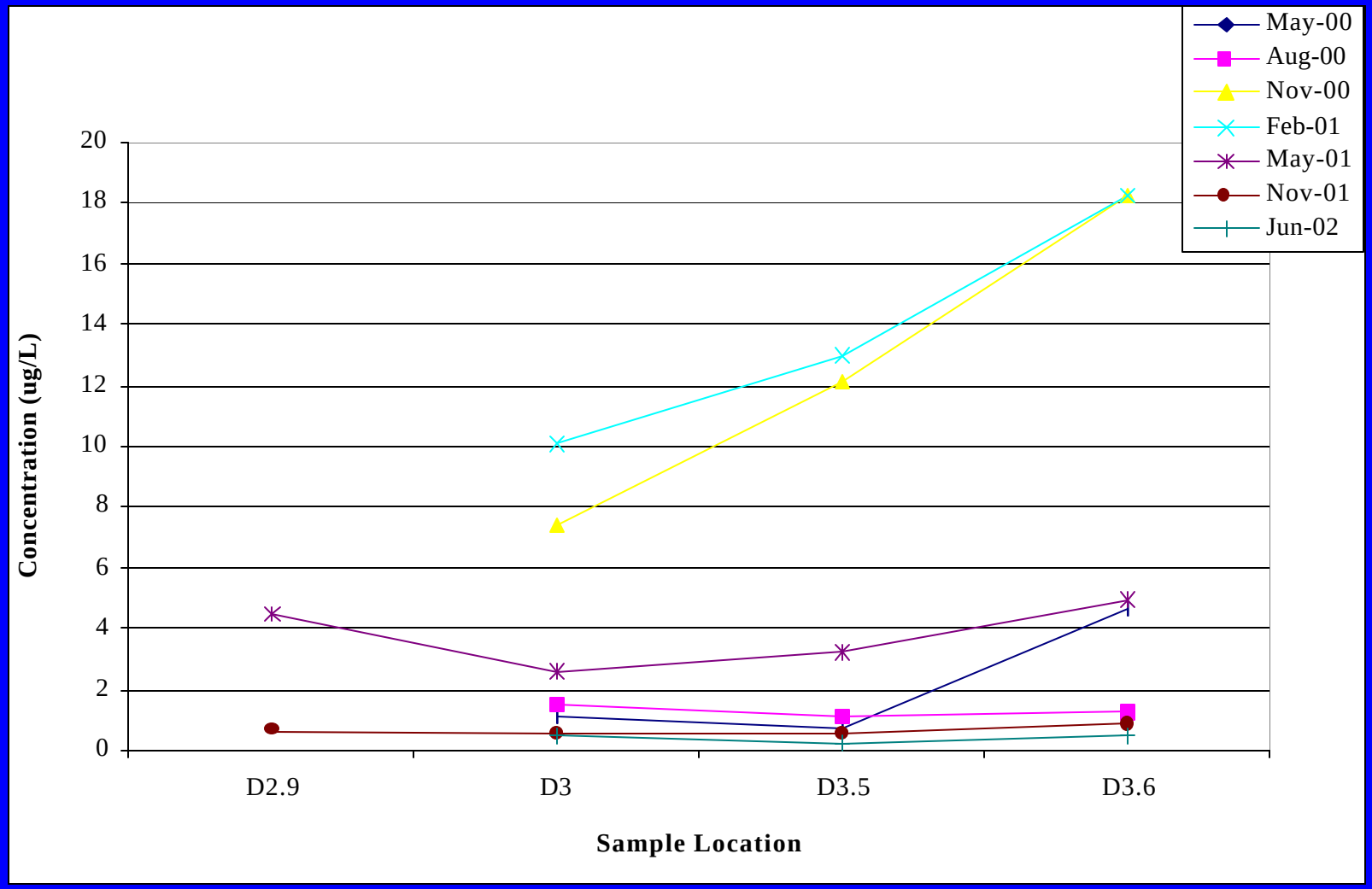
CONTAMINANT LOADING TO DIAMOND CREEK

- Surface water sampling/analysis for COCs and water quality parameters
  - Upstream (D3)
  - Plume contact (D3.5)
  - Downstream (D3.6)

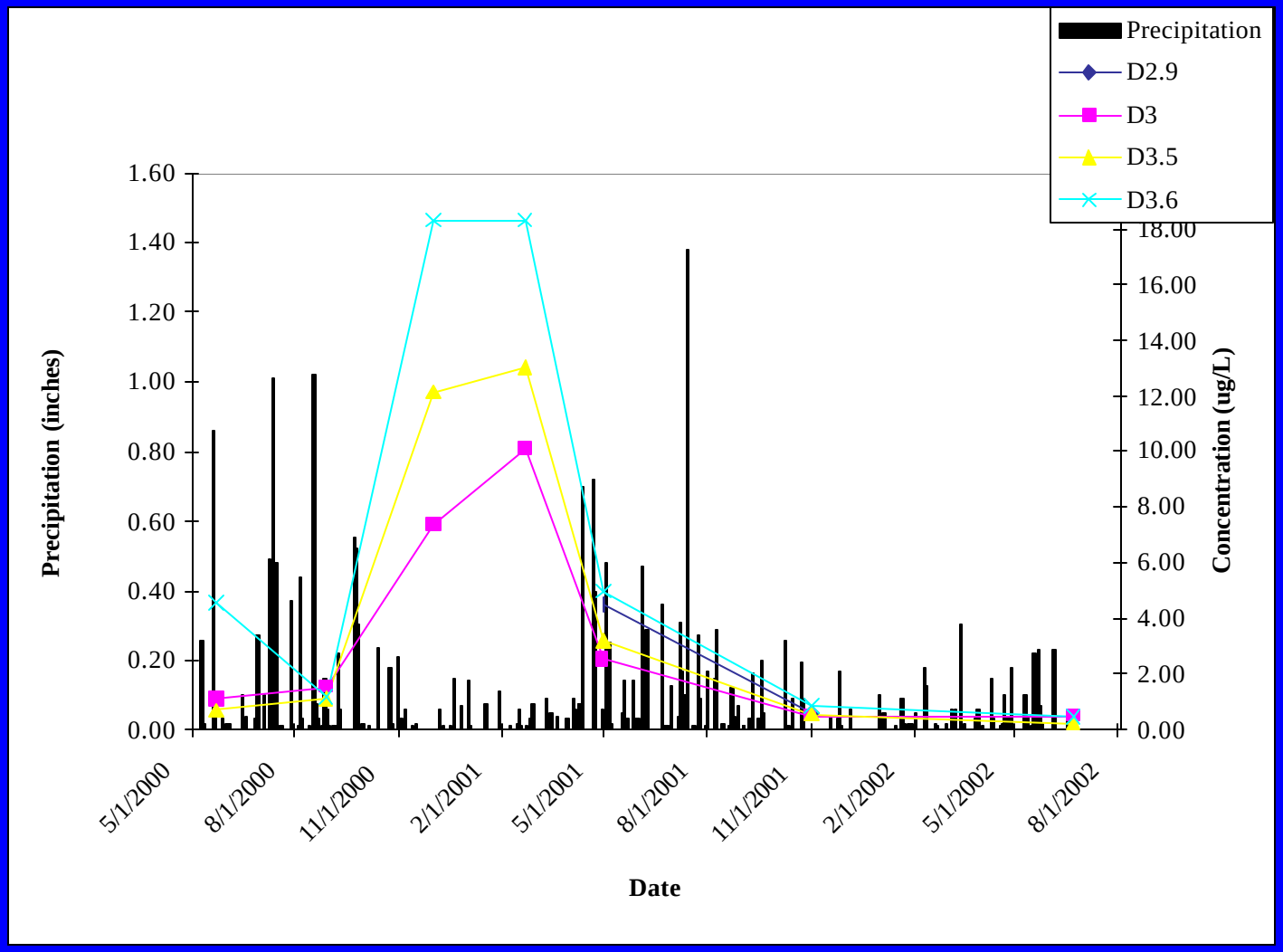
SURFACE WATER LOCATIONS



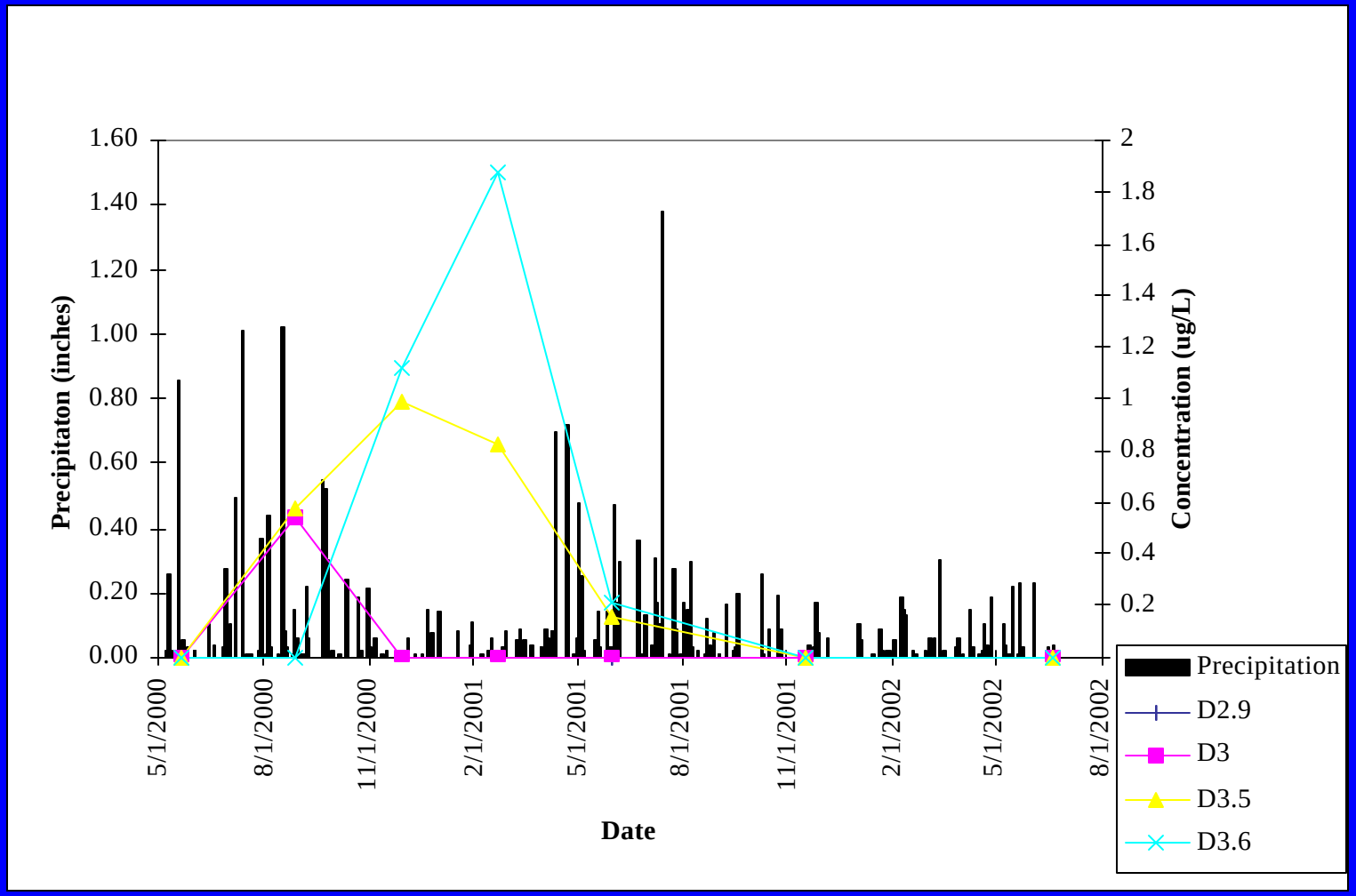
TCE in DC by LOCATION



TCE in DC Over Time vs. PPT



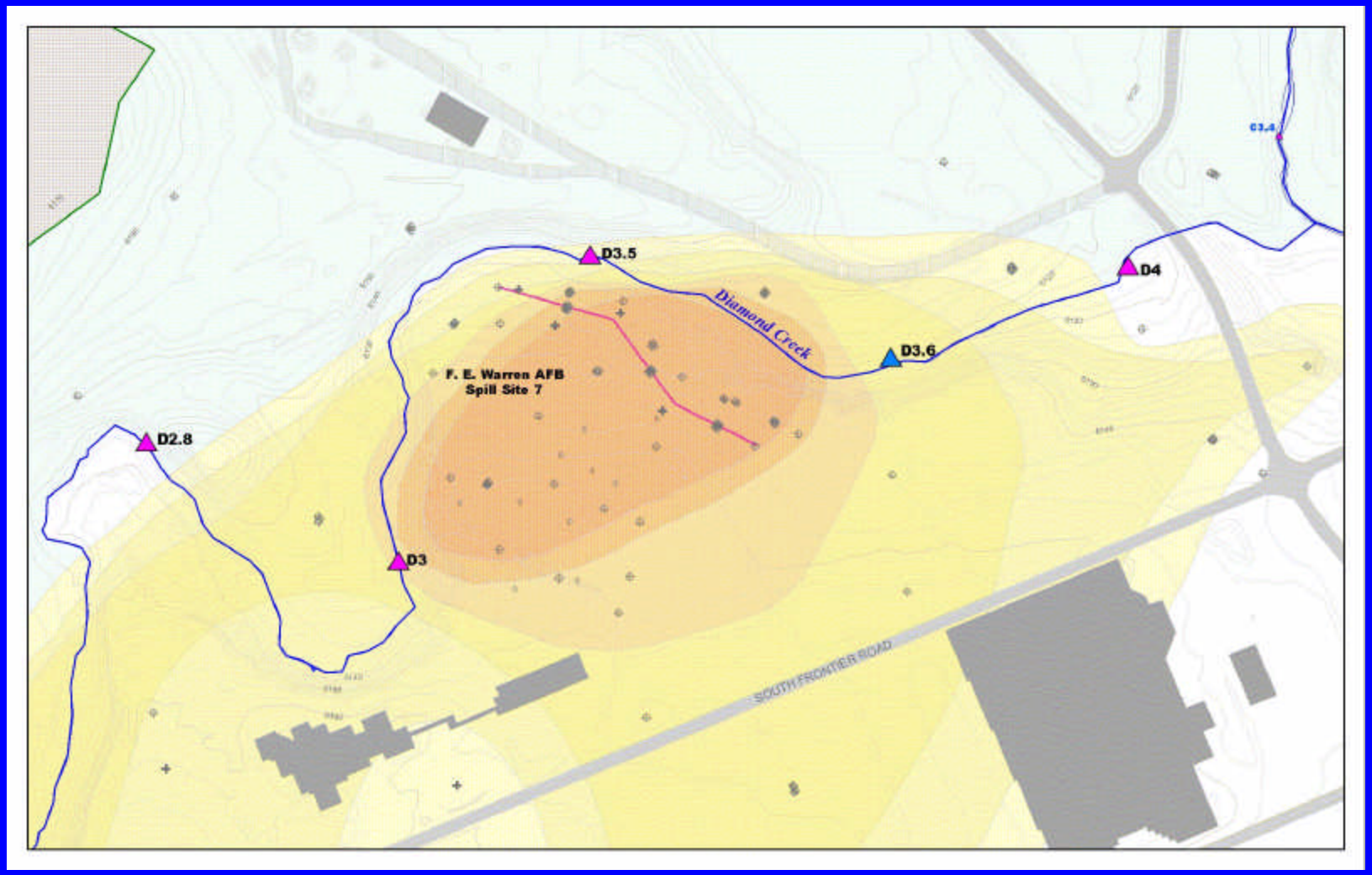
VC in DC Over TIME vs. PPT



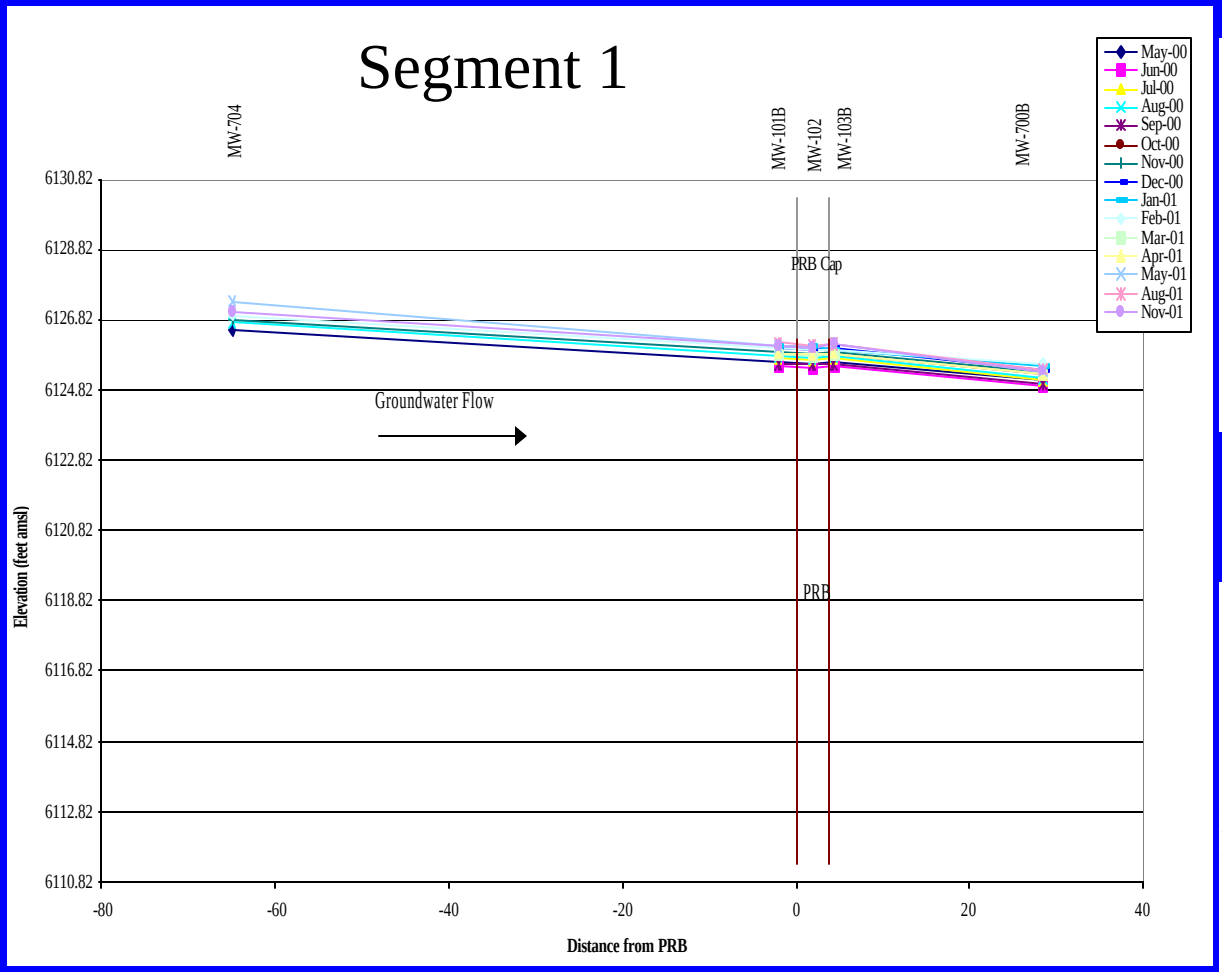
EFFECTS ON GW FLOW PATHS

- Water-level Measurements/Elevations
- Hydraulic Relationships
  - PRB permeability >= than native materials
  - Lateral bypass
  - Underflow and overflow
- Gradients Appear Unaffected by PRB
  - Vertical and Horizontal

SS7 POTENTIOMETRIC MAP



GW Elevation vs. Distance



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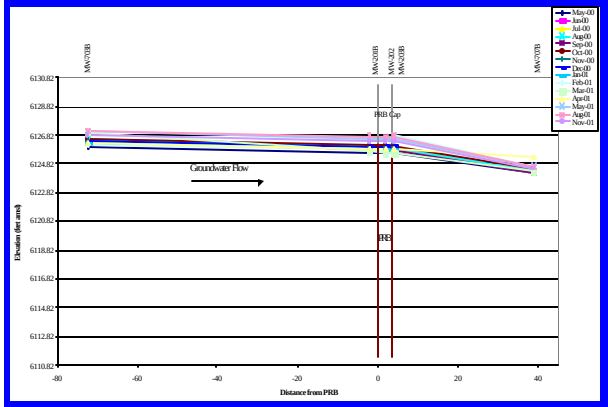

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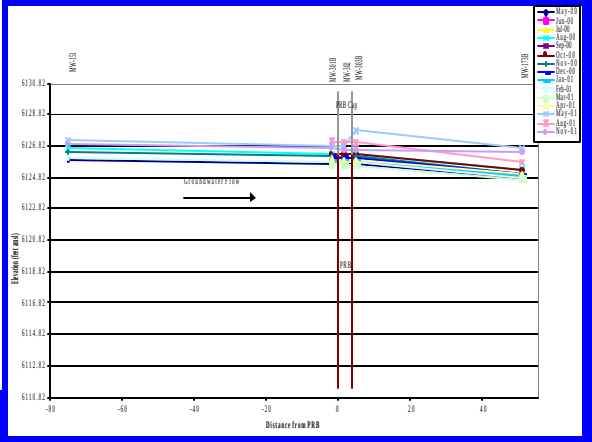


BYPRODUCTS IMPACTING DIAMOND CREEK

- Groundwater and surface water sampling of water quality parameters
  - pH, ORP (Eh), DO, Cond., Metals, Cl, N, SO_4
- Parameters re-stabilize in groundwater downgradient of PRB

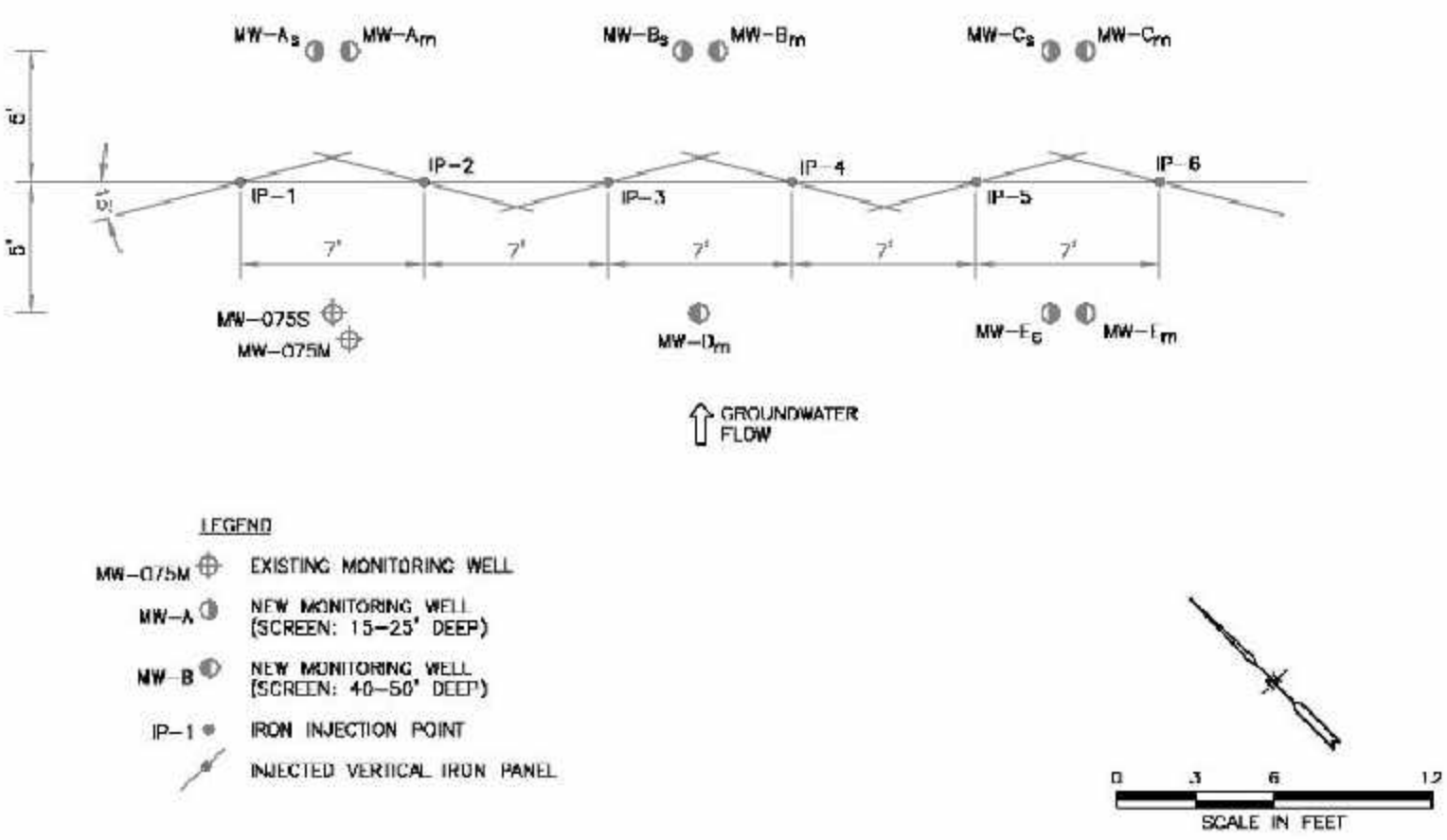
FUTURE

- Continue performance downgradient
- Decreasing trends downgradient (desorption)
- Attention to lateral and deep wells
- COC and byproduct concentrations in creek
- Zone D Groundwater RI/FS
  - Plume dimensions and dynamics
  - Vertical extent defined
  - SS7 IRA incorporated into Final Remedy
  - Treatability Study (supplemental actions)

INJECTED IRON PRB

- Drill to depths of 55 feet +
- high pressure/jet grouting
  - cavity→ quar → iron slurry
- vertical panels ~ 3” wide
- fence row alignment
- monitoring network
- install 5-6 September 2002

ALIGNMENT & MONITORING



SUMMARY OF RESULTS

- COCs below detection limits in wells within and immediately downgradient of PRB
- Concentrations 30 to 50 feet downgradient of PRB show decreasing trends
- VC in MW-186; origin being investigated
- Water quality parameters/inorganics as expected
- No byproducts impacting Diamond Creek

SUMMARY OF RESULTS
(Continued)

- No effects on groundwater flow paths
- TCE/VC in surface water decreasing
- Treatability Study evaluating injected iron
  - extend PRB depth and width
  - applications in Zone D