Assessment and Remediation of Contaminated Environments

CSIRO research expertise in contaminated soil, water and groundwater environments delivers innovative and effective solutions to a range of clients.

There is a pressing need for technological advancement in the assessment and clean-up of contaminated sites – and more efficient, cost-effective and technically feasible solutions are on the horizon.

At CSIRO Land and Water we have a strong research focus on environmental assessment, monitoring and field-scale remediation technologies for industrial and urban pollutants – including petroleum fuels, chlorinated solvents, munition compounds, pesticides, nutrients, and metals.

We strive to:
- Understand and quantify the behaviour of contaminants in the environment
- Develop innovative technologies for the clean-up of contaminated sites
- Design, test and evaluate novel monitoring and modelling tools – for both site assessment and the evaluation of remediation strategies.

There is an emphasis on field-scale demonstration of technologies to encourage uptake and adoption, which is facilitated by partnerships with industry, government agencies and private consultants.

Access to expertise

Our multi-disciplinary research team draws on skills in soil physics, hydrogeology, groundwater hydrology, geochemistry, environmental and analytical chemistry, modelling, microbiology, computing, field and laboratory technical skills, and project management. We seek to link water flow dynamics, multi-phase partitioning of contaminants, geochemical reactions and microbial degradation processes to determine contaminant fate, quantify contaminant exposures and devise clean-up solutions.

Innovative treatments for environmental contaminants include permeable reactive barrier systems, bioremediation, air and fluid flushing technologies, immobilisation techniques, natural attenuation and phytoremediation. Research efforts target off-site plume migration and source-zone remediation.

Specialised probes monitor oxygen and volatile organics (providing continuous feedback on subsurface conditions), while mid-infra red spectroscopy (MIR) and the diffuse gradients in thin films (DGT) techniques are used for sampling and monitoring inorganics (arsenic, cadmium, chromium, selenium), pesticides, and recalcitrant organics (PAHs, organochlorines).

Accurate risk assessment can save industry tens of millions of dollars

CSIRO has a particularly strong track record in defining risk via assessment of exposure pathways for a variety of contaminants in subsurface environments.

We have investigated the fate of:
- Fuels, and chlorinated and brominated solvents in sand aquifers
- Munition residues in fractured aquifers
- Organic residues in urban soils
- Hydrocarbon vapours in sandy and clayey soils
- Components of Otto Fuel II (a torpedo propellant)

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Non-aqueous phase liquid (NAPL) in three phase (air, water, NAPL) systems
Hydrocarbons in groundwater discharging to riverine and marine ecosystems
Pesticides in groundwater

Both risk definition and risk reduction technologies have been developed.

Development and evaluation of remediation technologies

Some remediation techniques currently in use are not sustainable, or fail to address the risks posed by contaminants. Others are costly, inefficient or simply inadequate for Australian conditions. For example, one of the most commonly applied methods used for soil remediation (excavation and disposal to landfill) is no longer acceptable.

On-site or in situ remediation has a number of advantages: it avoids the movement of large volumes of contaminated soil or water, saving costs associated with infrastructure and long-term treatment. Complete contaminant mass removal may not be feasible, but risk reduction is usually possible.

Research projects that have evaluated remediation technologies at the field scale have included:

- Air flushing strategies such as in situ bioventing of diesel contamination
- Air sparging and soil vapour extraction to remEDIATE gasoline contaminated groundwater
- Biotreatment piles and composting to remEDIATE hydrocarbon contaminated soil
- Containment strategies such as permeable reactive barriers for pesticide, nutrient and metal-contaminated groundwater
- Bioclogging to provide temporary containment of contaminated groundwater
- Evaluation of synthetic covers to reduce oxygen ingress and potential acid generation in sulphide tailings
- Multi-phase extraction technologies such as enhanced petroleum NAPL product recovery at field scale
- Enhanced permeability fracturing of rock aquifers for contaminant removal

New devices are being developed along with modelling tools that enable the efficient gathering and interpretation of data, prediction of contaminant behaviour and exposures, and design of innovative clean-up strategies.

- Water treatment techniques to reduce mining-related and nutrient impacts
- Phytoremediation to remEDIATE hydrocarbon contaminated soil and groundwater

Partners in Research

Projects have been carried out with the petrochemical industry, the mining industry, the chemical industry, Federal and State environment agencies, the Australian Department of Defence, and others. International links have been established with key Universities and research centres in Europe, USA, Canada, Asia and on the Arabian Peninsula.

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