Understanding the fate of coal seam gas chemicals

Assessing the fate of chemicals used in the process of extracting coal seam gas is the focus of a new CSIRO report.

The report, *Human and environmental exposure assessment: soil to shallow groundwater pathways – A study of predicted environmental concentrations,* uses a one-dimensional soil model and a three-dimensional groundwater model to understand the potential concentration of chemicals in the environment which could impact human and environmental health under chemical spill scenarios. It is one of five reports CSIRO has contributed to the Australian Government's *National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia*.

The report found:

- In the event of a small spill (typically several litres), soil contamination remains shallow (less than two metres).
- For a large spill (a tank volume up to 15,000 litres), groundwater contamination may occur only if the soil-groundwater interface is shallow (4-6 metres) and if no emergency response, consisting of containment, isolation and decontamination, was to occur within 10 days of the spill.

A systematic analysis of uncertainties was undertaken. This involved consideration of different scenarios, pathways, and model parameters.

For public health risks, predicted environmental concentrations were calculated for:

- A spill of up to 15,000 litres from a fluid storage container into soil.
- A long-term (between 3 to 30 years) undetected but small (on the order of several mm per year or less) sub-surface leak from a water holding pond.

This report uses computer modelling to understand how people and the environment could come into contact with chemicals during coal seam gas extraction. It documents the development and application of a numerical model for predicting environmental concentrations of chemicals associated with coal seam gas extraction. Both soil and shallow groundwater models were developed to predict environmental concentrations under the specified spill scenarios.

National Assessment of Chemicals

The models developed in this report were used by other agencies in human health risk assessments for the *National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia*. The Assessment aimed to develop an improved understanding of the occupational, public health and environmental risks these chemicals could pose when either used in or mobilised by drilling and hydraulic fracturing for coal seam gas in Australia. It has assessed and characterised the risks to human health and the environment from surface handling of chemicals used in coal seam gas extraction between 2010 and 2012 when measures to protect workers, the public and the environment were not in place.

Strengthening knowledge of the chemicals used in coal seam gas extraction

This research significantly strengthens the level of knowledge about chemicals used in coal seam gas extraction in Australia, and what risks they may pose to the public and the environment. This information directly informs our understanding of which chemicals can continue to be used safely, and which chemicals are likely to require extra monitoring, industry management and regulatory consideration

How are chemicals used in the extraction of coal seam gas?

- Chemicals are used during the drilling of a well and sometimes during hydraulic fracturing.
- Hydraulic fracturing for coal seam gas is the process of pumping water, proppant (e.g. sand) and chemical additives under high pressure into the underground coal layers to increase permeability of coal layers which improves the release of the trapped coal seam gas.
- The water and chemicals are then pumped back out of the well, leaving most of the sand and small amounts of the chemicals underground, allowing the gases in the coal seam to flow back up the well and be piped to processing facilities.
- Due to the varying geology of coal seams, hydraulic fracturing is only used in some coal seam gas operations.
- 'Flowback' and other associated or 'produced' waters are stored on the surface in water holding ponds for treatment and re-use (including reinjection) or removal and eventual discharge.

Industry regulation

This research supports Australia's existing framework of government regulations and industrial best practice which aims to protect people and the environment from adverse effects of industrial chemical use. For coal seam gas extraction, there are existing laws, regulations, standards and industry codes of practice that cover chemical use, including workplace and public health and safety, environmental protection, and the transport, handling, storage and disposal of chemicals. CSIRO is actively engaged in a range of research relating to onshore unconventional gas activity to enhance our understanding of the opportunities and risks associated with this energy source.

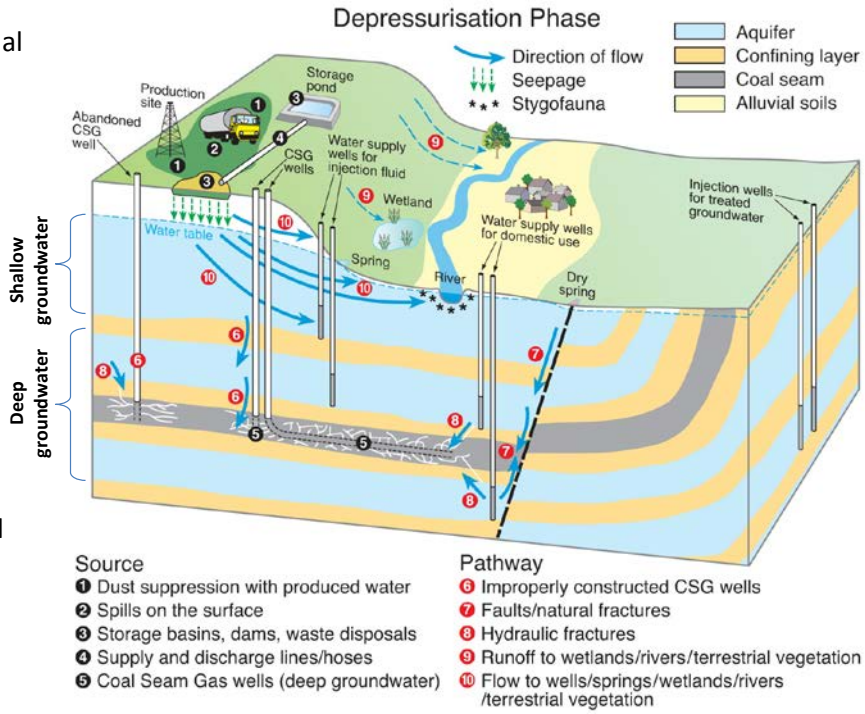

Figure 1 Possible contaminant sources at the coal seam gas site (1 to 5) and pathways (6 to 10) for transport of chemicals associated with hydraulic fracturing fluids.

Reference: Mallants D, Bekele E, Schmid W, Miotlinski K, Taylor A and Gerke K 2017, Human and environmental exposure assessment: Soil to shallow groundwater pathways – A study of predicted environmental concentrations, Project report prepared by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) as part of the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia, Commonwealth of Australia, Canberra.

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