

**NRC-CMRC**



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# ***In Situ Treatment of Chlorinated Solvents: Design and Monitoring of a 1,1,1- Trichloroethane Treatment System at CFB- Trenton***



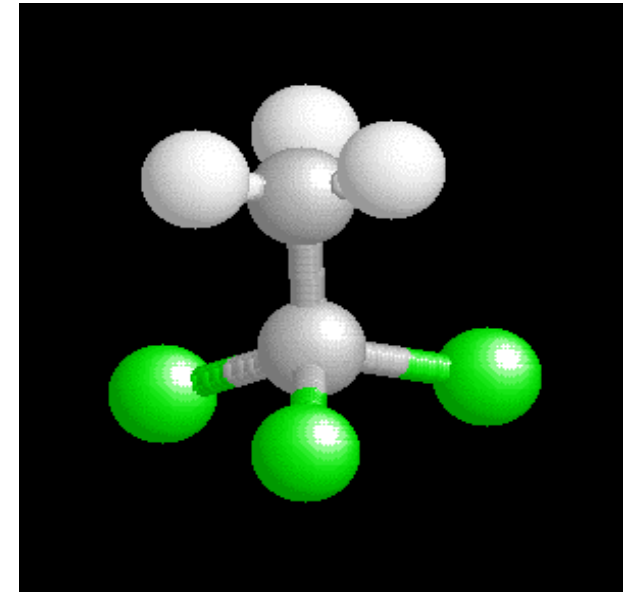
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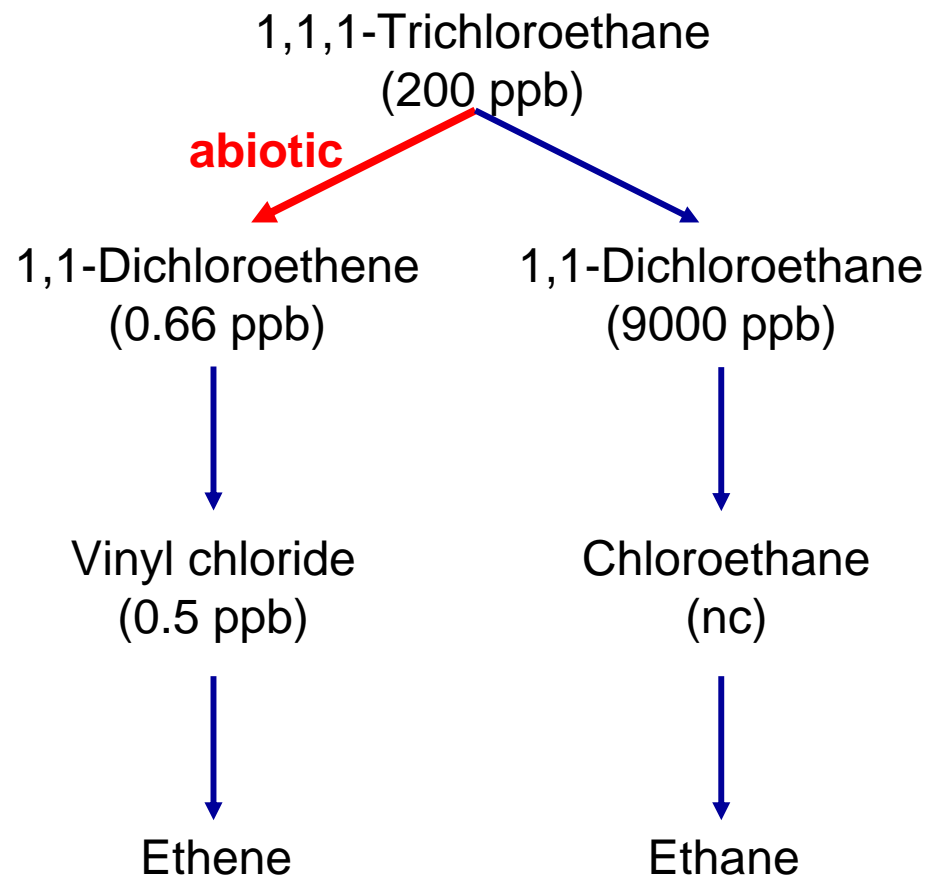
# 1,1,1- Trichloroethane

- Solvent, found in glues and paints
- Damages ozone layer, may affect nervous and circulatory systems
  - Use phased out due to ozone damage
- Not carcinogenic, but some degradation intermediates like 1,1-dichloroethene and vinyl chloride are

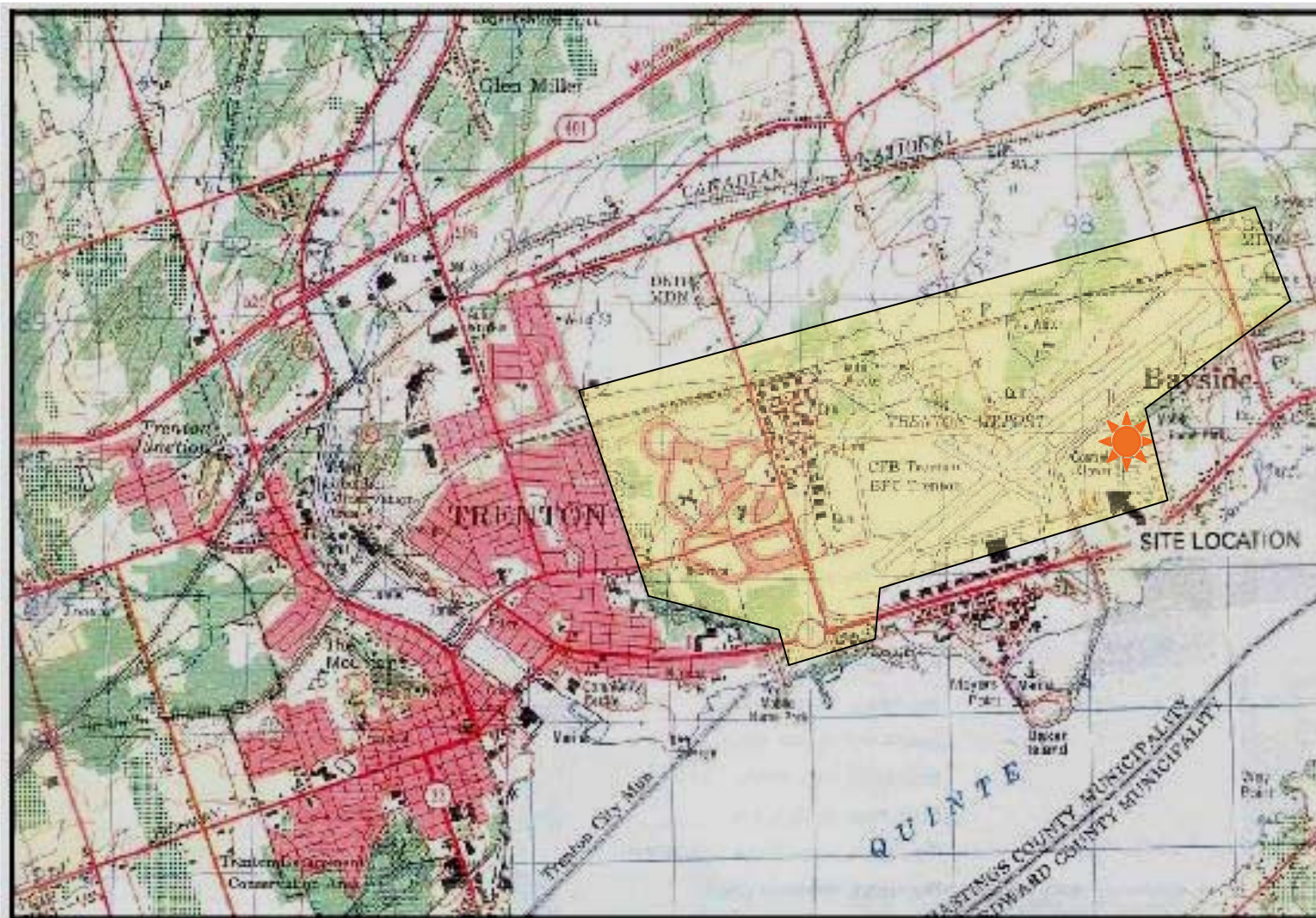


# 1,1,1-TCA Degradation

- Abiotic reduction of 1,1,1-TCA leads to VC
- Biotic reduction leads to ethane
- Several bacterial groups capable of reductive dehalogenation
- Reductive dehalogenators require anoxic, reducing conditions



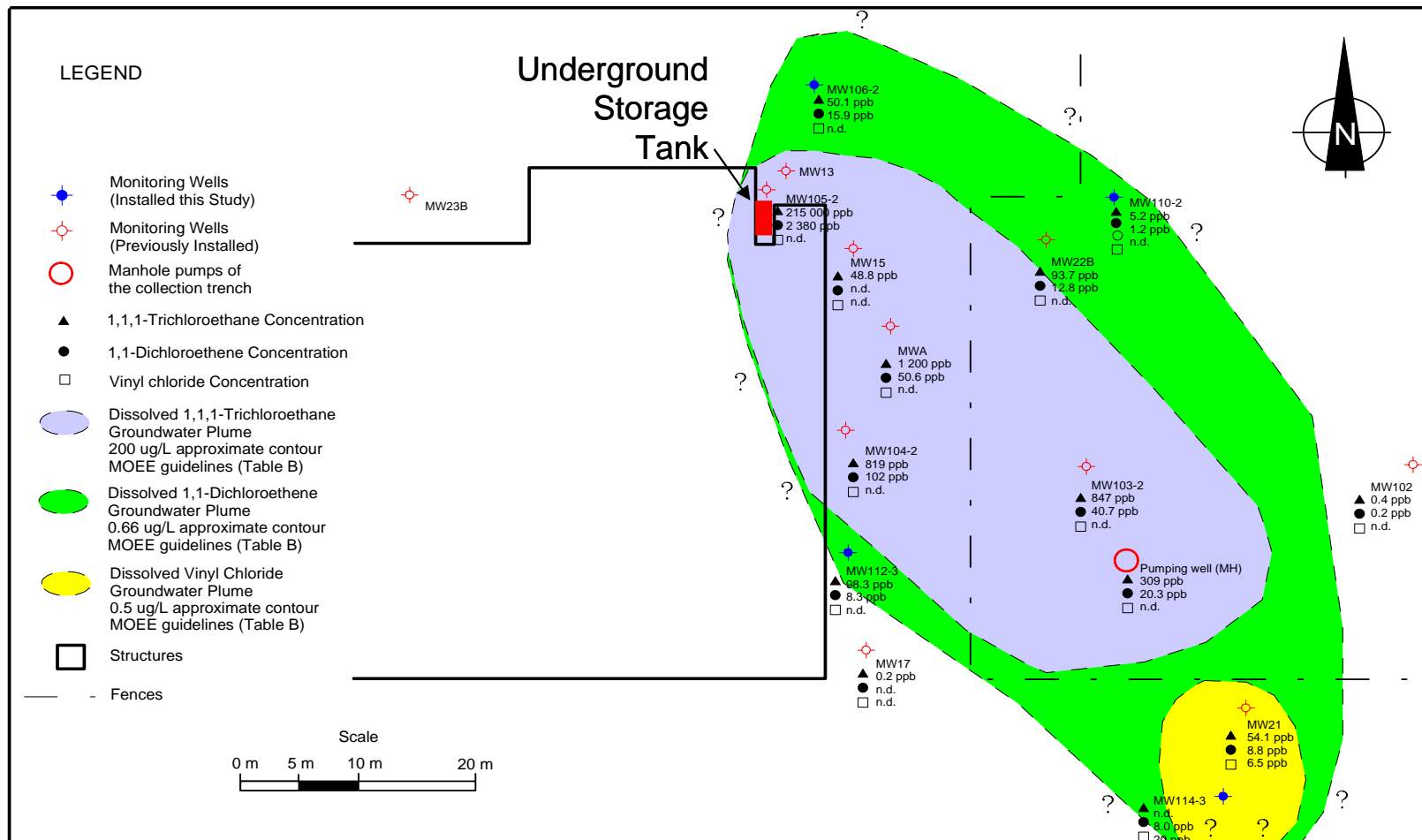
# CFB-Trenton



# **Introduction Building 151**

- **Building 151**
  - Active mechanical shop
  - 2,400 L Underground Storage Tank (UST) removed in 1995 due to a leak
  - Used to store chlorinated solvents
  - Monitoring wells installed to delineate the plume, samples taken for lab scale optimization

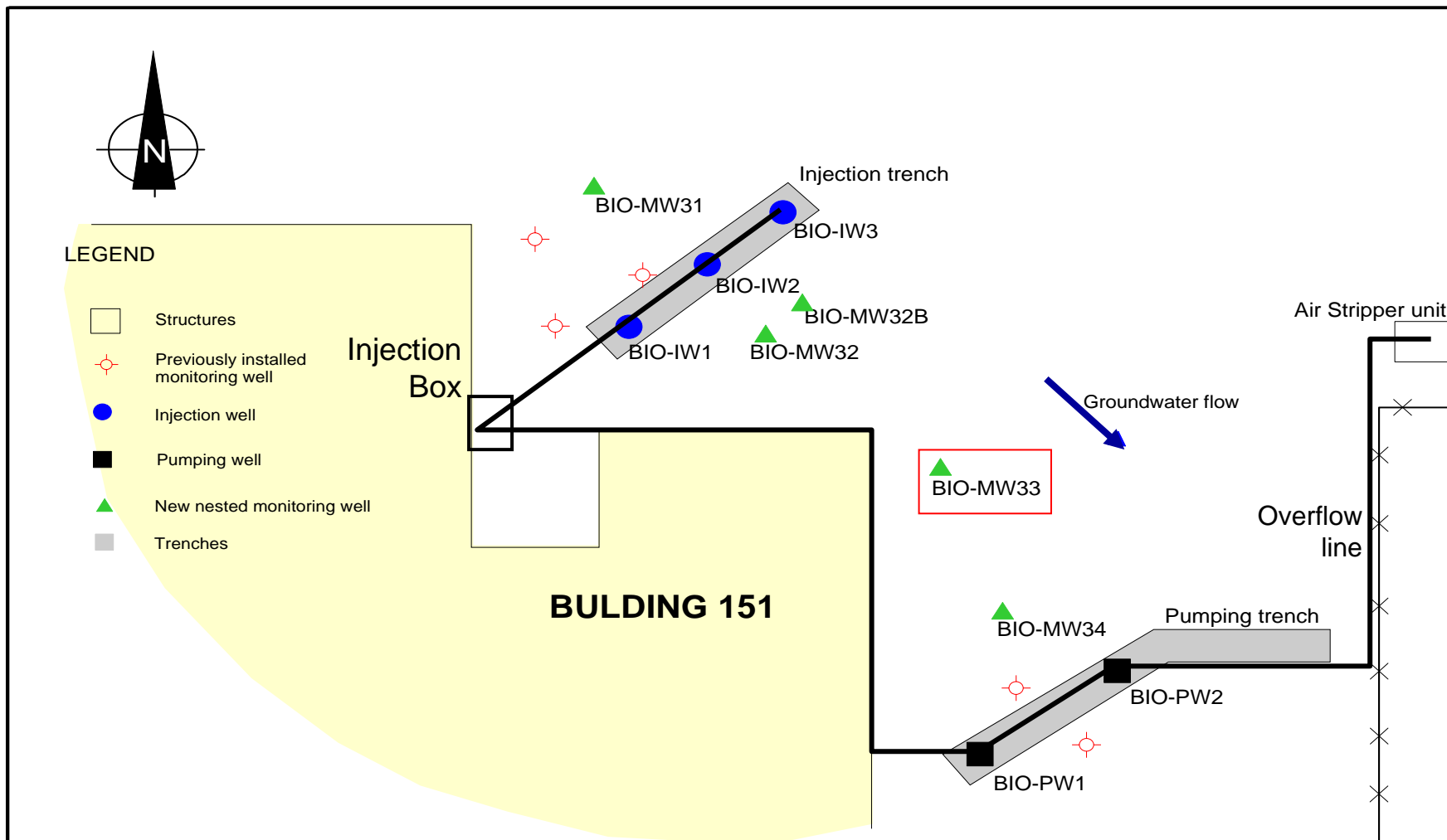
# Building 151



# ***Biostimulation Optimization***

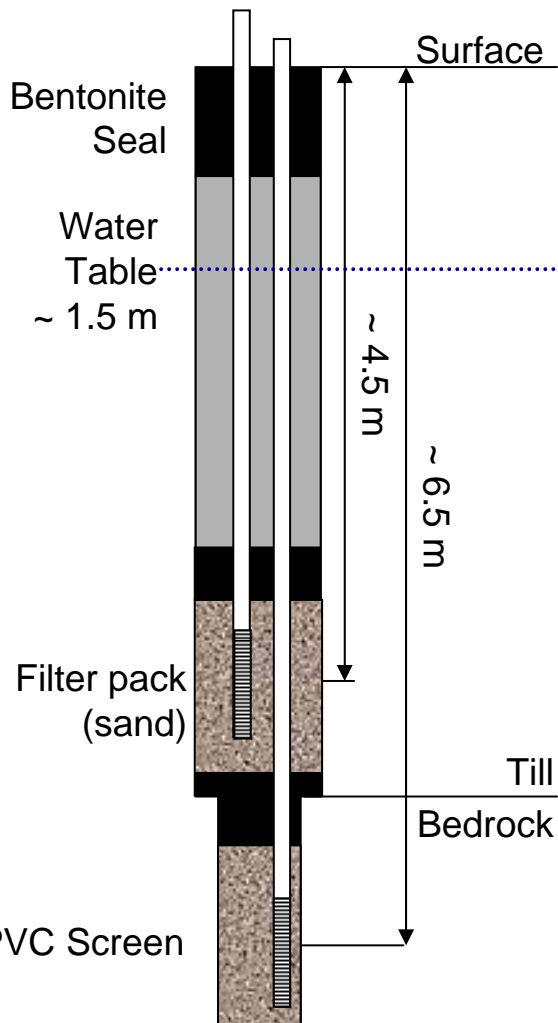
- **Biostimulation lab assays performed to determine optimal conditions**
  - Molasses and nutrient amendments to reduce  $O_2$  concentration and create reducing conditions
  - Effective degradation of 1,1,1-TCA
- **Design of a pilot scale treatment system**
  - Pulsed amendment addition to prevent clogging
  - System stopped several times - latest re-start September 2004
  - 1,1,1-TCA levels rose after each stoppage, dropped once system re-started

# Installed Biotreatment System

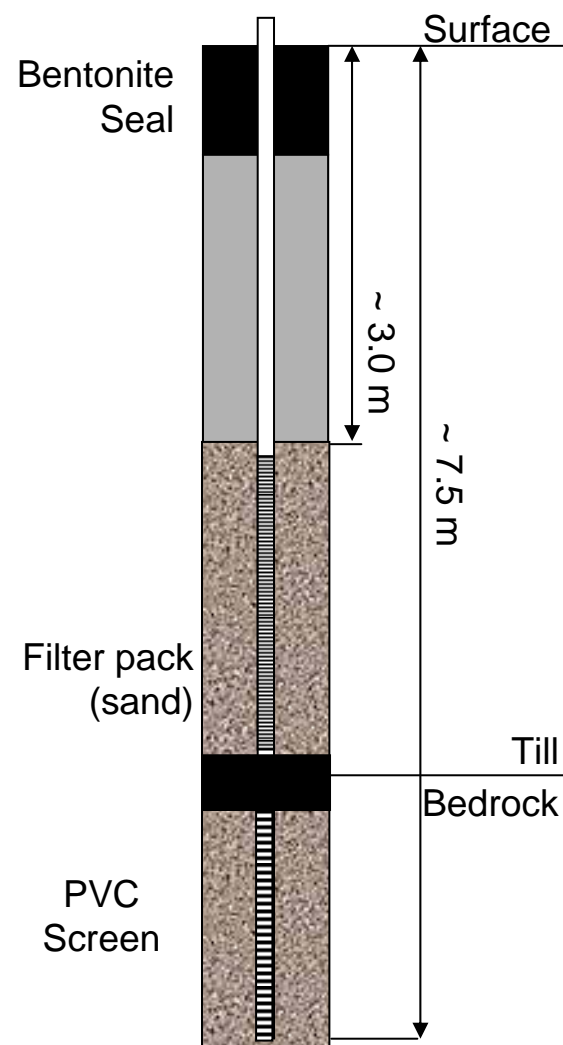




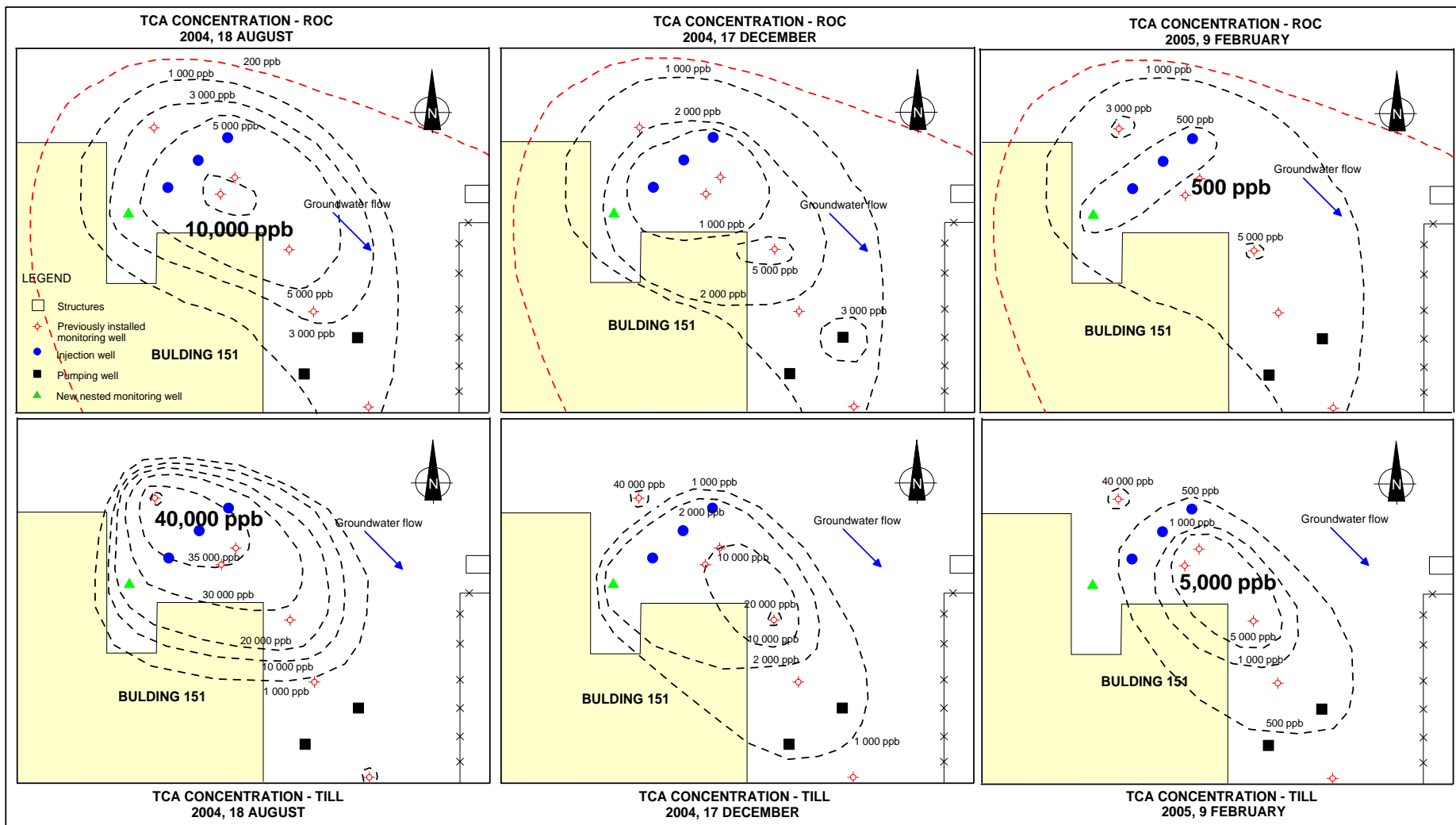
# Injection & Monitoring Wells



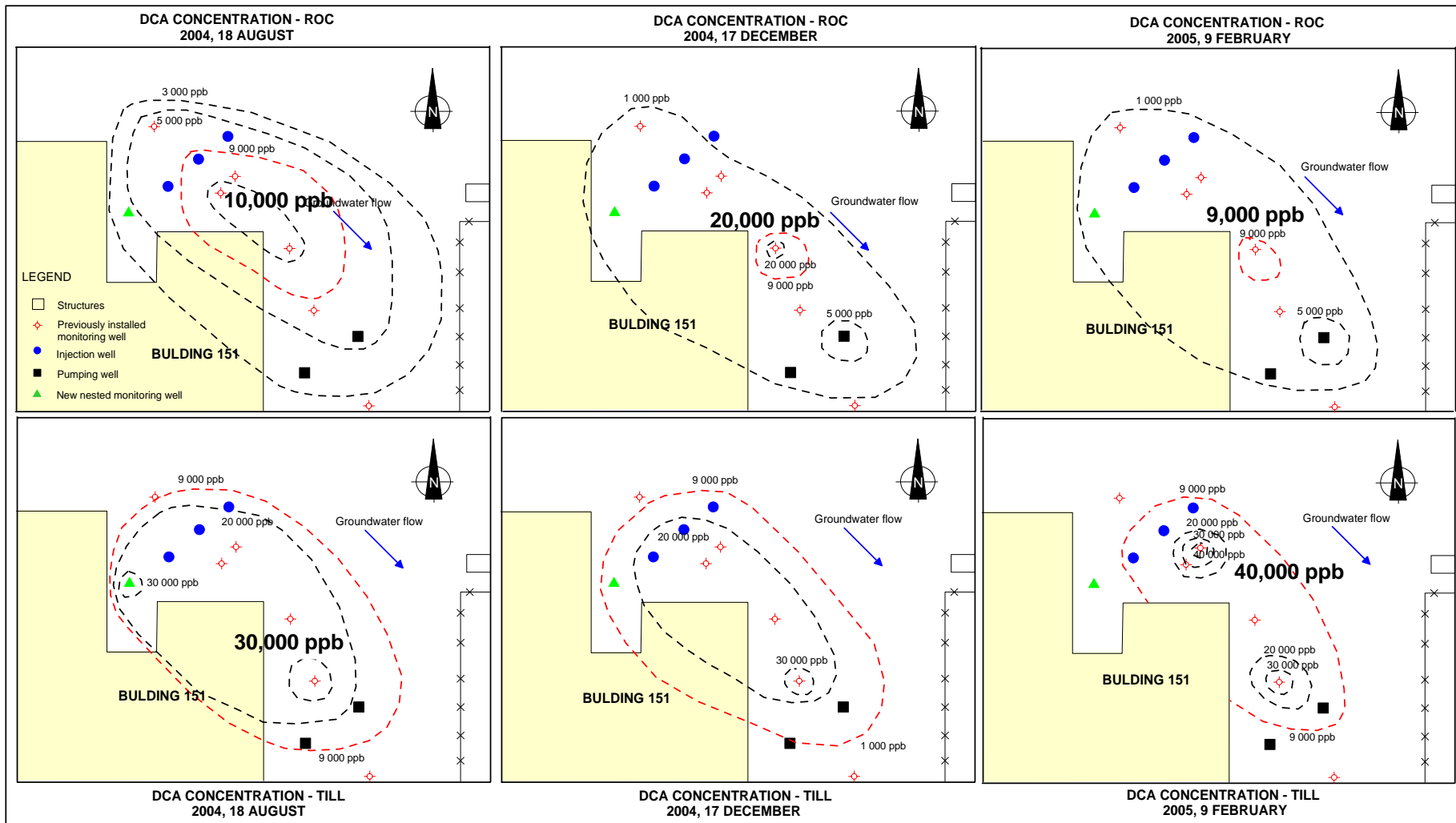
# Pumping Wells & Air Stripper



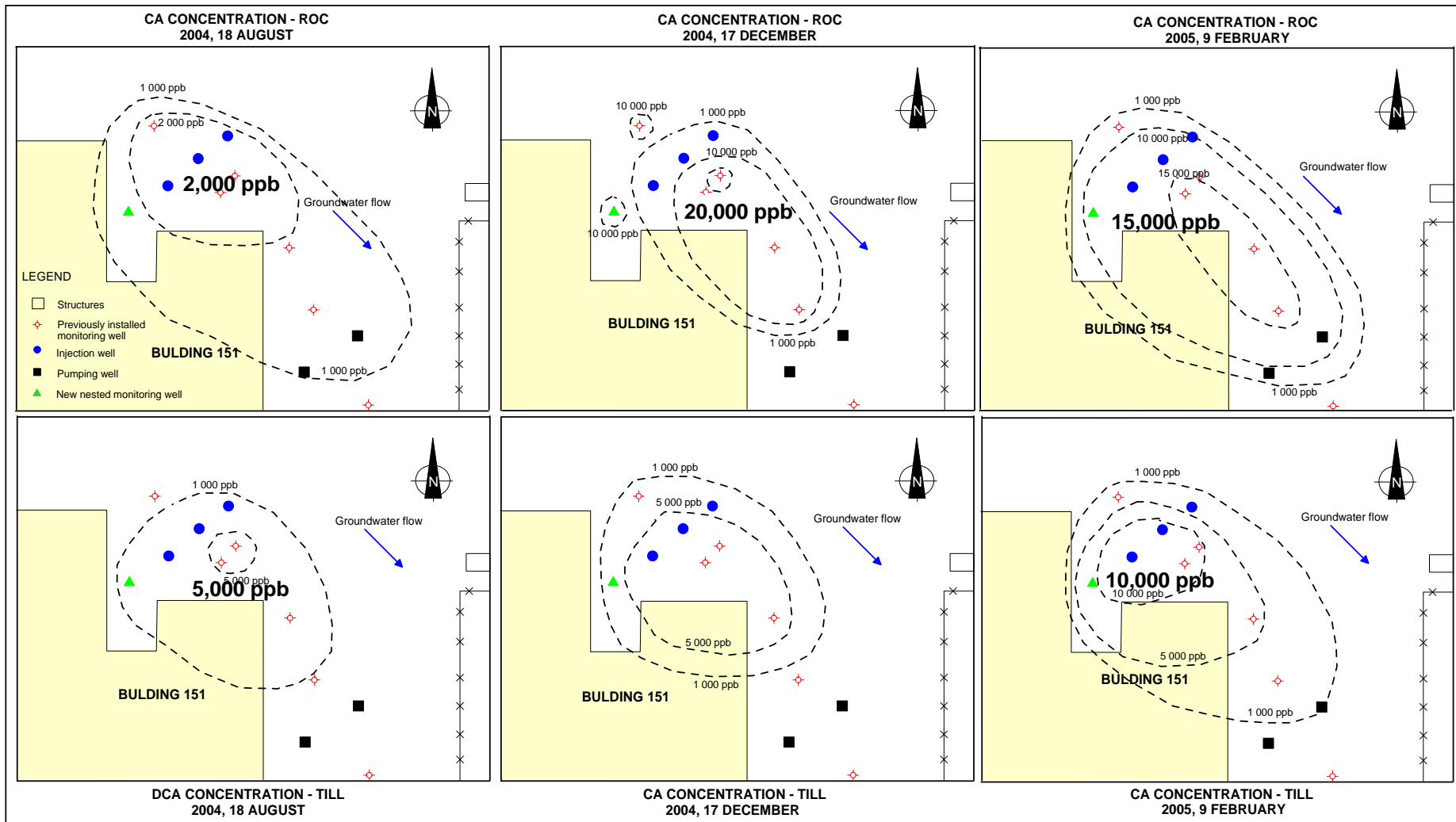
# 1,1,1-Trichloroethane



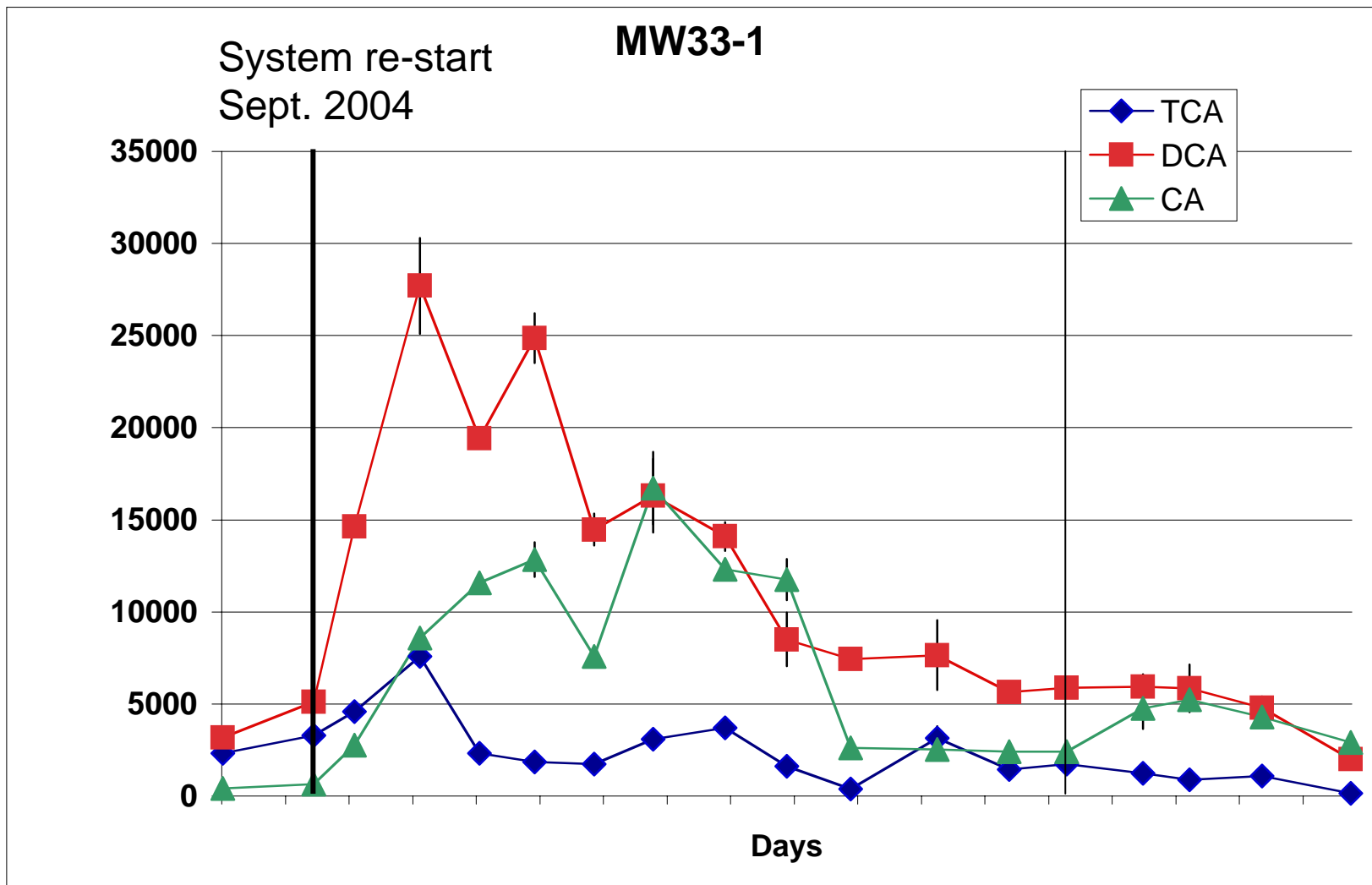
# 1,1-Dichloroethane



# Chloroethane



# 1,1,1-TCA & Intermediates

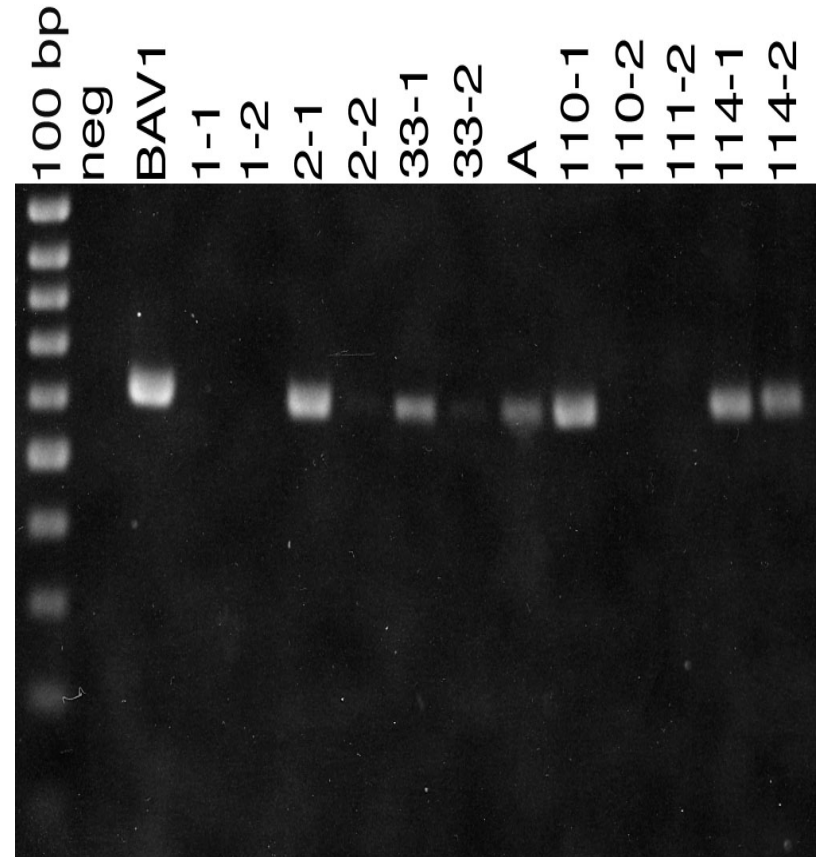


## ***Till vs. Bedrock***

- **Bedrock layer more permeable**
  - Greater penetration and impact of nutrient amendment
    - 1,1,1-TCA disappearance, transient intermediates
  - 1,1,1-TCA concentrations remain higher longer in till layer
    - Requires more fractionation for improved removal
  - Currently exploring techniques to increase the porosity of the till

# Presence of Dehalogenators

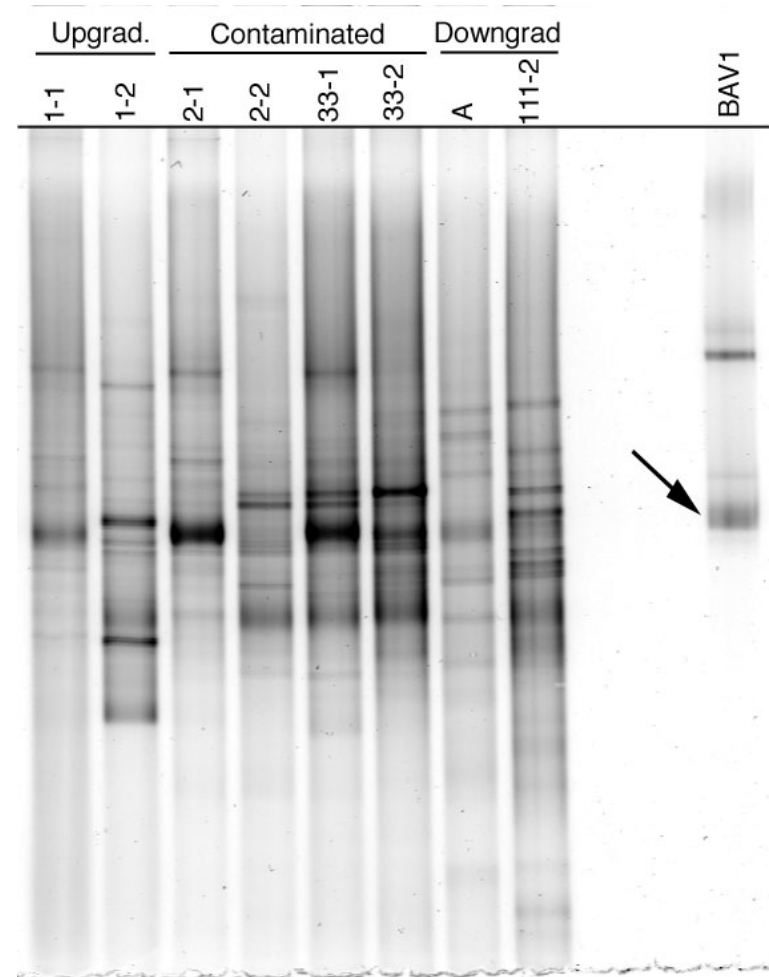
- Using molecular techniques (PCR):
  - Known dehalogenators present in the contamination plume (*Dehalococcoides*, *Dehalobacter*, *Desulfuromonas*) but not upgradient of the plume
  - Lower numbers/absent in till layer



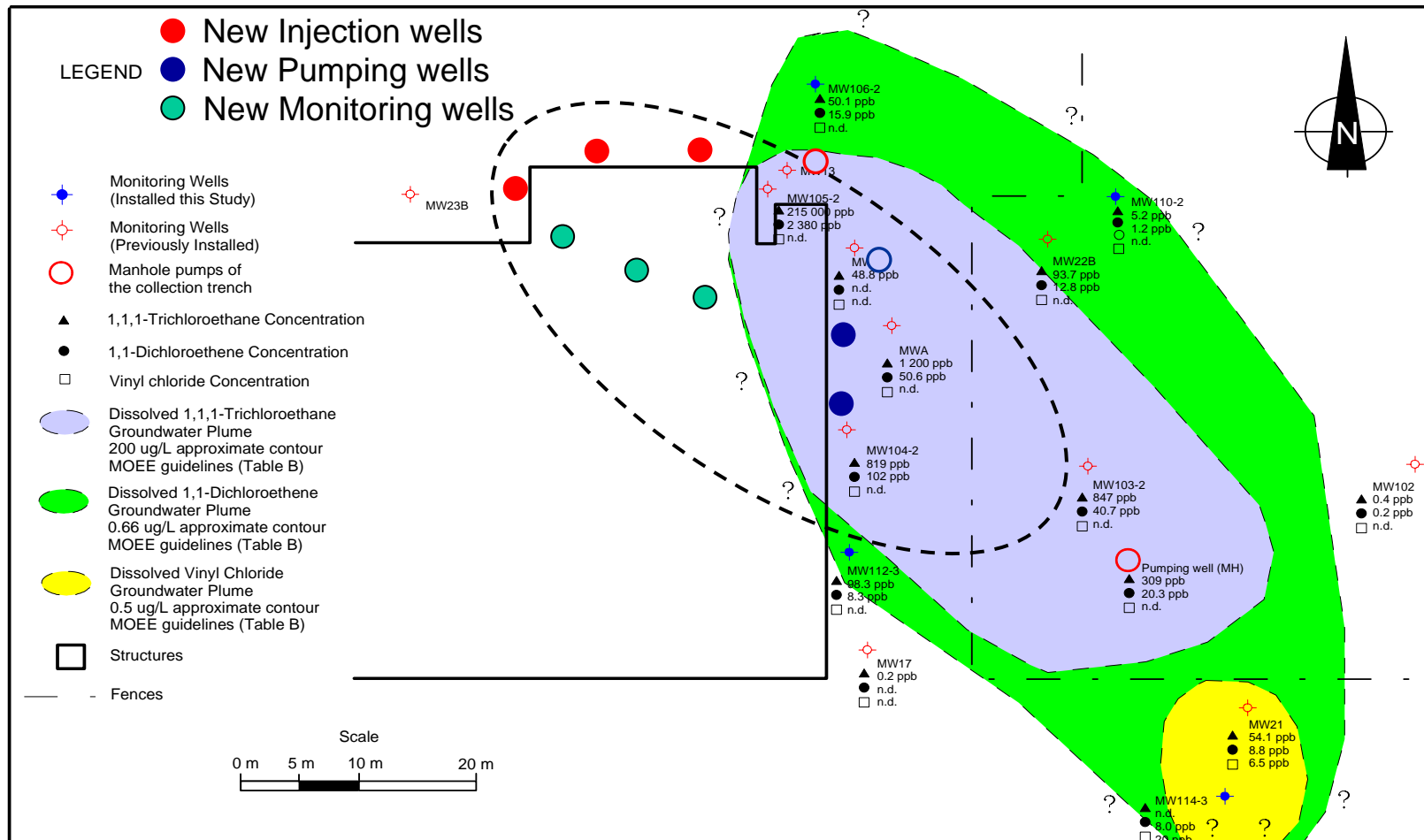


# Bacterial Diversity

- Bacterial diversity not significantly impacted
  - Either by 1,1,1-TCA or treatment system
- Dynamic system
  - Diversity profiles shifting
  - Possibly due to seasonal changes, release of 1,1,1-TCA from adsorbed substrates



# Expanded Treatment System



# Summary

- Design and implementation of an effective 1,1,1-TCA treatment system
  - Significant reduction in 1,1,1-TCA concentration
  - Treating source in situ
  - Pulsed amendment addition
  - Biostimulation of indigenous bacteria by the creation of favourable environmental conditions
    - Anerobic, reducing conditions
  - Significantly reduced abiotic degradation intermediates
    - 1,1-DCE & VC

# ***Acknowledgments***

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- Megan Hendry

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- Emmanuel Saydeh

## **Terrapex**

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**BRi** Biotechnology  
Research  
Institute

**IRB** Institut de  
recherche en  
biotechnologie

 **TERRAPEX**  
Environnement Ltée

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