

Extracts from

Groundwater Protection and Unconventional Gas Extraction: The Critical Need for Field-Based Hydrogeological Research

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- Unconventional natural gas extraction from **tight sandstones**, shales, and some coal-beds is typically accomplished by **horizontal drilling and hydraulic fracturing that is necessary for economic development of these new hydrocarbon resources**.
- Concerns have been raised regarding the potential for contamination of shallow groundwater by stray gases, formation waters, and fracturing chemicals associated with unconventional gas exploration. A lack of sound scientific hydrogeological field observations and a scarcity of published peer-reviewed articles on the effects of both **conventional** and unconventional oil and gas activities on shallow groundwater make it difficult to address these issues.
- Here, we discuss several case studies related to both **conventional and unconventional oil and gas activities** illustrating how under some circumstances stray or fugitive gas from deep gas-rich formations has migrated from the subsurface into shallow aquifers and how it has affected groundwater quality.
- Examples include impacts of uncemented well annuli in areas of historic drilling operations, effects related to poor cement bonding in both new and old hydrocarbon wells, and ineffective cementing practices.
- We also summarize studies describing how structural features influence the role of natural and induced fractures as contaminant fluid migration pathways.
- Although recent advances in directional drilling technology permit over **20 horizontal wells to be drilled from a single well pad**, large numbers of well pads can still create extensive regional footprints. (Can these additional bore holes be cased in cement to protect the Yarragadee?)
- Unfortunately, little peer-reviewed scientific information is available on the hydrogeological conditions—shallow groundwater quality in particular—associated with unconventional gas production or, for that matter, with conventional oil and gas production. There is a distinct

possibility such moratoria will continue until more objective scientific information is available.

- We discuss the potential contaminant migration pathways to shallow groundwater and the behaviour of these contaminants in shallow groundwater and factors affecting aquifer vulnerability. We stress that many of these problems are also common to conventional hydrocarbon production activities and are not solely related to unconventional gas production. Finally we address the field-based hydrogeological research needs necessary to help protect groundwater quality during the development of unconventional gas resources.
- The recovery of economic volumes of unconventional natural gas from low permeability and regionally extensive formations requires stimulation through hydraulic fracturing—that is, “fracing” or “fracking”—of the host rock.
- Because water used in hydraulic fracturing can imbibe (absorb) into the host rock’s matrix and reduce gas relative permeability (and hence gas production), nonaqueous based fracturing fluids provide an alternative approach that also assists with water supply and gas recovery issues.
- Clay stabilizer to prevent clay flocculation