



**TECHNOLOGY AND RESEARCH GROUP**

**ANNUAL REPORT  
2012**

## **Introduction by the TRG Chairman**

*This year we welcomed Steve Thornton and Richard Moss to the TRG to bring the total number of members to 14. Steve Thornton is a Reader in Environmental Engineering Science within the Groundwater Protection and Restoration Group at the University of Sheffield. He has over 20 years experience in contaminant hydrogeology, with particular interest in the application of natural attenuation for pollution management, monitoring techniques and performance assessment of natural attenuation at field scale and in situ / engineered bioremediation. Richard Moss is the Director of Global Environmental Affairs at AkzoNobel and is a process engineer with over 30 years of experience working in research, consulting and the chemical industry. His experience covers HSE, legacy and environmental liability issue management, environmental risk assessment and business risk management.*

*On the work front, I am pleased to say that the TRG members were kept busy in 2012. The work programme included the review of 7 bulletins and CL:AIRE's Industry State of the Market Report, together with the answering of many technical queries.*

*Since the TRG provides independent strategic peer review, support and technical steering functions in support of CL:AIRE's activities, a high workload indicates the continued success of CL:AIRE. Further, the TRG is fundamental to maintaining and enhancing CL:AIRE's reputation and supporting the development of the organisation.*

*I know that the CL:AIRE Board and Management Team greatly appreciate the time and effort taken by the TRG members in ensuring the quality of CL:AIRE products and supporting future developments. I would also like to express my personal thanks to the TRG members and their employers for their contributions and I look forward to a productive 2013.*

*This document is in two parts - the first gives background to the important role of the TRG within CL:AIRE, whilst the second details our activities during 2012.*

Mike Summersgill  
January 2013

## **BACKGROUND TO THE TRG**

### **INTRODUCTION**

CL:AIRE was established as a public/private partnership in March 1999, to facilitate the field demonstration of remediation research and technology, including innovative methods for site characterisation and monitoring, on contaminated sites throughout the UK.

CL:AIRE'S Technology and Research Group (TRG) provide strategic review, support and steering functions for CL:AIRE's activities. The TRG are a sub-committee of the CL:AIRE Board. As a result, the TRG chairman is required to be a trustee of the Board and provide the link to the strategic direction of the company.

### **CONTEXT**

CL:AIRE's reputation in the market place is for the dissemination of information and, in particular, the publication of high quality, peer reviewed, impartial and technically scientific robust reports. This is due in large part to two things:-

- the TRG process – which ensures consistency with UK policy and legislation, an appropriate scientific and technical quality of work, and transparency; and
- the TRG members – who are high calibre renowned experts in their field.

The TRG ensure the real added value to CL:AIRE.

### **THE TRG PROCESS**

The TRG review process works through a number of communication routes including meetings, conference calls and email exchanges.

The process comprises a detailed evaluation of project and publication submissions in terms of:-

- scientific validity of the application;
- robust nature of the methodology;
- contribution to the UK contaminated land marketplace;
- suitable assessment of site criteria; and
- competencies in forms of project management.

The process does allow for constructive feedback and resubmission, but not all applicants get through.

### **TRG MEMBERS AT END OF 2012**

**Chairman:** Mr Mike Summersgill – SEnSe Associates  
**Deputy Chair:** Dr Brian Bone – Bone Environmental Consultant  
**Deputy Chair:** Mr Steve Edgar – Vertase FLI  
Mr Bob Barnes – Environment Agency  
Dr John Campbell – SAC Associates  
Professor Max Coleman – Caltech  
Professor Mark Hodson – University of York  
Dr Theresa Kearney – Northern Ireland Environment Agency  
Professor Phil Morgan – The Sirius Group  
Mr Richard Moss – AkzoNobel  
Mr Mike Pearl – Babcock International Group  
Dr Mike Rivett – University of Birmingham  
Professor Jonathan Smith – Shell Global Solutions  
Dr Steven Thornton – University of Sheffield

# THE 2012 ANNUAL REPORT

## 1. TRG ACTIVITIES

### 1.1 TRG Meetings

During 2012, four TRG meetings were held.

### 1.2 Project Applications Reviewed

There were no project applications to review in 2012. The current status of CL:AIRE Technology Demonstration Projects (TDP) and Research Projects (RP) is provided in Appendix 1.

### 1.3 CL:AIRE Publications Reviewed

#### 1.3.1 Reports

TRG members reviewed CL:AIRE's 'Contaminated Land Industry State of the Market Report 2012' which was published this year. There were no CL:AIRE Project Reports to review in 2012.

#### 1.3.2 Bulletins

TRG members reviewed 7 bulletins during 2012, 3 of which were published and 4 of which are due to be published in early 2013 (shown in italics below):

Bulletin Type	Bulletin No.	Bulletin Title
Case Study	CSB10	The development of risk based generic assessment criteria (GAC) for assessment of chronic human health risks from exposure to soil contaminants
Research	RB17	A pragmatic approach to ground gas risk assessment
SABRE	SAB6	Source Area DNAPL Bioremediation: performance monitoring and assessment
<i>TDP</i>	<i>TDP25</i>	<i>Decision support tool for innovative in situ multi-contaminant groundwater remediation</i>
<i>TDP</i>	<i>TDP30</i>	<i>In situ 'deliverability' trials for chromium-contamination, at Shawfield, Glasgow using calcium polysulphide</i>
<i>TDP</i>	<i>TDP31</i>	<i>Demonstration of the Arvia™ Process of adsorption coupled with electrochemical regeneration for the on-site, ex situ, decomposition of organic contaminants in groundwaters</i>
<i>Treatability</i>	<i>TrB3</i>	<i>Chemical oxidation</i>

The current status of CL:AIRE Resources (publications and online training) is provided in Appendix 2.

### 1.4 Other Activities

In addition to the above activities the TRG were asked to comment on, or contribute to, a number of issues, including the following:

- Delivery of CL:AIRE's remediation technology eLearning
- Evaluation of TRG Member skills and gap analysis
- Identify potential for CL:AIRE working abroad
- Assisting in the search for field trial sites in the UK for a chlorinated VOC-degrading inoculum

- Completing a European-wide mercury questionnaire
- Review of three gasworks profiles
- Evaluation of a soil washing demonstration project using EDTA
- Helping to develop a webinar policy for CL:AIRE

## **2. A LOOK AHEAD TO 2013**

Building on the achievements of 2012, a new wave of CL:AIRE outputs is predicted for the forthcoming year. It is expected that the TRG will be called upon to review 2 project applications and 6 CL:AIRE bulletins, which the CL:AIRE team is currently working up with the various project teams. The TRG will also be reviewing the final gasworks profile, the LNAPL Handbook, the CL:AIRE State of the Market Report 2013 and the outputs from the SuRF-UK phase 3, as well as contributing strategic review, support and steering functions for CL:AIRE's activities.

This document was prepared by Dr Rob Sweeney, Project Director, CL:AIRE on behalf of the TRG.

**Status of CL:AIRE Technology Demonstration Projects**

<b>Code</b>	<b>Project Title and Project Operator</b>	<b>Status</b>
TDP 1:	Remediation Trial Using Low Temperature Thermal Desorption to Treat Hydrocarbon Contaminated Soil - British Aerospace Systems	Completed + Report Available
TDP 2:	Remediation of Basford Gasworks Using Soil Washing – National Grid Property/VHE	Completed + Report Available
TDP 3:	Design, Installation and Performance Assessment of a Zero Valent Iron Permeable Reactive Barrier in Monkstown, Northern Ireland- Nortel Networks/Golder Associates/Queen's University Belfast/Keller Ground Engineering Ltd	Completed + Report Available
TDP 4:	Slurry-Phase Bioreactor Trial - Parsons Brinckerhoff/National Grid Property	Completed + Report Available
TDP 5:	A Reducing and Alkalinity Producing System (RAPS) for Passive Treatment of Acidic, Aluminium Rich Leachates from Mine Spoils - University of Newcastle/Durham County Council	Completed + Report Available
TDP 6:	Bioremediation Trial at The Avenue - DEC NV/Jacobs/East Midlands Development Agency/Homes and Communities Agency	Completed + Report Available
TDP 8:	Field Demonstration of Accelerated Carbonation Technology (ACT) at The Avenue – Jacobs/East Midlands Development Agency/Homes and Communities Agency	Completed + Bulletin Available
TDP 9:	Use of an Air Sparge Treatment Curtain to Remediate Groundwater at a Former Gas Works – WorleyParsons Komex/National Grid Property	Completed + Report Available
TDP 10:	Thermal Remediation Trial at The Avenue - MEL Limited/Jacobs/East Midlands Development Agency/Homes and Communities Agency	Completed + Bulletin Available
TDP 11:	Soil Washing Remediation Trial at The Avenue - DEC NV/Jacobs/East Midlands Development Agency/Homes and Communities Agency	Completed + Bulletin Available
TDP 12:	Bioremediation of the Coke Works and Former Colliery at Askern, Doncaster - Ecologia Environmental Solutions Ltd/Carillion Civil Engineering/Yorkshire Forward	Completed + Report Available
TDP 13:	A Permeable Reactive Barrier for Remediation of Extremely Polluted Groundwater Associated with a Highly Pyritic Abandoned Colliery Spoil Heap - University of Newcastle upon Tyne and Northumberland County Council	Completed + Report Available
TDP 16:	Remediation of Chlorinated Hydrocarbon Contaminated Soils using <i>Ex Situ</i> Soil Vapour Extraction – RemedX and ABB	Completed + Report Available
TDP 17:	<i>In Situ</i> Bioremediation of Cyanide, PAHs and Heterocyclic Compounds using Engineered SEquenced REactive BARrier (SEREBAR) Techniques - Queen's University Belfast/National Grid Property/Parsons Brinckerhoff	Completed + Report Available

TDP 18:	Source Area <i>in situ</i> BioREmediation (SABRE) – Akzo Nobel/Archon Environmental/British Geological Survey/Celanese Acetate/Chevron/DuPont/ESI/ General Electric/Environment Agency/GeoSyntec/ Golder Associates/Honeywell/Scientifics/Strategic Environmental Research and Development Program (SERDP)/Shell Global Solutions/Terra Systems/University of Edinburgh/University of Sheffield/US Environmental Protection Agency	Completed + 6 Bulletins Available
TDP 20:	Design, Installation and Performance Assessment of a Permeable Reactive Barrier (PRB) to Treat Carbon Disulphide Contaminated Groundwater at a Former Chemicals Site in Manchester - CEL International Ltd, ESI, Akzo Nobel	Completed + Report Available
TDP 21:	Remediation of Agricultural Diffuse NITRAte Polluted Waters through the Implementation of a Permeable Reactive BARRier (NITRABAR) – University of Oxford/Queen’s University Belfast/Environment Agency/Ecomesh Ltd (N. Ireland)/PGRW (Poland)/Zenenzo (Belgium)/APCO Ltd (Malta)/CL:AIRE	Completed
TDP 22:	Improved Ground Gas Risk Prediction by Continuous In-borehole Gas Monitoring (IRP-IGM) - Salamander; Urban Vision; The University of Manchester	Completed + Bulletin Available
TDP 23:	<i>Ex situ</i> Treatment of Coal Tar Impacted Soil Using Low Temperature Thermal Desorption at the Former Gasworks, East Dock Street, Dundee - National Grid Property Holdings Ltd; White Young Green; Bilfinger Berger; I & H Brown	Completed + Report in Progress
TDP 24:	Application of Thermally Enhanced Soil Vapour Extraction (TESVE) to remediate the unsaturated zone at the Western Storage Area (WSA), Harwell - UK AEA; Provectus Group; Nuclear Decommissioning Authority	Completed + Report Available
TDP 25:	Decision Support Tool for Innovative In-Situ Multi-Contaminant Groundwater Remediation - WorleyParsons Komex, National Grid Property, Environment Agency, Bradford City Council and Imperial College	Completed + Bulletin in Progress
TDP 26:	<i>In situ</i> Soil and Groundwater Decontamination using Electric Resistive Heating Technology (Six-Phase Heating®) - Terra Vac (UK) Ltd; Taylor Wimpey Ltd	Completed + Bulletin Available
TDP 28:	<i>In situ</i> Heating using Radiofrequency (RF) Coupled with Soil Vapour Extraction/High Vacuum Dual Phase Extraction for the Remediation of Contaminated Soil in the Unsaturated Zone - Ecologia Environmental Solutions Ltd; Total UK Ltd	Completed + Bulletin Available
TDP 29:	Low-cost Rapid On-Site Quantification of Oil-based Contamination (ROSQUO) - National Grid, Cranfield University and WSP Remediation	Completed
TDP 30:	Remediation Field Trials for the Chromium-Contaminated Area at Shawfield, Glasgow - Clyde Gateway Urban Regeneration Company and URS Corporation Ltd	Completed + Bulletin in Progress
TDP 31:	Demonstration of the Arvia® Process of Adsorption Coupled with Electrochemical Regeneration for the On-site Destruction of Organic Contaminants in Groundwater - Arvia Technology Ltd and VertaseFLI.	Completed + Bulletin in Progress

### Status of CL:AIRE Research Projects

Project Code	Project Title and Principal Project Operator	Status
RP 2:	Hydro-biological Controls on Transport and Remediation of Organic Pollutants for Contaminated Land - Professor Howard Wheeler, Imperial College of Science, Technology and Medicine; Professor Jeremy Mason, Kings College, London; and National Grid Property	Completed
RP 3:	Processes Controlling the Natural Attenuation of Fuel Hydrocarbons and MTBE in Chalk - Dr Steve Thornton, University of Sheffield	Completed + Report Available
RP 4:	The Development of a Statistical Model to Optimise Investigation to Characterise Contaminated Land - Professor Mike Ramsey, University of Sussex	Completed + Report Available
RP 5:	The Use of Bonemeal Phosphates to Stabilise Metal Contamination - Dr Eva Valsami-Jones, The Natural History Museum	Completed + Bulletin Available
RP 6:	Phytoextraction of Metals: Investigation of Hyperaccumulation and Field Testing - Professor Steve McGrath - Rothamsted Research	Completed + Report Available
RP 9:	The Development of an Indicator Methodology to Determine the Plant Availability of Potentially Toxic Elements - Tony Hutchings, Forest Research/Martina Juvara – Arup	Completed + Bulletin Available
RP 10:	Comparative Assessment of Approaches for Predicting the Fate and Transport of Dissolved Phase Hydrocarbons in Chalk Aquifers - Natalyn Ala, Atkins Environment	Completed + Bulletin Available
RP 12:	Development of an <i>In Situ</i> Aquifer Assessment Tool with Risk Management Calculator for Natural Attenuation - Professor Steve Banwart, University of Sheffield	Completed
RP 13:	<i>In situ</i> Source Treatment for Enhanced Bioremediation Processes (IN-STEP) - Professor Bob Kalin, Queen's University Belfast	Completed + Report Available
RP 14:	Use of Longitudinal STREAMTUBE-Based Monitoring Approaches to Determine Contaminant Fate Within the SABRE Intra-Source/Plume Test Cell.- Dr Mike Rivett, University of Birmingham	Completed + Bulletin Available
RP 15:	Ferric Iron Remediation and Stabilisation (FIRS): electrokinetic remediation of heavy metal-contaminated back garden sites - Dr Andrew Cundy, University of Sussex, Dr Laurence Hopkinson, University of Brighton	Completed + Bulletin Available
RP 16:	Performance Assessment of Stabilised/Solidified Waste Forms (PASSiFy) – Dr Colin Hills, University of Greenwich	Completed
RP 17:	The Use of Recycled Construction/Demolition and Industrial Waste as a Substrate in a Novel Manganese Removal Passive Treatment System - Dr Selina Bamforth, University of Newcastle upon Tyne and Dr Karen Johnson, University of Durham	Completed

RP 18:	Optimising Biopile Processes for Weathered Hydrocarbons within a Risk Management Framework - Professor Simon Pollard, Cranfield University	Completed + Bulletin Available
RP 19:	Process Envelopes for Cement-based Stabilisation/Solidification (ProCeSS) - Dr Julia Stegemann, University College London	Completed
RP 20:	Increased Acceptability of On-Site Measurement by Estimation and Reduction of Uncertainty – Severn Trent Laboratory, University of Sussex, National Grid Property Holdings, Corus UK,	Completed
RP 21:	The Use of Biologically Enhanced Charcoal for In Situ Remediation of Contaminated Land – Aspire Defence Ltd, Forest Research, University of Surrey, University of Sheffield	Completed
RP 22:	Contaminant – the use of Supercritical Carbon Dioxide (SC-CO <sub>2</sub> ) for the In Situ Sampling and Analysis of Contaminants - PJH Partnership Limited, University of Birmingham, Pera Innovation, Lankelma	Completed + Bulletin in Progress
RP 23:	Regeneration of Brownfield Using Sustainable Technologies (ROBUST) – Dr Karen Johnson and Dr Clare Bamba, Durham University	Project in progress
RP 24:	Soil Mix Remediation Technology (SMiRT) – Robert McGall, Eco Foundations and Dr Abir Al-Tabbaa, University of Cambridge	Project in progress

## CL:AIRE RESOURCES

### **Technology Demonstration Project (TDP) Reports and Bulletins**

- TDP1 - *Remediation trial using low temperature thermal desorption to treat hydrocarbon-contaminated soil (2004)*
- TDP2 - *Remediation of Basford Gasworks using soil washing (2003)*
- TDP3 - *Design, installation and performance assessment of a zero valent iron permeable reactive barrier in Monkstown, Northern Ireland (2001)*
- TDP4 - *Slurry-phase bioreactor trial (2004)*
- TDP5 - *A Reducing and Alkalinity Producing System (RAPS) for passive treatment of acidic, aluminium rich mine waters (2005)*
- TDP6 - *Biopile field demonstration at the Avenue Coking Works (2004)*
- TDP9 - *Design, installation and performance assessment of an air sparge curtain system (2004)*
- TDP12 - *Bioremediation of the Coke Works and Former Colliery at Askern, Doncaster (2005)*
- TDP13 - *A permeable reactive barrier for remediation of extremely polluted groundwater associated with a highly pyritic abandoned colliery spoil heap (2006)*
- TDP16 - *Ex situ soil vapour extraction to remediate chlorinated hydrocarbons (2007)*
- TDP17 - *A biological sequential reactive barrier (SEREBAR): design, installation and performance at a former manufactured gas plant site in south west England (2008)*
- TDP20 - *Design and installation of a permeable reactive barrier to treat carbon disulphide contaminated groundwater (2009)*
- TDP24 - *Application of thermally enhanced soil vapour extraction (TESVE) to remediate the unsaturated zone at the Western Storage Area, Harwell (2010)*
- TDP26 - *In situ soil and groundwater decontamination using electric resistive heating technology (2008)*
- TDP28 - *In situ radio frequency heating (ISRFH) of hydrocarbon contaminated chalk at a former service station in Kent (2011)*

### **Research Project (RP) Reports**

- RP3 - *Processes controlling the natural attenuation of fuel hydrocarbons and MTBE in the UK Chalk aquifer (2006)*
- RP4 - *Cost-effective investigation of contaminated land (2007)*
- RP6 - *Phytoextraction of Metals: Investigation of hyperaccumulation and field testing (2005)*

### **Other CL:AIRE Bulletins**

#### **Technical Bulletins (TB)**

- TB1 - *Introduction to an integrated approach to the investigation of fractured rock aquifers contaminated with non-aqueous phase liquids (2002)*
- TB2 - *Multilevel sampling systems (2002)*
- TB3 - *Principles and practice for the collection of representative groundwater samples (2008)*
- TB4 - *Parameterisation of aquifer hydraulic properties: A contaminant hydrogeology perspective (2009)*
- TB5 - *The use of geophysical investigation techniques in the assessment of contaminated land and groundwater (2007)*
- TB7 - *Improving the reliability of contaminated land assessment using statistical methods : Part 1 (2004)*
- TB9 - *Stabilisation/Solidification Treatment and Remediation: Part 1: Summary of the State of Practice Reports I-IV STARNET (2004)*
- TB11 - *A practical guide to investigating DNAPL releases in the subsurface (2004)*
- TB12 - *Statistical assessment of contaminated land: Some implications of the 'Mean Value Test' (2006)*
- TB13 - *Understanding soil washing (2007)*
- TB14 - *Treatment of chromium contamination and chromium ore processing residue (2007)*
- TB15 - *Accounting for the groundwater-surface water interface in contaminated land assessments (2011)*

#### **Case Study Bulletins (CSB)**

- CSB1 - *Site characterisation in support of monitored natural attenuation of fuel hydrocarbons and MTBE in a chalk aquifer in Southern England (2002)*
- CSB2 - *A constructed wetland to treat acid mine drainage from colliery spoils at Quaking Houses, County Durham (2002)*

CSB3 - *Portadown biological reactive barrier (2005)*  
CSB4 - *Mine water treatment at Wheal Jane Tin Mine, Cornwall (2004)*  
CSB5 - *Remediation trial at The Avenue using stabilisation/solidification and accelerated carbonation technology (2006)*  
CSB6 - *Remediation trial at The Avenue using thermal treatment (2006)*  
CSB7 - *Remediation trial at The Avenue using soil washing (2008)*  
CSB8 - *Public affairs and communications on contaminated land projects (2007)*  
CSB9 - *Remediation of a former landfill in Coventry: A practical application of the Definition of Waste: Development Industry Code of Practice in a cluster project (2011)*  
CSB10 - *The development of risk based generic assessment criteria (GAC) for assessment of chronic human health risks from exposure to soil contaminants (2011)*

### **Research Bulletins (RB)**

RB1 - *Enhanced in situ bioremediation technique for manganese removal from mine waters (2003)*  
RB2 - *FIRS Ferric Iron Remediation and Stabilisation: a novel electrokinetic technique for soil remediation and engineering (2003)*  
RB3 - *Project SIReN: Research Projects (2006)*  
RB4 - *Project SIReN – Future Research Needs (2006)*  
RB5 - *Remediation of heavy metal pollution via bone meal amendments to soil: Field and laboratory trials (2007)*  
RB6 - *Results of a laboratory microcosm study to determine the potential for bioremediation of chlorinated solvent DNAPL source areas (2006)*  
RB7 - *Field Portable X-ray Fluorescence (FPXRF): A rapid and low cost alternative for measuring metals and metalloids in soils (2008)*  
RB8 - *Modelling approaches for assessing risks associated with petroleum hydrocarbon spills in the UK Chalk aquifer (2009)*  
RB9 - *Electrokinetic Ferric Iron Remediation and Stabilisation (FIRS) of hexavalent chromium contaminated soils: An ex situ field scale demonstration (2009)*  
RB10 - *Bioremediation of heavy hydrocarbons – reducing uncertainty in meeting risk-based targets: laboratory to field scale (2010)*  
RB11 - *Streamtube project overview: longitudinal transect assessment of the SABRE site DNAPL source zone (2010)*  
RB12 - *Modelling food-chain transfer of contaminants in soil to terrestrial ecological receptors (2010)*  
RB13 - *The utility of continuous monitoring in detection and prediction of "worst case" ground-gas concentration (2011)*  
RB14 - *Generic human-health assessment criteria for arsenic at former coking works sites (2011)*  
RB15 - *Generic human-health assessment criteria for benzo[a]pyrene at former coking works sites (2011)*  
RB16 - *Generic human-health assessment criteria for benzene at former coking works sites (2011)*  
RB17 - *A pragmatic approach to ground gas risk assessment (2012)*

### **Site Bulletins (SB)**

SB1 - *MNA Bulletin (2005)*  
SB2 - *SIReN (MNA) overview and description of projects (2005)*  
SB3 - *Coal Mine Sites for Targeted Remediation Research:- The CoSTaR Initiative (2006)*

### **Guidance Bulletins (GB)**

GB1 - *Stabilisation/Solidification for the treatment of contaminated soil (2005)*  
GB2 - *Managing Japanese Knotweed on Development Sites: Code of Practice (2008)*  
GB3 - *The Definition of Waste: Development Industry Code of Practice (2011)*

### **Treatability Bulletins (TrB)**

TrB 1 - *Soil washing (2011)*  
TrB 2 - *Permeable reactive barriers (2011)*

### **SABRE Bulletins (SAB)**

SAB1 - *Project SABRE (Source Area BioRemediation) – an Overview (2010)*  
SAB2 - *Site investigation techniques for DNAPL source and plume zone characterisation (2010)*  
SAB3 - *Results of laboratory column studies to determine the potential for bioremediation of chlorinated solvent DNAPL source areas*  
SAB4 - *Insights and modelling tools for designing and improving chlorinated solvent bioremediation applications (2010)*  
SAB5 - *Overview of the SABRE field tests (2010)*  
SAB6 - *Source Area DNAPL Bioremediation: performance monitoring and assessment (2012)*

### **SUBR:IM Bulletins (SUB)**

- SUB1 - *The role of the development industry in brownfield regeneration (2006)*
- SUB2 - *Uncovering the true impacts of remediation (2007)*
- SUB3 - *Climate change, pollutant linkage and brownfield regeneration (2007)*
- SUB4 - *Measuring sustainability: What's in a number? (2007)*
- SUB5 - *Avoiding future brownfield sites through design for deconstruction and the reuse of building components (2007)*
- SUB6 - *Communicating risk on contaminated sites: How best to engage with local residents (2007)*
- SUB7 - *Acid Tar Lagoons (2008)*
- SUB8 - *Community Engagement, Urban Regeneration, and Sustainability (2008)*
- SUB9 - *Quality in Land Remediation: Indicators and Protocols for Brownfield Land (2008)*
- SUB10 - *The Use of Compost in the Regeneration of Brownfield Land (2008)*
- SUB11 - *Integrated remediation, reclamation and greenspace creation on brownfield land (2009)*
- SUB12 - *SUBR:IM (Sustainable Urban Brownfield Regeneration: Integrated Management) - An overview (2009)*

### **UK Sustainable Remediation Forum (SuRF-UK) Publications**

- SuRF-UK: *A Review of Published Sustainability Indicator Sets: How applicable are they to contaminated land remediation indicator-set development? (2009)*
- SuRF-UK: *A Framework for Assessing the Sustainability of Soil and Groundwater Remediation (2010)*
- SuRF-UK: *Annex 1 - The SuRF-UK Indicator Set for Sustainable Remediation Assessment (2011)*

### **Other Publications**

- UK Trade & Investment/EISU & CL:AIRE Trade Guide (2006)
- CIEH & CL:AIRE Guidance on Comparing Soil Contamination Data with a Critical Concentration (2008)
- The Definition of Waste: Development Industry Code of Practice (2008)
- AGS, EIC & CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment (2010)
- Defra's "Contaminated land remediation report" (2011)
- The Definition of Waste: Development Industry Code of Practice (2011)
- Defra's "A Risk/Benefit Approach to the Application of Iron Nanoparticles for the Remediation of Contaminated Sites in the Environment" (2012)
- Cluster Guide (2012)

### **Online Training**

#### **Podcasts**

- The SuRF-UK framework for sustainable remediation (2011)
- Continuous monitoring of ground-gas (2011)
- CL:AIRE DNAPL site characterisation webinar (2011)
- CL:AIRE DNAPL site remediation webinar (2011)
- Using quality compost webinar: Soil manufacture and improvement in brownfield regeneration (WRAP, 2011)
- Using quality compost webinar: Achieving successful biomass production on brownfield land (WRAP, 2011)

#### **eLearning Modules**

- Remediation Technologies (2012)
- Introduction to Soil and Groundwater Risk Assessment (to be released in 2013)*
- Sustainable Remediation Appraisal (to be released in 2013)*

**All of the Publications and Online Training can be downloaded from the CL:AIRE website.**