Enhanced Monitored Natural Attenuation

Free-Phase to Non-Detect in 540 Days

Introduction

- Problem definition
- Site Conceptual Model
- Nature of Contaminant - PCE
- Risk Assessment “Choices”
- Enhanced Natural Attenuation
- Micro-Purge Pneumatic Bladder
- Good Sampling; Simple, right ?
- Lessons in DNAPL Source Zones

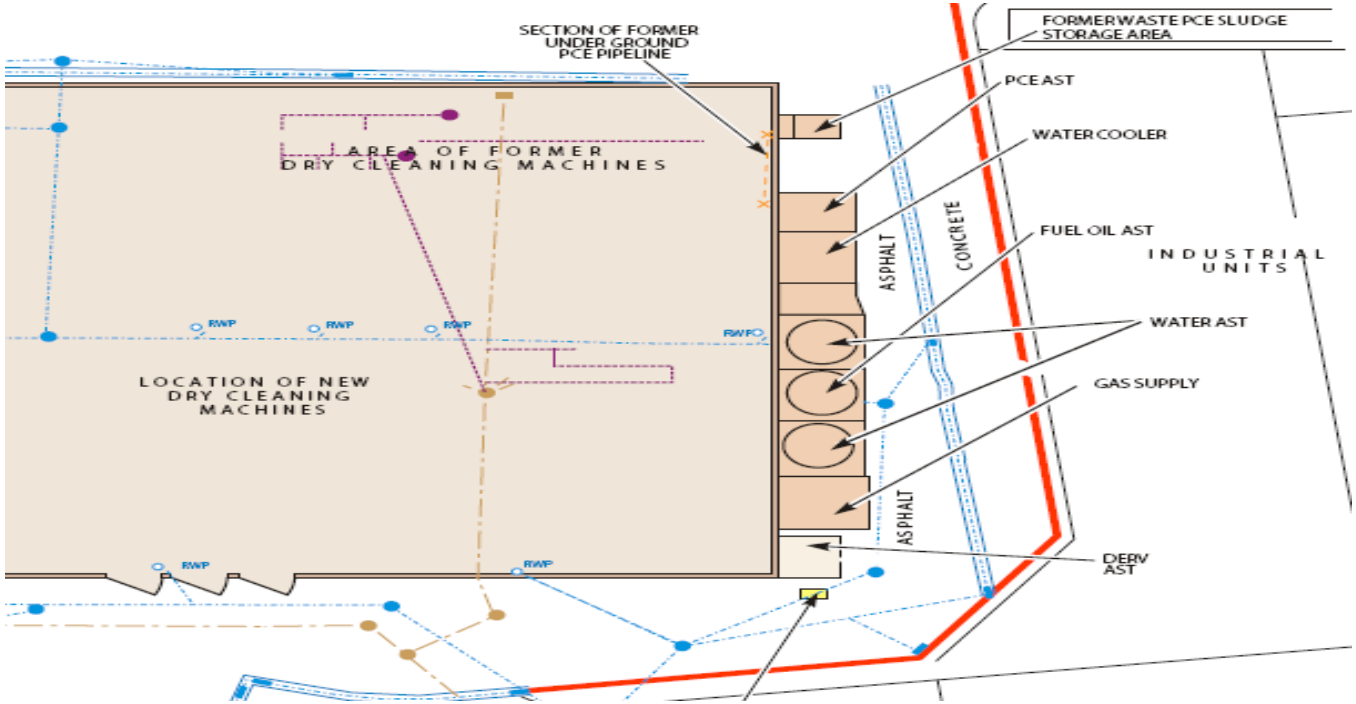
- *The HRC Application -Handover to Regenesis*

Dry Cleaning Facility

PCE Contamination – Tanker Delivery spill, 20 years ago

Estimated 2 Tonnes remaining in the ground

Clear evidence of residual DNAPL



Risk Assessment – The Problem

Migration off site was slow, but was ongoing

Degradation of the PCE was occurring, but very slowly

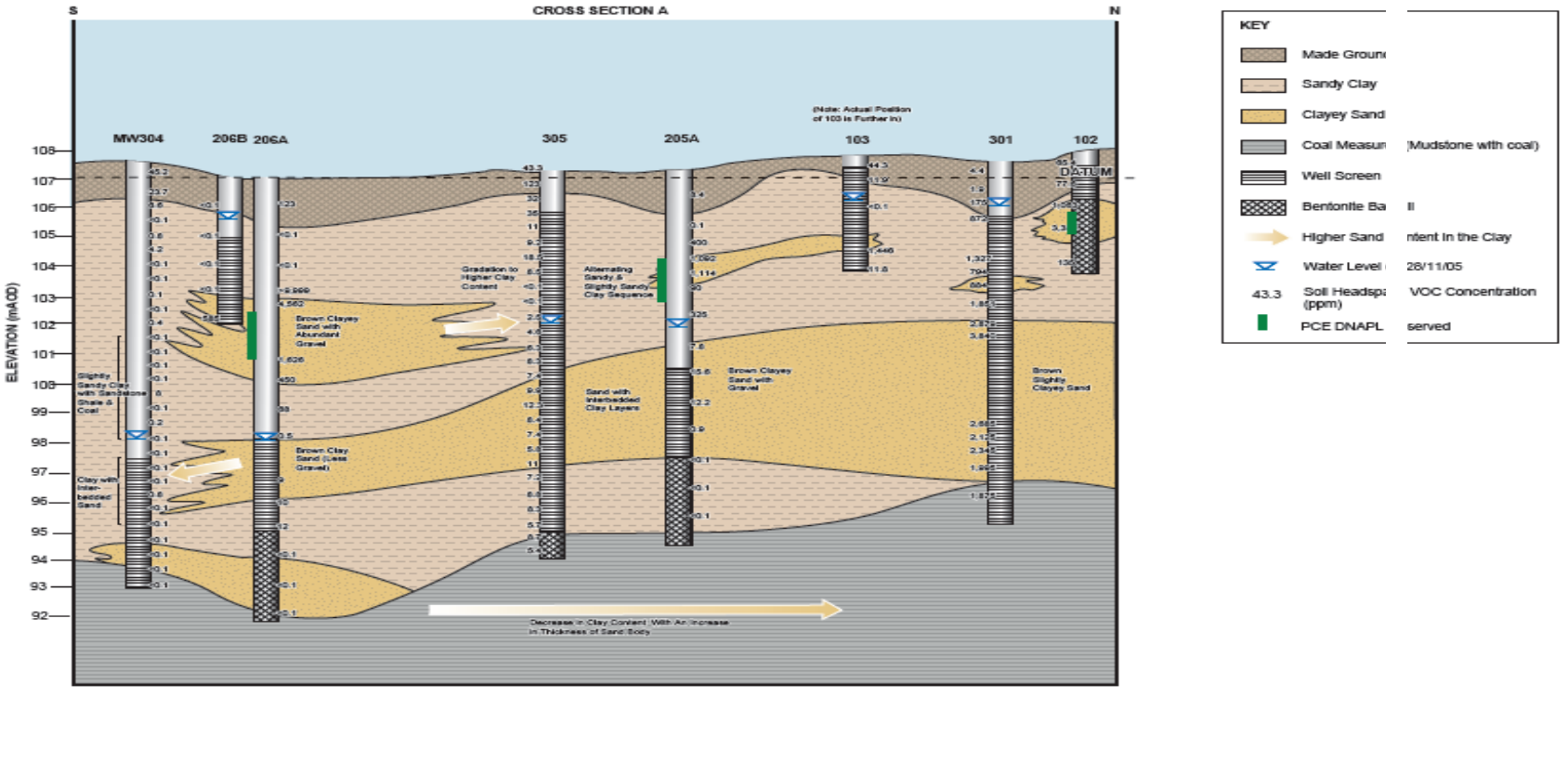
Risk modeling had predicted an unacceptable risk to homes

Site Condition – Conceptual Model - Strata

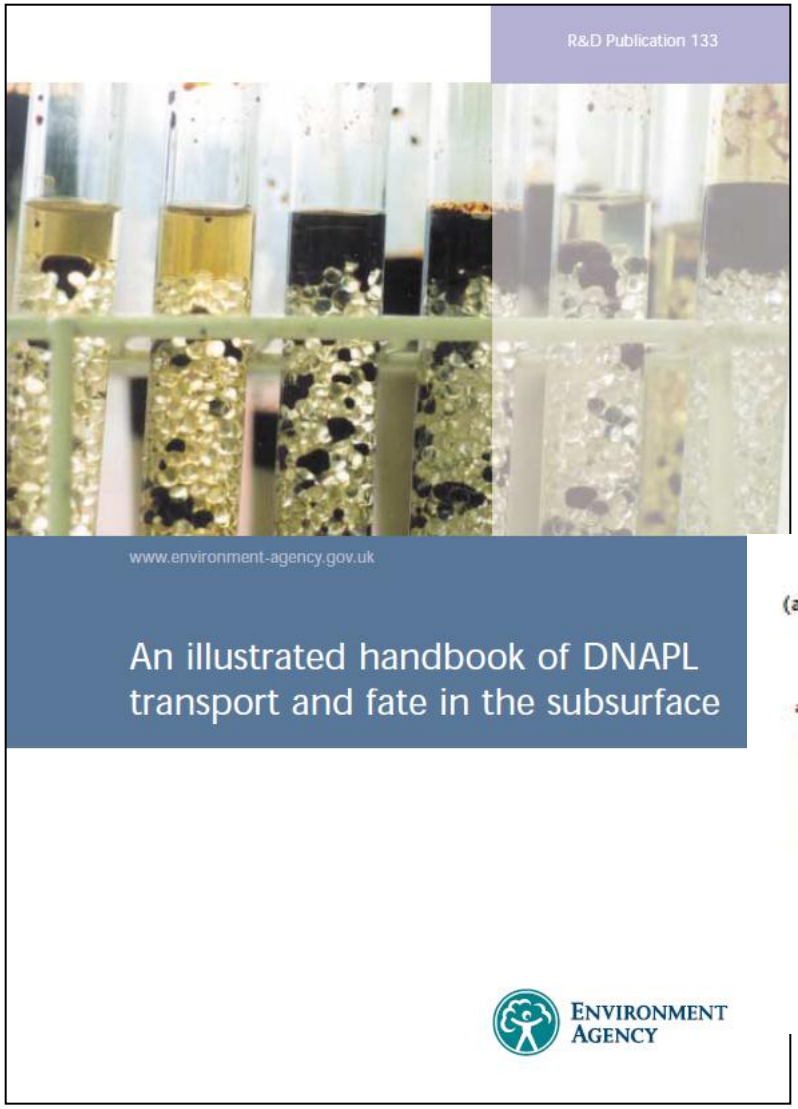
PCE is DNAPL – i.e. denser than water and tends to sink

Inter-bedded Glacial Clays and Fine Sand Lenses over mudstones

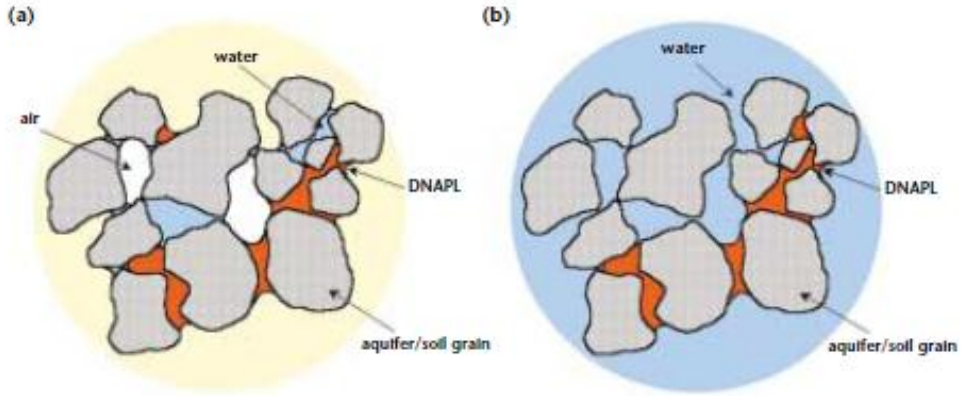
Clear evidence of DNAPL



The Nature of Contaminant



The various blobs and ganglia of residual DNAPL dissolve slowly into flowing groundwater, giving rise to aqueous phase plumes. Because the solubility of most DNAPLs is relatively low in water and groundwater velocities are typically low, it can be many decades before all residual DNAPL is depleted due to natural processes.



Risk Assessment - Controlling Factors

Original Conceptual Model

- Low dissolved carbon = Limits Reductive Dechlorination
- With little degradation, off site migration risk unacceptable
- Little degradation = Stringent remedial objectives (DWS)
- *"ABC"* Consultants; "**Unachievable by in-situ methods**"

Hyder Alternative Risk Model

- What if degradation could be enhanced?
- Remedial Objectives = equiv. 1% solubility PCE (<2mg/l)
- DNAPL depletion **is achievable by in-situ methods**
- In-situ Enhancement by Regenesis HRC application

Monitoring System – Natural Attenuation

Pneumatic Bladder Pump

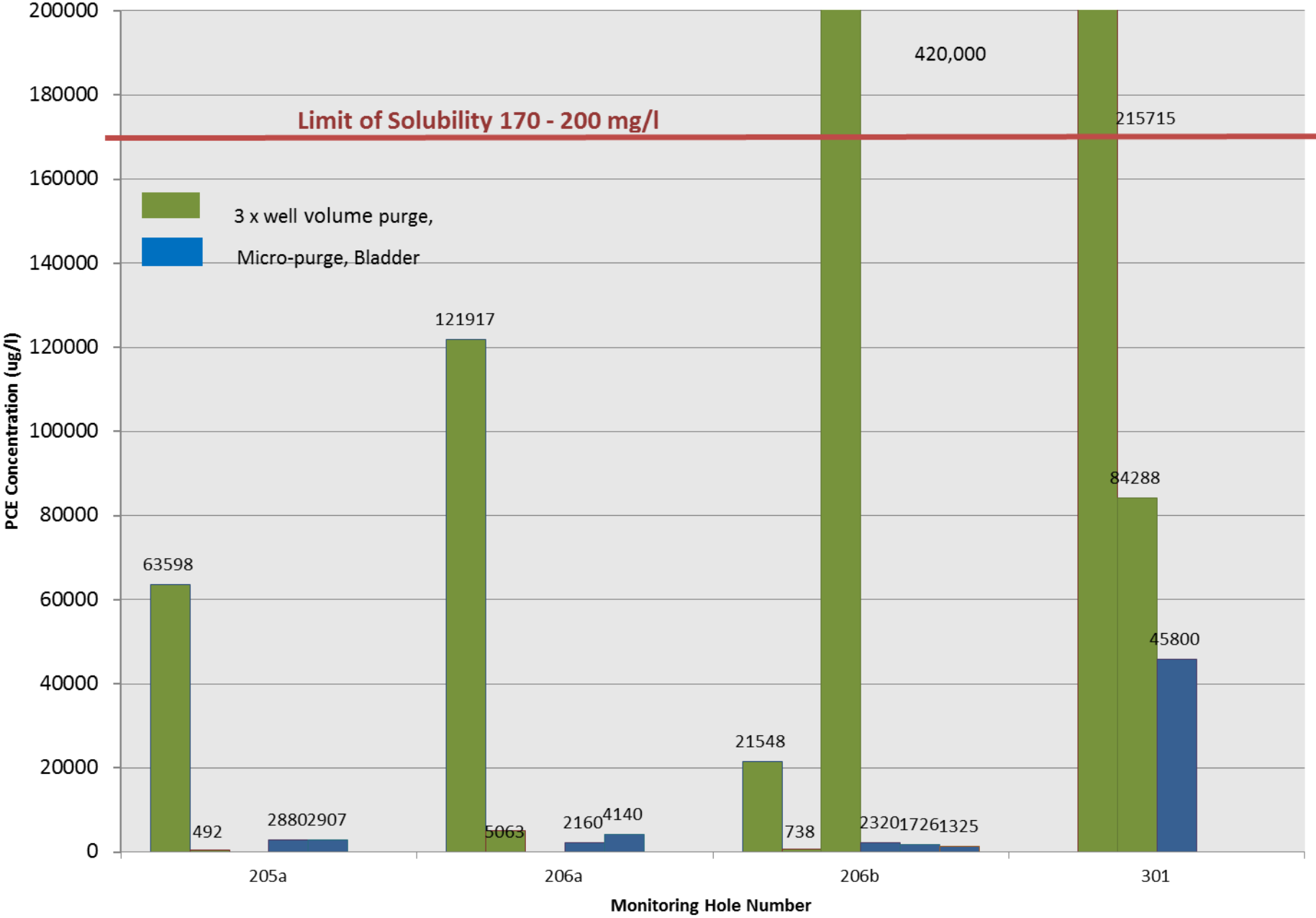
- MNA – Verification is **the** evidence of success
- Multiple lines of evidence
- Key parameters, ORP, DO
- Field measurement essential
- Consistency & repeatability
- A dataset you can believe

➢NEC “Pay for performance”

➢Regulatory Sign Off

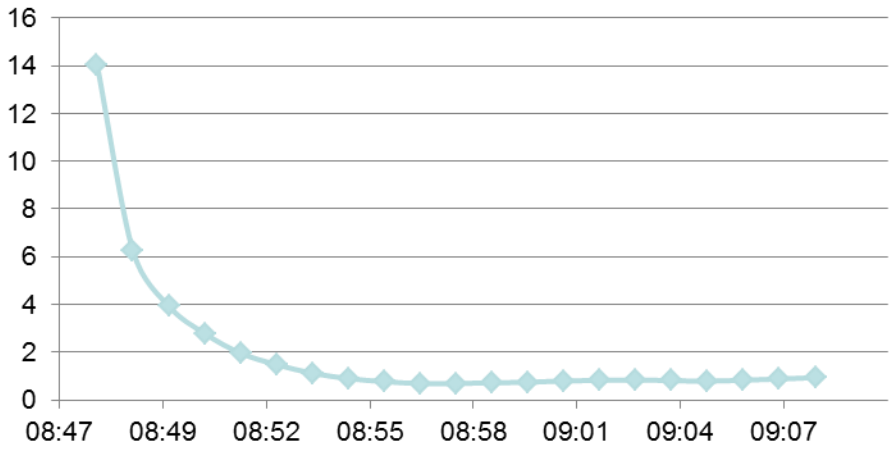
➢Core Client Objectives

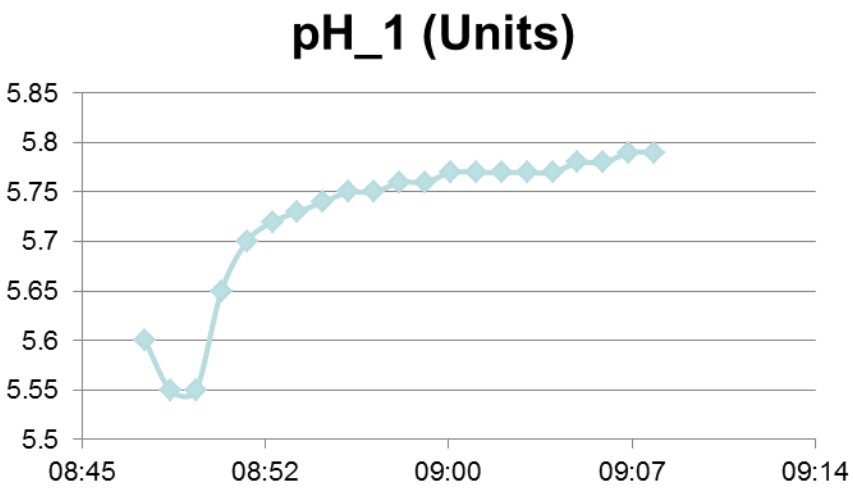
The Influence of Sampling Method in the Presence of DNAPL

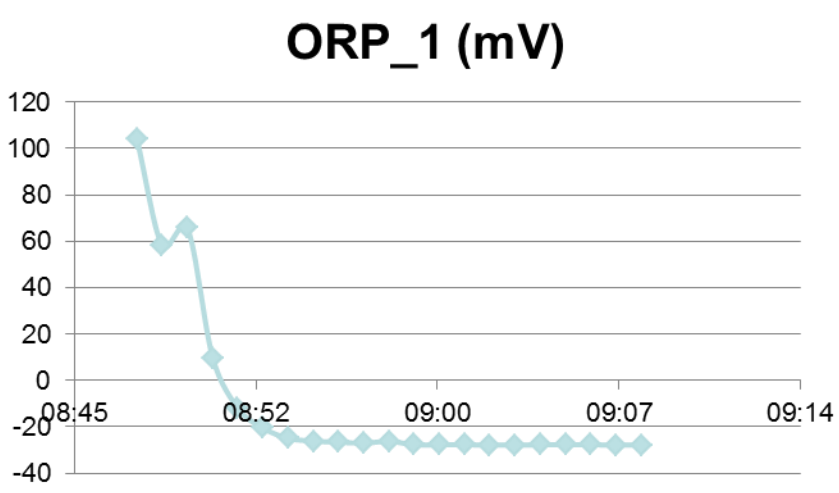


Micro Purge Stabilisation – Post HRC Injections

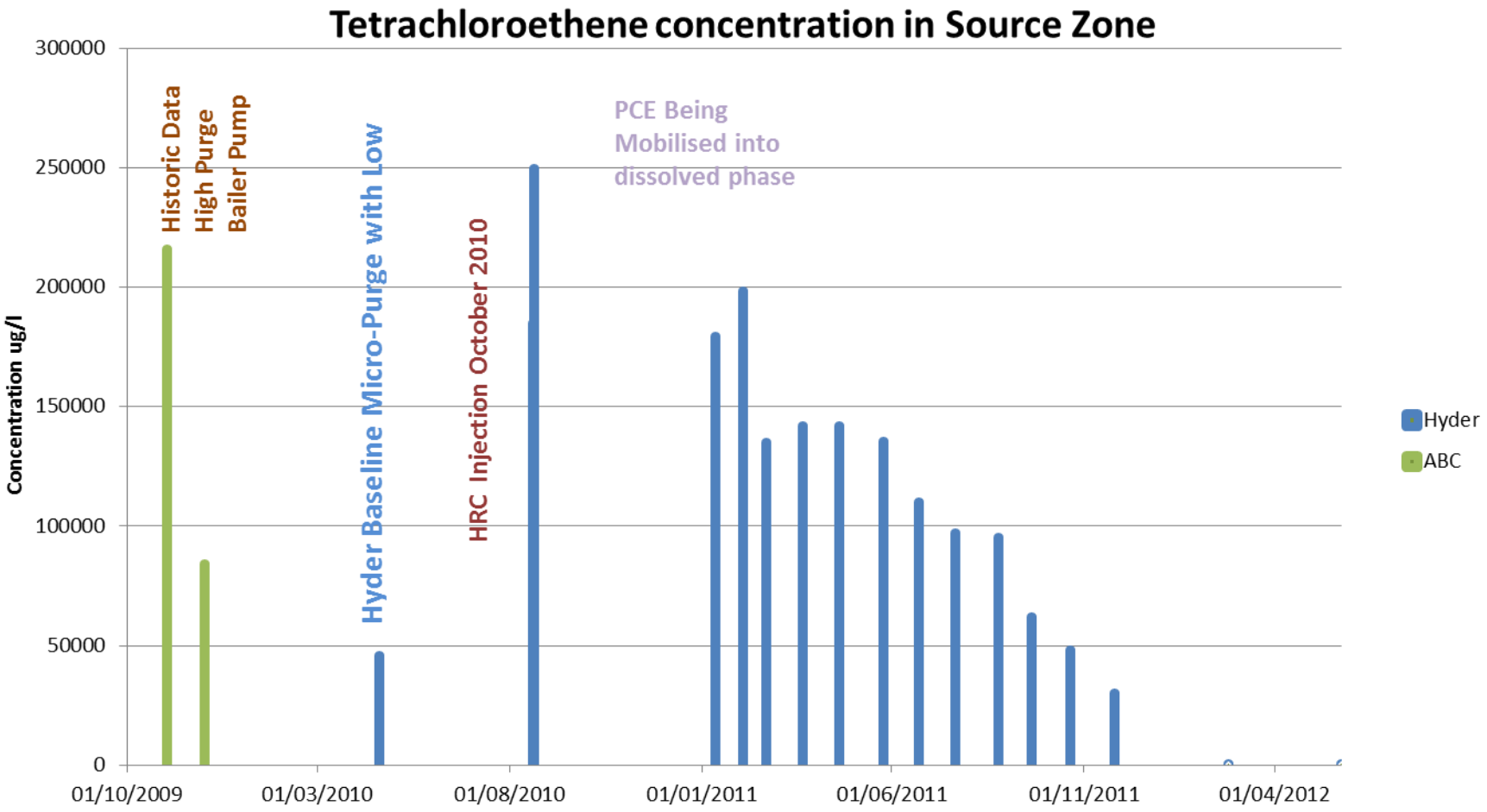
Remediation by Enhanced Monitored Natural Attenuation







Contaminant Source Degradation



Lessons Learnt – DNAPL Source Zone

Sampling significantly influences measured concentrations

High Purge (e.g. 3 well vols) + Bailer / Foot Valve

- ❖ Sample = +/- Groundwater with +/- DNAPL [random / variable]
- ❖ Overestimate of risk; Overestimate of Remediation, Excessive £££
- ✓ Makes you aware of DNAPL presence

Micro-Purge, Pneumatic Bladder Pump

- ✓ Sample = Groundwater, Excludes DNAPL, = "Dissolved" phase
- ✓ Migration risk better informed = lower cost remediation, more options
- ✓ Dedicated System, on site data = Consistency = "Believable Data"
- ✓ High Confidence, Verification of Success = Regulatory Sign-off.