Shale Gas Fracking Environmental Impact – Should we really be concerned?

Dr Mark Broomfield
Specialist Consultant

17 October 2013
Yes, but...
Yes, but…

- Should we be concerned? Yes of course…
  - … But does that mean we should not exploit it?
  - … What should we be concerned about?
  - … What can we do about those concerns?
- Can the environmental impacts be understood and managed?

- What would shale gas development look like?
- Environmental and health preliminary risk assessment
  - Priority areas for regulation
  - Further research
  - Should we be concerned?
Stages in shale gas field development

Stage 1: Site identification & preparation

Stage 2: Well design, drilling, casing & cementing

Stage 3: Technical hydraulic fracturing

Stage 4: Well completion, management of wastewater

Stage 5: Well production (refracturing may be carried out)

Stage 6: Well abandonment
Well pad during hydraulic fracturing

New York State DEC, 2011
Well pad during production phase

Photograph: Chesapeake Energy Corp
Associated infrastructure

Photograph: Noah Addis, Public Source [www.publicsource.org](http://www.publicsource.org)

Photograph: J and DR Pew
Associated infrastructure

Majorsville gas compressor station and fractionation plant, West Virginia

Houston Gas processing and cryogenic plant, Pennsylvania

Photographs: MarkWest Energy Partners LP
Associated infrastructure

Produced water storage facility, Texas
Photograph: Eastern Research Group
Shale gas field during production phase

- well pads
- pipelines
- compressor station
Shale gas field during production phase

From
www.fractracker.org
What could shale gas development in the UK look like?

- 23 – 65 trillion m³ of gas in the Bowland shale (BGS, 2013)
- Much less than this would be economically recoverable
- Annual consumption in the UK: 0.09 trillion m³
- UK Shale gas reserves are much thicker than US reserves, so will need new techniques
- Institute of Directors 2013
  - “each £1 million of capex and opex leads to the creation of 20 jobs in total (direct, indirect and induced).”
  - Estimate up to 1100 jobs created nationally with a peak in 2020
Environmental impacts

Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe.

Evidence

Monitoring and control of fugitive methane from unconventional gas.
European Commission study

- Commission saw a need for a coherent approach to unconventional fossil fuels
- DG ENV commissioned an initial assessment of the environmental and health risks and impacts associated with the use of hydraulic fracturing.

Study aims
- To enable objective evaluation of potential impacts
- To support legislative gap analysis at European level
- To identify priority areas for future research

Comprehensive study:
- Literature review and consultation
- Risk screening and prioritisation
- Regulatory gap analysis
- Industry and regulatory mitigation measures
European Commission study

- Preliminary risk assessment
- Based on industry framework for environmental risk assessment... but not an industrial/engineering site risk assessment
- All terms defined

<table>
<thead>
<tr>
<th>Probability classification</th>
<th>Slight</th>
<th>Minor</th>
<th>Moderate</th>
<th>Major</th>
<th>Catastrophic</th>
<th>No data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rare</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Occasional</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>Very high</td>
<td></td>
</tr>
<tr>
<td>Periodic/short term definite</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>Very high</td>
<td>Very high</td>
<td>Not classifiable</td>
</tr>
<tr>
<td>Frequent/long-term definite</td>
<td>Moderate</td>
<td>High</td>
<td>Very high</td>
<td>Very high</td>
<td>Very high</td>
<td></td>
</tr>
<tr>
<td>No data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not classifiable</td>
<td></td>
</tr>
</tbody>
</table>

“This approach ... has been applied ... to characterise the potential risks which could occur if specific mitigation ... is not carried out.”
# Environmental and health preliminary risk assessment: Individual well

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Site identification and preparation</th>
<th>Well design drilling, casing, cementing</th>
<th>Fracturing</th>
<th>Well completion</th>
<th>Production</th>
<th>Well abandonment and post-abandonment</th>
<th>Overall rating across all phases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater contamination</td>
<td>Not applicable</td>
<td>Low</td>
<td>Moderate-High</td>
<td>High</td>
<td>Moderate-High</td>
<td>Not classifiable</td>
<td>High</td>
</tr>
<tr>
<td>Surface water contamination</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate-High</td>
<td>High</td>
<td>Low</td>
<td>Not applicable</td>
<td>High</td>
</tr>
<tr>
<td>Water resources</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Moderate</td>
<td>Not applicable</td>
<td>Moderate</td>
<td>Not applicable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Release to air</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>Land take</td>
<td>Moderate</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Moderate</td>
<td>Not classifiable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Risk to biodiversity</td>
<td>Not classifiable</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Not classifiable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Noise impacts</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Not classifiable</td>
<td>Low</td>
<td>Not applicable</td>
<td>Moderate – High</td>
</tr>
<tr>
<td>Visual impact</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Not applicable</td>
<td>Low</td>
<td>Low-moderate</td>
<td>Low - Moderate</td>
</tr>
<tr>
<td>Seismicity</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Low</td>
<td>Low</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Low</td>
</tr>
<tr>
<td>Traffic</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Not applicable</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Environmental and health preliminary risk assessment: Cumulative

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Project phase</th>
<th>Overall rating across all phases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site identification and preparation</td>
<td>Well design drilling, casing, cementing</td>
</tr>
<tr>
<td>Groundwater contamination</td>
<td>Not applicable</td>
<td>Low</td>
</tr>
<tr>
<td>Surface water contamination</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Water resources</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Release to air</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Land take</td>
<td>Very high</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Risk to biodiversity</td>
<td>Not classifiable</td>
<td>Low</td>
</tr>
<tr>
<td>Noise impacts</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Visual impact</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Seismicity</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Traffic</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>
Environmental and health preliminary risk assessment findings

- Enables regulatory attention to be focused on key risks
  - (led into public consultation and further risk assessment studies)

- Cumulative impacts require consideration at initial stages of exploration
  - Very high: Land take (not expected to be so high in UK)
  - High: Groundwater contamination risk, accidents/spillages, water resources, air pollution, noise, traffic

- Management of groundwater contamination risks is critical:
  - 600 m separation between fracturing zone and groundwater
  - Systematic processes needed to characterise geological conditions
  - Quality and monitoring of casing and cementing is key
  - Baseline environmental monitoring required
  - Lack of data on impacts of repeated fracturing on well integrity

- Priority areas for future research
  - Biodiversity impacts
  - Long-term post-abandonment phase

- Climate impact: better than coal, marginally worse than piped conventional gas
Should we be concerned?

- Yes
  - The risks are real
  - The risks are not fully understood

- To frack, or not to frack – is no longer the question

- To frack safely or not is the question
  - We have a long history of managing industrial pollution
  - We are happy to let others deal with the environmental impacts of our energy needs
  - If we want gas, we should be prepared to take responsibility
  - There will inevitably be impacts
  - Robust planning and pollution controls are needed and available
To frack, or not to frack: that is the question

Mark Broomfield – specialist consultant, Ricardo-AEA

If you wanted to come up with a way to undermine a burgeoning industry, you couldn’t do much better than the term “fracking”. In the voice of a mining engineer, it can sound as if the shale gas industry is intent on riding roughshod over community worries and concerns. Meanwhile, on protesters’ placards, a well-placed “frack” lends itself to sound-bites and images on TV bulletins and newspapers worldwide.

In the UK, for instance, the British Geological Society recently published an evaluation of shale gas resources in the north of England, which indicates that there may be about 23 - 65 trillion m³ of gas in place, although much less than this would be economically gas is present, we in the UK will need to develop our own expertise to deal with the new technical challenges posed by the country’s reserves, which are much deeper and much thicker than those which have been successfully developed in the US.

We seem happy enough to let other nations accept the environmental risks of meeting their energy needs.

European Commission “Environmental Aspects on Unconventional Fossil Fuels”