

Workpackage I - Impacts of Climate Change on Pollutant Linkage

Objectives

1. To quantify the short- and long-term impacts of climate change predictions.
2. To evaluate the effects of climate change on contamination linkages.
3. To develop appropriate adaptation design strategies to account for climate change.
4. To examine the adaptive response of key brownfield stakeholders to climate change.
5. To provide guidance on the likely effect of climate change on brownfield remediation.

Conceptual Model

Despite considerable uncertainty, evidence suggests that in coming decades, the UK will be subjected to climate change impacts of higher average temperatures, summer droughts and increasingly wet and stormy winters. There will be considerable impacts on infrastructure generally, and hence a requirement to address the problems with suitable mitigation measures.

In relation to contaminated land, sites that currently pose a low risk to the environment under present climatic conditions, may become significant if pollutant linkages form under the new conditions. All containment systems – landfill, treated or untreated contaminated sites, unengineered excavations – could potentially be affected, usually by increasing the mobility of contaminants in the ground caused by the changes in soil behaviour due to drying out and/or changing groundwater levels. For example, increasing ground temperatures could lead to soil desiccation and upward capillary suction of polluted water, exposing the contaminant at the ground surface. The mobility/volatility of certain organic compounds could be increased, causing extended pollutant movement in the ground. Higher intensity rainfall would almost certainly increase rates of erosion and may also increase the spread of ground contaminants.

Vegetation and wetlands will be an important part of the research. The vegetation itself may be itself subject to ecological adaptation due to climate change. Vegetation is increasingly used in applications such as constructed wetlands, for green space reclamation and for tertiary wastewater treatment schemes such as colliery spoil drainage.

Most contaminated sites are located in close proximity to terrestrial and wetland sites of ecological importance. It is vital that the effect of climate change on pollutant linkage be explored so that suitable protection measures can be implemented if required.

Method

- Project is a collaboration between University of Cambridge (lead Institution), Forest Research, College of Estate Management, University of Reading & BRE.
- Investigators: Dr Abir Al-Tabbaa, Professor Peter Guthrie, Dr Andy Moffat, Tony Hutchings, Dr Stephen Garvin, Dr Tim Dixon, Dr Mike Raco, Joe Doak & Dr Sophie Boulby.
- Researchers: Sinéad Smith (PhD student, University of Cambridge), 3 years.
Three RAs for up to six months each at FR, Reading/CEM and BRE in latter half of project.
Post-doc at Cambridge University at later half of project.
- Dates: 8 October 2003 for 3 years.
- Data to be collected or generated
 - Collation of information*
 1. Literature review
 2. Obtain climate change scenarios/adaptation tool kits (from climate change research agencies, principally UKCIP)
 3. Liaison with land remediation agencies including OPDM, DEFRA, Regional Development Agencies, Environment Agency
 4. Determine requirements for further experimental/modelling work
 - Experiments/surveys
 - Impacts of climate change on ground contamination*
 1. Experimental work based on simulated ground contamination and contaminant containment systems subjected to various environmental conditions predicted under climate change scenarios
 2. Various different time-scales simulated under accelerated conditions to quantify long- and short-term effects
 3. Range of climate changes and cyclic effects will be investigated
 - Evaluating effects on contamination linkages*
 1. Climate change scenarios will be applied to land-use/vegetation suitability models (e.g. CONSIM, CLEA) to evaluate the robustness of common vegetation strategies, in collaboration with WP F.
 2. Processes studied will include sediment movement via wind and water erosion, surface water and groundwater regimes, hydrological changes in soil water flux magnitude and direction, contaminant speciation and adsorption, mineralisation, weathering processes and plant growth.
 - Adaptation strategies*
 1. Literature review, interviews/case studies and focus groups will be used to formulate adaptation strategies
 - Interpretation
 - Adaptation strategies and responses*
 1. Current engineering design and remediation practices will be reviewed in the light of experimental results to determine whether existing strategies are suitable
 2. Adaptation strategies will be developed for key stakeholders including local authorities, site owners, investors and developers
 3. Decision-support framework formulated to clearly define the interaction between climate change and brownfield regeneration