Optimizing a Complex Remediation Project in an Evolving Environment

Camillo Coladonato (Dow Chemical [Australia] Pty Ltd., Melbourne, Australia)
Bryan Goodwin (Goodwin Remediation Consulting Pty Ltd.)
Peter Nadebaum (Peter.nadebaum@ghd.com) (GHD, Melbourne, Australia)

Overview. The evolution of a complex Australian Groundwater Remediation Project in fractured rock reflects the evolution of the environmental industry in Australia, and the need to select, adapt and optimize remedial approaches to changing regulatory and community requirements, and most recently adopting the principles of sustainable management and remediation.

The Australian Groundwater Remediation Project involves cleaning up soil and groundwater contamination that has resulted from chemical manufacture, involving a range of chlorinated organics and metals, with a particular focus on 1,2-dichloroethane (EDC) contamination resulting from a fire in the late 1960s. The contamination is present on site in fractured basalt, and has extended off site as a groundwater plume under downgradient industrial and commercial premises, and at the far end of the plume, residential land. Stakeholders, including EPA and the local community, have been closely involved. A conceptual site model has been developed to describe the soil and groundwater contamination, and a cleanup strategy and target levels have been agreed upon. Because of the inherent complexity of the project, remedial activities at the site will continue for some years.

Initial work in the late 1990s focused on pump and treat to contain off-site migration of contaminants; however, this was not found to be viable in view of the high natural salinity of the aquifer, the difficulty of disposal of saline water, and the very long time that it would take to significantly reduce the mass of contamination. The focus then shifted to in situ treatment technologies, including soil vapor extraction, air sparging (SVE/AS), and in situ bioremediation.

Results of initial SVE/AS trials were encouraging, but the technology was impaired by limited connections between the fractures of the basalt. To improve performance, blasting was undertaken in 2004 to increase the vertical connectivity of the fractures in sections of the basalt along the site downgradient boundary. This was successful and the SVE/AS system has subsequently been operating effectively. In parallel, since the late 1990s, in situ bioremediation was pursued as it was seen to offer significant advantages, if it could be made to work. Various rounds of pilot studies were undertaken; initial studies were not encouraging; however, as understanding of environmental microbiology evolved, in the late 2000s a native bacterial population able to treat the site contaminants of concern was discovered. In the early 2010s, this resulted in the successful full-scale application of enhanced in situ bioremediation (EISB) to particular areas of the site. Further work was undertaken to optimize the performance of the EISB system in terms of percentage destruction efficiency and cost effectiveness, utilizing propylene glycol which is manufactured on the site.

In the last few years, reflecting the evolution to adopt the principles of sustainable management and remediation of contaminated sites, further combinations of approaches and technologies are being applied to better understand and target risk reduction, to optimize performance, to achieve more rapid reduction in residual contamination levels, and to satisfy the long-term objective of restoring the aquifer. New technologies such as radio frequency heating to enhance the effectiveness of the existing EISB, and the use of zero valent iron (ZVI) to provide more complete boundary containment of chlorinated hydrocarbons using a permeable reactive barrier (PRB), are now being field tested.

This project emphasizes the need for complex and difficult remediation projects to continually review the approach being taken, to consider the optimization of existing methods, to consider the applicability of new technologies and approaches, and to adapt to evolving regulatory requirements.