

# Enhanced Monitored Natural Attenuation

Free-Phase to Non-Detect  
under an Active Dry Cleaning  
Facility



# Introduction

- Regeneration
- Contaminant distribution onsite
- Targeted remediation
- Enhanced Reductive Dechlorination
- Application Photos
- Results
- Conclusion

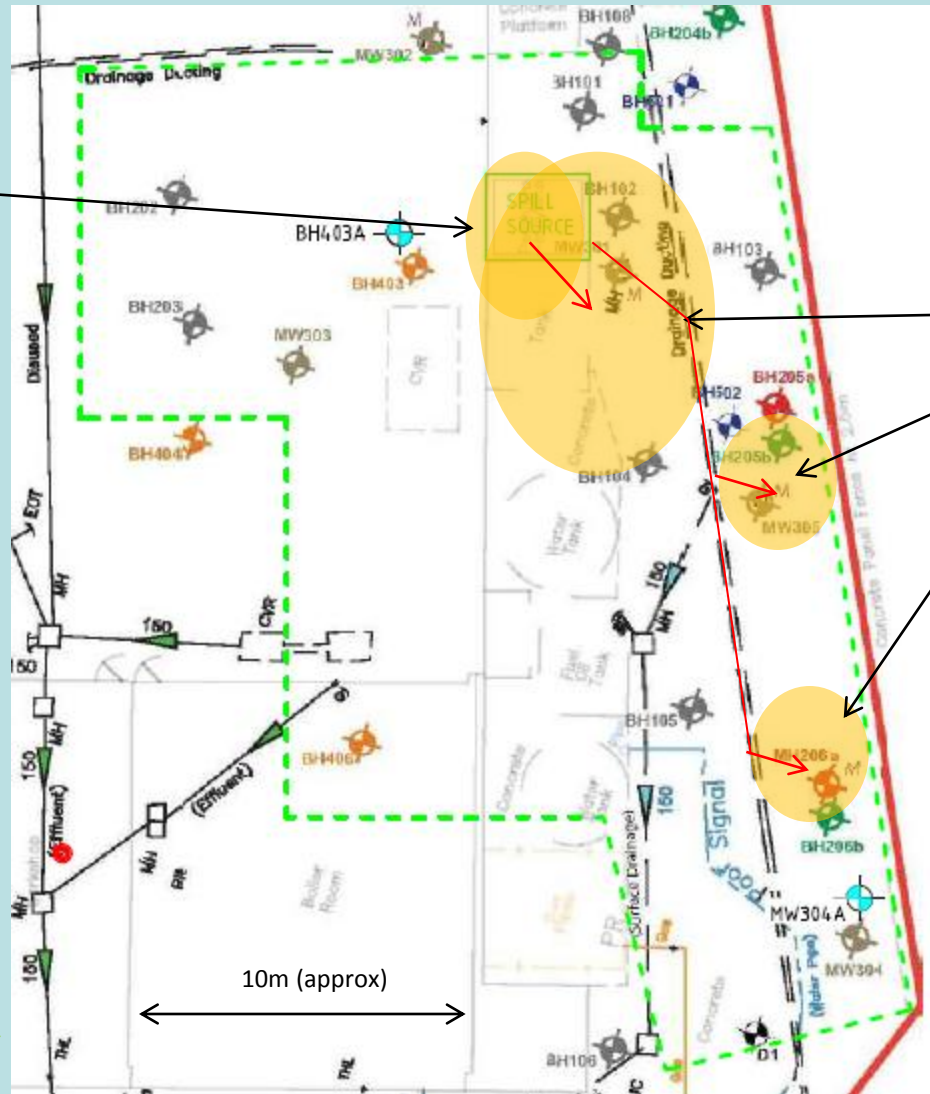
# Contaminant Distribution

Source / spill Area

Groundwater flow

Extremely high concentrations / DNAPL

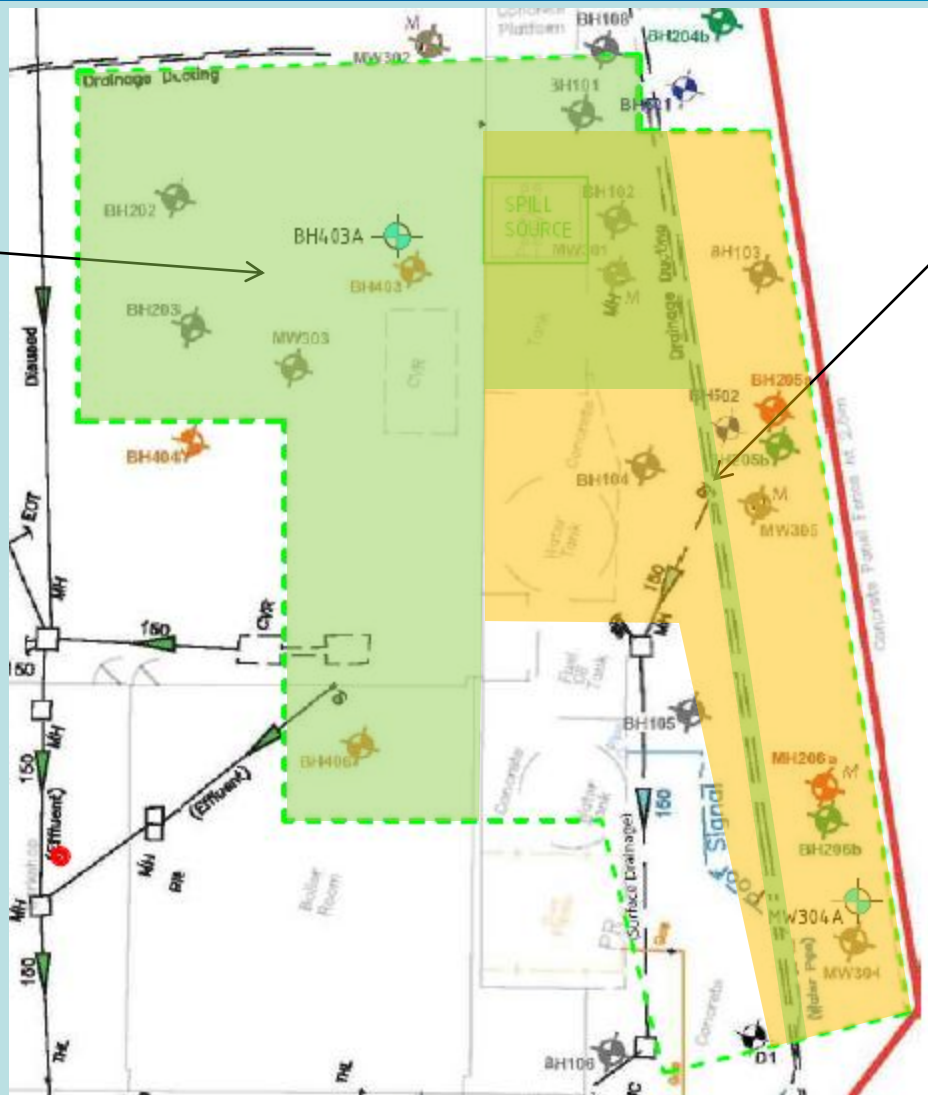
Surface gradient



# Contaminant Distribution

Lower concentration plume

- Mostly few hundred  $\mu\text{g/L}$  to  $16\text{mg/L}$
- Shallow
- Perched groundwater
- Highly permeable made ground



Highly impacted zone

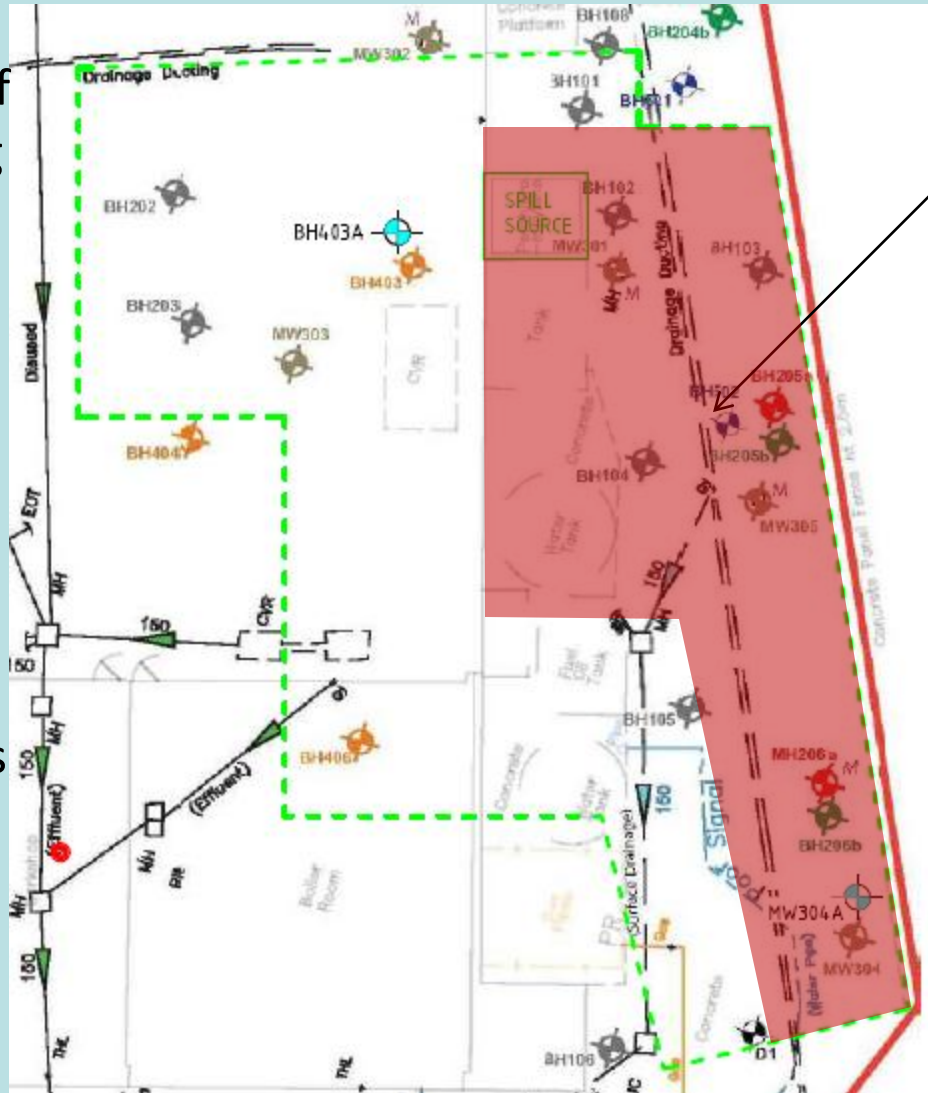
- Up to  $150\text{mg/L}$  PCE
- Deep ( $10\text{mBGL}$ )
- Groundwater DNAPL
- Low permeability natural formation

# Remediation Solution - Clays

Lack of evidence of naturally occurring reductive dechlorination

Lead to development of excavation strategy

- Very expensive
- H&S issues
- Structural issues
- Disruptive
- Did not address contam under building



Alternative *in situ* solution;  
Single injection of;

- HRC
- HRC Primer
- HRC X

Stimulates Enhanced Reductive Dechlorination

- Low vol. for low permeability
- 3m x 3m grid
- 32 direct push injection points
- 2-3mBGL to 9-11mBGL



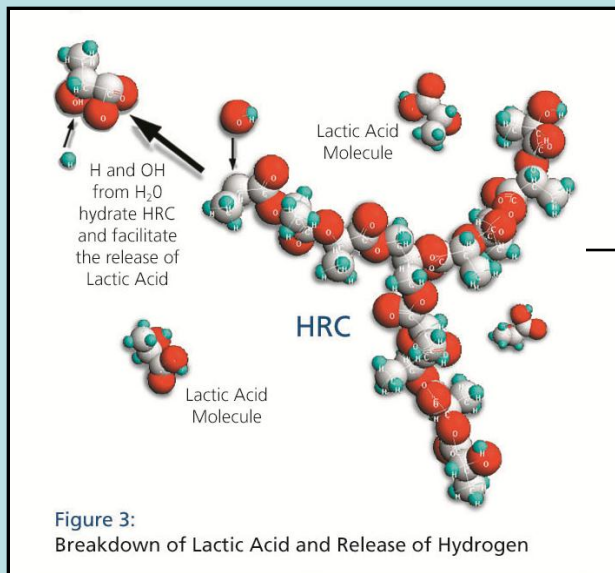
# Hydrogen Release Compound



- Created in 1998 and now used on >4,000 sites worldwide
- Designed specifically for the *in situ* remediation of CHC's
- Stimulates and maintains Enhanced Reductive Dechlorination for approx. 18 months

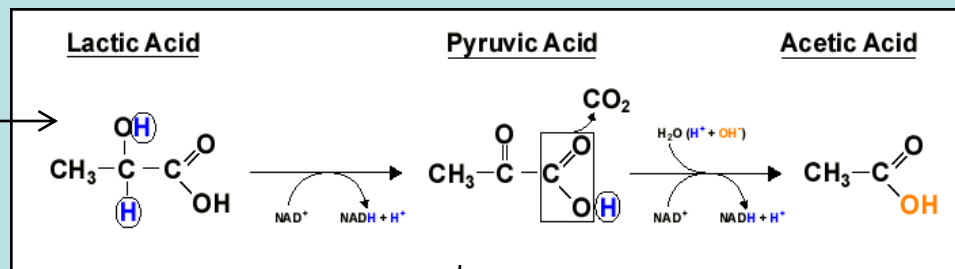


# Hydrogen Release Compound

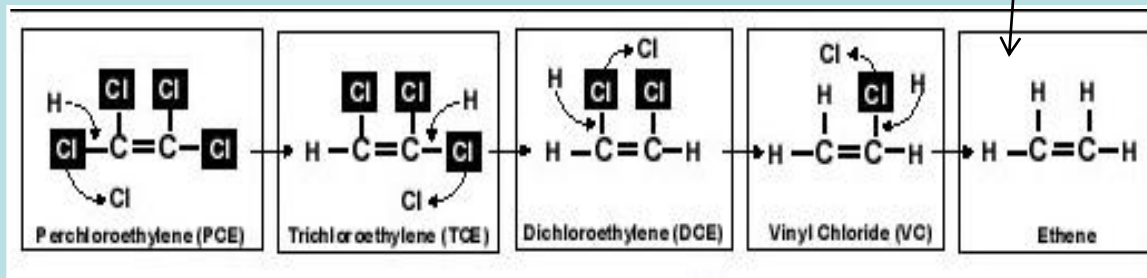


## Dissolution

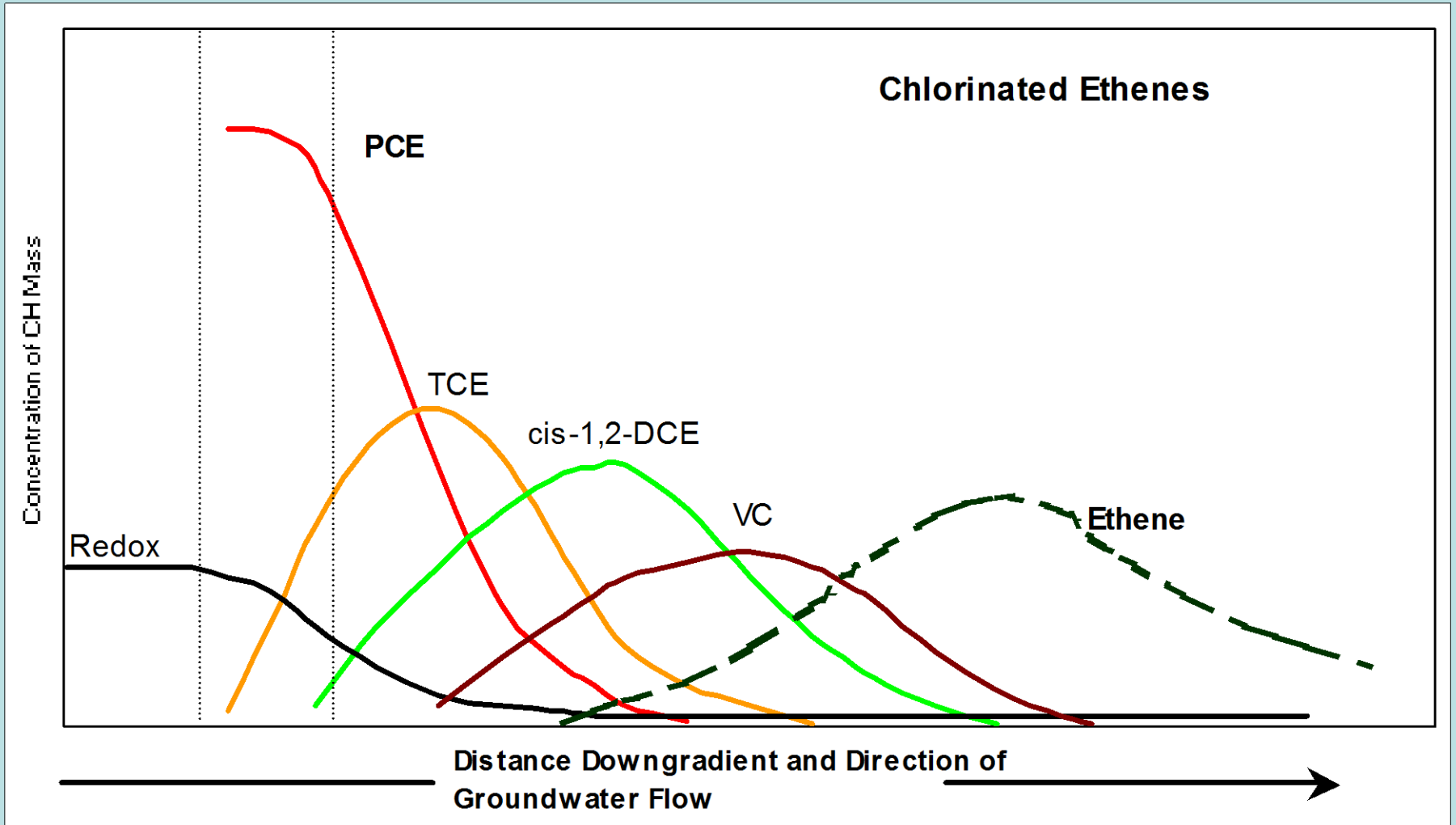
## Fermentation



## Enhanced Reductive Dechlorination



# Reductive Dechlorination



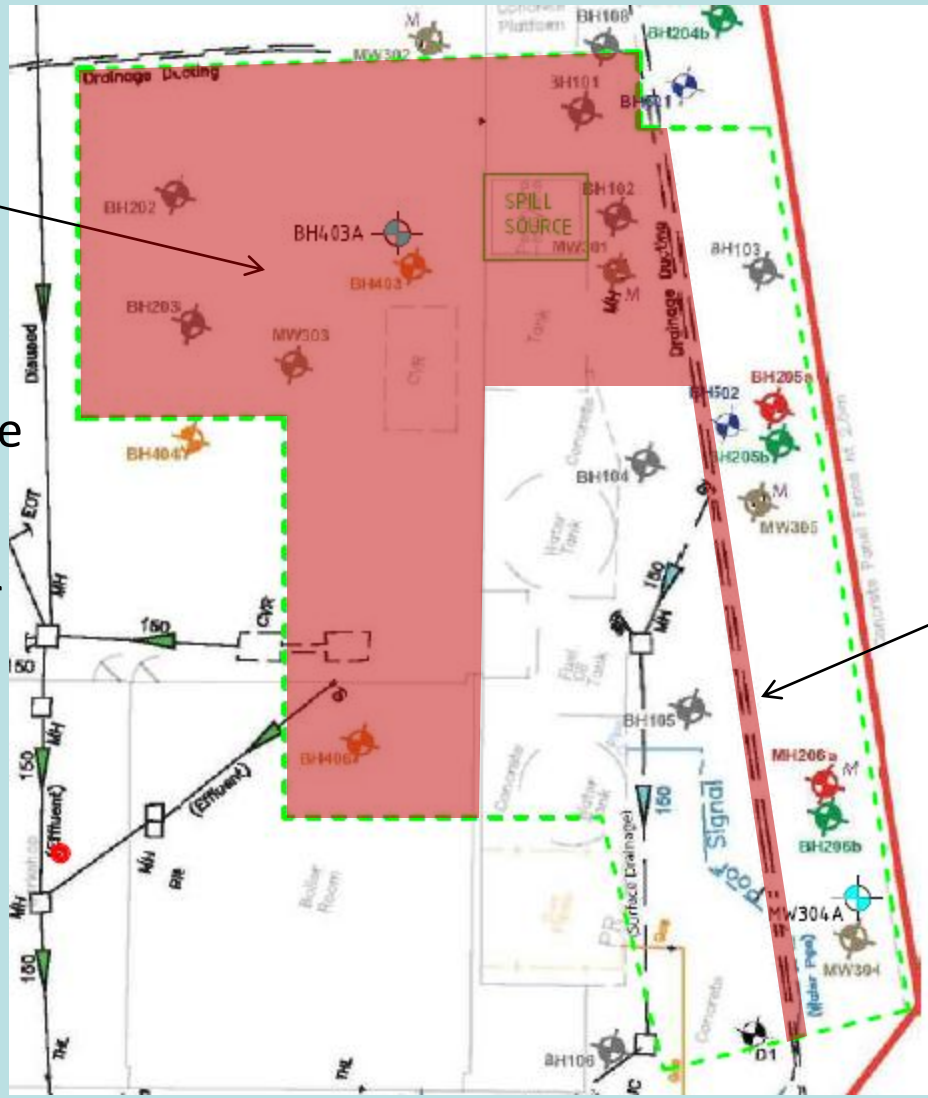


# Remediation Solution – Made Ground

Targeted with a single injection of 3D Microemulsion

Stimulates Enhanced Reductive Dechlorination

- High volume for high perm.
- Minimises No. of injection points
- 5m by 5m grid
- 22 injection points

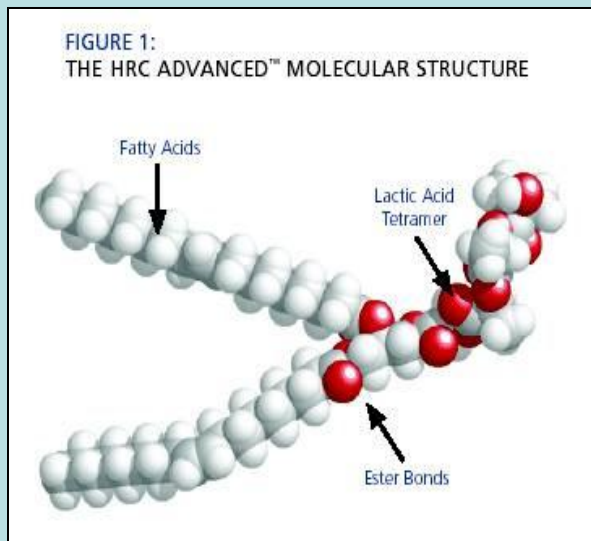


Internal work done in evening and at the weekend

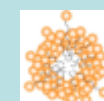
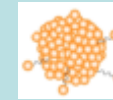
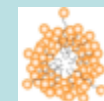
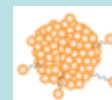
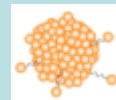
- Drain bunged
- 3 injection points
- Drain bedding

# 3D Microemulsion

**3-D MicroEmulsion™**  
HRC ADVANCED®



- High volume version of HRC
- 3 stage electron donor production
  - 3, 18 and 48 month controlled release
- Polar and non-polar ends
  - Micelles 0.01-0.05 $\mu$ m
  - No emulsifiers
- Appropriate HLB
- Self distribution *in situ*
- Very wide radius of influence

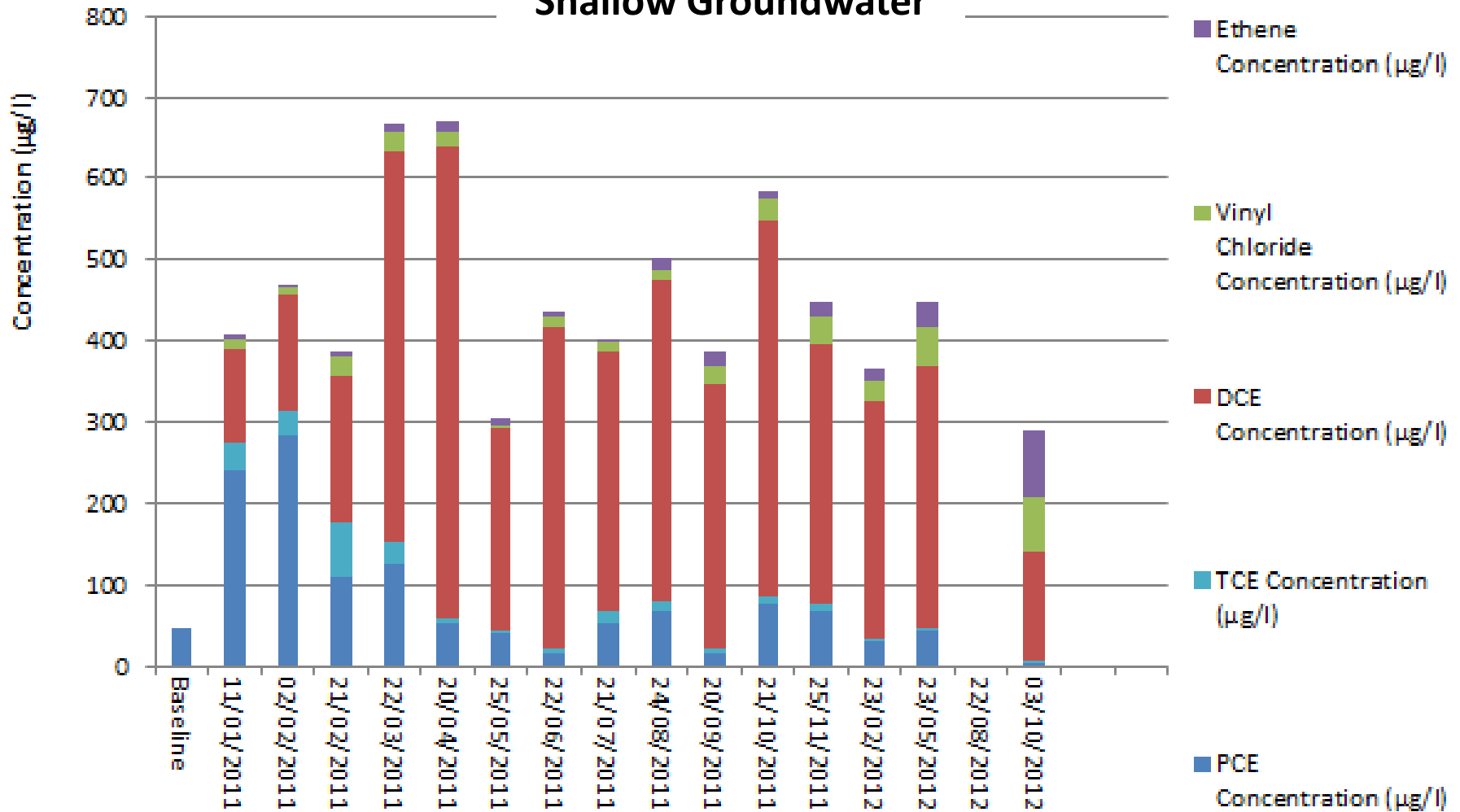


# Application



# Results

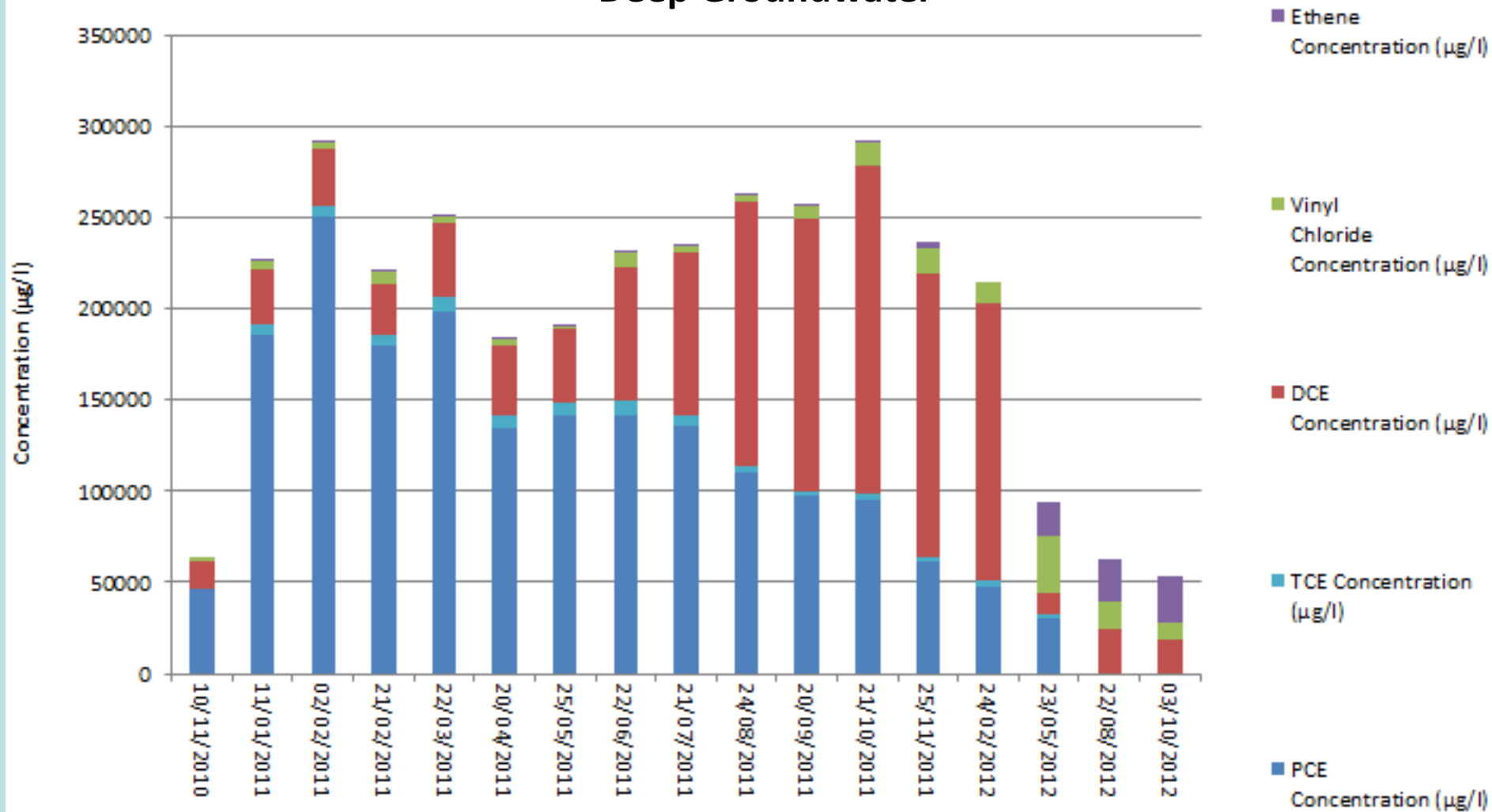
## Shallow Groundwater





# Results

## Deep Groundwater





# Conclusions

- *In situ* remediation of the site was successful despite the challenges of;
  - high concentrations / presence of DNAPL
  - active property
  - variable permeability
  - little evidence of reductive dechlorination prior to treatment
- *In situ* remediation was made possible by;
  - a quality sampling regime
  - allowed accurate remedial design
    - spatially – good lateral and vertical delineation
    - dose – confidence in results (full range of MNA parameters)
  - consistent/trustworthy validation data
- *Avoided very expensive excavation works*
- *Avoided disruption to client's business*
- *Gained regulatory sign off*

Thank you for listening!

**Gareth Leonard**  
Managing Director  
Regenesis  
01833 630 411  
gleonard@regenesisis.com

**George Flower**  
Geo-Environmental  
Technical Director  
Hyder  
0117 3721326  
george.flower@hyderconsulting.com



## Any Questions?

**Gareth Leonard**  
Managing Director  
Regenesis

01833 630 411  
gleonard@regenesisis.com



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