



Botany Groundwater Cleanup Project Strategy Review Community Workshop

Agenda Item 3 - Background to the Strategy Review

James Stening

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Presentation Outline

- Groundwater Cleanup Plan
 - Key Elements
- Technology Evaluation
 - Groundwater (dissolved phase)
 - Source Area (DNAPL)
- Remediation Strategy Review
 - Need for Strategy Review

Contents

- ▶ **Groundwater Cleanup Plan**
- Technology Evaluation
- Remediation Strategy Review

Groundwater Cleanup Plan

- Prepared by Orica in response to the NCUA in 2003
 - Identify, contain and remediate DNAPL source areas to the maximum extent practicable
 - Establish primary containment area (PCA), use ex situ treatment, target 80% mass removal in PCA
 - Establish a secondary containment area (SCA) to protect Penrhyn Estuary/Botany Bay
 - Implement comprehensive environmental monitoring program
- NCUA Condition 7E:
 - Consider best practice technology in the remediation of DNAPL and groundwater containing dissolved phase contaminants
 - Continued review of relevant, emergent technologies
 - Ongoing investigation into the practical application and effectiveness of these technologies in relation to the remediation

Progress to date

- Relining stormwater pipes between BIP and Springvale Drain
- Springvale Drain sediments removal
- Hydraulic containment
- Improvements to surface water quality – drains and Penrhyn Estuary
- Ambient air quality improvements near Springvale Drain
- 5,200 ML groundwater treated, 670 t of chlorinated hydrocarbons destroyed (Nov 2004 – Mar 2009)
- Treated water being reused (proportion increasing)
- Ongoing evaluation of technologies for groundwater and source area in situ remediation in addition to pump and treat

Contents

Groundwater Cleanup Plan



Technology Evaluation

Remediation Strategy Review

Technology Evaluations – Groundwater

- Permeable reactive iron barrier
 - Installed pilot-scale barrier in February 1999 (5 m x 1.5 m x 3 m)
 - Targeted southern plumes (CTC, PCE, TCE - not EDC)
 - 90+% contaminant mass destruction through barrier
 - Full-scale barrier (450 m x 1 m x 20 m) redundant with hydraulic containment
 - Related research
 - Manufacture of injectable iron (nano-scale zero valent iron)
 - Further sampling of pilot scale barrier in November 2007 showed biodegradation of EDC



Technology Evaluations – Groundwater (Cont)

- Enhanced in situ bioremediation
 - Injected electron donors (nutrients) to stimulate existing microorganisms
 - Lab trial 1999-2000; field trials 2003-2004
 - Targeted central and northern plumes (high EDC concentrations)
 - Very good mass removal ... eventually
 - Harvested biomass to develop bio-cultures that destroy CHCs
 - Bioaugmentation field trials in mid 2009



Technology Evaluations – Groundwater (Cont)

- Reactive iron barriers and in situ bioremediation are still considered feasible for groundwater remediation
 - Large-scale deployment issues remain
 - Do not provide same certainty of contaminant containment as pump and treat
 - Complex to operate in parallel with pump and treat
 - Continued involvement in R&D
 - Potential future applications

Technology Evaluations – Source Areas

- Direct Recovery (DNAPL pumping)
 - Manual bailing of a well on BIP recovered ~10 litres
 - Low flow automated pumping planned for mid 2009
- Hydraulic Displacement (inject water to flush out contamination)
 - Desktop evaluation in 2006/07
 - Need steep hydraulic gradient; small increase in rate of dissolving
 - Limited to more soluble CHCs (e.g., EDC)
 - No plans to implement – limited benefit and ability

Technology Evaluations – Source Areas (Cont)

- Thermal Treatment
 - Steam/air + Thermal Conductive Heating
 - Field trial conceptual and detail designs prepared in 2006/07
 - On hold for strategy review
- In Situ Chemical Oxidation (ISCO)
 - Injection of activated sodium persulphate
 - Targeted all volatile CHCs
 - Lab trials in 2006/07 – encouraging results
 - On hold for strategy review
- Injection enhancement technology
 - Electrokinetics



Contents

Groundwater Cleanup Plan

Technology Evaluation

 **Remediation Strategy Review**

Need for a Strategy Review

- Preliminary costing of ISCO and Thermal field trials substantial
- If trials were successful, then full-scale implementation would be an enormous undertaking
- What could these options deliver for the costs involved?
- Preparedness for future review of regulation of Botany Groundwater Cleanup Project
- Views of leading experts required
 - Strategy Review Workshop convened in December 2007
- Proposed revised strategy presented to DECC in September 2008



Prof Bernie Kueper

- Department of Civil Engineering, Queen's University, Ontario, Canada
- Associate Editor for *Journal of Ground Water*
- Recognised international expert on the topic of groundwater contamination and remediation, particularly chlorinated solvent DNAPLs
 - Researching and publishing on these topics for 20 years
 - Consulting to regulators, government bodies and private industry
 - Professional short course instruction on contaminant hydrogeology and remediation
 - To practising hydrogeologists, including regulators
 - Many countries for past 20 years; Australia for past 7 years
 - Extensive experience at 'real sites' on a consulting basis, including the Orica Site (2007)
- Strategy Review Workshop participant