



Public Health  
England

# The potential public health impacts of exposures to chemical and radioactive pollutants as a result of shale gas extraction

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# Public Health England

- Executive Agency of the Department of Health
- Established in April 2013, 5000 staff
- We protect and improve the nation's health and wellbeing, and reduce health inequalities.
- 9 local centres across 4 regions, supported by several expert centres
- We work closely with public health professionals throughout England, Wales, Scotland and Northern Ireland, and internationally.



# Background

- Shale gas extraction is at an early exploratory stage in UK
- Issue has resulted in public concern
- Reports suggest potential exists for adverse effects on the environment and human health
- Review based on published or peer-reviewed scientific literature until January 2014



# Potential Emissions to Air

- Direct emissions from engines during drilling and fracking operations and compressors used to capture and transport the gas on site. Pollutants may include particulate matter (PM), carbon monoxide (CO), NO<sub>x</sub> including nitrogen dioxide (NO<sub>2</sub>).
- Emissions from the venting of condensate and oil tanks on site. Pollutants may include a range of volatile organic compounds (VOCs).
- Emissions from gas capture and flaring. Pollutants may include methane, No<sub>x</sub>, PM and other gases (e.g. VOCs).
- Fugitive emissions associated with operational infrastructure e.g. storage tanks, leaks from pumps, valves, pipe connectors etc.



# Water and waste water

- Production and storage of fracking fluid and flowback water on site
- Possibility of spills which may percolate to subsurface aquifers or may enter surface water courses.
- Well blows out during well completion resulting in contamination of surface waters and also possible impacts on ground water.
- Possible contamination of aquifers during injection of fracking fluids and flow back if well integrity is not maintained.
- Potential release of methane and other gases reaching aquifers through poor well integrity and/or through fissures in the strata.
- Treatment and disposal of wastewaters; spills during transportation off-site or improper waste treatment prior to discharge may result in possible contamination of surface waters.



# Hydraulic Fracturing Fluid

- Operators in the UK intend to publicly disclose the chemical additives of fracturing fluids
- Water Framework Directive requires protection of groundwater against pollution by preventing or limiting the entry of pollutants to groundwater
- Joint Agencies Groundwater Directive Advisory Group (JAGDAG) will peer review assessments of fracking fluid components



# Radiological pollutants

- Potential for radon gas to be present in natural gas extracted from UK shale, as is the case with existing natural gas supplies.
- Using the existing UK model, it is estimated that natural gas containing radon at the upper end of the range (2,923 Bq m<sup>-3</sup>) reported by the USGS (Rowan and Kraemer, 2012) would give individual exposures of about 60 µSv/year representing about 2% of the UK average individual radiation exposure from all sources
- Myers T, 2012 concluded that, based on the depth of target shales, any radon released is likely to decay before it reaches any ground water supply via advection.
- UK has established capability to measure radon levels in various media including indoor air, water and natural gas (UK radon 2012).



# Radiological pollutants

- Levels of naturally occurring radioactive material (NORM) encountered are highly dependent on the local geology
- Analysis of flowback water from exploratory drilling in Lancashire by the Environment Agency (EA 2012) detected a number of radionuclides of natural origin, including  $^{40}\text{K}$ ,  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{214}\text{Bi}$ ,  $^{228}\text{Ac}$  and  $^{226}\text{Ra}$ .
- The waste management process will need to be optimised to ensure that the maximum dose to a member of the public is well below the dose constraint of 0.3 mSv per year





# Challenges

- Further work is needed to profile emissions during the stages of gas well development.
- Non-methane pollutant emissions appear to vary substantially by field type, number of well heads, completion process, and controls in place. Consideration is also needed of the impact of local meteorology and topography
- Other pollutant sources need further assessment. The existing background level of pollution needs further assessment as it is not clear how much extra pollution is caused by the shale gas extraction and related activities.
- Currently reported health concerns have multiple causes
- Epidemiological data must be combined with exposure data, proximity analysis, biomonitoring and biomarkers of exposure and effect



# Key Recommendations

- PHE needs to continue to work with regulators to ensure all aspects of shale gas extraction and related activities are properly risk assessed as part of the planning and permitting process.
- Baseline environmental monitoring is needed to facilitate the assessment of the impact of shale gas extraction on the environment and public health.
- Effective environmental monitoring in the vicinity of shale gas extraction sites is needed throughout the lifetime of development, production and post-production.
- Chemicals used in fracking fluid should be publically disclosed and risk assessed prior to use.
- The UK has the opportunity in advance of significant development of shale gas extraction activities to consider appropriate environmental and epidemiological studies to extend and strengthen the evidence base