In-Situ Groundwater Remediation

Design and Implementation Considerations

SCLF Webinar Series - 8 October 2020

Presenter: JP Renaud

www.ersremediation.com

SCLF
Scottish Contaminated Land Forum

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Content

- What is in-situ groundwater remediation?
- What does a remediation contractor actually do?
- Mass of contaminant
- Reagent selection and dosage
- Reagent distribution
- Licensing

What is in-situ groundwater remediation?

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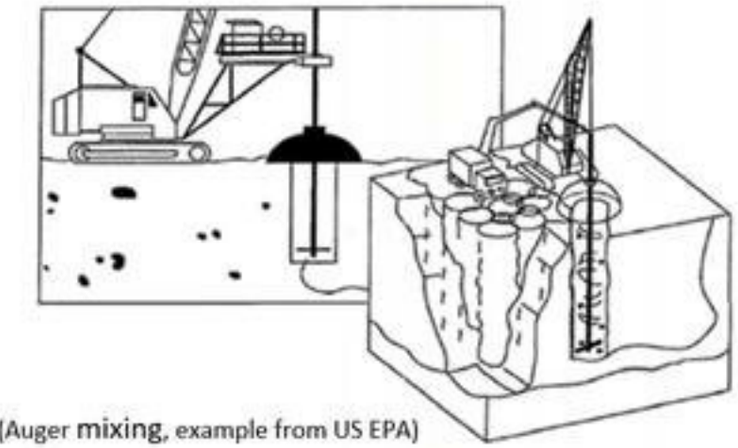
Treat or immobilise contaminants in groundwater "in-situ":

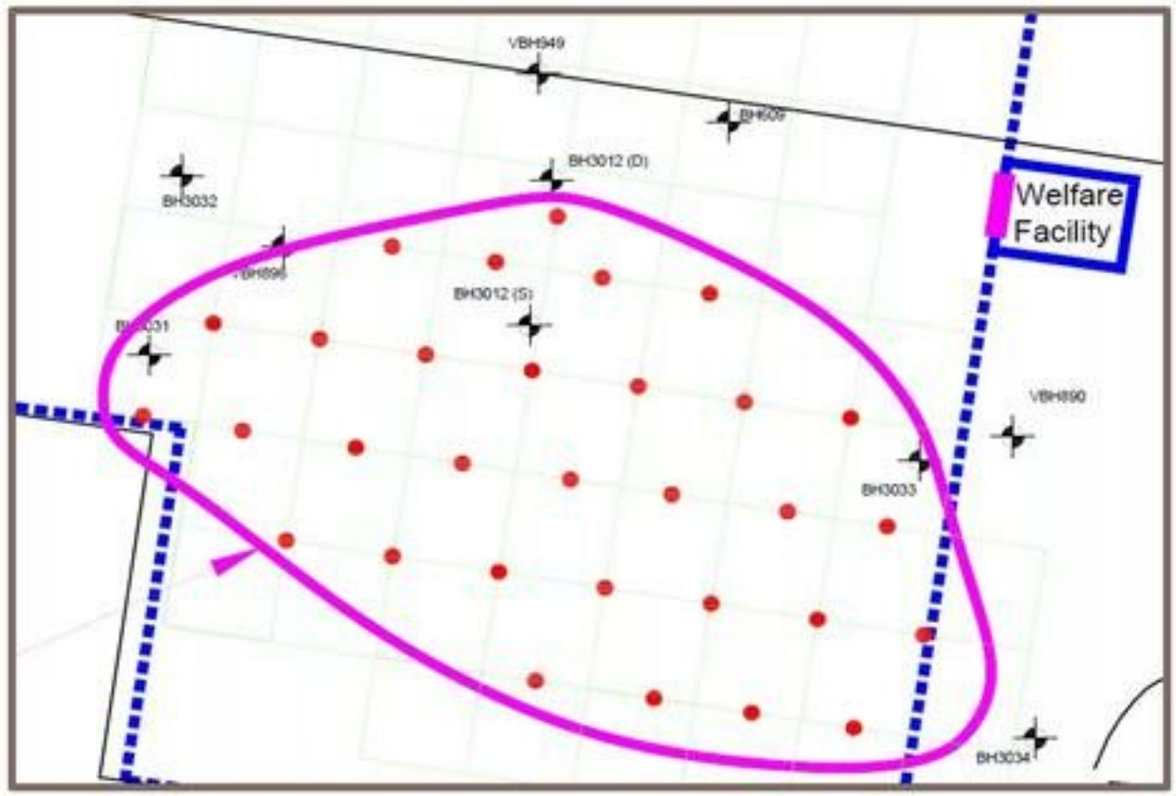
- In-situ chemical remediation (ISCO/ISCR)
- In-situ bioremediation
- In-situ "immobilisation" via activated carbon
- In-situ stabilisation



(Auger mixing, example from US EPA)

- Other "on-site" methods: pump and treat, dual/multi phase extraction, surfactant/solvent flushing, air sparging, thermal desorption, smouldering…

Direct Injection Example



Well Injection Example

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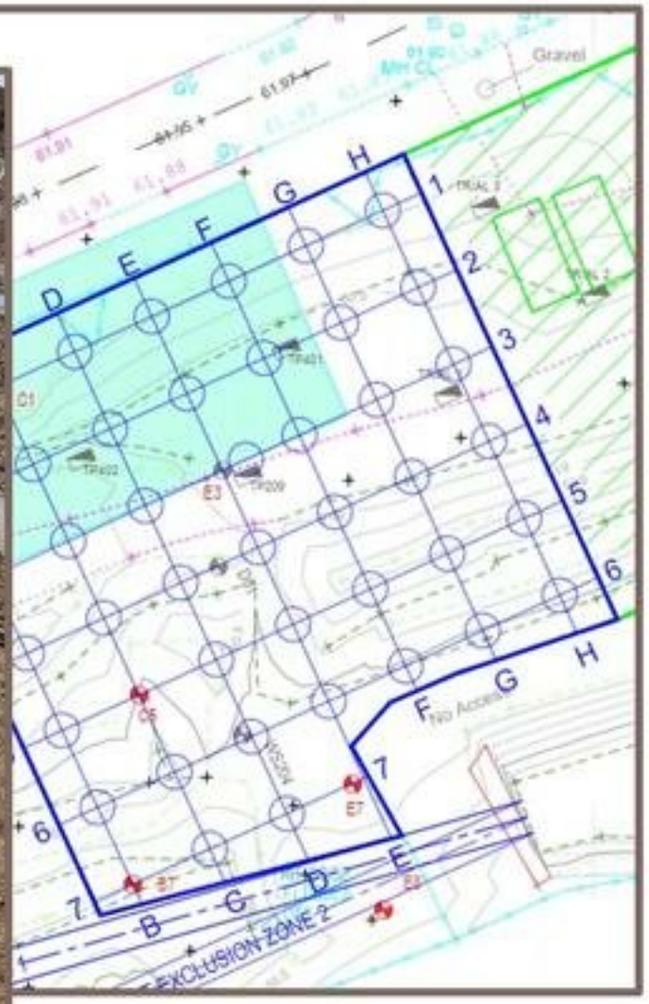
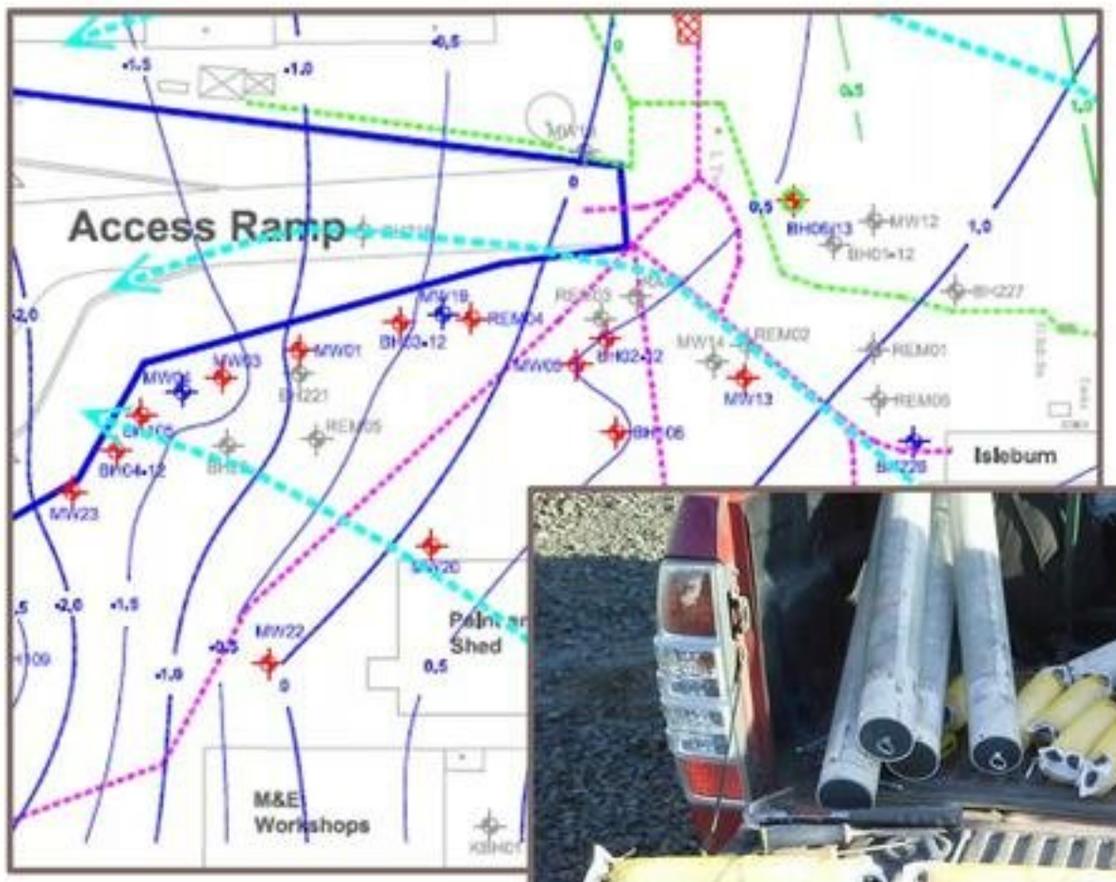


“PRB” Example


Access Ramp
Isleburn
Shop 1
Shop 2
Shop 3
M&E Workshops
Paint Shed
MW22
MW23
MW20
MW21
BH06/13
BH01-12
BH02-12
BH03-12
BH04-12
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What we will do:

- Review the information provided to understand:
  - the site / CSM
  - the remedial objectives
- Determine the best way to reach these objectives
- Note the uncertainties / unknowns along the way

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- Determine the best way to reach these objectives
- Note the uncertainties / unknowns along the way
- Price the job accordingly

Mass of contaminant

- Mass=(Volume of gw) x (Concentration in gw)

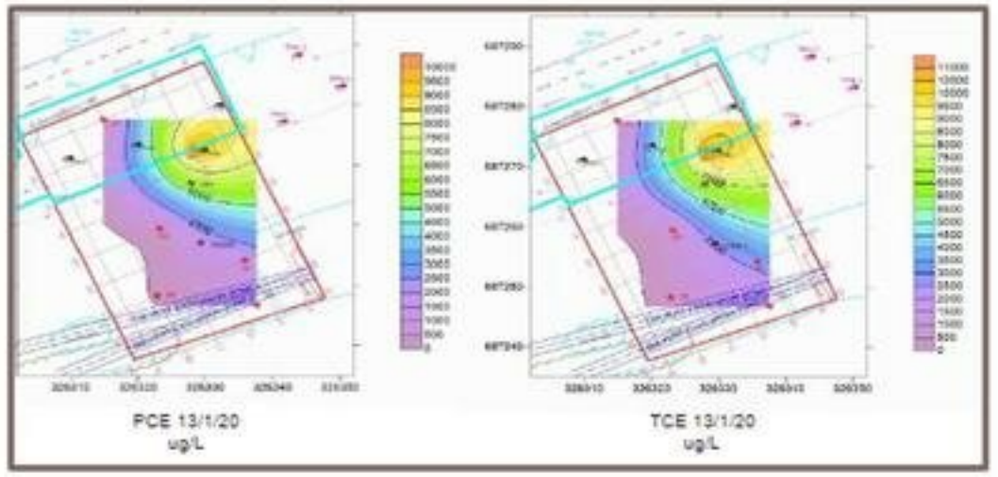
- Volume
  - Delineation - horizontal and vertical
  - Effective Porosity

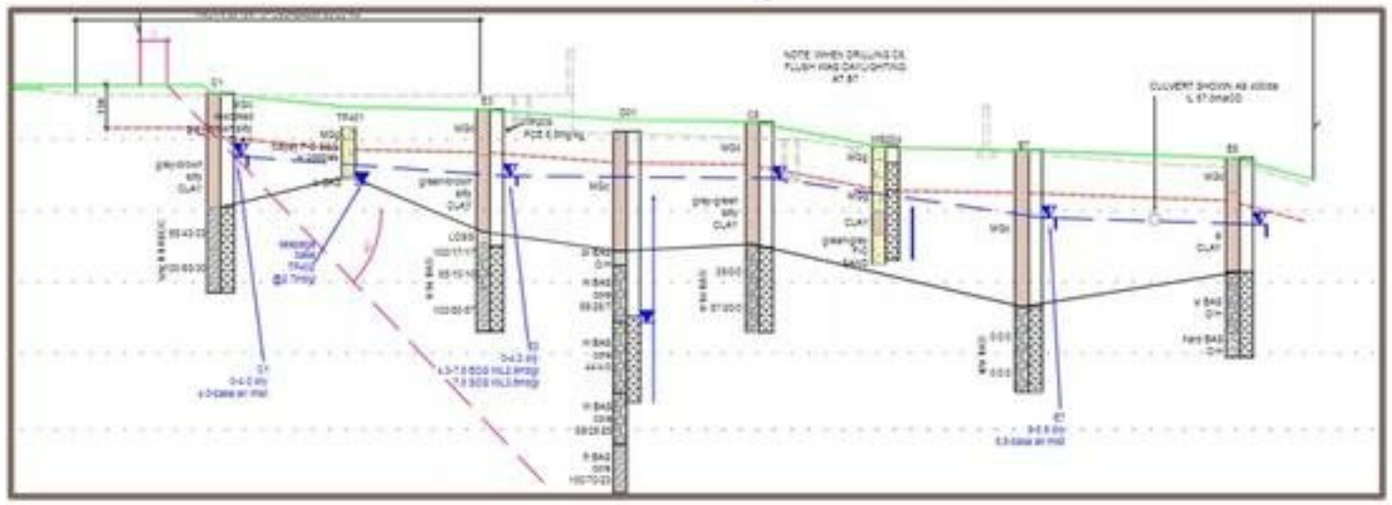
- Concentration
  - Representative of the treatment thickness?
  - Is there a source remaining? Is there NAPL?

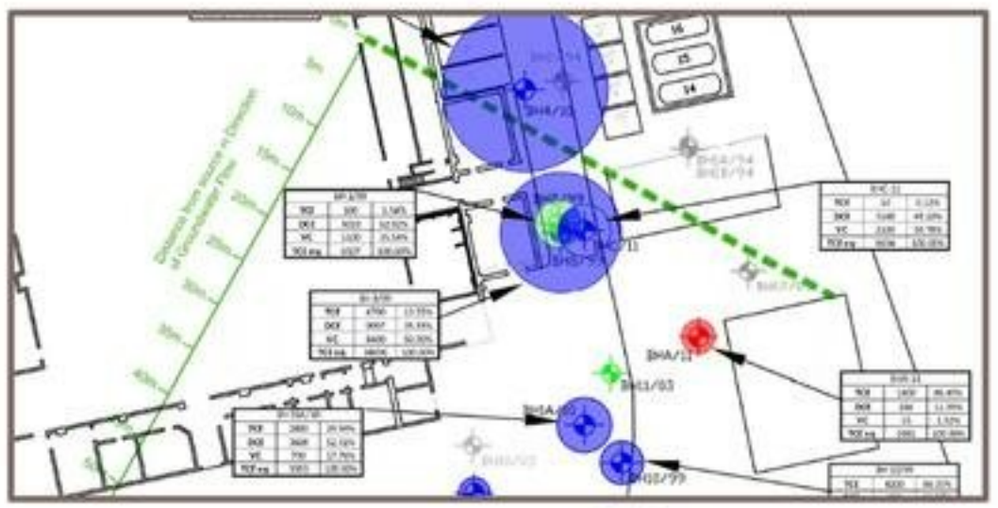
Horizontal and vertical delineation

Horizontal and vertical delineation

- Concentrations plots
- Groundwater flow
- Cross sections
- (Electronic data: Excel, AGS)

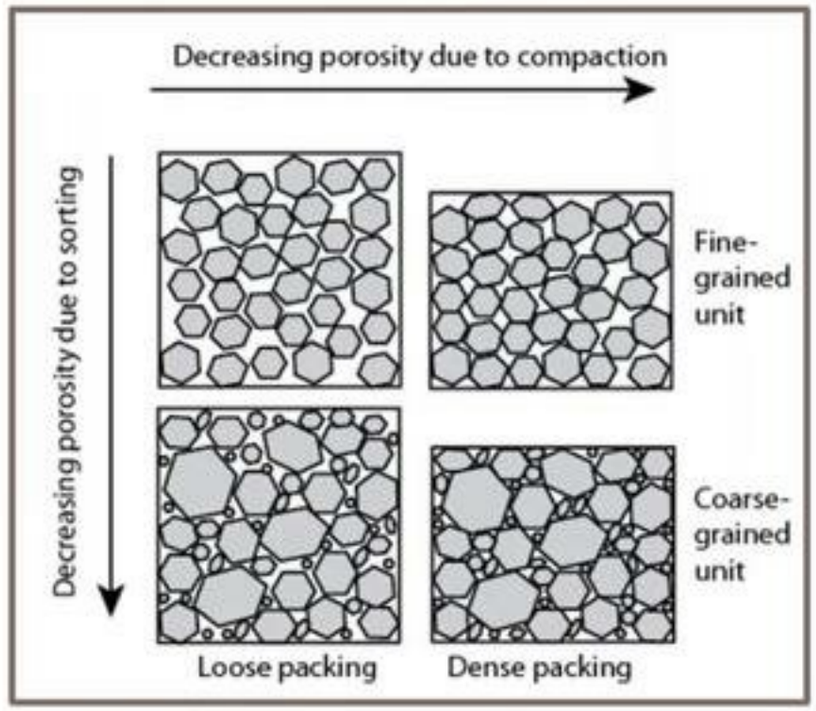






Porosity

- Not often measured
- Soil:
  - Particle size distribution
  - Sorting coefficient
  - Apparent density
- Rock is difficult



(From Skurveit at al, 2014)

Representative concentration

- Can be impacted by NAPL
- Can be impacted by well screen length
  - Can make things "better" or worse
- Can be impacted by delineation
  - Wells far apart – likely overestimation

Presence of NAPL

- Huge effect on the mass
- Effective secondary source
- Not easy to observe directly
  - Sheen on arisings
  - Interface probes / bailers
  - Always check probe readings
  - Borehole screens

- Use GW concentration as proxy
- Effective solubility (NAPL mixtures)

Reagent Selection and Dosage

- Environmental conditions
  - RedOx conditions, pH
  - In-situ monitoring, MNA indicators

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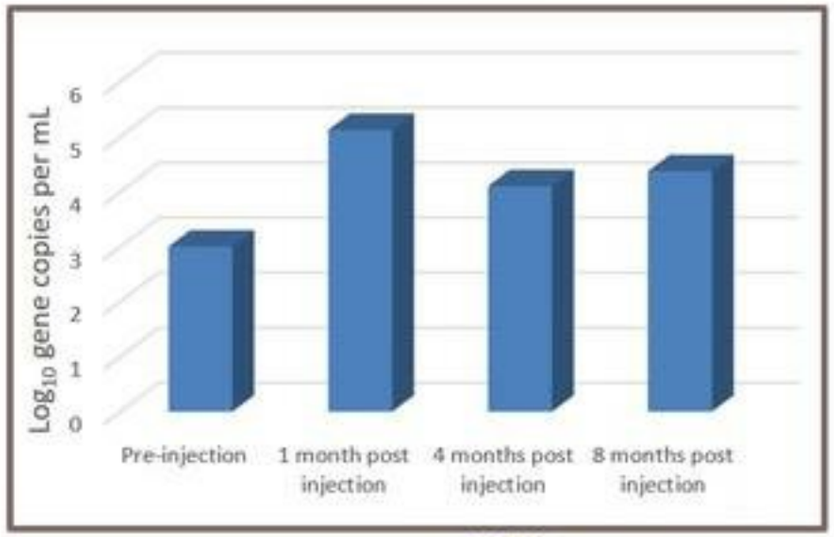
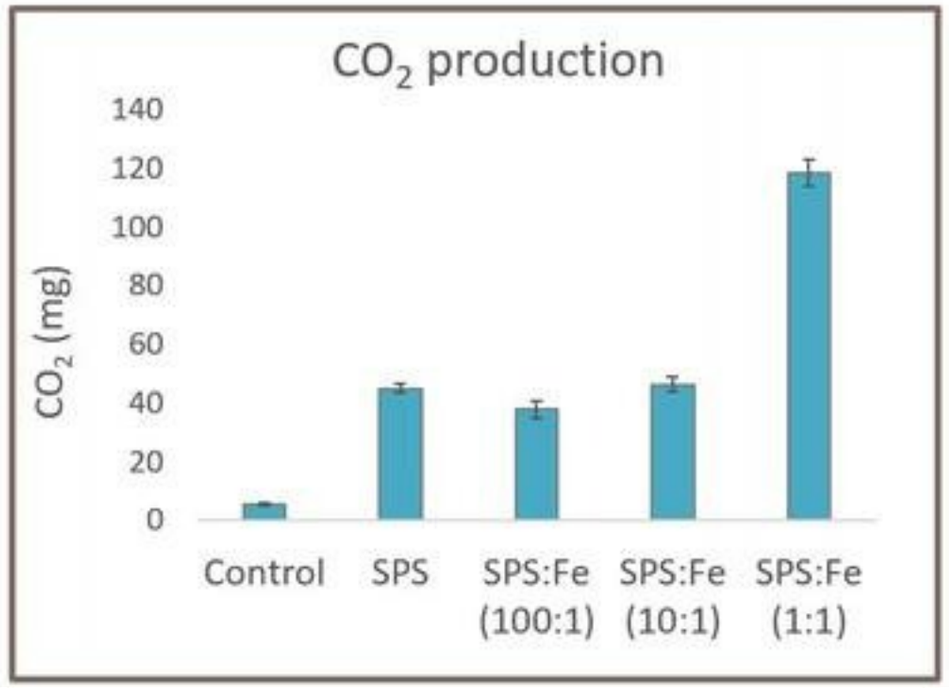
- Environmental conditions
  - RedOx conditions, pH
  - In-situ monitoring, MNA indicators
- In-situ bio – microbes
  - Molecular biology (qPCR)
  - Biostimulation / bioaugmentation?



Reagent Selection and Dosage

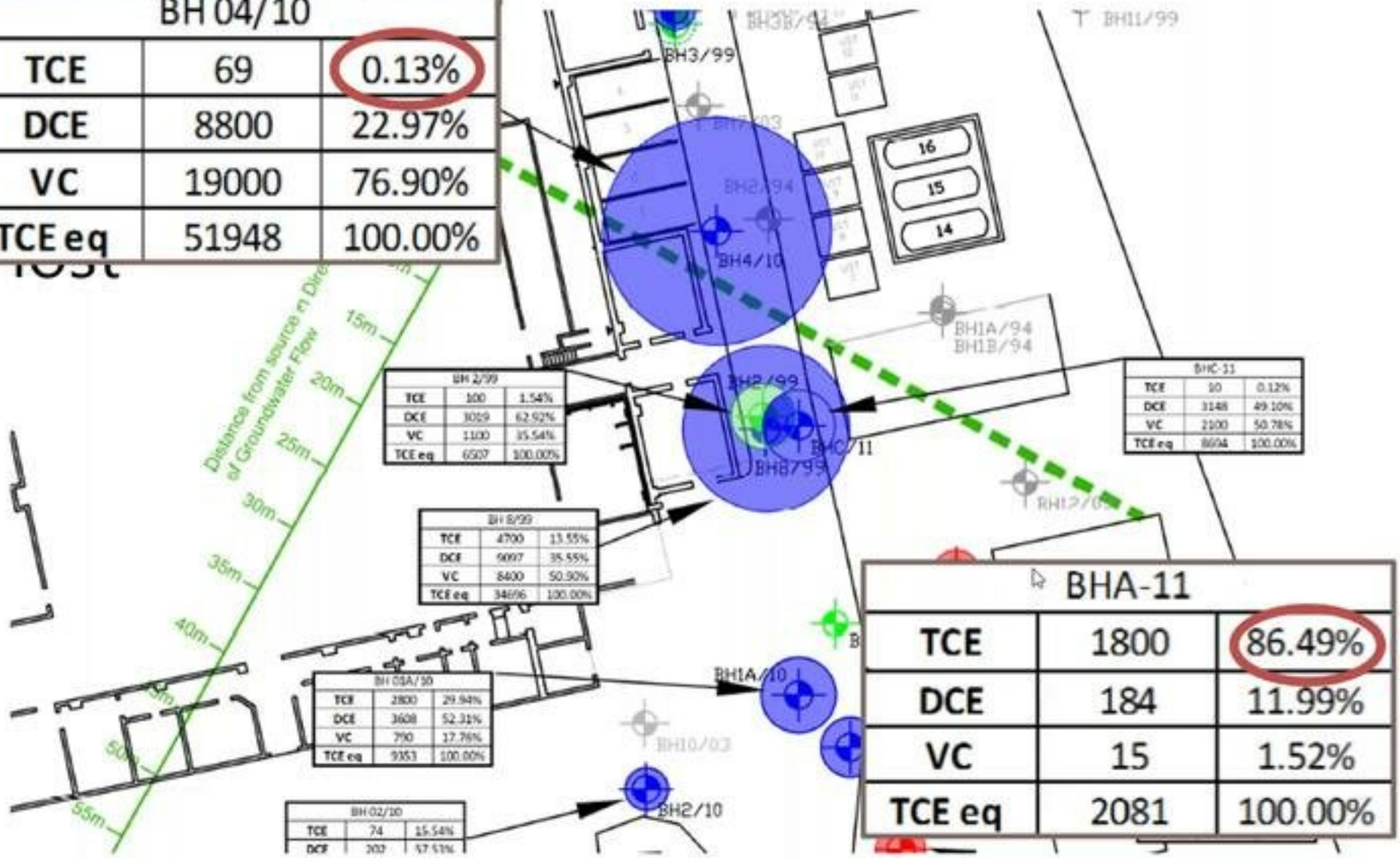
- Environmental conditions
  - RedOx conditions, pH
  - In-situ monitoring, MNA indicators
- In-situ bio – microbes
- Oxidant demand, co-contaminants
- Consult reagent suppliers
- Bench tests



Co-contaminants example

- Industrial site
- Various solvents lost
- TCE, DCE, VC
- Molar fractions
- Toluene

BH 04/10		
TCE	69	0.13%
DCE	8800	22.97%
VC	19000	76.90%
TCE eq	51948	100.00%



BHA-11		
TCE	1800	86.49%
DCE	184	11.99%
VC	15	1.52%
TCE eq	2081	100.00%

Reagent Distribution

- Reagent prepared / diluted first

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Reagent Distribution

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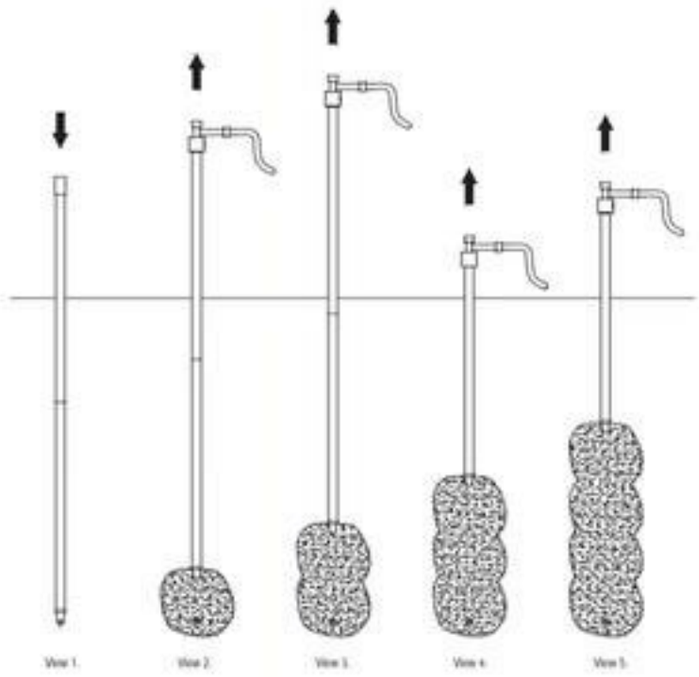
- Injected into the formation
  - Direct push



(Bottom-up injection, from Geoprobe manual)

Reagent Distribution

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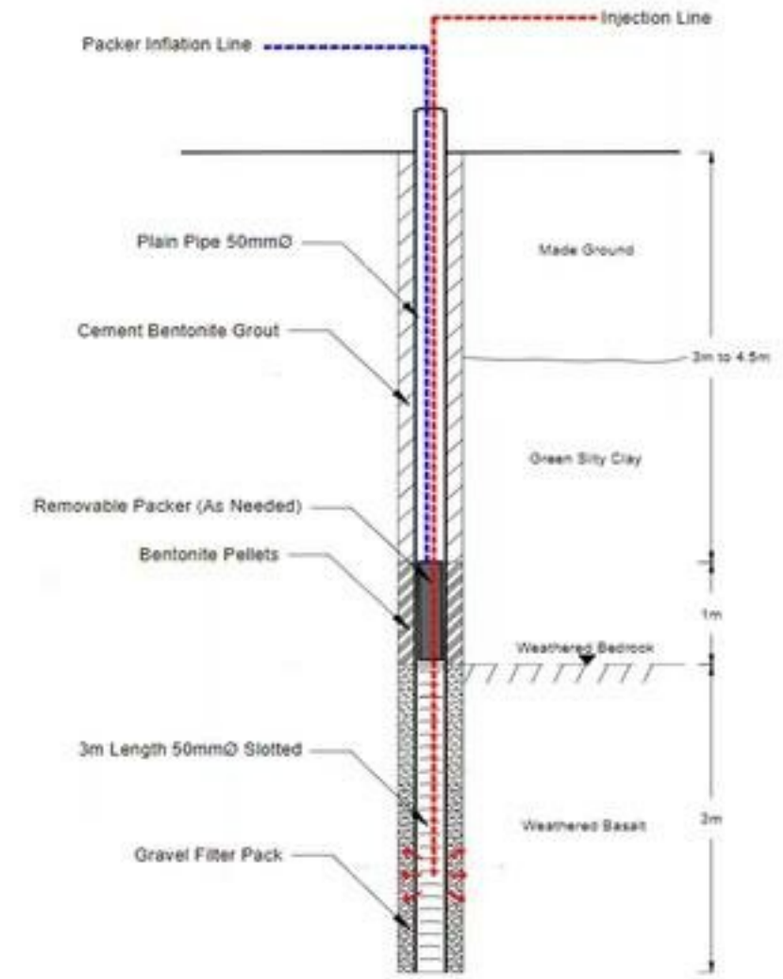
  - Injection wells



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  - Injection wells
- Need to control pressure
  - Daylighting
  - Fracturing

Reagent Distribution

- Reagent prepared / diluted first
- Injected into the formation
  - Direct push
  - Injection wells
- Need to control pressure
  - Avoid daylighting, hydraulic fracturing
  - Correct radius of influence, volume delivery
- Do a pilot trial, especially in complex geology

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Permitting

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- Country specific
- Scotland: Mobile Plant Licence (MPL)

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- Site Specific Working Plan (SSWP)
  - Method, monitoring plan and verification
  - Environmental controls
  - Competent person

- Applies to:
  - Treatment
  - Trials and testing (when there is treatment)
  - Drilling (when needed for the treatment)

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Thanks for listening!

Any question / comment, please contact:

jp.renaud@ersremediation.com

Glasgow
Westerhill Road
Bishopbriggs, G64 2QH

Edinburgh
Midlothian Innovation Centre
Roslin, Midlothian, EH25 9RE

Inverness
23 Henderson Drive,
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