SIREn: the site for innovative research into monitored natural attenuation

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Abstract The aims of the SIREn project were to identify a site that could allow demonstration of monitored natural attenuation (MNA) under UK conditions and to make that site available as a national research facility. A chemical works was identified which is contaminated with substances including BTEX, styrene, naphthalene, and chlorinated aliphatic hydrocarbons (CAH). There are four geological layers: sand and gravels, overlaying clay, overlaying sands and gravels, overlaying sandstone. Several plumes have been identified, at least one of which has entered the sandstone aquifer. Technical reports (the site selection procedure and the conceptual site model) are available from the Environment Agency. The site is available to researchers for five years in the first instance, and SIREn welcomes proposals. The site offers an excellent opportunity for MNA research.

Key words BTEX; chlorinated solvents; consolidated aquifer; monitored natural attenuation; UK

INTRODUCTION

Monitored natural attenuation (MNA) can be harnessed to mitigate the risk to health and the environment associated with soil and groundwater contamination. As such it may be an effective and cost-effective remedial tool even when compared with more traditional engineering options. Although there is significant experience in North America, The Netherlands and Germany, of assessing and monitoring natural attenuation processes the great majority of these cases have been on shallow, unconsolidated geology. There is very limited experience with MNA in consolidated formations. However, such conditions are common in the UK. There is also low awareness of the potential for natural attenuation amongst regulators, problem owners, property developers and consultants in the UK (BBSRC, 1999; DETR, 2001). One common difficulty in carrying out research has often been securing access to a suitable site. A well documented demonstration of MNA has a crucial role to play in improving understanding of this approach and can provide a platform for further research.

The partners involved therefore came together to address these two needs: to provide a well documented case study of MNA and to create a unique national facility for further research. Herein we introduce the site selected for the SIREn project (Site
for Innovative Research on Monitored Natural Attenuation). The site will be available for large scale research and development from summer 2002 for five years.

RESULTS

Site selection

A series of criteria for a suitable site were drawn up and initial assessments were made of over 200 potential sites around the UK. The criteria included environmental and geological considerations, legal and regulatory concerns and long-term availability. From the initial 200+ sites, 41 were found to lie over consolidated aquifers. Thirty sites were available for 3–5 years, a prerequisite for any site chosen for long-term research. The likelihood of contaminant migration off-site further decreased the number of possible sites to 18 of which just four were not undergoing remediation. It was from these locations that the SIReN site was chosen (Table 1; Environment Agency, 2000b).

Table 1 Evaluation of the four sites pre-selected for the SIReN project.

<table>
<thead>
<tr>
<th>Site</th>
<th>Site characterization</th>
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<tbody>
<tr>
<td>Waste transfer centre</td>
<td>Nine metres of blown sand overlaying Upper Carboniferous Sandstone. PAH, CAH, and CFCs (slow attenuation). Site contamination is subject to additional investigation because of migration off-site.</td>
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<tr>
<td>Petroleum distribution plant</td>
<td>Limited number of source areas, mainly cleared. Consolidated aquifer. Plume flow towards the nearby river. Multiple owners.</td>
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<tr>
<td>Chemical plant</td>
<td>Large site. Unconsolidated and consolidated (sandstone) aquifers. Site geology: four layers (sand and gravels, overlaying clay, overlaying sands and gravels, overlaying sandstone). Mixed BTEX, volatile chlorinated solvents, LNAPL, DNAPL multi-level plumes with a limited number of sources. Single owner.</td>
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Of these four locations the single owner chemical plant was selected as the most appropriate site for the SIREN project.

Site characterization

The Environment Agency has recently published guidance on the assessment of monitored natural attenuation (Environment Agency, 2000a). Following these Agency guidelines, site characterization took the form of development of a conceptual site model (CSM) based on intrusive site investigation data (Environment Agency, 2001; Sheffield, 2001). The CSM confirmed that the major contaminants at this site are benzene, toluene, ethyl benzene and xylenes (BTEX), styrene, naphthalene, and chlorinated aliphatic hydrocarbons (CAH).

Thus far, 76 monitoring wells have been installed throughout the site in clusters. Contaminants are present in a number of plumes in both the perched groundwater and the sandstone aquifer. At least two of the plumes have penetrated the clay layer with at least one of these having entered the Sherwood Sandstone aquifer, considered a “major aquifer” by the Environment Agency (Environment Agency, 2001). Chemical and
microbiological evidence has indicated that BTEX biodegradation is occurring at the site with components in several locations at the site decreasing in concentration between 1995 and 2000 (Environment Agency, 2001; A. Tucker, personal communication). Moreover, the data thus far obtained for CAH and CAH daughter products (including vinyl chloride, ethane and ethene) has suggested that the natural attenuation of CAHs is progressing (Environment Agency, 2001).

Establishment of SIReN as a research facility

To date information concerning the SIReN project has been disseminated in presentations at both national (NNAGS Sheffield, 2000) and international (Consoil, 2000) conferences, and at meetings held within conferences (e.g. NNAGS SKB workshop follow up meeting, Consoil, 2000). All SIReN technical reports can be obtained via the project management; contact details are available at:

www.claire.co.uk/siren/index.htm

A more detailed characterization of the major contaminant plumes is ongoing and will be completed by early 2002. Following completion of this site characterization, a further Environment Agency R&D Technical Report will be produced which will be most easily obtained by contacting the SIReN project management, e.g.

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Funding

The project as a demonstration of MNA, and establishment of the site, has been funded by Shell and the Environment Agency. Further funding from these will be limited to modest amounts to provide site maintenance and administration. Projects wishing to use the site will need to source their own funding, and will benefit from the ongoing site maintenance, access to all site characterization data, and the comprehensive project management. Research groups interested in utilizing the SIReN site are advised to first contact the project management for details of up-to-date characterization and technical reports. The SIReN project has been registered with CL:AIRE. As such, any project submissions are encouraged to also register as CL:AIRE projects.

REFERENCES