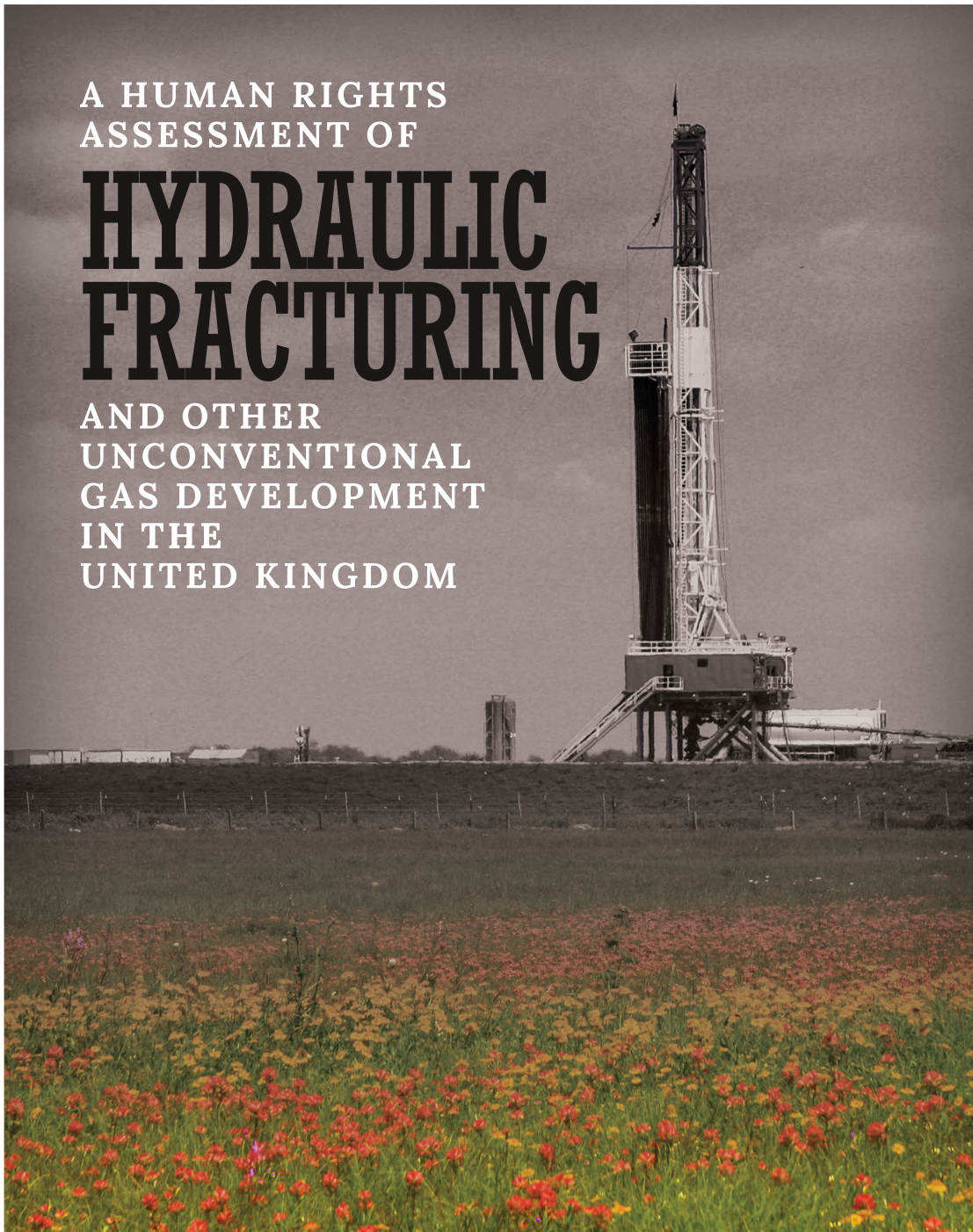


A HUMAN RIGHTS
ASSESSMENT OF
**HYDRAULIC
FRACTURING**

AND OTHER
UNCONVENTIONAL
GAS DEVELOPMENT
IN THE
UNITED KINGDOM



Global Network for the Study of
Human Rights and the Environment
<http://gnhre.org>

Environment and Human Rights Advisory
<http://environmentandhumanrights.org>

Human Rights Consortium
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A Human Rights Assessment of Hydraulic Fracturing and Other Unconventional Gas Development in the United Kingdom

Prepared for:

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Commissioned by: The Bianca Jagger Human Rights Foundation

Matter of Concern: Environmental, Human Health and Climate
Impacts Associated with Hydraulic Fracturing
Operations

Date: October 30, 2014



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Appendix A: *Compendium of Scientific, Medical and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction)*, Concerned Health Professionals of New York, July 10, 2014

Appendix B: Report of the Independent Expert on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment, John H. Knox

Executive Summary

This Report argues that the UK Government has a clear and urgent duty to fully investigate the human rights implications of fracking before authorising any exploratory or extractive fracking operations in the UK. It strongly recommends a moratorium on the conduct of fracking operations until such a time as a full, industry-independent, publicly funded Human Rights Impact Assessment has been properly undertaken and placed in the public domain.

1. Introduction

This Report focuses on the human rights implications of the proposed adoption in the UK of a particular technique of oil and gas extraction, known as hydraulic fracturing or 'fracking'. While conventional oil and gas deposits are fairly easily recovered from permeable rocks such as sandstone, unconventional deposits are trapped in low permeability rock, like shale, and are extracted by drilling hundreds of metres below the surface and creating tiny fractures (hence the term 'fracking') to release the oil or gas. An earlier form of fracking has previously been used in the UK (and elsewhere), but the use of directional drilling (horizontal as well as vertical) and the pumping of large volumes of water containing sand and additive chemicals at high pressure to bring about fracturing together pose new challenges and risks. These include a range of potentially adverse and serious effects on health and the environment and, importantly for this Report, on human rights. While much has been written about the likely risks associated with fracking operations, there has been virtually no consideration at the policy level of the human rights dimensions of the issue. This Report seeks to make good this omission by offering a brief account of the human rights implications of fracking.

Before proceeding, it is important to note that this report is concerned primarily with fracking for shale gas since this has been the focus of much of the recent policy debate in the UK. However, while references herein are specifically directed towards fracking, many of the issues raised are relevant for unconventional gas production generally.

1.1 Policies

The current UK Government is proactively and publicly committed to a pro-fracking stance.¹ Its enthusiasm for unconventional gas production is said to

¹ Oral Statement to Parliament by the Rt. Hon George Osborne MP, 26th June 2013, <<https://www.gov.uk/government/speeches/spending-round-2013-speech>>, accessed 14th March 2014; Written Statement to Parliament by the Rt. Hon Edward Davey MP, 'Exploration for shale gas', 13th

have been inspired by developments in the United States, where a widely publicised shale gas ‘boom’ has transformed the perceptions of some about the place of unconventional gas in the future global energy mix.² The discovery of shale gas resources in the UK has led to calls for its exploitation based on the assumption that the technology will produce economic benefits similar to those claimed in the US. Although the consensus is that shale gas is unlikely to be a ‘game changer’ in the UK, the Government claims it could be an important energy resource in the UK’s transition to a low-carbon future. In particular, it has been suggested that fracking for shale gas will contribute to overcoming the UK’s so-called ‘energy trilemma’ by reducing energy bills, reducing emissions and enhancing energy security.³ To avoid any doubt about the Government’s position, Prime Minister David Cameron recently confirmed that ‘we’re going all out for shale’.⁴

To that end, the Government has introduced a range of policy initiatives designed to encourage shale gas development in the UK. These include tax reductions to incentivise industry investment, as well as proposals to allow local councils to retain 100% (instead of 50%) of the business rates collected from shale gas sites.⁵ The Government has also published several guidance documents to supplement existing regulatory provisions, since those provisions currently make no specific mention of hydraulic fracturing or ‘fracking’.⁶ These forms of guidance aim to clarify the application of regulations to fracking in order to avoid delays in the environmental permitting and planning permission processes. The Government has also worked closely with industry representatives to ensure that local communities also benefit from fracking operations. For instance, the UK Onshore Operators Group (UKOOG) has issued a Community Engagement Charter to ensure ‘open and transparent communications between industry, stakeholder groups and the communities’ in which unconventional oil and gas reservoirs are worked.⁷ Under the Charter, communities will also be entitled to £100,000 for every exploratory site fracked and a 1% share of profits from commercial production.

December 2012, <<https://www.gov.uk/government/speeches/written-ministerial-statement-by-edward-davey-exploration-for-shale-gas>>, accessed 13th March 2014.

² Department of Energy and Climate Change and The Rt Hon Michael Fallon MP, Speech ‘Michael Fallon addressed the Tudor Pickering Holt seminar: UK in Focus - government’s role in the investment environment’, 22 November 2013, <<https://www.gov.uk/government/speeches/speech-to-a-tudor-pickering-holt-seminar>> accessed 12 June 2014.

³ HM Treasury, A Fiscal Regime for Shale Gas: Summary of Responses, December 2013, Foreword by Nicky Morgan, Economic Secretary to the Treasury, at page 3: ‘It could create thousands of jobs, generate billions of pounds of business investment, lead to substantial revenue for the Exchequer and increase our energy security. Critically, it also has the potential to drive down energy bills for households and businesses’.

⁴ ‘Local councils to receive millions in business rates from shale gas developments’, 13 January 2014, <<https://www.gov.uk/government/news/local-councils-to-receive-millions-in-business-rates-from-shale-gas-developments>> accessed 16 April 2014.

⁵ Ibid.

⁶ Department for Communities and Local Government, *Planning practice guidance for onshore oil and gas*, July 2013.

⁷ UKOOG, *Community Engagement Charter: Oil and Gas from Unconventional Reservoirs*, June 2013.

As intimated above, arguments concerning the anticipated and putative benefits of fracking focus upon three main concerns:

- Cleaner energy, reduced carbon emissions

It is often argued that, because shale gas is said to be cleaner than coal, it will lead to lower greenhouse gas (GHG) emissions. The UK Government has committed itself to reducing GHG emissions by at least 80% by 2050 compared with 1990 levels⁸ and has been advised by the statutory Committee on Climate Change that gas-fired power stations have a role to play in the GHG reduction strategy, since the burning of gas emits 57% carbon dioxide per kilowatt hour less than coal-fired power plants.⁹ The Department for Energy and Climate Change (DECC) also claims that ‘emissions from the production and transport of UK shale gas would likely be lower than from the imported Liquefied Natural Gas that it could replace’,¹⁰ and that ‘[r]eplacing coal or petroleum with natural gas can help us reduce greenhouse gas emissions in the near-to-mid-term’.¹¹

- Indigenous energy supply — improved energy security

It is clear that conventional gas resources in the UK are rapidly depleting and that UK conventional gas production has declined.¹² Estimates concerning future production also point towards this trend continuing.¹³ Accordingly, it is clear that any further increase in the use of gas for power generation will require increasing levels of imports from beyond the UK. Accordingly, the current Government has concluded that increasing our indigenous energy supply will contribute to the UK’s energy security, and make it less vulnerable to market volatilities.

- Lower gas prices

In a situation in which dual fuel bills for the average UK household have increased 40% between 2006-2013¹⁴ — and despite the fact that this may in part reflect existing industry practices and profit margin expansion¹⁵ — a dash for cheap natural gas has been embraced as part of the UK Government’s strategy.

⁸ Climate Change Act 2008, s 1(1).

⁹ Department of Energy and Climate Change (DECC), *Digest of United Kingdom energy statistics 2012 – Chapter 5: Electricity*, (London: DECC, 2012).

¹⁰ DECC, *Developing Onshore Shale Gas and Oil – Facts about ‘Fracking’*, December 2013, 10.

¹¹ DECC, *Fracking UK Shale: Climate Change*, February 2014, 3.

¹² S Bassi, et al, ‘A UK ‘dash’ for smart gas: Policy Brief’ March 2013 (London, Grantham Research Institute on Climate Change and Environment, 2013), 19, citing National Grid, *UK Future Energy Scenarios* (London, National Grid, 2012) available at <<http://www2.nationalgrid.com/uk/industry-information/future-of-energy/future-energy-scenarios/>> accessed 10th July 2014.

¹³ *Ibid.*

¹⁴ Ofgem, *Electricity and gas supply market indicators* (London: Ofgem, 2013).

¹⁵ K McCann ‘Big Six Energy Firms Face Fresh Accusations of Profiteering’: June 27, 2014—A M News. Available at <<http://www.cityam.com/1403831554/energy-firms-face-probe-over-competition>> (date of last access: 20th July (2014)).

1.2 Risks and uncertainties

Fracking is associated with a range of risks to health and/or the environment. Among the principal concerns are:

- Risk of surface water and soils contamination from surface spills;¹⁶
- Risk of groundwater contamination from leaks at depth;¹⁷
- Poorly designed or maintained wells and risk of well casing failures over time;¹⁸
- Radiation risks to surface and groundwater from documented radiation in waste fluids and drill cuttings;¹⁹
- Increased pressure on and competition for water resources;²⁰
- Impact on local air quality of direct emissions from drilling sites at each stage of the process;²¹
- Traffic, noise, light and dust pollution associated with fracking operations;
- Risk of spills from improper disposal of waste fluids and drill cuttings;²²
- Seismic risks associated with injection well disposal of waste fluids;²³
- Impact on climate change caused by fugitive emissions and the subsequent burning of gas;²⁴
- Landscape disruption;
- Compromised land stability.²⁵

In 2012, the UN Environment Programme (UNEP) issued a 'Global Environment Alert' on the issue of fracking, warning of the considerable health and environmental risks associated with unconventional gas production.

¹⁶ SM Olmstead et al., 'Shale Gas Development Impacts on Surface Water Quality in Pennsylvania' *Proceedings of the National Academy of the Sciences*, March 11, (2013), doi:10.1073/pnas.1213871110

¹⁷ M Fischetti, 'Groundwater Contamination May End the Gas-Fracking Boom', *Scientific American*, Aug 20, (2013). <http://www.scientificamerican.com/article/groundwater-contamination-may-end-the-gas-fracking-boom/>. Accessed July 19, 2013.

¹⁸ A Ingraffea, et al., 'Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000-2012', May, (2014) *Proceedings of the National Academy of the Sciences*. doi:10.1073/pnas.1323422111

¹⁹ Concerned Health Professionals of New York, *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction)* 10 July 2014, 5, 29-32, <http://concernedhealthny.org/wp-content/uploads/2014/07/CHPNY-Fracking-Compendium.pdf>, accessed 14 July 2014. P Mobbs, 'An abuse of science - concealing fracking's radioactive footprint', *The Ecologist*, 8th July (2014). Available at http://www.theecologist.org/News/news_analysis/2469495/an_abuse_of_science_concealing_frackings_radioactive_footprint.html

²⁰ S Postel. 'As oil and gas drilling competes for water, one New Mexico County says no', *National Geographic*, May 3, (2013).

²¹ T Colborn, et al 'An Exploratory Study of Air Quality Near Natural Gas Operations', *Human and Ecological Risk Assessment: An International Journal* [Volume 20, Issue 1](#), (2014).

²² Olmstead et al, n 16 above.

²³ N J Van der Elst, 'Enhanced Remote Earthquake Triggering at Fluid-Injection Sites in the Midwestern United States', *Science* 12 July 2013: Vol. 341 no. 6142 pp. 164-167 DOI: 10.1126/science.1238948

²⁴ RW Howarth, R Santoro and A Ingraffea, 'Methane and the Greenhouse-Gas Footprint of Natural Gas from Shale Formations' (2011) 106 *Climate Change* 679; RA Howarth. 'A bridge to nowhere: methane emissions and the greenhouse gas footprint of natural gas', (2014) *Energy Science and Engineering*, doi: 10.1002/ese3.35

²⁵ R Heinberg, *Snake Oil* (Sussex: Clairview Books, 2014) at 87-89.

UNEP also cautioned that the potential benefits of coal-to-gas substitution 'are both less clear and more limited than initially claimed'.²⁶ Other studies show that industry estimates of shale gas reserves have been notoriously unreliable.²⁷ Consequently, it is not entirely clear that the unconventional production of shale gas is the best way forward, despite the Government's current commitment to development by offering support for fracking companies to begin exploration and production.

For example, while it is conceivable that domestically produced shale gas may contribute to reducing the impact of potential price shocks caused by supply interruption or shortages of imported gas, it is unclear that a) the amount of domestic shale gas will be sufficient to achieve the Government's energy security goal and b) the commercial production of shale gas will be worth the human and environmental risks — particularly given the availability of alternative, safer forms of energy supply that could be invested in and pursued. Furthermore, while fracking for shale gas is commonly represented as a convenient 'bridging' fuel to a low-carbon future, there is little evidence of energy policy beyond the short or medium term, a fact undermining the plausibility of such a future-facing climate argument.

Regarding the purported economic benefit for consumers, the Grantham Research Institute's examination of energy costs and the implications of shale gas production for wholesale prices and consumer bills suggests that despite the fact that 'domestic shale gas production could benefit the economy by generating jobs and tax revenues while displacing imports, it is unlikely that gas consumers would see much, if any, benefit in terms of reduced gas and electricity bills'.²⁸ A report published by the DECC also notes that '[b]ecause the UK is well-connected to the Western European gas market, the effect of UK shale gas production on gas prices is likely to be small'.²⁹

Likewise, the emissions benefits of UK shale gas production are not universally accepted or known for certain. It has been reported, for example, that the UK production of shale 'could increase global cumulative GHG emissions if the fossil fuels displaced by shale gas are used elsewhere'.³⁰ This 'carbon leakage' problem is not unique to fracking, but it is brought into

²⁶ UNEP Global Environmental Alert Service, *Thematic Focus: Resource Efficiency, Harmful Substances and Hazardous Waste, Gas fracking: can we safely squeeze the rocks?* November 2012, 1, < http://na.unep.net/geas/archive/pdfs/GEAS_Nov2012_Fracking.pdf>. Accessed 10 July 2014.

²⁷ Concerned Health Professionals of New York, *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction)* 10 July 2014, 7, 62-64, <http://concernedhealthny.org/wp-content/uploads/2014/07/CHPNY-Fracking-Compendium.pdf>, accessed 14 July 2014.

²⁸ S Bassi, *et al*, 'A UK 'dash' for smart gas' Policy Brief March 2013 (London, Grantham Research Institute on Climate Change and Environment, 2013), 18. In this connection, it is worth noting that current regulatory controls of market actors in the energy sector consistently fail to protect consumers adequately against price hikes or (particularly apposite here) to ensure that supply-side price falls are passed on to consumers: See M Beech: 'Davey: There is a problem with passing on wholesale costs' at <http://www.utilityweek.co.uk/news/davey-there-is-a-problem-with-passing-on-wholesale-costs/1022042#.U8keOFJ0XMw> 19/06/2014.

²⁹ DECC, D MacKay, T Stone, *Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use*, September 2013, 5.

³⁰ Howarth *et al*, n 24 above.

particularly sharp focus by the oft-repeated argument that shale gas is 'part of the answer to climate change',³¹ an argument undermined by recent peer reviewed academic research.³² A Tyndall Centre report concludes that emissions from large-scale shale gas fracking in the UK 'would likely be very substantial in their own right',³³ going on to note that '[i]f the UK Government is to respect its obligations under both the Copenhagen Accord and Low Carbon Transition Plan, shale gas offers no meaningful potential as even a transition fuel.'³⁴ Moreover, a recent peer reviewed academic research paper from Cornell University in the US casts doubt on the 'bridge fuel' argument. After analysing the latest and best data available, the paper concluded that over the crucial 20-year time period that must be prioritised because of the urgent need to reduce methane emissions over the coming 15–35 years, and comparing the warming potential of methane to carbon dioxide, both shale gas and conventional natural gas have a larger GHG impact than do coal or oil.³⁵ Furthermore, shale gas may divert attention and, more importantly, investment, from alternative, renewable energy sources.³⁶ In summary, the Government and industry's 'bridge fuel'/climate change arguments in favour of shale gas production face considered and serious refutation by well-established independent research and policy institutions.

In light of the considerable uncertainty concerning the proposed benefits of fracking, the Government is in favour of proceeding for now with exploratory fracking for shale gas in order to determine how much is likely to be technically or commercially recoverable in the UK, and to develop a more accurate assessment of the risks.³⁷ This position, however, seems somewhat at odds with David Cameron's 'all out for shale gas' statement and the other signals visible in the Government's policy decisions, such as the recently announced plan to modify trespass law in order to enable the intrusion into a landowner's subsoil by fracking companies irrespective of the landowner's absence of consent or even active resistance to the prospect. Moreover, the uncertainty in this field extends beyond technical aspects of risk and cannot

³¹ DECC and The Rt Hon Edward Davey, Speech, 'The Myths and Realities of Shale Gas Exploration', 9 September 2013, <<https://www.gov.uk/government/speeches/the-myths-and-realities-of-shale-gas-exploration>> accessed 10 July 2014.

³² 'A range of studies have shown high levels of methane leaks from gas drilling and fracking operations, undermining the notion that natural gas is a climate solution or a transition fuel. Major studies have concluded that early work by the EPA greatly underestimated the impacts of methane and natural gas drilling on the climate. Drilling, fracking and expanded use of natural gas threaten not only to exacerbate climate change but also to stifle investments in, and expansion of, renewable energy'. Concerned Health Professionals of New York, *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction)* 10 July 2014, 7, 50-55, <http://concernedhealthny.org/wp-content/uploads/2014/07/CHPNY-Fracking-Compendium.pdf>, accessed 14 July 2014.

³³ Tyndall Centre for Climate Change Research, 'Shale gas: an updated assessment of environmental and climate change impacts', November 2011, 7.

³⁴ *Ibid.*

³⁵ Howarth, 'A bridge to nowhere', n 24 above.

³⁶ DP Schrag, 'Is shale gas good for climate change?' (2012) 141(2) *Daedalus*, 72.

³⁷ See, for example, the conclusions of the House of Commons Energy and Climate Change Committee: 'The Impact of Shale Gas on Energy Markets', Seventh Report of Session 2012-13, Volume 1. Available at <<https://www.publications.parliament.uk/pa/cm201213/cmselect/cmenergy/785/785.pdf>>. (date of last access: 12th July 2014).

responsibly be resolved simply by giving the green light to fracking exploration and operations. Indeed, the broader social implications of shale gas fracking remain significantly under-explored. For example, opportunities for public consultation on the Government's strategy on shale gas have so far been limited. Additionally, the appropriateness of existing regulation — as it applies to fracking — is subject to important and well-informed disagreement. Whereas some might argue that existing regulatory frameworks are able to deal with any associated risks, others contend that fracking exposes a host of problematic regulatory gaps.³⁸

In its Global Alert, UNEP concluded that '[u]ltimately the best solution would be to lessen our dependency on fossil fuels'.³⁹ Moreover, it warned that:

Given the uncertainty in terms of GHG emissions, public health, environmental issues and depletion of water resources, the continued development of UG [unconventional gas] reserves is an option which brings with it great responsibility.⁴⁰

This responsibility is (at best) incompletely expressed in any situation where the full range of human, environmental and social factors is not fully, independently and rationally weighed up before permission is given to proceed with the exploration and exploitation of shale gas reserves. A failure properly to take all relevant factors into consideration amounts to a most serious breach of public trust. The human rights dimensions of fracking are a central consideration in ensuring the requisite degree of respect for relevant substantive international and national law and principles. The human rights implications of fracking are extremely pressing — as is increasingly made clear in international law and policy fora — and the absence of a full and proper assessment of the human rights implications of fracking in the UK

³⁸ See for example, European Commission, Impact Assessment Accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on 'Exploration and production of hydrocarbons (such as shale gas) using high volume hydraulic fracturing in the EU' SWD(2014) 21 final, especially Annex 9. Also E Stokes, 'Do we need new laws to regulate fracking?' Available at: <http://rationalist.org.uk/articles/4446/do-we-need-new-laws-to-regulate-fracking> (date of last access: 12th July 2014); 'Energy Generation in Wales: Shale Gas': Written Evidence from Dr. Elen Stokes, Law School, Cardiff University (ESG 16), available at <http://www.publications.parliament.uk/pa/cm201314/cmselect/cmwelaf/writev/esg16.htm> (date of last access, 12 July 2014). See also V Moore, A Beresford and B Gove, 'Hydraulic Fracturing for Shale Gas in the UK: Examining the Evidence for Potential Environmental Impacts' (RSPB, March 2014), especially at p. 47, where the authors of the report conclude that '[a]ctivities associated with unconventional gas exploration and production in the UK are covered by existing EU and national environmental legislation. Our analysis suggests that the current regulatory regime is not fit for purpose and therefore unable to adequately manage serious environmental risks that may arise from individual projects and cumulative developments, such as species disturbance, water stress and inevitably the residual risk around pollution. Additionally, there is a significant risk that taxpayers and third parties could be forced to pick up liability for damage caused'; furthermore see RSPB and others, 'Are We Fit to Frack? Policy Recommendations for a Robust Regulatory Framework for the Shale Gas Industry in the UK' (RSPB, Version 1.2 Amended, March 2014).

³⁹ UNEP Global Environmental Alert Service, *Thematic Focus: Resource Efficiency, Harmful Substances and Hazardous Waste, Gas fracking: can we safely squeeze the rocks?* November 2012, 10, < http://na.unep.net/geas/archive/pdfs/GEAS_Nov2012_Fracking.pdf > accessed 10 July 2014.

⁴⁰ Ibid.

represents a glaring omission in the current Government's approach to the issue.

This report now turns to a consideration of the human rights dimensions of fracking and the duties of the UK government under the most directly relevant human rights law and standards. There are multiple and overlapping sources of human rights obligations, particularly since the European Court of Human Rights increasingly draws upon a convergent range of international and national standards in its jurisprudence concerning environment and human rights questions. However, this report, as a *purely preliminary case* for a comprehensive, evidence-led Human Rights Impact Assessment of Fracking in the UK, focuses on the most compelling and direct sources of human rights liability for the current UK Government, in particular, the Human Rights Act 1998, the European Convention on Human Rights and Fundamental Freedoms and core English common law sources relevant to the protection of human rights.

2. UK and European Human Rights Law

The purpose of this Report is to call on the UK Government fully to consider the human rights dimensions of shale gas fracking activities and unconventional gas production — and to take seriously its own responsibility under human rights laws, both national and international.

2.1 Duties of UK Government

The UK is legally bound to respect and to protect human rights, both under the auspices of its own Human Rights Act 1998,⁴¹ and of the European Convention on Human Rights and Fundamental Freedoms 1950 (ECHR).⁴² The UK is also bound to respect multiple and interlocking standards under international human rights law — which includes the Universal Declaration of Human Rights,⁴³ the International Covenant on Civil and Political Rights (ICCPR),⁴⁴ and the International Covenant on Economic, Social and Cultural Rights (ICESCR).⁴⁵ Further specific human rights instruments of relevance include the European Social Charter,⁴⁶ the EU Charter of Fundamental Rights,⁴⁷ the Convention on the Rights of the Child,⁴⁸ and the 1998 'Aarhus'

⁴¹ Human Rights Act 1998. (c.42), London: HMSO.

⁴² Convention for the Protection of Human Rights and Fundamental Freedoms, opened for signature 4 November 1950, 213 UNTS 262 (entered into force 3 September 1953).

⁴³ GA Res 217 (111) of 10 December 1948, UN Doc A/810 at 71 (1948).

⁴⁴ Opened for signature 16 December 1966, 999 UNTS 171 (entered into force 23 March 1976).

⁴⁵ Opened for signature 16 December 1966, 993 UNTS 3 (entered into force 3 January 1976).

⁴⁶ European Social Charter, opened for signature 18 October 1961, 529 UNTS 89 (entered into force on 26 February 1965).

⁴⁷ Charter of Fundamental Rights of the European Union (2007/C 303/01).

⁴⁸ Opened for signature 20 November 1989, 1577 UNTS 3 (entered into force 2 September 1990).

Convention⁴⁹ which provides rights of access to information, to participation and to justice in environmental matters — and which draws extensively upon international human rights law.

2.2. Fracking as a Human Rights Issue

Fracking is clearly an issue through which human rights and the environment — and human rights and climate change — come into especially sharp focus. A 2011 UN Human Rights Council (HRC) Resolution on human rights and the environment specifically recognises that ‘environmental damage can have negative implications, both direct and indirect, for the effective enjoyment of human rights’.⁵⁰ More explicitly, a report submitted to the HRC in 2011 argues that the environmental damage caused by hydraulic fracturing for natural gas poses ‘a new threat to human rights’.⁵¹ Indeed, a range of negative effects of fracking has led one international NGO to petition the HRC⁵² to condemn the fracking process as a threat to basic human rights, particularly to the rights to water and to health.

More recently, the UN Special Rapporteur on the human right to safe drinking water and sanitation, Catarina de Albuquerque, concluded her recent mission to the United States by outlining serious concerns over the effect of a range of polluting activities associated with the hydraulic fracturing process, observing a distinct,

policy disconnect ... between polluting activities and their ultimate impact on the safety of drinking water sources. The absence of integrated thinking has generated enormous burdens, including increased costs to public water systems to monitor and treat water to remove regulated contaminants and detrimental health outcomes for individuals and communities.⁵³

The UN Special Rapporteur on the human rights obligations related to environmentally sound management and disposal of hazardous substances and waste, Calin Georgescu, also warned of the potential contamination of

⁴⁹ Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, opened for signature 25 June 1998, 2161 UNTS 447 (entered into force 30 October 2001).

⁵⁰ Document A/HRC/RES/16/11, Resolution adopted by the Human Rights Council: Human Rights and the environment, distributed 12th April 2011.

⁵¹ Document A/HRC/18/NGO/91, Written statement submitted by UNANIMA International, a non-governmental organization in special consultative status: ‘Hydraulic fracturing for natural gas: A new threat to human rights’, distributed 19th September 2011.

⁵² Human Rights Council (2011) Eighteenth session, Agenda 3, Promotion and protection of all human rights, civil, political, economic, social and cultural rights, including the right to development. A/HRC/18/NGO/91 ‘Hydraulic fracturing for natural gas: A new threat to human rights’, Written statement submitted by UNANIMA International, a non-governmental organization with special consultative status.

⁵³ United Nations (2011) A/HRC/18/33/Add.4 ‘*Report of the Special Rapporteur on the human right to safe drinking water and sanitation*’, Catarina de Albuquerque, Mission to the United States of America, 10-11, <http://www2.ohchr.org/english/bodies/hrcouncil/docs/18session/A-HRC-18-33-Add4_en.pdf> accessed 10 July 2014.

water supplies caused by fracking, specifically by the toxic substances in fracking fluids.⁵⁴

We turn now to address human rights norms of particular application to the UK and its Government in relation to the risks presented by fracking.

2.3 Principal Substantive UK Human Rights Obligations

Human Rights Act 1998

The Human Rights Act (HRA) 1998⁵⁵ incorporates a range of fundamental human rights contained in the European Convention on Human Rights and Fundamental Freedoms (ECHR), into UK law, enabling citizens to bring human rights claims directly before UK courts. Section 3 of the Act requires all UK legislation (past and present) to be read and given effect compatibly with the Convention, 'so far as it is possible to do so'. Moreover, in terms of section 6 it is 'unlawful for a public authority to act in a way which is incompatible with a Convention right' — a provision with direct relevance for a wide range of authorities involved in the present and future conduct of fracking related hearings, enquiries and decision making. Under section 7 HRA, any 'victim' of such an unlawful act by a public authority may bring proceedings under the Act.

Under section 2 UK courts are obliged to 'take into account' relevant jurisprudence of the European Court of Human Rights (ECtHR). In particular, UK Courts and tribunals must take into account any 'judgment, decision, declaration or advisory opinion of the European Court of Human Rights, or opinion of the Commission given in a report adopted under Article 31 of the Convention, or decision of the Commission in connection with Article 26 or 27(2) of the Convention, or decision of the Committee of Ministers taken under Article 46 of the Convention'. This is a relatively extensive set of potential sources of human rights authority of varying kinds with direct bearing on the development of UK human rights duties, although the UK courts and tribunals are also able to evolve, and have cautiously evolved, a distinctive UK human rights jurisprudence.⁵⁶ The UK higher Courts⁵⁷ have the power to make 'a declaration of incompatibility' concerning a legislative provision deemed incompatible with Convention rights.⁵⁸ However, Parliament has

⁵⁴ Report of the Special Rapporteur (Calin Georgescu) on the human rights obligations related to environmentally sound management and disposal of hazardous substances and waste' also warned that toxic substances in fracking fluids and resulting mud can be released into the surface water during the extraction, transport, storage and waste disposal stages. The storage of wastewater and other waste products may result in further contamination of water supplies due to spills, leaks and/or floods. (2012) UN doc A/HRC/21/48.

⁵⁵ Human Rights Act 1998. (c.42), London: HMSO.

⁵⁶ For a discussion of the constrained openness permitting the independent development of UK human rights jurisprudence, see Sir Philip Sales, 'Strasbourg Jurisprudence and the Human Rights Act' (2012) 2 *Public Law* 253.

⁵⁷ These are principally, the UK Supreme Court; the Judicial Committee of the Privy Council and the Court Martial Appeal Court; in Scotland the High Court of Justiciary (sitting otherwise than as a trial court of the Court of Session and in England and Wales, the High Court or the Court of Appeal)

⁵⁸ Human Rights Act 1998, s 4.

reserved the power for a Minister of the Crown, in either House of Parliament, under section 19 of the HRA, to 'make a statement to the effect that although he is unable to make a statement of compatibility the government nevertheless wishes the House to proceed with the Bill'.

Certain of the fundamental ECHR rights enshrined in UK law by the HRA 1998 have already become directly relevant to the question of fracking in the UK. Here we focus upon the most directly applicable rights that have significant relevance to fracking and to associated questions of the public's democratic and human rights interests.

European Convention on Human Rights

The ECHR remains fundamental, and independently significant for the legal position of the UK Government with respect to ECHR rights violations. Even if the current UK Government were to repeal the HRA 1998, the UK remains bound as a Contracting Party to the ECHR⁵⁹ to respect the human rights standards enumerated therein. Under the ECHR, the UK government and individuals holding public authority are obligated to uphold various human rights,⁶⁰ many of which are potentially infringed by fracking. In addition, UK litigants, provided that they have exhausted all national remedies, retain an individual right of appeal to the Strasbourg Court, a right making ECHR jurisprudence of continuing and direct relevance to the question of potential future UK human rights accountability, irrespective of the future direction of UK human rights jurisprudence.

Significantly, the ECtHR has taken an approach increasingly responsive to shifting social realities in ECHR Member States (an approach often referred to as 'evolutive'⁶¹) to the scope of guaranteed rights, and which — crucially — expresses 'growing and legitimate concern both in Europe and internationally about offences against the environment'.⁶² The Court has emphasised that effective enjoyment of Convention rights depends on a healthy environment and as environmental concerns have moved up the agenda both internationally and domestically, the Court has increasingly reflected the idea that human rights law and environmental law are mutually reinforcing.⁶³ In this respect, it is also highly significant that the ECtHR has shown increasing willingness to draw upon international environmental principles, standards and norms to draw out the human rights implications of environmentally risky actions.⁶⁴ The ECtHR is highly responsive, indeed, to 'evolving convergence

⁵⁹ Convention for the Protection of Human Rights and Fundamental Freedoms, opened for signature 4 November 1950, 213 UNTS 262 (entered into force 3 September 1953).

⁶⁰ Article 4 of the Draft Articles on the Responsibility of States for Internationally Wrongful Acts, International Law Commission. Annex to GA Res 56/83 of 12 December 2001.

⁶¹ D Shelton, 'Developing substantive environmental rights' (2010) 1/1 Journal of Human Rights and the Environment 89, 94.

⁶² *Mangouras v Spain* (App no 12050/04) (8 January 2009), para 41.

⁶³ Council of Europe, *Manual on Human Rights and the Environment* (Council of Europe Publishing, 2edn 2012) 30.

⁶⁴ *Oneryildiz v Turkey* [GC] Reports 2004-V1 (30 November) (drawing on Convention on Civil Liability for Damage resulting from Activities Dangerous to the Environment, ETS No 150 – Lugano, 21 June 1993 and on the Conventions on the Protection of the Environment through Criminal Law: ETS No 172

as to the standards to be achieved⁶⁵ and has held that it is 'of critical importance that the Convention is interpreted and applied in a manner which renders its rights practical and effective, not theoretical and illusory'.⁶⁶ This approach strongly suggests that the current and growing convergence between environmental standards and human rights will feature strongly in any ECtHR deliberations concerning the human rights impacts of fracking.

- Article 2: Right to life

The right to life has powerful and direct implications for the use of fracking technologies and contaminants in the UK. The right establishes that no one may be intentionally deprived of his or her life and can be interpreted more broadly as the right to security of person and to bodily integrity.⁶⁷ In the environmental context, Article 2 is applicable when activities harmful to the environment also endanger human life. The ECtHR has interpreted Article 2 to include not only negative State obligations to prevent deaths arising from State actions, but also positive obligations of protection. This means that States are under an obligation to take action to protect the right to life from threats by persons or activities not directly connected with the State.⁶⁸

The ECtHR has held that this right can be infringed by the failure of the State to inform residents living near potentially dangerous sites of any environmental safety risks or by failure to take practical measures to avoid safety risks, as well as by the use of a defective regulatory framework or planning policy.⁶⁹ This interpretation of the right has clear relevance, accordingly, for the potential lawfulness of fracking operations in certain situations.

Case law⁷⁰ makes it clear that the State has a positive obligation to take measures to prevent infringements of the right to life as a result of dangerous activities. Minimally, the jurisprudence implies that the UK government is under a clear duty to ensure a robust regulatory framework that should in particular ensure that measures are in place to protect people whose lives might be endangered by dangerous activities, including activities that cause environmental destruction which endangers lives.⁷¹ In addition, the public

– Strasbourg 4 November 1998; *Taskin and Others v Turkey* (App no 49517/99) §§99 and 119, 2004 IX (2005) Eur Ct HR 145, drawing on the Aarhus Convention on Access to Information and Public Participation in Decision Making and Access to Environmental Matters (despite Turkey being a non-signatory at the date of the judgment).

⁶⁵ Shelton, n 61 above, 94.

⁶⁶ *Christine Goodwin v The United Kingdom* [GC], (App no 28957/95) (2002) 35 EHRR 18, (11 July 2002) para 74.

⁶⁷ A number of exceptions apply, including self defence and lawful arrest. The death penalty was abolished in 1999 when the UK ratified the Second Optional Protocol to the International Covenant on Civil and Political Rights (1989).

⁶⁸ Council of Europe, *Manual on Human Rights and the Environment* (Council of Europe Publishing, 2edn 2012) 35.

⁶⁹ *Oneryildiz v Turkey* (2004) (App No 48939/99) (30 November 2004).

⁷⁰ See for example *Oneryildiz v Turkey* (2004) (App No 48939/99) (30 November 2004); and *Budayeva and Others v Russia* (2008) (App no's 15339/02, 21166/02, 20058/02, 11673/02, 15343/02) (29 September 2008).

⁷¹ Council of Europe, *Manual on Human Rights and the Environment* (Council of Europe Publishing, 2edn 2012) 38.

must be provided with information concerning activities which potentially pose a danger to life. Moreover, the State is responsible for providing for the necessary procedures for identifying shortcomings in the technical processes concerned and errors committed by those responsible.⁷² The suitability of existing frameworks, as noted above, is at present a question of considerable doubt.

- Article 8: Right to respect for private and family life

The ECtHR has been particularly adept at using environmental standards to interpret environmental harm as a breach of the right to private life and the home. Article 8 provides that '[e]veryone has the right to respect for his private and family life, his home and his correspondence'. This right may not be interfered with 'except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others.' The ECtHR has interpreted the right broadly to include both respect for the quality of family life as well as the enjoyment of the home as living space. Breaches of the right to the home as living space is not confined to interferences such as unauthorised entry, but may also result from noise, smells, emissions or other intangible sources.⁷³ Moreover, the Court has indicated a close connection between the notions of private and family life and home, indicating that the home is the place where private and family life is able to flourish.⁷⁴ Environmental damage comes into play if such damage affects private and family life or the home. As is the case for Article 2, State obligations are not limited to protection against interference by public authorities, but include obligations to take positive steps to secure the right. Moreover, the obligation does not only apply to State activities causing environmental harm, but to activities of private parties as well.⁷⁵

Environmental human rights cases in the ECtHR strongly imply that in the context of fracking, Article 8 may be infringed if the State does not reasonably act to balance community economic interests alleged to attach to a polluting activity (which would include fracking) with the effects on individual 'well-being'⁷⁶ or if adequate information on pollution risks is not provided to those living near fracking industry sites.⁷⁷

In its first major decision on environmental harm as a breach of the right to respect for home, private and family life, *Lopez Ostra v Spain*,⁷⁸ the ECtHR was clear that environmental pollution can be severe enough to constitute a violation of Article 8 due to its effect on individual 'well-being'. Importantly, the

⁷² Ibid, 39.

⁷³ Ibid, 45.

⁷⁴ Ibid, 45.

⁷⁵ *Hutton and Other v UK* (App no 36022/97) (Grand Chamber) 100, 119, 123 (08 July 2003); Council of Europe, *Manual on Human Rights and the Environment* (Council of Europe Publishing, 2edn 2012) 51-52.

⁷⁶ *Lopez Ostra v Spain* (1994) 16798 ECtHR 90.

⁷⁷ *Guerra and Others v Italy* (1998) 14967 ECtHR 89.

⁷⁸ *Lopez Ostra v Spain* (1994) Eur Ct Hum Rts Series A no 303C.

pollution in question 'need not reach the point of affecting health, if the enjoyment of home, private and family life are reduced and there is no fair balance struck between the community's economic well-being and the individual's effective enjoyment of guaranteed rights'.⁷⁹

The finding in *Lopez Ostra* was elaborated in *Fadayeva v Russia*.⁸⁰ The applicant's claim succeeded in that case because she was made more vulnerable to various diseases, despite the fact that there was no proven quantifiable harm to her health. Significantly, it is sufficient that serious risks are posed. The applicant's increased vulnerability to disease was held sufficient adversely to affect the applicant's quality of life in her home, engaging Article 8 protection. Thus it seems that deleterious consequences or serious impacts, including the posing of serious risk, and increased vulnerability to disease, will attract a protective interpretation of Article 8. While, in resolving the complex causal and evidential questions relevant to questions invoking the 'quality of life', the ECtHR will 'repose trust primarily, although not exclusively, in the findings of the domestic courts and other competent authorities in establishing factual circumstances of the case', the Court will step in 'to assess the evidence in its entirety' when 'the decisions of the domestic authorities [are] . . . obviously inconsistent or contradict each other'.⁸¹

Another case with potential significance for fracking operations is *Taskin and Others v Turkey*.⁸² This case involved challenges to the development and operation of a gold mine, which the applicants alleged detrimentally affected people in the region due to environmental damage caused such as to constitute a violation of Article 8 ECHR. The ECtHR drew on a range of standards (Rio Principle 10, the Aarhus Convention) and in particular a Council of Europe Parliamentary Assembly Recommendation on environment and human rights,⁸³ which proved decisive in the reasoning of the ECtHR which found a violation of Article 8 despite the absence of any accidents or incidents at the time. The mine was deemed to present an unacceptable risk.

The case is highly significant, it is submitted, for the likely liabilities of the UK Government with respect to fracking operations. The relevant Council of Europe Parliamentary Assembly Recommendation states at paragraph 3 that '[t]he Assembly believes that in view of developments in international law on both the environment and human rights as well as in European case-law, especially that of the European Court of Human Rights, the time has now come to consider legal ways in which the human rights protection system can contribute to the protection of the environment', and recommends (paragraph 9) that the governments of member states:

⁷⁹ Shelton, n 61 above, 105.

⁸⁰ *Fadayeva v Russia*, (App no 55723/00) 2005/IV Eur Ct H R 255 (9 June 2005).

⁸² *Taskin and Others v Turkey* (App no 46117/99) (2004) Eur Ct H R 621 (10 November 2004).

⁸³ Parliamentary Assembly Recommendation 1614 (2003) of 27 June 2003.

- should ‘ensure appropriate protection of the life, health, family and private life, physical integrity and private property of persons in accordance with Articles 2, 3 and 8 of the European Convention on Human Rights and by Article 1 of its Additional Protocol, by also taking particular account of the need for environmental protection’;
- should ‘recognise a human right to a healthy, viable and decent environment which includes the objective obligation for states to protect the environment, in national laws, preferably at constitutional level’;
- should ‘safeguard the individual procedural rights to access to information, public participation in decision making and access to justice in environmental matters set out in the Aarhus Convention’ and ‘harmonise their legislation on environmental protection and safety’.

It was this particular Recommendation that proved decisive in the *Taskin* decision, and it is important to note the mutual references made between the Recommendation (which refers to the developing jurisprudence of the ECtHR) and the judgment which refers to the Recommendation.

Another aspect of the interpretation of Article 8 by the ECtHR which is relevant to fracking is the recognition of an obligation on the part of the State to inform the public about environmental risks.⁸⁴ In *Guerra and Others v Italy* the applicants lived a short distance from a chemical factory with a known history of accidents affecting the health of people living in the area. The Court held that the State had failed to act to secure their rights under Article 8 on the basis that the applicants had not been provided with the necessary information for them to be able to assess the risks of living in the vicinity of the factory.

It is highly significant that the ECtHR draws increasingly upon a set of converging international and national standards and references to the relationship between human rights and the environment. The case-law concerning Article 8 and other directly relevant Articles of the ECHR suggests that the Court is expanding its concern with the potential impacts and environmental risks as human rights matters. In *Taskin* the Court, in holding that ‘where the dangerous effects of an activity to which individuals are *likely to be exposed* have been determined as part of an environmental impact assessment procedure in such a way as to establish a sufficiently close link with private and family life for purposes of Article 8’,⁸⁵ moreover, clearly expands the reach of a precautionary approach in a manner directly relevant to fracking. This conclusion is strengthened by the holding *Bacila v Romania*.⁸⁶ The applicant lived close to a large industrial plant which was a major long-term source of pollution, yet, as Morrow notes, ‘[d]espite repeated attempts to get the state to act to curb the plant’s emissions, the problems were not effectively addressed and ultimately the applicant’s health was adversely affected. A violation of Article 8 was found based on the state’s

⁸⁴ *Guerra and Others v Italy* (App no 14967/89) 19 February 1998.

⁸⁵ *Taskin and Others v Turkey* (App no 46117/99) (2004) Eur Ct H R 621 (10 November 2004), para. 113, emphasis added.

⁸⁶ *Bacila v Romania* (App no 19234/04) (30 March 2010, ECtHR).

relative inaction, which was prompted by the economic need to keep the plant open. Significantly, the court explicitly stated that the economic arguments should not have been allowed to prevail over the locals' "right to enjoy a healthy environment".⁸⁷ It is therefore essential, we submit, that each fracking operation, whether exploratory or extractive, should be subject to detailed environmental impact assessment and health impact assessment procedures sensitive to the human rights implications of the proposed operation.

Such a recommendation is further reinforced, in particular, by the findings of the ECtHR in the case of *Tatar v Romania*.⁸⁸ Of particular significance in that case is the ECtHR's declaration that the precautionary principle has evolved. It has 'moved from being a philosophical concept to being a juridical norm with content to be applied'.⁸⁹ Significantly, the ECtHR observed that 'pollution could interfere with a person's private and family life by harming his or her well-being and that the State had a duty to ensure the protection of its citizens by regulating the authorising, setting up, operating, safety and monitoring of industrial activities, especially activities that were dangerous for the environment and human health'. Despite the difficulties of establishing a causal link between the applicant's health condition and the toxicity of the sodium cyanide that escaped into local water systems, the Court held that the 'existence of a serious or material risk for the applicants' health and well-being' was sufficient to trigger the State's duty to 'assess the risks, both at the time it granted the operating permit and subsequent to the accident, and to take appropriate measures'.⁹⁰ A part of the judgment with particular relevance to the UK at present concerns the Court's insistence that 'the State had a duty to guarantee the right of members of the public to participate in the decision-making process concerning environmental issues'.

- ECHR Protocol 1, Article 1: *Protection of property*

Article 1 of Protocol 1 provides every natural and legal person with the right to peacefully enjoy his/her possessions. This is balanced by the right in the State to interfere with this enjoyment if such interference is justified by considerations of public interest and subjected to conditions provided for by law—including the payment of reasonable compensation. The State may enforce laws as 'necessary to control the use of property' for the general interest or 'to secure the payment of taxes or other contributions or penalties'. The UK has ratified Protocol 1 and it is included in Part II of the HRA 1998.

The ECtHR has held that protection of the right to property requires public authorities not only to refrain from direct interference but may also require the State to take positive measures to secure the right. The case of *Öneryildiz v*

⁸⁷ K. Morrow, 'After the Honeymoon: The Uneasy Marriage of Human Rights and the Environment Under the European Convention on Human Rights and in UK Law Under the Human Rights Act 1998' (2013) 43 *Revue générale de droit*, 317-368.

⁸⁸ *Tatar v Romania* (App no 67021/01) (2009) Eur Ct H R (27 January 2009).

⁸⁹ Shelton, n 61 above, 107.

⁹⁰ For further analysis of the human rights implications of non-definitive causality with respect to human health impacts, see also LM Collins, 'Security of the person, peace of mind: a precautionary approach to environmental uncertainty' (2013) 4 *Journal of Human Rights and the Environment* 79

*Turkey*⁹¹ discussed above, involved arguments relating to both the right to private and family life and the right to property. In spite of the fact that the applicant's house, which had been destroyed by an explosion at a rubbish tip, had been built illegally, the court held that the applicant could rely on the right to property. In the view of the court, regulation of waste treatment was the responsibility of the State and the failure to take measures to protect private property from environmental risks in this context amounted to a breach of the State's obligations under Article 1 of Protocol 1.

This right has become highly relevant to the UK fracking issue, particularly as changes to the common law of trespass have been discussed that would permit horizontal drilling below an individual's property without their consent.⁹² Furthermore, individuals living near fracking sites may arguably face violations of this right due to potential light,⁹³ noise,⁹⁴ water,⁹⁵ and air⁹⁶ pollution associated with all stages of the extraction process.

Given the importance attaching to the intimacy between Art 8 and property rights, it may be that (in accordance with the broad teleological interpretive practices associated with ECHR jurisprudence) litigants can draw upon the text and the spirit of Article 1 Protocol 1 when making arguments based upon the common law concerning the torts of nuisance and trespass.⁹⁷

Climate Change Act 2008⁹⁸

This Act is also central to the fracking issue. The Act requires the UK government (and the Secretary of State in particular) to cut net UK carbon emissions to 80% of the 1990 baseline by 2050. The Climate Change Act 2008 is highly pertinent to human rights-based considerations of fracking, because the connection between climate change and human rights violations

⁹¹ *Öneryildiz v Turkey* (App no 48939/99) (2004) Grand Chamber (30 November 2004).

⁹² L Armitstead, (2014) 'Queen's speech: IoD calls for trespass laws to be scrapped for fracking', *The Telegraph*, Jun 03. <<http://www.telegraph.co.uk/finance/newsbysector/banksandfinance/10873099/Queens-Speech-IoD-calls-for-trespass-laws-to-be-scrapped-for-fracking.html>> accessed 10 July 2014.

⁹³ A Hudson, (2013) 'Environmentalists claim night skies are being polluted by light', *The Colorado Observer*, May 29. <<http://thecoloradoobserver.com/2013/05/environmentalists-claim-night-skies-are-being-polluted-by-light/>> accessed 10 July 2014.

⁹⁴ B Gardner, (2013) 'Fracking firm stops drilling in Balcombe after "rattling" noise complaints', *The Argus*, Sep 09. <http://www.theargus.co.uk/news/10662407.Fracking_firm_ordered_to_stop_drilling_in_Balcombe_after_rattling_noise_complaints/> accessed 10 July 2014.

⁹⁵ K Begos, (2014) '4 states confirm water pollution from drilling', *USA Today*, Jan 05. <<http://www.usatoday.com/story/money/business/2014/01/05/some-states-confirm-water-pollution-from-drilling/4328859/>> accessed 10 July 2014.

⁹⁶ Center for Western Priorities, *Oil and Gas Drilling Linked to Air Pollution*. Denver, USA. <<http://westernpriorities.org/wp-content/uploads/2013/06/Oil-and-Gas-Emissions.pdf>> accessed 10 July 2014.

⁹⁷ This suggestion is somewhat reinforced by the *obiter* statement of Buckley J in *Dennis v Ministry of Defence* [2003] EWHC 793 (a nuisance case in which a claim based on interference with use and enjoyment of land caused by RAF activities succeeded) that the application of Article 8 of the ECHR and Article 1 of the First Protocol would have achieved the same result.

⁹⁸ Climate Change Act 2008. (c.27), London: HMSO.

has been clearly demonstrated,⁹⁹ and is increasingly accepted by key human rights institutions, bodies and scholars alike. It is worth noting in this context that heavy investment in fracking exploration, extraction and infrastructure further extends the commitment to fossil fuels well into the future and thus contributes to climate change in that way as well.

2.4 The Common Law

*Civil Liberties: Entick v Carrington*¹⁰⁰

This 1765 case has iconic legal status as a guide to the proper parameters of state power with regard to the important boundary function of property as a form of limit protecting important private liberty interests. The case serves to demonstrate the common law principle that trespass to, and/or seizure of, property must be expressly approved by law. The direct implication of the case will inevitably be muted by the proposed legislation altering the law of trespass but nonetheless will retain vital argumentative resonance for the intimacy of the legal relationship between private space and the fundamental centrality to the common law of human dignity and inviolability. In this sense, the case confirms human rights values more broadly—as well as sharing normative values and texture with environmental and human concerns animating the common law of nuisance.

The references above to ‘private space’ as a human rights issue are highly pertinent to private nuisance, as are the references to limitations on relevant common law rights under statute (in a nuisance context most notably the defence of statutory authority).

Private nuisance has historically provided a critically important rights-based framework for protecting the amenity of property from polluting industrial enterprise of all kinds (‘polluting’ here having a broad meaning, encompassing toxic emissions to water, land and air, as well as noise, smells, vibrations, and even — though this is more contentious — injury to the way a neighbourhood looks aesthetically). But nuisance has tended to be difficult to enforce — and in some cases impossible — where the activity that gives rise to the tort is permitted by regulatory bodies and/or positively promoted by the government, as is currently the case with fracking.

In *Coventry v Lawrence*¹⁰¹ whilst the Supreme Court was unanimous in ruling that planning permission did not limit common law liability in nuisance, it was divided on the remedies available to a victim of a nuisance caused by an activity judged by the government to be in the ‘public interest’. Lord Sumption (at [161]) stated that a nuisance-causing development that has the approval of the appropriate local or national planning authority should not generally be

⁹⁹ S Humphreys, (2008), International Council on Human Rights Policy, *Climate Change and Human Rights: A Rough Guide*. Geneva, Switzerland. <http://www.ichrp.org/files/reports/45/136_report.pdf> accessed 10 July 2014.

¹⁰⁰ *Entick v Carrington & Others* (1765) EWHC KB J98.

¹⁰¹ [2014] UKSC 14.

subject to an injunction, with some support from Lord Neuberger (at [126]). On that reasoning, the victim of a 'permitted' development causing a nuisance should expect at most equitable damages in lieu of the nuisance continuing, for it would be inefficient (per Lord Sumption, at [160]) to injunct the offending activity (given its 'public interest').

These *dicta* raise an important human rights concern in the context of 'fracking nuisance', in that one's home is not typically (as Lord Mance in that case acknowledged at [168]) a commodity that can be exchanged for money (equitable damages). On the contrary (again as recognised by Lord Mance), a proprietor whose home is rendered uncomfortable by tortious pollution from a fracking enterprise would expect to be entitled to have that pollution halted by an injunction on an application to the court. As the common law stands, therefore, there is a danger that Government support for the tortious enterprise could deprive the victim of an effective remedy (an injunction).

Indeed, as a general matter, when it comes to the impact of permits on nuisance liability, individual rights claims clearly operate, as Morrow has argued, 'in a complex context in which public (and indeed commercial) interests compete, which makes determining cases a sensitive and highly nuanced matter'.¹⁰² There is a pressing need to 'map the contours of the interplay between modern regulatory law and private law rights'.¹⁰³ Morrow casts doubt on Carnwath LJ's suggestion, in *Barr v. Biffa Waste Services Ltd*¹⁰⁴ that the relative lack of case law on the subject is because these issues are 'relatively straightforward'.¹⁰⁵ The case concerned a nuisance caused by a smell emitted from a licensed waste tip operated by Biffa. In deciding for the appellants, who were appealing against an earlier decision to dismiss a group action against Biffa, Carnwath LJ stated that 'the common law of nuisance has co-existed with statutory controls . . . since the 19th century. . . Short of express or implied statutory authority to commit a nuisance . . . there is no basis, in principle or authority, for using such a statutory scheme to cut down private law rights'.¹⁰⁶ While the interplay between private law rights and statutorily permitted operations remains uncertain, it currently appears to be the case, as Morrow argues, that '[t]he continued importance of the common law as a guarantor of redress for individuals whose individual rights are adversely affected by environmental pollution has, for now at least, once again been underlined'.¹⁰⁷

The gravity of the danger that Government support for a tortious enterprise could deprive the victim of an effective remedy remains. It would apply, for example, in circumstances where planning consent is granted under the Planning Act 2008, which applies to 'national infrastructure development'. Section 158 provides immunity from a nuisance action on the following terms:

¹⁰² K Morrow, 'Rights, Interests and the Water Resource: Crossing the Rubicon' (Oxford: The Foundation for Law, Justice and Society, 2013) at 5.

¹⁰³ Morrow, *ibid*, at 6.

¹⁰⁴ [2012] EWCA Civ 312.

¹⁰⁵ At para. 5.

¹⁰⁶ At para 44.

¹⁰⁷ Morrow, n 109 above, at 6.

Section 158 Nuisance: statutory authority

- (1) This subsection confers statutory authority for—
 - (a) carrying out development for which consent is granted by an order granting development consent;
 - (b) doing anything else authorised by an order granting development consent.
- (2) Statutory authority under subsection (1) is conferred only for the purpose of providing a defence in civil or criminal proceedings for nuisance.

Whilst fracking is not among the energy projects that have to date been designated by the relevant minister as falling within the scope of this Act (and in turn the defence of statutory authority), that could change in future.¹⁰⁸ Fracking could be brought within the scope of the Act by secondary legislation — something that would require Parliamentary approval, but not primary legislation.

A separate concern is that ‘mere’ residents of homes are not intrinsically protected by the rights provided for by private nuisance. That is to say, standing to sue is limited to the person with exclusive possession — a tenant or freeholder normally. *Dobson and Others v Thames Water Utilities Limited*,¹⁰⁹ emphasises this, and suggests important inconsistencies in the law concerning redress for environmental pollution. The case involved a mixed group of applicants seeking to bring actions in private nuisance and under the HRA 1998 (in respect of an alleged breach of Article 8 rights) in response to problems caused by negligence at a sewage treatment works. Those who held proprietary interests in the affected property could claim in nuisance, while those who had no such interests relied upon section 8(3) HRA 1998. The outcome of the case suggests that ‘for claimants with common law rights, human rights interests and redress for interference with them are virtually subsumed in the former’,¹¹⁰ while for those who lack a proprietary interest may receive an award for just satisfaction under the HRA 1998. However, the case leaves unresolved an inconsistent legal approach, while the proprietary qualification at the foundation of the law of private nuisance continues

¹⁰⁸ This will depend upon what is deemed to qualify as a ‘national infrastructure development’. See Department for Communities and Local Government, *Major infrastructure planning: extending the regime to business and commercial projects: Summary of responses and government response* (DCLG, 2013), page 8: ‘After considering the responses received and comments made during the passage of the Growth and Infrastructure Act, the Government has concluded that applications for planning permission for onshore oil and gas schemes, including any future planning proposals for shale gas development, should not be included in the new business and commercial category *but will keep this under review*’ (emphasis added). It is plausible that if shale gas extraction were to take place at a commercial scale, the Government would consider bringing it within the nationally significant infrastructure regime.

¹⁰⁹ [2009] EWCA Civ 28

¹¹⁰ K Morrow, ‘Worth the paper they are written on? Human rights and the environment in the law of England and Wales’ (2010) 1/1 *Journal of Human Rights and the Environment* 66 at 71.

potentially to exclude a large proportion of the community of neighbours affected by a nuisance arising from fracking (family members without exclusive possession and cohabitants for example).

Whether the doctrine of public nuisance adequately bridges the gaps implied by the *Dobson* case and the analysis above is as yet unclear. Concerning personal injury and physical damage to property, it might — though most relevant case on the point (*Corby Group Litigation v Corby DC*¹¹¹) was settled and thus fails to provide sufficiently definitive guidance. Certainly, statutory nuisance is limited by the defence of ‘best practicable means — and for that reason is also of limited and uncertain value in remedying human rights violations.

2.5 Procedural Human Rights Responsibilities

We turn now to a consideration of procedural rights, which though less ambitious in tone than their more substantive counterparts (largely canvassed above) are of particular practical significance to litigants seeking human rights protection for environmental harm. We focus entirely upon the law of England and Wales—but note that in international environmental law, procedural rights currently offer the most viable source of protection in the absence of clear agreement (where it does not exist) concerning the protective scope of substantive environmental rights. Of particular relevance for the analysis to follow is the ECHR (particularly Article 6: the right to a fair hearing) and the 1998 UNECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (the ‘Aarhus Convention’).

The Aarhus Convention is not directly applicable in the UK courts, since it has not been incorporated into domestic law. However, it is an international treaty to which the UK is a signatory and can act as an aid to interpretation in UK courts where UK law is unclear. That said, the EU is a signatory to the Convention, which means that when a case involves EU law, the claimant’s ability to access Aarhus Convention rights is greatly increased.

Finally, it should be noted that procedural environmental rights and human rights litigation are predominantly pursued in UK law through a claim for judicial review. Cases brought on procedural failures with respect to environmental and human rights cases tend to draw upon an increasingly complex web of normative and legal sources, ‘calling into play inventive combinations of ECHR rights, Aarhus rights, participation rights in EU law and domestic administrative law’.¹¹²

As with substantive human rights protection in environmental matters, the relevant law and jurisprudence is far more extensive than the brief

¹¹¹ [2009] EWHC1944.

¹¹² Morrow, above n 117, 70.

introductory analysis offered here. The analysis here will simply aim to support the case, made above, for a full and independent human rights impact assessment to be undertaken before fracking operations are permitted in the UK.

The present analysis focuses most closely on rights to public participation, since this is of fundamental importance for communities affected by proposed fracking operations and prospective fracking licence grants — and for a wide range of concerned members of the public in the UK. Participation is an issue that is frequently rather technical, but raises profoundly important and highly visible issues of democratic principle. A case of particular potential relevance to the fracking question is *R (Greenpeace Ltd) v Secretary of State for Trade and Industry*.¹¹³ The case involved a claim for judicial review concerning a public consultation process — and an alleged failure with regard to participation — concerning future government policy on nuclear power in the UK. Greenpeace sought a quashing order in respect of a change of Government policy in 2006, deciding to support new nuclear facility building — a reversal of policy.¹¹⁴ The Government's decision came after the minimum period prescribed for consultation processes at the time (12 weeks).¹¹⁵ In reality, coverage of nuclear power and the related public processes was sparse. Greenpeace alleged breach of legitimate expectation on the consultation process itself, and on the change of policy. It further argued that the information provided was vague, inadequate and incomplete. Despite the policy-intensive nature of the issue, Sullivan J (as he then was) determined that the issue was justiciable. He also added — significantly for litigants wishing to dispute fracking policy and decisions — that the Government's obligations with respect to consultation in the environmental sphere were now to be examined in the light of the Aarhus Convention, although the case was decided on the basis of UK administrative law — the basis upon which it had been argued. Sullivan J found for the applicants: the consultation had been unfair, since it was inadequate and lacked precision in key respects. Furthermore, the judge disapproved of the deployment of the minimum consultation period. In particular, the notion of fairness deployed in Sullivan J's reading of the issues emphasises — critically for the fracking question — the needs and understandings of the general public,¹¹⁶ not simply specialised NGOs such as Greenpeace.

Procedural rights under the ECHR

As briefly noted above, Articles 2 and 8 ECHR may impose positive obligations on States to ensure access to information relating to environmental issues and to positively provide information to persons whose

¹¹³ [2007] EWHC 311 Admin, [2007] Env LR 29.

¹¹⁴ DTI, The Energy Challenge: Energy Review Report 2006 <<http://www.berr.gov.uk/files/file31890.pdf>> accessed 10 July 2014.

¹¹⁵ Cabinet Office, *Code of Practice on Consultation*, January 2004.

¹¹⁶ *R (Greenpeace Ltd) v Secretary of State for Trade and Industry* [2007] EWHC 311 Admin, [2007] Env LR 29, para 113.

rights under those provisions are threatened.¹¹⁷ In *Öneryildiz v Turkey* the ECtHR held that the obligation to provide information established in relation to article 8 in *Guerra and Others v Italy* was similarly applicable to article 2, with perhaps an even sharper focus, the Court finding that even if the applicant was in fact able to assess some of the risks, the State was not absolved of the duty to be proactive and inform the applicant. That Article 2 imposes both substantive and procedural obligations on States was reaffirmed in *Budayeva and Others v Russia*.

The ECtHR has furthermore established that where public authorities engage in dangerous activities with known risks to health, they must ensure that affected individuals are able to access relevant information.¹¹⁸ In addition, the Court has held that if environmental and health impact assessments are carried out, the public should have access to the results.¹¹⁹

The ECtHR has also broadened the interpretation of the right to private and family life by recognising that it includes a right to public participation in the decision making process in environmental matters.¹²⁰ This was first elaborated in *Hatton and Others v UK* and subsequently applied in a range of cases, including *Giacomelli v Italy*, *Tatar v Romania* and *Taskin and Others v Turkey* discussed above.

There is no doubt that a range of cases has seen new opportunities for litigating environmental claims related to human rights open up in UK domestic law — despite certain limitations.¹²¹ Minimally, such cases have ‘recontextualised and reinvigorated discussion of the common law in established areas, notably nuisance. They have also contributed to the development of the concept of fairness in judicial review. This type of litigation has also wrought more diffuse impacts. The enhanced profile that they offer to environmental interests has proved significant in forging greater publicity for “campaigning cases” than they have previously enjoyed’.¹²² This latter point, in particular, is a particularly strategic political reality in the light of the ultimately carefully constrained protection given to human rights under the HRA 1998, under which, as noted above, despite the issue of a declaration of incompatibility, the UK Government need not ultimately comply with a Convention right. However, and despite this, the UK remains fully exposed to the ECtHR’s jurisdiction — which, in combination with the increasing convergence between legal spaces in which human rights and environmental questions are brought into closer relationship, fully suggests the importance of adequate reflection on the potential and future human rights liabilities of the UK government. Most importantly of all, however, the UK Government owes a

¹¹⁷ Council of Europe, *Manual on Human Rights and the Environment* (Council of Europe Publishing, 2edn 2012), 81.

¹¹⁸ *McGinley and Egan v UK*, (App No’s 10/1997/794/995-996), (9 June 1998), para 97, 101.

¹¹⁹ *Giacomelli v Italy*, (App No 59909/00), (2 November 2006), para 83; *Lemke v Turkey* (App No 17381/02), (5 June 2007), para 41.

¹²⁰ Council of Europe, *Manual on Human Rights and the Environment* (Council of Europe Publishing, 2edn 2012), 88.

¹²¹ Morrow, n 117 above.

¹²² Morrow, n 117 above, 87.

fundamental democratic duty to the citizens of the UK fully to consider the human rights impacts, both substantive and procedural, of fracking in the UK.

3 Recommended Measures

It is strongly recommended that a moratorium should be issued preventing exploratory and extractive fracking operations until such a time as a full, publicly funded, industry-independent, evidence-led Human Rights Impact Assessment has been properly undertaken and provided in the public interest.

This assessment should provide:

- a) A clear scientific examination of human rights-impacting activities connected with fracking;
- b) An in-depth analysis of the legal duties placed upon the UK Government and UK public authorities with regard to fracking;
- c) A thorough and thoughtful human rights-based assessment of the balance of public interest with regard to the uncertain economic benefits of fracking and the potential risk of serious and irreversible human and environmental damage.
- d) A thorough analysis of the implications of fracking for climate change effects and the human rights implications of such climate impacts in the UK.
- e) A thorough analysis of the potential human rights impacts of fracking on future generations, from climate change and the eventual failure of well casings over time.

4 Conclusion

As a legal matter, it is abundantly clear that the ECtHR, like many other transnational and international courts, is moving towards giving environmental human rights substantive content and effect. Moreover, it is also clear that State responsibility can arise, not simply due to the State's direct involvement in causing environmental harm, but from its failure properly to regulate private sector activities¹²³ — a consideration of particular relevance to the UK Government's current approach, which strongly favours the interests of private actors despite extensive public concern and protest.

This preliminary assessment of directly relevant UK and ECHR human rights law and common law suggests that for the UK Government to proceed with fracking without adequate assessment of the human rights position would amount to a serious failure of responsibility. In particular, the profound nature of the core rights at stake: the rights to life, to respect for home and private life, to the peaceful enjoyment of possessions, in combination with the existing evidence of extremely deleterious health impacts of fracking around the world

¹²³ *Mareno Gomez v Spain*, (App no 4143/02), (16 November 2004), para 55; *Surugia v Romania* (App no 48995/99) (20 April 2004).

suggests the urgency of considering human rights properly before ‘the dash for gas’ produces irreversible, potentially serious and irreversible, health, human and environmental impacts.¹²⁴

¹²⁴ Furthermore, while this report addresses these core issues, emerging evidence from the front line of fracking protests in the UK suggests that there may also be cause for concern in relation to key civil and political rights: to liberty and security, to a fair trial, to freedom of expression and assembly and association (ECHR Articles, 5, 6, 10 and 11): D Short, K Nader, J Elliot, J and E Lloyd-Davies, ‘Extreme Energy, Fracking and Human Rights: A New Field for Impact Assessments?’ (2014) *International Journal of Human Rights*, forthcoming October, 2014.

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APPENDIX A

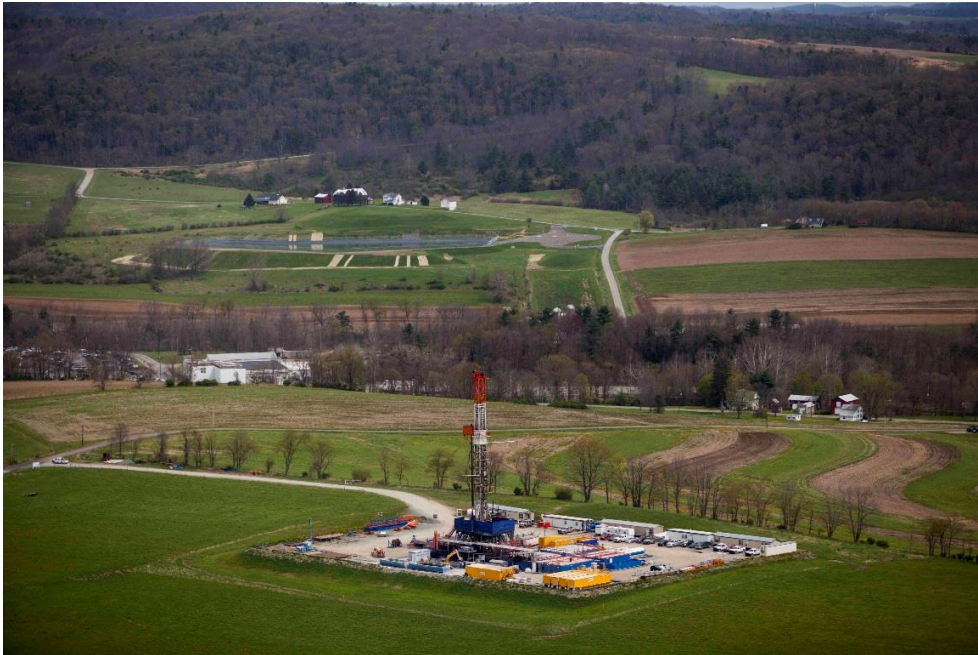
Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction)

July 10, 2014



COMPENDIUM OF SCIENTIFIC, MEDICAL, AND MEDIA FINDINGS DEMONSTRATING RISKS AND HARMS OF FRACKING (UNCONVENTIONAL GAS AND OIL EXTRACTION)

July 10, 2014



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Introduction

Horizontal drilling combined with high-volume hydraulic fracturing and clustered multi-well pads are recently combined technologies for extracting oil and natural gas from shale bedrock. As this unconventional extraction method (collectively known as “fracking”) has pushed into more densely populated areas of the United States, and as fracking operations have increased in frequency and intensity, a significant body of evidence has emerged to demonstrate that these activities are inherently dangerous to people and their communities. Risks include adverse impacts on water, air, agriculture, public health and safety, property values, climate stability and economic vitality.

Researching these complex, large-scale industrialized activities—and the ancillary infrastructure that supports them—takes time and has been hindered by institutional secrecy. Nonetheless, research is gradually catching up to the last decade’s surge in unconventional oil and gas extraction from shale. A growing body of peer-reviewed studies, accident reports, and investigative articles is now confirming specific, quantifiable evidence of harm and has revealed fundamental problems with the drilling and fracking. Industry studies as well as independent analyses indicate inherent engineering problems including well casing and cement impairments that cannot be prevented. Earlier scientific predictions and anecdotal evidence are now bolstered by empirical data, confirming that the public health risks from unconventional gas and oil extraction are real, the range of adverse impacts significant, and the negative economic consequences considerable. Our examination of the peer-reviewed medical and public health literature uncovered no evidence that fracking can be practiced in a manner that does not threaten human health.

Despite this emerging body of knowledge, industry secrecy and government inaction continue to thwart scientific inquiry, leaving many potential problems—especially cumulative, long-term risks—unidentified, unmonitored and largely unexplored. This problem is compounded by non-disclosure agreements, sealed court records, and legal settlements that prevent families (and their doctors) from discussing injuries. As a result, no comprehensive inventory of human hazards yet exists.

At the same time, inflated estimates of shale reserves and potential profitability continue to fuel the rush to drill new wells, cut regulatory corners, and press into densely populated communities, as corporations attempt to compensate for the unexpectedly rapid depletion of their existing wells and coincident drop off in revenue. Thus do the fundamental economic uncertainties of shale gas and oil production further exacerbate the risks of fracking to public health and society. With the industry intention of drilling tens of thousands of new wells into shale every year in the United States and with more than 15 million Americans already living within a mile of a fracking well that has been drilled since 2000, the stakes could not be higher.

About This Report

The Compendium is a fully referenced compilation of the significant body of scientific, medical and journalistic findings demonstrating risks and harms of fracking. Organized to be accessible to public officials, researchers, journalists and the public at large, the Compendium succinctly summarizes key studies and other findings relevant to the ongoing public debate about unconventional methods of oil and gas extraction. The Compendium should be used by readers to grasp the scope of the information about both public health and safety concerns and the economic realities of fracking that frame these concerns. The reader who wants to delve deeper may consult the reviews, studies, and articles referenced. (In addition, a fully searchable, near-exhaustive citation database of peer-reviewed journal articles pertaining to shale gas and oil extraction is housed at the PSE Healthy Energy Library.¹)

¹ Physicians Scientists & Engineers for Health Energy. <http://www.psehealthyenergy.org/site/view/1180>.

The pace at which new studies and information are emerging has rapidly accelerated in the past year and a half: the first few months of 2014 saw more studies published on the health effects of fracking than all studies published in 2011 and 2012 combined.² In accordance, the Compendium is organized in reverse chronological order, with the most recent information first.

Fifteen compelling themes emerged in reviewing the data, and these serve as the organizational structure of the Compendium. The document opens with sections on two of the most acute threats—air pollution and water contamination—and ends with medical and scientific calls for more study and transparency. Readers will quickly notice the recent upsurge in studies making each section top-heavy with recent data.

The Compendium focuses on topics most closely related to the public health and safety impacts of unconventional gas and oil drilling and fracking. Many additional risks and harms arise from associated infrastructure and industrial activities that necessarily accompany drilling and fracking operations. These include pipelines, compressor stations, oil trains, sand mining operations, cryogenic and liquefaction facilities, processing and fractionation complexes, import/export terminals, and so forth. While impacts from infrastructure are critically important to public health and safety and while the Compendium refers to these impacts in certain instances when studies covered have also addressed them, a detailed accounting of these ancillary impacts are not included in this document.

Given the quickly expanding body of evidence, the Compendium will be revised and updated approximately every six months. It is a living document, housed on the Concerned Health Professionals of New York website, and serves as an educational tool in the public and policy dialogue. The studies cited in this first edition are current through June 30, 2014.

The Compendium was not a funded project; it was written utilizing the benefit of expertise and experiences of numerous health professionals and scientists who have been involved in this issue for years.

We welcome your feedback and comments.

About Concerned Health Professionals of New York

Concerned Health Professionals of New York (CHPNY) is an initiative by health professionals, scientists and medical organizations for raising science-based concerns about the impacts of fracking on public health and safety. CHPNY provides educational resources and works to ensure that careful consideration of the science and health impacts are at the forefront of the fracking debate. <http://concernedhealthny.org>

² Mobbs, P. (2014). Shale gas and public health - the whitewash exposed. *The Ecologist*. Retrieved July 3, 2014, from http://www.theecologist.org/News/news_analysis/2385900/shale_gas_and_public_health_the_whitewash_exposed.html

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*Note that for the purposes of this compendium, the terms “fracking” and “drilling and fracking” refer to the entire unconventional oil and gas extraction and distribution process, from well site preparation to waste disposal and all associated infrastructure including pipelines and compressor stations. Not every aspect of this process is fully addressed in the Compendium.

Executive Summary

Evidence of risks, harms, and associated trends demonstrated by this Compendium:

- **Air pollution** – Studies increasingly show that air pollution associated with drilling and fracking operations is a grave concern with a range of impacts. Researchers have documented dozens of air pollutants from drilling and fracking operations that pose serious health hazards. Areas with substantial drilling and fracking build-out show high levels of ozone, striking declines in air quality, and, in several cases, increased rates of health problems with known links to air pollution.
- **Water contamination** – The emerging science has significantly strengthened the case that drilling and fracking inherently threaten groundwater. A range of studies from across the United States present strong evidence that groundwater contamination occurs and is

more likely to occur close to drilling sites. Likewise, the number of well blowouts, spills and cases of surface water contamination has steadily grown. Meanwhile, the gas industry's use of "gag orders," non-disclosure agreements and settlements impede scientific study and stifle public awareness of the extent of these problems.

- **Inherent engineering problems that worsen with time** – Studies and emerging data consistently show that oil and gas wells routinely leak, allowing for the migration of natural gas and potentially other substances into groundwater and the atmosphere. Leakage from faulty wells is an issue that the industry has identified and for which it has no solution. For instance, Schlumberger, one of the world's largest companies specializing in fracking, published an article in its magazine in 2003 showing that about five percent of wells leak immediately, 50 percent leak after 15 years and 60 percent leak after 30 years. Data from Pennsylvania's Department of Environmental Protection (DEP) also confirm these initial leakage rates, with a six percent structural integrity failure rate observed for shale gas wells drilled in 2010, 7.1 percent observed for wells drilled in 2011, and 8.9 percent observed for wells drilled in 2012. Leaks pose serious risks including potential loss of life or property from explosions and the migration of gas or other chemicals into drinking water supplies. Leaks also allow methane to escape into the atmosphere, where it acts as a powerful greenhouse gas. There is no evidence to suggest that the problem of cement and well casing impairment is abating. Indeed, a 2014 analysis of more than 75,000 compliance reports for more than 41,000 wells in Pennsylvania found that newer wells have higher leakage rates and that unconventional shale gas wells leak more than conventional wells drilled within the same time period. Industry has no solution for rectifying the chronic problem of well casing leakage.
- **Radioactive releases** – High levels of radiation documented in fracking wastewater raise special concerns in terms of impacts to groundwater and surface water. Studies have indicated that the Marcellus Shale is more radioactive than other shale formations. Measurements of radium in fracking wastewater in New York and Pennsylvania have been as high as 3,600 times the United States Environmental Protection Agency's (EPA) limit for drinking water. One recent study found toxic levels of radiation in a Pennsylvania waterway even after fracking wastewater was disposed of through an industrial wastewater treatment plant. In addition, the disposal of radioactive drill cuttings is a concern. Unsafe levels of radon and its decay products in natural gas produced from the Marcellus Shale, known to have particularly high radon content, may also contaminate pipelines and compressor stations, as well as pose risks to end-users when allowed to travel into homes.
- **Occupational health and safety hazards** – Fracking jobs are dangerous jobs. Occupational hazards include head injuries, traffic accidents, blunt trauma, burns, toxic chemical exposures, heat exhaustion, dehydration, and sleep deprivation. As a group, oil and gas industry workers have an on-the-job fatality rate seven times that of other industries. Exposure to silica dust, which is definitively linked to silicosis and lung cancer, was singled out by National Institutes for Occupational Safety and Health as a particular threat to workers in fracking operations where silica sand is used. At the same time, research shows that many gas field workers, despite these serious occupational

hazards, are uninsured or underinsured and lack access to basic medical care.

- **Noise pollution, light pollution and stress** – Drilling and fracking operations and ancillary infrastructure expose workers and nearby residents to continuous noise and light pollution that is sustained for periods lasting many months. Chronic exposure to light at night is linked to adverse health effects, including breast cancer. Sources of fracking-related noise pollution include blasting, drilling, flaring, generators, compressor stations and truck traffic. Exposure to environmental noise pollution is linked to cardiovascular disease, cognitive impairment, and sleep disturbance. Workers and residents whose homes, schools and workplaces are in close proximity to well sites are at risk from these exposures as well as from related stressors.
- **Earthquake and seismic activity** – A growing body of evidence links fracking wastewater injection (disposal) wells to earthquakes of magnitudes as high as 5.7, in addition to “swarms” of minor earthquakes and fault slipping. In some cases, the fracking process itself has been linked to earthquakes and seismic activity, including instances in which gas corporations have acknowledged the connection. In New York, this issue is of particular concern to New York City’s aqueduct-dependent drinking water supply and watershed infrastructure, as the New York City Department of Environmental Protection (NYC DEP) has warned repeatedly, but similar concerns apply to all drinking water resources. The question of what to do with wastewater remains a problem with no viable, safe solution.
- **Abandoned and active oil and natural gas wells (as pathways for gas and fluid migration)** – Millions of abandoned and undocumented oil and gas wells exist across the United States, according to the U.S. Department of Energy. All serve as potential pathways for pollution, heightening the risks of groundwater contamination and other problems when horizontal drilling and fracking operations intersect with pre-existing vertical channels leading through drinking water aquifers and to the atmosphere. Industry experts, consultants and government agencies including the U.S. Environmental Protection Agency, the U.S. General Accounting Office (now the Government Accountability Office), Texas Department of Agriculture, New York State Department of Environmental Conservation, Pennsylvania Department of Environmental Protection, Illinois Environmental Protection Agency and the British Columbia Oil and Gas Commission have all warned about problems with abandoned wells due to the potential for pressurized fluids and gases to migrate through inactive and in some cases, active wells.
- **Flood risks** – Massive land clearing and forest fragmentation that necessarily accompany well site preparation increase erosion and risks for catastrophic flooding, as do access roads, pipeline easements and other related infrastructure. In addition, in some cases, operators choose to site well pads on flood-prone areas in order to have easy access to water for fracking, to abide by setback requirements intended to keep well pads away from inhabited buildings, or to avoid productive agricultural areas. In turn, flooding increases the dangers of unconventional gas extraction, resulting in the contamination of soils and water supplies, the overflow or breaching of containment ponds, and the escape

of chemicals and hazardous materials. In at least six of the past ten years, New York State has experienced serious flooding in parts of the state targeted for drilling and fracking. Some of these areas have been hit with “100-year floods” in five or more of the past ten years. Gas companies acknowledge threats posed by flooding, and the New York State Department of Environmental Conservation (DEC) has recommended drilling be prohibited from 100-year flood areas; however, accelerating rates of extreme weather events make existing flood maps obsolete, making this approach insufficiently protective.

- **Threats to agriculture and soil quality** – Drilling and fracking pose risks to the agricultural industry. Studies and case reports from across the country have highlighted instances of deaths, neurological disorders, aborted pregnancies, and stillbirths in cattle and goats associated with livestock coming into contact with wastewater. Potential water and air contamination puts soil quality as well as livestock health at risk. Additionally, farmers have expressed concern that nearby fracking operations can hurt the perception of agricultural quality and nullify value-added organic certification.
- **Threats to the climate system** – A range of studies have shown high levels of methane leaks from gas drilling and fracking operations, undermining the notion that natural gas is a climate solution or a transition fuel. Major studies have concluded that early work by the EPA greatly underestimated the impacts of methane and natural gas drilling on the climate. Drilling, fracking and expanded use of natural gas threaten not only to exacerbate climate change but also to stifle investments in, and expansion of, renewable energy.
- **Inaccurate jobs claims, increased crime rates, and threats to property value and mortgages** – Experiences in various states and accompanying studies have shown that the oil and gas industry’s promises for job creation from drilling for natural gas have been greatly exaggerated and that many of the jobs are short-lived and/or have gone to out-of-area workers. With the arrival of drilling and fracking operations, communities have experienced steep increases in rates of crime – including sexual assault, drunk driving, drug abuse, and violent victimization, all of which carry public health consequences. Social costs include strain on municipal services and road damage. Economic analyses have found that drilling and fracking operations threaten property values. Additionally, gas drilling and fracking pose an inherent conflict with mortgages and property insurance due to the hazardous materials used and the associated risks.
- **Inflated estimates of oil and gas reserves and profitability** – Industry estimates of oil and gas reserves and profitability of drilling have proven unreliable, casting serious doubts on the bright economic prospects the industry has painted for the public, media and investors. Increasingly, well production has been short-lived, which has led companies to reduce the value of their assets by billions of dollars.
- **Disclosure of serious risks to investors** – Oil and gas companies are required to disclose risks to their investors in an annual Form 10-K. Those disclosures acknowledge the inherent dangers posed by gas drilling and fracking operations, including leaks, spills, explosions, blowouts, environmental damage, property damage, injury and death.

Adequate protections have not kept pace with these documented dangers and inherent risks.

- **Medical and scientific calls for more study and more transparency** – With increasing urgency, groups of medical professionals and scientists are issuing calls for comprehensive, long-term study of the full range of the potential health and ecosystem effects of drilling and fracking. These appeals underscore the accumulating evidence of harm, point to the major knowledge gaps that remain, and denounce the atmosphere of secrecy and intimidation that continues to impede the progress of scientific inquiry. Health professionals and scientists in the United States and around the world have urged tighter regulation of and in some cases, suspension of unconventional gas and oil extraction activities in order to limit, mitigate or eliminate its serious, adverse public health hazards.

Compilation of Studies & Findings

Air pollution

- June 26, 2014 – Public health professionals at the Southwest Pennsylvania Environmental Health Project reported significant recurrent spikes in the amount of particulate matter in the air inside of residential homes located near drilling and fracking operations. Captured by indoor air monitors, the spikes tend to occur at night when stable atmospheric conditions hold particulate matter low to the ground. Director Raina Ripple emphasized that spikes in airborne particulate matter are likely to cause acute health impacts in community members. She added, “What the long term effects are going to be, we’re not certain.” At this writing, researchers from Yale University and the University of Washington are working to collect and analyze more samples.³
- May 21, 2014 – Raising questions about possible links to worsening air pollution from the Uintah Basin’s 11,200 oil and gas wells, health professionals reported that infant deaths in Vernal, Utah, rose to six times the normal rate over the past three years. Physician Brian Moench said, “We know that pregnant women who breathe more air pollution have much higher rates of virtually every adverse pregnancy outcome that exists....And we know that this particular town is the center of an oil and gas boom that’s been going on for the past five or six years and has uniquely high particulate matter and

³ McMahon, J. (2014, June 26). Air Pollution Spikes In Homes Near Fracking Wells. *Forbes*. Retrieved July 4, 2014, from <http://www.forbes.com/sites/jeffmcmahon/2014/06/26/air-pollution-spikes-in-homes-near-fracking-wells/>

high ozone.”⁴ With air quality that was formerly pristine, Uintah County, Utah received a grade “F” for ozone in the American Lung Association’s 2013 State of the Air Report, with 27.3 more high ozone days than 2007.⁵

- May 8, 2014 – Researchers at the National Oceanic and Atmospheric Administration (NOAA) found high levels of methane leaks as well as benzene and smog-forming volatile organic compounds in the air over oil and gas drilling areas in Colorado. Researchers found methane emissions three times higher than previously estimated and benzene and volatile organic compound levels seven times higher than estimated by government agencies. *The Denver Post* noted that Colorado’s Front Range has failed to meet federal ozone air quality standards for years.⁶
- April 26, 2014 – A Texas jury awarded a family \$2.8 million because, according to the lawsuit, a fracking company operating on property nearby had “created a ‘private nuisance’ by producing harmful air pollution and exposing [members of the affected family] to harmful emissions of volatile organic compounds, toxic air pollutants and diesel exhaust.” The family’s 11-year-old daughter became ill, and family members suffered a range of symptoms, including “nosebleeds, vision problems, nausea, rashes, blood pressure issues.”⁷ Because drilling did not occur on their property, the family had initially been unaware that their symptoms were caused by activities around them.
- April 16, 2014 – Reviewing the peer-review literature to date of “direct pertinence to the environmental public health and environmental exposure pathways,” a U.S. team of researchers concluded: “[a] number of studies suggest that shale gas development contributes to levels of ambient air concentrations known to be associated with increased risk of morbidity and mortality.”⁸

April 11, 2014 – A modeling study commissioned by the state of Texas made striking projections about worsening air quality in the Eagle Ford Shale. Findings included the possibility of a 281 percent increase in emissions of volatile organic compounds (VOCs). Some VOCs cause respiratory and neurological problems; others, like benzene, are also carcinogens. Another finding was that nitrogen oxides—which react with VOCs in

⁴ S Schlanger, Z. (2014, May 21). In Utah boom town, a spike in infant deaths raises questions. *Newsweek*. Retrieved June 10, 2014, from <http://www.newsweek.com/2014/05/30/utah-boom-town-spike-infant-deaths-raises-questions-251605.html>

⁵ American Lung Association. (2013). American Lung Association state of the air 2013. Retrieved June 10, 2014, from <http://www.stateoftheair.org/2013/states/utah/uintah-49047.html>

⁶ Finley, B. (2014, May 8). Scientists flying over Colorado oil boom find worse air pollution. *The Denver Post*. Retrieved June 10, 2014, from http://www.denverpost.com/environment/ci_25719742/scientists-flying-over-colorado-oil-boom-find-worse

⁷ Morris, J. (2014, April 26). Texas family plagued with ailments gets \$3M in 1st-of-its-kind fracking judgment. *CNN*. Retrieved June 10, 2014, from <http://www.cnn.com/2014/04/25/justice/texas-family-wins-fracking-lawsuit/>

⁸ Shonkoff, S. B., Hays, J., & Finkel, M. L. (2014). Environmental public health dimensions of shale and tight gas development [Abstract]. *Environmental Health Perspectives*. doi: 10.1289/ehp.1307866

sunlight to create ground-level ozone, the main component of smog—increased 69 percent during the peak ozone season.”⁹

- March 29, 2014 – Scientists warn that current methods of collecting and analyzing emissions data do not accurately assess health risks. Researchers with the Southwest Pennsylvania Environmental Health Project showed that methods do not adequately measure the intensity, frequency or durations of community exposure to the toxic chemicals routinely released from drilling and fracking activities. They found that exposures may be underestimated by an order of magnitude, mixtures of chemicals are not taken into account, and local weather conditions and vulnerable populations are ignored.¹⁰
- March 27, 2014 – University of Texas research pointed to “potentially false assurances” in response to community health concerns in shale gas development areas. Dramatic shortcomings in air pollution monitoring to date include no accounting for cumulative toxic emissions or children’s exposures during critical developmental stages, and the potential interactive effects of mixtures of chemicals. Chemical mixtures of concern include benzene, toluene, ethylbenzene, and xylenes.¹¹¹²
- March 13, 2014 – Volatile organic compounds (VOCs) emitted in Utah’s heavily drilled Uintah Basin led to 39 winter days exceeding the EPA’s eight-hour National Ambient Air Quality Standards level for ozone pollutants the previous winter. “Levels above this threshold are considered to be harmful to human health, and high levels of ozone are known to cause respiratory distress and be responsible for an estimated 5,000 premature deaths in the U.S. per year,” according to researchers at the University of Colorado. Their observations “reveal a strong causal link between oil and gas emissions, accumulation of air toxics, and significant production of ozone in the atmospheric surface layer.”¹³ Researchers estimated that total annual VOC emissions at the fracking sites are equivalent to those of about 100 million cars.¹⁴

⁹ Morris, J., Song, L., & Hasemayer, D. (2014, April 11). Report: Air quality to worsen in Eagle Ford shale. *The Texas Tribune*. Retrieved June 10, 2014, from <http://www.texastribune.org/2014/04/11/report-air-quality-worsen-eagle-ford-shale/>

¹⁰ Brown, D., Weinberger, B., Lewis, C., & Bonaparte, H. (2014). Understanding exposure from natural gas drilling puts current air standards to the test. *Reviews on Environmental Health*, 0(0). doi: 10.1515/reveh-2014-0002

¹¹ Rawlins, R. (2013). Planning for fracking on the Barnett shale: Urban air pollution, improving health based regulation, and the role of local governments. *Virginia Environmental Law Journal*, 31, 226-306. Retrieved June 10, 2014, from http://www.velj.org/uploads/1/2/7/0/12706894/2._rawlins_-_barnett_shale.pdf

¹² University of Texas at Austin. (2014, March 27). Air pollution and hydraulic fracturing: Better monitoring, planning and tracking of health effects needed in Texas. Retrieved June 10, 2014, from <http://www.utexas.edu/news/2014/03/27/hydraulic-fracturing-texas/>

¹³ Helmig, D., Thompson, C. R., Evans, J., Boylan, P., Hueber, J., & Park, J. (2014). Highly elevated atmospheric levels of volatile organic compounds in the Uintah Basin, Utah [Abstract]. *Environmental Science & Technology*, 48(9), 4707-4715. doi: 10.1021/es405046r

¹⁴ Lockwood, D. (2014, March 25). Harmful air pollutants build up near oil and gas fields. *Chemical & Engineering News*. Retrieved June 10, 2014, from <http://cen.acs.org/articles/92/web/2014/03/Harmful-Air-Pollutants-Build-Near.html>

- March 3, 2014 – In a report summarizing “the current understanding of local and regional air quality impacts of natural gas extraction, production, and use,” a group of researchers from the NOAA, Stanford, Duke, and other institutions described what is known and unknown with regard to air emissions including greenhouse gases, ozone precursors (volatile organic compounds and nitrogen oxides), air toxics, and particulates. Crystalline silica was also discussed, including as a concern for people living near well pads and production staging areas.¹⁵
- February 18, 2014 – An eight-month investigation by the *Weather Channel*, *Center for Public Integrity* and *InsideClimate News* into fracking in the Eagle Ford Shale in Texas revealed that fracking is “releasing a toxic soup of chemicals into the air.” They noted very poor monitoring by the state of Texas and reported on hundreds of air complaints filed relating to air pollution associated with fracking.¹⁶
- January 28, 2014 – Congenital heart defects and possibly neural tube defects in babies were associated with the density and proximity of natural gas wells within a 10-mile radius of mothers’ residences in a study of almost 25,000 births from 1996-2009 in rural Colorado. The researchers note that natural gas development emits several chemicals known to increase risk of birth defects (teratogens).¹⁷
- January 4, 2014 – As summarized by *Bloomberg View* Editorial Board’s Mark Whitehouse, preliminary data from researchers at Princeton University, Columbia University and MIT showed elevated rates of low birthweight among infants born to mothers living near drilling and fracking operations during their pregnancies.¹⁸
- December 18, 2013 – An interdisciplinary group of researchers in Texas collected air samples in residential areas near shale gas extraction and production, going beyond previous Barnett Shale studies by including emissions from the whole range of production equipment. They found that most areas had “atmospheric methane concentrations considerably higher than reported urban background concentrations,” and many toxic chemicals were “strongly associated” with compressor stations.¹⁹
- December 10, 2013 – Health department testing at fracking sites in West Virginia revealed dangerous levels of benzene in the air. Wheeling-Ohio County Health Department Administrator Howard Gamble stated, “The levels of benzene really pop out.

¹⁵ Moore, C. W., Zielinska, B., Petron, G., & Jackson, R. B. (2014). Air impacts of increased natural gas acquisition, processing, and use: A critical review. *Environmental Science & Technology*. doi: 10.1021/es4053472

¹⁶ Morris, J., Song, L., & Hasemayer, D. (2014, February 18). Fracking the Eagle Ford Shale. *The Weather Channel*. Retrieved June 10, 2014, from <http://stories.weather.com/fracking>

¹⁷ McKenzie, L. M., Guo, R., Witter, R. Z., Savitz, D. A., Newman, L. S., & Adgate, J. L. (2014). Birth outcomes and maternal residential proximity to natural gas development in rural Colorado. *Environmental Health Perspectives*, 122, 412-417. doi: 10.1289/ehp.1306722

¹⁸ Whitehouse, M. (2014, January 4). Study shows fracking is bad for babies. *Bloomberg*. Retrieved June 10, 2014, from <http://www.bloombergview.com/articles/2014-01-04/study-shows-fracking-is-bad-for-babies>

¹⁹ Rich, A., Grover, J. P., & Sattler, M. L. (2014). An exploratory study of air emissions associated with shale gas development and production in the Barnett Shale. *Journal of the Air & Waste Management Association*, 64(1), 61-72. doi: 10.1080/10962247.2013.832713

The amounts they were seeing were at levels of concern. The concerns of the public are validated.”²⁰

- October, 2013 – A preliminary 2013 Cornell University study of the health impacts of oil and gas extraction on infant health in Colorado found that proximity to wells—linked with air pollutants from fracking operations—was associated with reductions in average birthweight and length of pregnancy as well as increased risk for low birthweight and premature birth.²¹ A study by the same author, currently under review, analyzed births to Pennsylvania mothers residing close to a shale gas well in Pennsylvania from 2003-2010 also identified increased risk of adverse effects. This includes low birth weight, as well as a 26% increase in APGAR scores under 8 (APGAR—or American Pediatric Gross Assessment Record—is a measure of newborn responsiveness. Scores of less than 8 predict an increase in the need for respiratory support).²²
- October 11, 2013 – Air sampling before, during, and after drilling and fracking of a new natural gas well pad in rural western Colorado documented the presence of the toxic solvent methylene chloride, along with several polycyclic aromatic hydrocarbons (PAHs) at “concentrations greater than those at which prenatally exposed children in urban studies had lower developmental and IQ scores.”²³
- September 19, 2013 – In Texas, air monitoring data in the Eagle Ford Shale area revealed potentially dangerous exposures of nearby residents to hazardous air pollutants, including cancer-causing benzene and the neurological toxicant, hydrogen sulfide.²⁴
- September 13, 2013 – A study by researchers at the University of California at Irvine found dangerous levels of volatile organic compounds in Canada’s “Industrial Heartland” where there are more than 40 oil, gas and chemical facilities. The researchers noted high levels of hematopoietic cancers (leukemia and non-Hodgkin’s lymphoma) in men who live closer to the facilities.²⁵

²⁰ Junkins, C. (2013, December 10). Health dept. concerned about benzene emissions near local gas drilling sites. *The Intelligencer, Wheeling News-Register*. Retrieved June 10, 2014, from <http://www.theintelligencer.net/page/content.detail/id/593209/Health-Dept--Concerned-About-Benzene-Emissions-Near-Local-Gas-Drilling-Sites.html?nav=510>

²¹ Hill, E. L. (2013, October). The impact of oil and gas extraction on infant health in Colorado. Retrieved June 10, 2014, from <http://www.elainehill.com/research>

²² Hill, E.L. (2013, December). Shale Gas Development and Infant Health: Evidence from Pennsylvania (under review). Retrieved June 23, 2014 from <http://www.elainehill.com/research>.

²³ Colborn, T., Schultz, K., Herrick, L., & Kwiatkowski, C. (2014). An Exploratory Study of Air Quality Near Natural Gas Operations. *Human and Ecological Risk Assessment: An International Journal*, 20(1), 86-105. doi: 10.1080/10807039.2012.749447

²⁴ Wilson, S., Sumi, L., & Subra, W. (2013, September 19). Reckless endangerment while fracking the Eagle Ford shale. *Earthworks*. Retrieved June 10, 2014, from http://www.earthworksaction.org/library/detail/reckless_endangerment_in_the_eagle_ford_shale#UkGi-4Y3uSo.

²⁵ Blake, D. R. Air quality in the Industrial Heartland of Alberta, Canada and potential impacts on human health. *Atmospheric Environment*, 702-709. Retrieved June 16, 2014, from <http://concernedhealthny.org/wp-content/uploads/2013/07/Simpson2013-AE-in-press.pdf>

- August 26, 2013 – Medical experts at a rural clinic in heavily drilled Washington County, PA reported case studies of 20 individuals with acute symptoms consistent with exposure to air contaminants known to be emitted from local fracking operations.^{26, 27}
- May 2, 2013 – Reports of symptoms commonly linked to exposure to elevated levels of ground-level ozone associated with gas drilling have been documented in shale-heavy states. In Pennsylvania in 2012, a study of more than 100 state residents living near gas facilities found that reported health symptoms closely matched the scientifically established effects of chemicals detected through air and water testing at those nearby sites, and that those negative health effects occurred at significantly higher rates in households closer to the gas facilities than those further away.²⁸ Indicative of the growing prevalence of such health impacts in the state, a poll showed that two-thirds of Pennsylvanians support a moratorium on fracking because of concern about negative health impacts.²⁹
- April 29, 2013 – Using American Lung Association data, researchers with the Environmental Defense Fund determined that air quality in rural areas with fracking was worse than air quality in urban areas.³⁰
- March, 2013 – A review of regional air quality damages in parts of Pennsylvania in 2012 from Marcellus Shale development found that air pollution was a significant concern, with regional damages ranging from \$7.2 to \$32 million dollars in 2011.³¹
- February 27, 2013 – In a letter from Concerned Health Professionals of New York to Governor Andrew Cuomo, a coalition of hundreds of health organizations, scientists, medical experts, elected officials and environmental organizations noted serious health concerns about the prospects of fracking in New York State, making specific note of air pollution.³² Signatory organizations included the American Academy of Pediatrics of New York, the American Lung Association of New York and Physicians for Social

²⁶ Abrams, L. (2013, August 26). Fracking's real health risk may be from air pollution. *Salon*. Retrieved June 10, 2014, from http://www.salon.com/2013/08/26/frackings_real_health_risk_may_be_from_air_pollution/

²⁷ Dyrszka, L., Nolan, K., & Steingraber, S. (2013, August 27). *Statement on preliminary findings from the Southwest Pennsylvania Environmental Health Project study*. Press release. Concerned Health Professionals of NY. Retrieved June 10, 2014, from <http://concernedhealthny.org/statement-on-preliminary-findings-from-the-southwest-pennsylvania-envir...>

²⁸ Steinzor, N., Subra, W., & Sumi, L. (2013). Investigating Links between Shale Gas Development and Health Impacts Through a Community Survey Project in Pennsylvania. *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*, 23(1), 55-83. doi: 10.2190/NS.23.1.e

²⁹ Phillips, S. (2013, May 14). Poll shows support for a drilling moratorium in Pennsylvania. *StateImpact*. Retrieved June 10, 2014, from <http://stateimpact.npr.org/pennsylvania/2013/05/14/poll-shows-support-for-a-drilling-moratorium-in-pennsylvania/>

³⁰ Grossman, D. (2013, April 29). Clean air report card: CO, WY Counties get F's due to oil and gas pollution. *Environmental Defense Fund*. Retrieved June 10, 2014, from <http://blogs.edf.org/energyexchange/2013/04/29/clean-air-report-card-co-wy-counties-get-fs-due-to-oil-and-gas-pollution/#sthash.FXRv6Nxi.dpuf>

³¹ Litovitz, A., Curtright, A., Abramzon, S., Burger, N., & Samaras, C. (2013). Estimation of regional air-quality damages from Marcellus Shale natural gas extraction in Pennsylvania. *Environmental Research Letters*, 8(1). doi: 10.1088/1748-9326/8/1/014017

³² Concerned Health Professionals of NY. (2013, February 27). Letter to Governor Cuomo. Retrieved June 10, 2014, from <http://concernedhealthny.org/letters-to-governor-cuomo/>

Responsibility. The New York State Medical Society, representing 30,000 medical professionals, has issued similar statements.³³

- January 2, 2013 – A NOAA study identified emissions from oil and gas fields in Utah as a significant source of pollutants that contribute to ozone problems.³⁴ Exposure to elevated levels of ground-level ozone is known to worsen asthma and has been linked to respiratory illnesses and increased risk of stroke and heart attack.³⁵
- December 3, 2012 – A study linked a single well pad in Colorado to more than 50 airborne chemicals, 44 of which have known health effects.³⁶
- July 18, 2012 – A study by the Houston Advanced Research Center modeled ozone formation from a natural gas processing facility using accepted emissions estimates and showed that regular operations could significantly raise levels of ground-level ozone (smog) in the Barnett Shale in Texas and that gas flaring further contributed to ozone levels.³⁷
- March 19, 2012 – A Colorado School of Public Health study found air pollutants near fracking sites linked to neurological and respiratory problems and cancer.^{38,39} The study, based on three years of monitoring at Colorado sites, found a number of “potentially toxic petroleum hydrocarbons in the air near gas wells including benzene, ethylbenzene, toluene and xylene.” Lisa McKenzie, PhD, MPH, lead author of the study and research associate at the Colorado School of Public Health, said, “Our data show that it is important to include air pollution in the national dialogue on natural gas development that has focused largely on water exposures to hydraulic fracturing.”⁴⁰

³³ Campbell, J. (2013, April 17). Fracking roundup: Gas prices up; Medical society wants moratorium. *Politics on the Hudson*. Retrieved June 10, 2014, from <http://polhudson.lohudblogs.com/2013/04/17/fracking-roundup-gas-prices-up-medical-society-wants-moratorium/>

³⁴ Tollefson, J. (2013). Methane leaks erode green credentials of natural gas. *Nature*, 493(7430), 12-12. doi: 10.1038/493012a

³⁵ American Lung Association. (2013). American Lung Association state of the air 2013 - Ozone pollution. Retrieved June 10, 2014, from <http://www.stateoftheair.org/2013/health-risks/health-risks-ozone.html>

³⁶ Song, L. (2012, December 3). Hazardous air pollutants detected near fracking sites. *Bloomberg*. Retrieved June 10, 2014, from <http://www.bloomberg.com/news/2012-12-03/hazardous-air-pollutants-detected-near-fracking-sites.html>

³⁷ Olaguer, E. P. (2012). The potential near-source ozone impacts of upstream oil and gas industry emissions. *Journal of the Air & Waste Management Association*, 62(8), 966-977. doi: 10.1080/10962247.2012.688923

³⁸ Kelly, D. (2012, March 19). Study shows air emissions near fracking sites may pose health risk. *University of Colorado Denver*. Retrieved June 10, 2014, from <http://www.ucdenver.edu/about/newsroom/newsreleases/Pages/health-impacts-of-fracking-emissions.aspx>

³⁹ McKenzie, L. M., Witter, R. Z., Newman, L. S., & Adgate, J. L. (2012). Human health risk assessment of air emissions from development of unconventional natural gas resources. *Science of the Total Environment*, 424, 79-87. doi: 10.1016/j.scitotenv.2012.02.018

⁴⁰ Banerjee, N. (2012, March 20). Study: 'Fracking' may increase air pollution health risks. *Los Angeles Times*. Retrieved June 11, 2014, from <http://articles.latimes.com/2012/mar/20/local/la-me-gs-fracking-increases-air-pollution-health-risks-to-residents-20120320>

- December 12, 2011 – Cancer specialists, cancer advocacy organizations, and health organizations summarized the cancer risks posed by all stages of the shale gas extraction process in a letter to New York Governor Andrew Cuomo.⁴¹
- October 5, 2011 – More than 250 medical experts and health organizations reviewed the multiple health risks from fracking in a letter sent to New York Governor Andrew Cuomo.⁴²
- April 21, 2011 – *Environment & Energy (E&E)* reported that ozone levels exceeding federal health standards in Utah’s Uintah Basin, as well as wintertime ozone problems in other parts of the Intermountain West, stem from oil and gas extraction. Levels reached nearly twice the federal standard, potentially dangerous even for healthy adults to breathe. Keith Guille, spokesman for the Wyoming Department of Environmental Quality, said, “We recognize that definitely the main contributor to the emissions that are out there is the oil and gas industry....”⁴³
- March 8, 2011 – The Associated Press reported that gas drilling in some remote areas of Wyoming caused a decline of air quality from pristine mountain air to levels of smog and pollution worse than Los Angeles on its worst days, resulting in residents complaining of watery eyes, shortness of breath and bloody noses.⁴⁴
- November 18, 2010 – A study of air quality in the Haynesville Shale region of east Texas, northern Louisiana, and southwestern Arkansas found that shale oil and gas extraction activities contributed significantly to ground-level ozone (smog) via high emissions of ozone precursors, including volatile organic compounds and nitrogen

⁴¹ Physicians, Scientists & Engineers for Healthy Energy. (2011, December 12). Appeal to Gov. Cuomo to consider cancer risks re: High volume hydraulic fracturing for natural gas [Letter to A. Cuomo].

⁴² Physicians, Scientists & Engineers for Healthy Energy. (2011, October 5). Letter to Governor Cuomo [Letter to A. Cuomo].

⁴³ Streater, S. (2011, April 21). Air pollution: Winter ozone problem continues to mystify regulators, industry. *E&E Publishing, LLC*. Retrieved June 11, 2014, from <http://www.eenews.net/stories/1059948108>

⁴⁴ Gruver, M. (2011, March 8). Wyoming is beset by a big-city problem: Smog. *USA Today*. Retrieved June 11, 2014, from http://usatoday30.usatoday.com/money/industries/energy/2011-03-08-natural-gas-ozone-wyoming_N.htm

oxides.⁴⁵ Ozone is a key risk factor for asthma and other respiratory and cardiovascular illnesses.^{46 47 48 49}

- September, 2010 – A health assessment by the Colorado School of Public Health for gas development in Garfield County, Colorado determined that air pollution will likely “be high enough to cause short-term and long-term disease, especially for residents living near gas wells. Health effects may include respiratory disease, neurological problems, birth defects and cancer.”^{50 51}
- January 27, 2010 – Of 94 drilling sites tested for benzene in air over the Barnett Shale, the Texas Commission on Environmental Quality (TECQ) discovered two well sites emitting what they determined to be “extremely high levels” and another 19 emitting elevated levels.⁵²

Water contamination

- June 25, 2014 – A study by Cornell University researchers found that fracking fluid and fracking wastewater mobilized previously deposited chemical contaminants in soil particles in ways that could potentially exacerbate the impacts of fracking fluid spills or leaks. That research team concluded that, by interfering with the ability of soil to bond to and sequester pollutants such as heavy metals, fracking fluids may release from soils an additional repository of contaminants that could migrate into groundwater.⁵³

⁴⁵ Kemball-Cook, S., Bar-Ilan, A., Grant, J., Parker, L., Jung, J., Santamaria, W., ... Yarwood, G. (2010). Ozone Impacts of Natural Gas Development in the Haynesville Shale. *Environmental Science & Technology*, 44(24), 9357-9363. doi: 10.1021/es1021137

⁴⁶ U.S. Environmental Protection Agency. (2013). *Integrated Science Assessment for Ozone and Related Photochemical Oxidants*. Retrieved June 11, 2014, from <http://www.epa.gov/ncea/isa/ozone.htm>

⁴⁷ Kemball-Cook, S., Bar-Ilan, A., Grant, J., Parker, L., Jung, J., Santamaria, W., ... Yarwood, G. (2010). Ozone Impacts of Natural Gas Development in the Haynesville Shale. *Environmental Science & Technology*, 44(24), 9357-9363. doi: 10.1021/es1021137

⁴⁸ McKenzie, L. M., Witter, R. Z., Newman, L. S., & Adgate, J. L. (2012). Human health risk assessment of air emissions from development of unconventional natural gas resources. *Science of the Total Environment*, 424, 79-87. doi: 10.1016/j.scitotenv.2012.02.018

⁴⁹ Myers, O., Flowers, H., Kang, H., Bedrick, E., Whorton, B., Cui, X., & Stidley, C. A. (2007). *The association between ambient air quality ozone levels and medical visits for asthma in San Juan County* (U.S.A., New Mexico Department of Health, Environmental Health Epidemiology Bureau Epidemiology and Response Division).

⁵⁰ Witter, R., McKenzie, L., Towle, M., Stinson, K., Scott, K., Newman, L., & Adgate, J. (2010). Health impact assessment for Battlement Mesa, Garfield County Colorado. *Colorado School of Public Health*. Retrieved June 10, 2014, from <http://www.garfield-county.com/public-health/documents/1%20%20%20Complete%20HIA%20without%20Appendix%20D.pdf>

⁵¹ Battlement Mesa HIA/EHMS. (2013, November 30). Retrieved June 10, 2014, from <http://www.garfield-county.com/environmental-health/battlement-mesa-health-impact-assessment-draft2.aspx>

⁵² The Associated Press. (2010, January 27). Texas agency finds high benzene levels on Barnett Shale. Retrieved June 10, 2014, from http://www.nola.com/business/index.ssf/2010/01/texas_agency_finds_high_benzen.html

⁵³ Sang, W., Stoof, C., Zhang, W., Morales, V., Gao, B., Kay, R., et al. Effect of Hydrofracking Fluid on Colloid Transport in the Unsaturated Zone. *Environmental Science & Technology*. Retrieved July 4, 2014, from <http://pubs.acs.org/doi/abs/10.1021/es501441e>

- June 23, 2014 – Building on earlier findings that water samples collected from sites with confirmed fracking spills in Garfield County, Colorado exhibited moderate to high levels of estrogen and androgen-disrupting activity, a University of Missouri team extended their investigation to other types of hormonal effects. As reported at a joint meeting of the International Society of Endocrinology and the Endocrine Society, their research documented that commonly used fracking chemicals can also block the receptors for thyroid hormone, progesterone, and glucocorticoids (a family of hormones involved in both fertility and immune functioning). Of 24 fracking chemicals tested, all 24 interfered with the activity of one or more important hormone receptors. There is no known safe level of exposure to hormone-disrupting chemicals.⁵⁴
- May 11, 2014 – According to the U.S. Government Accountability Office, the federal government is failing to inspect thousands of oil and gas wells located on public land, including those that pose special risks of water contamination or other environmental damage. An investigation by the Associated Press found that the Bureau of Land Management (BLM) “had failed to conduct inspections on more than 2,100 of the 3,702 wells that it had specified as ‘high priority’ and drilled from 2009 through 2012. The agency considers a well ‘high priority’ based on a greater need to protect against possible water contamination and other environmental safety issues.”⁵⁵
- March 25, 2014 – An industry-funded study of oil and gas well integrity found that more than six percent of wells in a major shale exploration region in Pennsylvania showed evidence of leaking and conceded that this number is likely an underestimate. Researchers concluded that the percentage of wells with some form of well barrier or integrity failure is highly variable and could be as high as 75 percent. A separate analysis in the same study found 85 examples of cement or casing failures in Pennsylvania wells monitored between 2008 and 2011.⁵⁶
- March 7, 2014 – In a comprehensive evaluation, Duke University scientists and colleagues reviewed the state of knowledge on possible effects of shale gas and hydraulic fracturing on water resources in the United States and concluded, “Analysis of published data (through January 2014) reveals evidence for stray gas contamination, surface water impacts in areas of intensive shale gas development, and the accumulation of radium

⁵⁴ The Endocrine Society (2014). Hormone-disrupting activity of fracking chemicals worse than initially found. *Science Daily*, June 23, 2014 Retrieved from: http://www.sciencedaily.com/releases/2014/06/140623103939.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Ftop_news%2Ftop_health+%28ScienceDaily%3A+Top+Health+News%29

⁵⁵ Yen, H. (2014, May 11). Fed govt failed to inspect higher risk oil wells. *Associated Press*. Retrieved June 9, 2014, from <http://bigstory.ap.org/article/fed-govt-failed-inspect-higher-risk-oil-wells>

⁵⁶ Davies, R. J., Almond, S., Ward, R. S., Jackson, R. B., Adams, C., Worrall, F., ... Whitehead, M. A. (2014). Oil and gas wells and their integrity: Implications for shale and unconventional resource exploitation. *Marine and Petroleum Geology*, 56, 239-254. doi: 10.1016/j.marpetgeo.2014.03.001

isotopes in some disposal and spill sites.”⁵⁷

- February 19, 2014 – A Pennsylvania court found a gas corporation guilty of contaminating a woman’s drinking water well in Bradford County. Methane levels after fracking were 1,300 to 2,000 times higher than baseline, according to the court brief. Iron levels and turbidity had also increased. The brief stated, “In short, Jacqueline Place lived for ten months deprived totally of the use of her well, and even after its ‘restoration,’ has been burdened with a water supply with chronic contamination, requiring constant vigilance and ongoing monitoring.”⁵⁸
- January 16, 2014 – Data from the Colorado Oil and Gas Commission showed that fracking-related chemical spills in Colorado exceed an average rate of one spill per day. Of the 495 chemical spills that occurred in that state over a one-year period of time, nearly a quarter impacted ground or surface water. Sixty-three of the spills spread within 1,500 feet of pigs, sheep and cows, and 225 spread within 1,500 feet of buildings.⁵⁹
- January 10, 2014 – Duke University water tests revealed ongoing water contamination in Parker County, Texas, providing evidence that EPA had prematurely ended its prior investigation into the water contamination.⁶⁰ A letter sent to the EPA from more than 200 environmental organizations called on the EPA to re-open its investigation.⁶¹
- January 5, 2014 – An Associated Press investigation into drinking water contamination from fracking in four states—Pennsylvania, Ohio, West Virginia and Texas—found many cases of confirmed water contamination and hundreds more complaints. The Associated Press noted that their analysis “casts doubt on industry view that it rarely happens.”⁶²

⁵⁷ Vengosh, A., Jackson, R. B., Warner, N., Darrah, T. H., & Kondash, A. (2014). A critical review of the risks to water resources from unconventional shale gas development and hydraulic fracturing in the United States [Abstract]. *Environmental Science & Technology*. doi: 10.1021/es405118y

⁵⁸ Gibbons, B. (2014, February 19). Woman wins case against Chesapeake Jaqueline Place of Terry Township to receive compensation for well contamination. *TheDailyReview.com*. Retrieved June 9, 2014, from <http://thedailyreview.com/news/woman-wins-case-against-chesapeake-jaqueline-place-of-terry-township-to-receive-compensation-for-well-contamination-1.1636832>

⁵⁹ Tomasic, J. (2014, January 16). Colorado drilling data: More than a spill a day | The Colorado Independent. *The Colorado Independent*. Retrieved June 9, 2014, from <http://www.coloradoindependent.com/145629/colorado-drilling-data-more-than-a-spill-a-day>

⁶⁰ Drajem, M. (2014, January 9). Duke fracking tests reveal dangers driller's data missed. *Bloomberg*. Retrieved June 9, 2014, from <http://www.bloomberg.com/news/2014-01-10/epa-s-reliance-on-driller-data-for-water-irks-homeowners.html>

⁶¹ Drajem, M. (2014, January 27). EPA needs fracking review: 'Gasland' maker, environmentalists. *Bloomberg*. Retrieved June 9, 2014, from <http://go.bloomberg.com/political-capital/2014-01-27/epa-needs-fracking-review-gasland-producer-environmentalists-say/>.

⁶² Begos, K. (2014, January 05). 4 states confirm water pollution from drilling. *USA Today*. Retrieved June 9, 2014, from <http://www.usatoday.com/story/money/business/2014/01/05/some-states-confirm-water-pollution-from-drilling/4328859/>

- December 24, 2013 – A report from the EPA Inspector General concluded that evidence of fracking-related water contamination in Parker County, Texas was sound and faulted the EPA for prematurely ending its investigation there, relying on faulty water testing data from the gas industry in doing so, and failure to intervene when affected residents’ drinking water remained unsafe.⁶³ As reported by *Business Insider*, “The EPA Screwed Up When It Dropped This Fracking Investigation.”⁶⁴
- December 16, 2013 – Lead by Susan Nagel of the University of Missouri School of Medicine, researchers documented endocrine-disrupting properties in chemicals commonly used as ingredients of fracking fluid and found similar endocrine-disrupting activity in groundwater and surface water samples collected near drilling and fracking sites in Garfield County, Colorado. Endocrine disruptors are chemicals that interfere with the activity of hormones in the body and, at very low concentrations, can raise the risk of reproductive, metabolic, and neurological disorders, especially when exposures occur in early life.^{65 66 67}
- December 7, 2013 – Reporting on the second gas leak at a single gas well in one month, the Fort Worth *Star-Telegram* uncovered another inherent risk of fracking for groundwater contamination: Silica sand, which is used as an ingredient in fracking fluid for its ability to prop open the shale fractures, can damage steel pipes as it flows back up the well along with the gas. According to Dan Hill, head of the petroleum engineering department at Texas A&M University, new wells are the most susceptible to sand erosion because “the amount of sand and gas rushing through valves and flow lines is at its greatest when a well first goes into production.”⁶⁸
- November 28, 2013 – An Associated Press investigation uncovered nearly 300 oil pipeline spills in North Dakota in the previous ten months, all with no public notification. These were among some 750 “oil field incidents” that had occurred in the state over the same time period, also without public notification. Until the AP inquiry, industry and state officials had kept quiet about one particular “massive spill” that had been

⁶³ Banerjee, N. (2013, December 24). EPA report on fracking in Texas raises new concerns. *Los Angeles Times*. Retrieved June 9, 2014, from <http://www.latimes.com/nation/la-na-epa-fracking-20131225,0,6042944.story#ixzz2oVB9FXVY>

⁶⁴ Miedema, D. (2013, December 25). The EPA screwed up when it dropped this fracking investigation. *Business Insider*. Retrieved June 9, 2014, from <http://www.businessinsider.com/epa-criticized-for-dropping-fracking-investigation-2013-12>

⁶⁵ Kassotis, C. D., Tillitt, D. E., Davis, J. W., Hormann, A. M., & Nagel, S. C. (2013). Estrogen and androgen receptor activities of hydraulic fracturing chemicals and surface and ground water in a drilling-dense region. *Endocrinology*. doi: 10.1210/en.2013-1697

⁶⁶ Banerjee, N. (2013, December 16). Hormone-disrupting chemicals found in water at fracking sites. *Los Angeles Times*. Retrieved June 11, 2014, from <http://articles.latimes.com/2013/dec/16/science/la-sci-fracking-health-20131217>

⁶⁷ Endocrine Society. (2013, December 16). Fracking chemicals disrupt hormone function. ScienceDaily. Retrieved June 11, 2014 from www.sciencedaily.com/releases/2013/12/131216140428.htm

⁶⁸ Hirst, C., & Fuquay, J. (2013, December 7). Second leak reported at east Fort Worth gas well site. *Star-Telegram*. Retrieved June 9, 2014, from <http://www.star-telegram.com/2013/12/07/5399740/second-leak-reported-at-east-fort.html?rh=1>

accidentally discovered by a wheat farmer. Even small spills can contaminate water sources permanently and take cropland out of production.⁶⁹

- November 26, 2013 – A U.S. Geological Survey report found serious impacts of fracking on watersheds and water quality throughout the Appalachian Basin, as well as issues with radiation and seismic events. As noted in the report, the knowledge of how extraction affects water resources has not kept pace with the technology.^{70 71} Meanwhile, clean fresh water is becoming an increasingly scant resource. A report from the U.S. State Department found that the United States will face a serious freshwater shortage by 2030, with demand exceeding supply by 40 percent.⁷²
- November 22, 2013 – A U.S. Geological Survey study of pollution from oil production in North Dakota, where horizontal drilling and hydraulic fracturing are heavily used, identified two potential plumes of groundwater contamination covering 12 square miles. The cause was traced to a casing failure in a wastewater disposal well. Drilling companies had incorrectly assumed that, once injected underground, the wastewater would remain contained. According to *EnergyWire*, the development of the Bakken oil formation is “leaving behind an imprint on the land as distinct as the ones left by the receding ice sheets of the ice age.”⁷³
- September 10, 2013 – Pennsylvania Attorney General Kathleen Kane filed criminal charges against Exxon Mobil Corporation’s subsidiary, XTO Energy Corporation, for a spill of 50,000 gallons of toxic drilling wastewater in 2010 that contaminated a spring and a tributary of the Susquehanna River. In July, XTO settled civil charges for the incident without admitting liability by agreeing to pay a \$100,000 fine and improve its wastewater management.⁷⁴
- September 10, 2013 – Out of concern for risks posed to drinking water in our nation’s capital, George Hawkins, general manager of DC Water, Washington, DC’s local water provider, called for a prohibition on horizontal drilling and hydraulic fracturing in the

⁶⁹ MacPherson, J. (2013, October 28). Nearly 300 pipeline spills in North Dakota have gone unreported to the public since January 2012. *Huffington Post*. Retrieved June 9, 2014, from http://www.huffingtonpost.com/2013/10/28/pipeline-spills-north-dakota_n_4170133.html?ncid=edlinkusaolp00000003

⁷⁰ Kappel, W. M., Williams, J. H., & Szabo, Z. (2013). Water resources and shale gas/oil production in the Appalachian Basin - Critical issues and evolving developments. *U.S. Geological Survey*. Retrieved June 9, 2014, from <http://pubs.usgs.gov/of/2013/1137/pdf/ofr2013-1137.pdf>

⁷¹ Mall, A. (2013, November 26). New USGS analysis: Threats to water, wildlife, and health from oil and gas development in the Appalachian basin [Web log post]. Retrieved June 9, 2014, from http://switchboard.nrdc.org/blogs/amall/new_usgs_analysis.html

⁷² A freshwater shortage is expected in the US by 2030. (2013, September 8). *MSN Now*. Retrieved June 11, 2014, from <http://now.msn.com/freshwater-shortage-in-us-will-reach-a-worrying-stage-by-2030-1#scpsrtru>

⁷³ Vaidyanathan, G. (2013, November 22). Bakken shale: As oil production sets in, pollution starts to migrate -- scientists. *E&E Publishing, LLC*. Retrieved June 9, 2014, from <http://www.eenews.net/stories/105990892>

⁷⁴ Maykuth, A. (2013, September 13). Shale criminal charges stun drilling industry. *Philly.com*. Retrieved June 9, 2014, from http://articles.philly.com/2013-09-13/news/42012429_1_xto-energy-inc-criminal-charges-attorney-general

George Washington National Forest until the process can be proven safe.⁷⁵ The Potomac River is the source of the District's water supply and has its headwaters in the George Washington National Forest, which sits atop the Marcellus Shale. The general managers of Fairfax Water, provider of drinking water for Fairfax County, Virginia, and the U.S. Army Corps of Engineers have called for a similar prohibition.⁷⁶

- September 3, 2013 – The North Dakota Department of Mineral Resources voiced concern about an increasing number of fracking well blowouts (23 incidents in the past year) that result in spills and public safety threats.⁷⁷
- August 28, 2013 – A joint U.S. Geological Survey and U.S. Fish and Wildlife Service study documented a causal link between a fracking wastewater spill and the widespread death of fish in the Acorn Fork, a creek in Kentucky.⁷⁸
- July 25, 2013 – A University of Texas at Arlington study of drinking water found elevated levels of arsenic and other heavy metals in some samples from private drinking water wells located within 5 km of active natural gas wells in the Barnett Shale.^{79 80}
- July 3, 2013 – *ProPublica* reported that the EPA was wrong to have halted its investigation of water contamination in Wyoming, Texas and Pennsylvania—where high levels of benzene, methane, arsenic, oil, methane, copper, vanadium and other chemicals associated with fracking operations have been documented.⁸¹ Although numerous organizations and health professionals around the country have since called on the agency to resume its investigation, no action has been taken.
- June 6, 2013 – *Bloomberg News* reported,

In cases from Wyoming to Arkansas, Pennsylvania to Texas, drillers have agreed to cash settlements or property buyouts with people who say hydraulic fracturing, also known as fracking, ruined their water according to a review by Bloomberg News of hundreds of regulatory and legal filings. In most cases homeowners must agree to

⁷⁵ Letter from George Hawkins, General Manager, DC Water, to U.S. Secretary of Agriculture, Thomas Vilsack, (Sept. 10, 2013), <http://www.washingtoncitypaper.com/blogs/housingcomplex/2013/09/20/dc-water-chief-urges-agriculture-secretary-not-to-allow-fracking-near-d-c/>.

⁷⁶ Wiener, A. (2013, September 20). DC Water Chief urges Agriculture Secretary not to allow fracking near D.C. *Washington City Paper*. Retrieved June 11, 2014, from <http://www.washingtoncitypaper.com/blogs/housingcomplex/2013/09/20/dc-water-chief-urges-agriculture-secretary-not-to-allow-fracking-near-d-c/>

⁷⁷ Sun Staff. (2013, September 3). More blowouts a concern for N.D. *The Jamestown Sun*. Retrieved June 9, 2014, from <http://www.jamestownsun.com/content/more-blowouts-concern-nd>

⁷⁸ Papoulias, D., & MacKenzie, T. (2013, August 28). Hydraulic fracturing fluids likely harmed threatened Kentucky fish species. *USGS Newsroom*. Retrieved June 9, 2014, from <http://www.usgs.gov/newsroom/article.asp?ID=3677>

⁷⁹ Fontenot, B. E., Hunt, L. R., Hildenbrand, Z. L., Jr., D. D., Oka, H., Walton, J. L., ... Schug, K. A. (2013). An Evaluation of Water Quality in Private Drinking Water Wells Near Natural Gas Extraction Sites in the Barnett Shale Formation. *Environmental Science & Technology*, 47(17), 10032-10040. doi: 10.1021/es4011724

⁸⁰ *Id.*

⁸¹ Lustgarten, A. (2013, July 3). EPA's abandoned Wyoming fracking study one retreat of many. *ProPublica*. Retrieved June 9, 2014, from <http://www.propublica.org/article/epas-abandoned-wyoming-fracking-study-one-retreat-of-many>

keep quiet. The strategy keeps data from regulators, policymakers, the news media and health researchers, and makes it difficult to challenge the industry's claim that fracking has never tainted anyone's water.

Bloomberg quoted Aaron Bernstein, associate director of the Center for Health and the Global Environment at the Harvard School of Public Health, saying that non-disclosure agreements “have interfered with the ability of scientists and public health experts to understand what is at stake here.”⁸² The EPA also long ago noted how non-disclosure agreements challenge scientific progress and keep examples of drilling harm secret from the public. In a 1987 report, the EPA wrote,

*Very often damage claims against oil and gas operators are settled out of court, and information on known damage cases has often been sealed through agreements between landowners and oil companies. This is typical practice, for instance, in Texas. In some cases, even the records of well-publicized damage incidents are almost entirely unavailable for review. In addition to concealing the nature and size of any settlement entered into between the parties, impoundment curtails access to scientific and administrative documentation of the incident.*⁸³

- June 3, 2013 – A study by Duke University researchers linked fracking with elevated levels of methane, ethane, and propane in nearby groundwater.⁸⁴ Published in *Proceedings of the National Academy of Sciences*, the study included results from 141 northeastern Pennsylvania water wells. Methane levels were, on average, six times higher in drinking water wells closer to drilling sites when compared with those farther away, while ethane was 23 times higher.⁸⁵
- May 19, 2013 – In Pennsylvania, the *Scranton Times-Tribune* released details of an investigation that revealed at least 161 cases of water contamination from fracking between 2008 and the fall of 2012, according to state Department of Environmental Protection records.⁸⁶
- April 2013 – Researchers analyzing publicly available Colorado data found 77 surface spills impacting groundwater in Weld County alone. Samples of these spills often exceeded drinking water maximum contaminant levels (MCLs) for benzene, toluene,

⁸² Efstathiou, J., Jr., & Drajem, M. (2013, June 5). Drillers Silence Fracking Claims With Sealed Settlements. *Bloomberg*. Retrieved June 9, 2014, from <http://www.bloomberg.com/news/2013-06-06/drillers-silence-fracking-claims-with-sealed-settlements.html>

⁸³ Environmental Protection Agency. (1987). *Report to Congress: Management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy* (Rep.). 137-138. Washington, D.C.: U.S. Environmental Protection Agency.

⁸⁴ Jackson, R. B., Vengosh, A., Darrah, T. H., Warner, N. R., Down, A., Poreda, R. J., ... Karr, J. D. (2013). Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction. *Proceedings of the National Academy of Sciences*, 110(28), 11250-11255. doi: 10.1073/pnas.1221635110

⁸⁵ CBS/AP. (2013, June 25). Methane found in Pa. drinking water near fracked wells. *CBS News*. Retrieved June 9, 2014, from <http://www.cbsnews.com/news/methane-found-in-pa-drinking-water-near-fracked-wells/>

⁸⁶ Legere, L. (2013, May 19). Sunday Times review of DEP drilling records reveals water damage, murky testing methods. *The Times-Tribune*. Retrieved June 9, 2014, from <http://thetimes-tribune.com/news/sunday-times-review-of-dep-drilling-records-reveals-water-damage-murky-testing-methods-1.1491547>

ethylbenzene and xylene; for benzene, a known carcinogen, 90% of the samples exceeded the legal limit.⁸⁷

- March 4, 2013 – Researchers at the University of Pittsburgh Graduate School of Public Health analyzed samples of gas drilling wastewater discharged to surface water through wastewater treatment plants. Barium, strontium, bromides, chlorides, and benzene all exceeded levels known to cause human health impacts.⁸⁸
- December 9, 2012 – State data in Colorado showed more than 350 instances of groundwater contamination resulting from more than 2,000 spills from oil and gas operations over the past five years. Further, as the *Denver Post* reported, “Contamination of groundwater—along with air emissions, truck traffic and changed landscapes—has spurred public concerns about drilling along Colorado’s Front Range.”⁸⁹
- May, 2012 – A report by researchers at Natural Resources Defense Council and Carnegie Mellon University found that the options available for dealing with fracking wastewater are inadequate to protect public health and the environment, resulting in increasing quantities of toxic wastewater as an ongoing problem without a good solution.⁹⁰
- January 11, 2012 – The U.S. Geological Survey found that the Marcellus Shale is already highly fractured and that numerous fissures naturally occurring within the formation could potentially provide pathways for contaminants to migrate vertically into water supplies.⁹¹
- October 17, 2011 – Thomas P. Jacobus, General Manager of the U.S. Army Corps of Engineers’ Washington Aqueduct, that provides drinking water to Washington, DC, Arlington County, Virginia, and Falls Church, Virginia, called for a prohibition on horizontal hydraulic fracturing in the George Washington National Forest because of concern that fracking poses risks to drinking water. The Washington Aqueduct—which provides drinking water to Washington, DC, Arlington County, Virginia, and Falls Church, Virginia—is supplied by the Potomac River, which has its headwaters in the George Washington National Forest that sits atop the Marcellus Shale. Jacobus said, “Enough study on the technique [hydraulic fracturing] has been published to give us great

⁸⁷ Gross, S. A., Avens, H. J., Banducci, A. M., Sahlme, J., Panko, J. M., & Tvermoes, B. E. (2013). Analysis of BTEX groundwater concentrations from surface spills associated with hydraulic fracturing operations. *Journal of the Air & Waste Management Association*, 63(4), 424-432. doi: 10.1080/10962247.2012.759166

⁸⁸ Ferrar, K. J., Michanowicz, D. R., Christen, C. L., Mulcahy, N., Malone, S. L., & Sharma, R. K. (2013). Assessment of effluent contaminants from three facilities discharging Marcellus shale wastewater to surface waters in Pennsylvania. *Environmental Science & Technology*, 47(7), 3472-3481. doi: 10.1021/es301411q

⁸⁹ Finley, B. (2012, December 9). Drilling spills reaching Colorado groundwater; state mulls test rules. *The Denver Post*. Retrieved June 9, 2014, from http://www.denverpost.com/environment/ci_22154751/drilling-spills-reaching-colorado-groundwater-state-mulls-test#ixzz2EihHU2fg

⁹⁰ Hammer, R., & VanBriesen, J. (2012, May). *In fracking’s wake: New rules are needed to protect our health and environment from contaminated wastewater* (Rep.). Retrieved June 11, 2014, from National Resource Defence Council website: <http://www.nrdc.org/energy/files/fracking-wastewater-fullreport.pdf>

⁹¹ U.S. Geological Survey, New York Water Science Center. (2012, January 11). *Comments on the revised draft supplemental generic environmental impact statement* (Rep.). Retrieved June 11, 2014, from http://www.ewg.org/sites/default/files/report/ReviseddraftSGEIS_USGScomments_Version3_0.pdf

cause for concern about the potential for degradation of the quality of our raw water supply....”⁹²

- October 11, 2011 – Charles M. Murray, General Manager of Fairfax Water, the water provider for Fairfax County, Virginia, called for a prohibition on horizontal hydraulic fracturing in the George Washington National Forest. “Natural gas development activities have the potential to impact the quantity and quality of Fairfax Water’s source water,” Murray wrote. “Downstream water users and consumers will bear the economic burden if drinking water sources are contaminated or the quality of our source water supply is degraded.”⁹³
- September 7, 2011 – In its draft Supplemental Generic Environmental Impact Statement (SGEIS), the NYS DEC acknowledged that “there is questionable available capacity”⁹⁴ for New York’s public sewage treatment plants to accept drilling wastewater, yet the agency said that it would allow those facilities to accept such waste if the plants meet permitting conditions.⁹⁵ The NYS DEC proposed underground injection as one alternative to sewage treatment procession of fracking waste. Although it is a common method of disposal for fracking wastewater,⁹⁶ the last significant government study of pollution risks from oil and gas wastewater injection wells occurred in 1989 and found multiple cases of costly groundwater contamination.⁹⁷ In subsequent years, studies have continued to link underground injection of drilling wastewater to pollution as well as earthquakes.⁹⁸
- September, 2011 – A team led by Theo Colburn of the Endocrine Disruptor Exchange found that 25 percent of chemicals known to be used in fracking fluids are implicated in cancer, 37 percent could disrupt the endocrine system, and 40 to 50 percent could cause

⁹² Jacobus, T. P. (2012, April 25). Draft environmental impact statement for the George Washington National Forest [Letter written October 17, 2011 to K. Landgraf]. Retrieved June 11, 2014, from http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5366331.pdf

⁹³ Murray, C. M. (n.d.). Draft environmental impact statement for the George Washington National Forest [Letter written October 11, 2013 to K. Landgraf]. Retrieved June 11, 2014, from <http://www.svnva.org/wp-content/uploads/fairfax-wash-aquaduct-gwnf-comments.pdf>

⁹⁴ New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (6-62, Rep.).

⁹⁵ New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (6-57 through 6-63, Rep.).

⁹⁶ New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (6-64, Rep.).

⁹⁷ United States Government Accountability Office. (1989, July 5). Drinking water: Safeguards are not preventing contamination from injected oil and gas wastes. Retrieved June 10, 2014, from <http://www.gao.gov/products/RCED-89-97>

⁹⁸ Fountain, H. (2012, January 01). Disposal halted at well after new quake in Ohio. *The New York Times*. Retrieved June 10, 2014, from <http://www.nytimes.com/2012/01/02/science/earth/youngstown-injection-well-stays-shut-after-earthquake.html>

nervous, immune and cardiovascular system problems. The research team also found that and more than 75 percent could affect the skin, eyes and respiratory system, resulting in various problems such as skin and eye irritation or flu-like symptoms.⁹⁹

- August 4, 2011 – As reported by *The New York Times*, the EPA had alerted Congress in 1987 about a case of water contamination caused by fracking. Its report documented that a shale gas well hydraulically fractured at a depth of more than 4,200 feet contaminated a water supply only 400 feet from the surface.^{100 101 102}
- May 17, 2011 – The state of Pennsylvania fined Chesapeake Energy Corp. \$900,000 for an incident in which improper cementing and casing in one of the company's gas wells allowed methane to migrate underground and contaminate 16 private drinking water wells in Bradford County.¹⁰³
- May 9, 2011 – A Duke University study documented “systematic evidence for methane contamination of drinking water associated with shale gas extraction.” The study showed that methane levels were 17 times higher in water wells near drilling sites than in water wells in areas without active drilling.¹⁰⁴
- January 2011 – A team of scientists led by a University of Central Arkansas researcher called attention to the threat posed to surface waters by rapidly expanding shale gas development, noting a lack of data collection accompanying the rush to drill. “Gas wells are often close to surface waters that could be impacted by elevated sediment runoff from pipelines and roads, alteration of stream flow as a result of water extraction, and contamination from introduced chemicals or the resulting wastewater.”¹⁰⁵
- April 29, 2010 – In 2010, the Colorado Oil and Gas Conservation Commission fined OXY USA a record \$390,000 for an incident of pollution, discovered in 2008, when its drilling wastes leaked through an unlined pit, contaminated two springs with benzene and polluted other nearby water sources. In addition, the regulators separately fined OXY USA \$257,400 for a nearby case of pollution, also discovered in 2008, in which a torn

⁹⁹ Colborn, T., Kwiatkowski, C., Schultz, K., & Bachran, M. (2011). Natural Gas Operations from a Public Health Perspective. *Human and Ecological Risk Assessment: An International Journal*, 17(5), 1039-1056. doi: 10.1080/10807039.2011.605662

¹⁰⁰ Urbina, I. (2011, August 4). A tainted water well, and concern there may be more. Retrieved June 11, 2014, from <http://www.nytimes.com/2011/08/04/us/04natgas.html>

¹⁰¹ U.S. Environmental Protection Agency. (1987). *Report to Congress: Management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy* (Rep.). 4-22, 4-23. Retrieved June 11, 2014, from <http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=20012D4P.PDF>

¹⁰² Horwitt, D. (2011, August 3). Cracks in the facade. *Environmental Working Group*. Retrieved June 11, 2014, from <http://www.ewg.org/research/cracks-façade>

¹⁰³ Levy, M. (2011, May 18). DEP fines Chesapeake \$1 million. *Pressconnects.com*. Retrieved June 9, 2014, from <http://www.pressconnects.com/viewart/20110517/NEWS01/105170345/DEP-fines-Chesapeake-1-million>

¹⁰⁴ Duke University. (2011). Methane levels 17 times higher in water wells near hydrofracking sites, study finds. *ScienceDaily*. Retrieved June 11, 2014, from <http://www.sciencedaily.com/releases/2011/05/110509151234.htm>

¹⁰⁵ Entekin, S., Evans-White, M., Johnson, B., & Hagenbuch, E. (2011). Rapid expansion of natural gas development poses a threat to surface waters. *Frontiers in Ecology and the Environment*, 9(9), 503-511. doi: 10.1890/110053

liner in a pit caused drilling waste fluids to leak out and contaminate two springs with benzene.¹⁰⁶

- April 22, 2011 – Describing one of many blowouts, the Associated Press reported on a shale gas well in Canton, Pennsylvania that spewed thousands of gallons of chemical-laced water on farmland and into a stream for two consecutive days before being brought under control.¹⁰⁷
- January 31, 2011 – As part of a year-long investigation into hydraulic fracturing and its potential impact on water quality, U.S. Representatives Henry Waxman (D-Calif.), Edward Markey (D-Mass.) and Diana DeGette (D-Colo.) reported that “between 2005 and 2009, oil and gas service companies injected 32.2 million gallons of diesel fuel or hydraulic fracturing fluids containing diesel fuel in wells in 19 states.” Furthermore, revealing apparent widespread violation of the Safe Drinking Water Act, the investigation found that no oil and gas service companies had sought—and no state or federal regulators had issued—permits for the use of diesel fuel in hydraulic fracturing.¹⁰⁸
- June 5, 2009 – A leaking pipe carrying fracking waste in Washington County, Pennsylvania, polluted a tributary of Cross Creek Lake, killing fish, salamanders, crayfish and aquatic insect life in approximately three-quarters of a mile of the stream.¹⁰⁹
- April 26, 2009 – Officials in three states linked water contamination and methane leaks to gas drilling. Incidents included a case in Ohio where a house exploded after gas seeped into its water well and multiple cases of exploding drinking water wells in Dimock, PA.¹¹⁰
- November 13, 2008 – *ProPublica* reported more than 1,000 cases of drilling-related contamination documented by courts and state and local governments in Colorado, New Mexico, Alabama, Ohio and Pennsylvania.¹¹¹
- December 15, 2007 – In Bainbridge, Ohio, a gas well that was improperly cemented and

¹⁰⁶ Webb, D. (2010, April 29). Record fine, second one against Oxy approved | GJSentinel.com. *Grand Junction Sentinel*. Retrieved June 11, 2014, from <http://www.gjsentinel.com/news/articles/record-fine-second-one-against-oxy-approved>

¹⁰⁷ The Associated Press. (2011, April 22). Crews stop flow of drilling fluid from Pennsylvania well. *Syracuse.com*. Retrieved June 9, 2014, from http://www.syracuse.com/news/index.ssf/2011/04/crews_stop_flow_of_drilling_fl.html

¹⁰⁸ Waxman, H. A., Markey, E. J., & DeGette, D. (2011, January 31). *Committee on Energy & Commerce* (U.S.A., Congress, Committee on Energy & Commerce). Retrieved June 9, 2014, from <http://democrats.energycommerce.house.gov/index.php?q=news/waxman-markey-and-degette-investigation-finds-continued-use-of-diesel-in-hydraulic-fracturing-f>

¹⁰⁹ Pittsburgh Post-Gazette. (2009, June 5). Waste from Marcellus shale drilling in Cross Creek Park kills fish. *Pittsburgh Post-Gazette*. Retrieved June 9, 2014, from <http://www.post-gazette.com/washington/2009/06/05/Waste-from-Marcellus-shale-drilling-in-Cross-Creek-Park-kills-fish/stories/200906050136>

¹¹⁰ Lustgarten, A. (2009, April 26). Officials in three states pin water woes on gas drilling. *ProPublica*. Retrieved June 9, 2014, from <http://www.propublica.org/article/officials-in-three-states-pin-water-woes-on-gas-drilling-426>

¹¹¹ Lustgarten, A. (2008, November 13). Buried secrets: Is natural gas drilling endangering U.S. water supplies? *ProPublica*. Retrieved June 9, 2014, from <http://www.propublica.org/article/buried-secrets-is-natural-gas-drilling-endangering-us-water-supplies-1113>

subsequently fractured by Ohio Valley Energy Systems Corp. allowed natural gas to migrate outside of the well, causing a home to explode. In addition, 23 nearby water wells were contaminated, two of which were located more than 2,300 feet from the drilling site.^{112 113 114}

Inherent engineering problems that worsen with time

- June 30, 2014 – A study published in *Proceedings of the National Academy of Sciences* by a Cornell University research team projected that over 40 percent of shale gas wells in Northeastern Pennsylvania will leak methane into groundwater or the atmosphere over time. Analyzing more than 75,000 state inspections of more than 41,000 oil and gas wells in Pennsylvania since 2000, the researchers identified high occurrences of casing and cement impairments inside and outside the wells. A comparative analysis showed that newer, unconventional (horizontally fracked) shale gas wells were leaking at six times the rate of conventional (vertical) wells drilled over the same time period. The leak rate for unconventional wells drilled after 2009 was at least 6 percent, and rising with time.¹¹⁵ The study also discovered that over 8,000 oil and gas wells drilled since 2000 had not received a facility-level inspection. This study helps explain the results of earlier studies that documented elevated levels of methane in drinking water aquifers located near drilling and fracking operations in Pennsylvania and points to compromised structural integrity of well casings and cement as a possible mechanism.
- May 22, 2014 – In a 69-page report, University of Waterloo researchers warned that natural gas seeping from 500,000 wellbores in Canada represents “a threat to environment and public safety“ due to groundwater contamination, greenhouse gas emissions and explosion risks wherever methane collects in unvented buildings and spaces. The report found that 10 percent of all active and suspended gas wells in British Columbia now leak methane. Additionally, the report found that some hydraulically fractured shale gas wells in that province have become “super methane emitters” that

¹¹² Ohio Department of Natural Resources Division of Mineral Resources Management. (2008, September 1). *Report on the investigation of the natural gas invasion of aquifers in Bainbridge Township of Geauga County, Ohio* (Rep.). Retrieved June 9, 2014, from Ohio Department of Natural Resources website: <http://www.ohiodnr.com/mineral/bainbridge/tabid/20484/default.aspx>

¹¹³ Bair, E. S., Freeman, D. C., & Senko, J. M. (2010, June). *Expert panel technical report, subsurface gas invasion Bainbridge Township, Geauga County, Ohio* (Rep.). Retrieved June 11, 2014, from Ohio Department of Natural Resources website: [http://oilandgas.ohiodnr.gov/portals/oilgas/pdf/bainbridge/DMRM%200%20Title%20Page,%20Preface,%20Ackno](http://oilandgas.ohiodnr.gov/portals/oilgas/pdf/bainbridge/DMRM%200%20Title%20Page,%20Preface,%20Acknowledgements.pdf)

¹¹⁴ Ohio Dep't of Natural Res., Order Number 2009-17 (Apr. 14, 2009) (see attachments A, B).

¹¹⁵ Ingraffea, A., Wells, M., Santoro, R., & Shonkoff, S. Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000–2012. *Proceedings of the National Academy of Sciences*. Retrieved July 4, 2014, from <http://www.pnas.org/content/early/2014/06/25/1323422111.abstract>

spew as much as 2,000 kilograms of methane a year.^{116 117}

- May 1, 2014 – Following a comprehensive review of evidence, the Council of Canadian Academies identified inherent problems with well integrity as one of its top concerns about unconventional drilling and fracking. According to one expert panel, “the greatest threat to groundwater is gas leakage from wells from which even existing best practices cannot assure long-term prevention.”¹¹⁸ Regarding their concerns related to well integrity and cement issues, the panel wrote:

Two issues of particular concern to panel members are water resources, especially groundwater, and GHG emissions. Both related to well integrity.... Natural gas leakage from improperly formed, damaged, or deteriorated cement seals is a long-recognized yet unresolved problem.... Leaky wells due to improperly placed cement seals, damage from repeated fracturing treatments, or cement deterioration over time, have the potential to create pathways for contamination of groundwater resources and to increase GHG emissions.

They further explain:

Cement may crack, shrink, or become deformed over time, thereby reducing the tightness of the seal around the well and allowing the fluids and gases ... to escape into the annulus between casing and rock and thus to the surface.... The challenge of ensuring a tight cement seal [will] be greater for shale gas wells that are subjected to repeated pulses of high pressure during the hydraulic fracturing process than for conventional gas wells. This pressure stresses the casing and therefore the cement that isolates the well from surrounding formations repeatedly.

- 2013 – According to state inspections of all 6,000 wells drilled in Pennsylvania’s Marcellus Shale before 2013, six to ten percent of them leaked natural gas, with the rate of leakage increasing over time. The rate was six percent in 2010 (97 well failures out of 1,609 wells drilled); 7.1 percent in 2011 (140 well failures out of 1,972 wells drilled); and 8.9 percent in 2012 (120 well failures out of 1,346 wells drilled).¹¹⁹ These data include wells that were cited for leakage violations, and wells that were noted to be leaking by inspectors but which had not been given violations. The New York State DEC forecasts that 50,000 wells could be drilled over the life of the Marcellus Shale play. If they fail at the same rate as wells in Pennsylvania, 4,000 wells would fail and leak in New York

¹¹⁶ Dusseault, M. B., Jackson, R. E., & MacDonal, D. (2014, May 22). *Towards a road map for mitigating the rates and occurrences of long-term wellbore leakage* [Scholarly project]. In *Geofirma*. Retrieved June 10, 2014, from http://www.geofirma.com/Links/Wellbore_Leakage_Study%20compressed.pdf

¹¹⁷ Nikiforuk, A. (2014, June 5). Canada's 500,000 leaky energy wells: 'Threat to public' *The Tyee*. Retrieved June 10, 2014, from <http://www.thetyee.ca/News/2014/06/05/Canada-Leaky-Energy-Wells/>

¹¹⁸ Council of Canadian Academies. (2014, May 1). *Environmental Impacts of Shale Gas Extraction in Canada: the Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction*. Retrieved June 24, 2014, from <http://bit.ly/1nNicuf>

¹¹⁹ Ingraffea, A. R. (2013). Some scientific failings within high volume hydraulic fracturing proposed regulations. Retrieved June 10, 2014, from http://www.psehealthyenergy.org/data/NYS_DEC_Proposed_REGS_comments_Ingraffea_Jan_2013.pdf

almost immediately.¹²⁰

- 2009 – A study published by the Society of Petroleum Engineers of more than 315,000 oil, gas and injection wells in Alberta, Canada, found that 4.5 percent of the wells had unintended gas flow to the surface. In one designated area, officials required testing for gas migration outside the well casings in addition to routine testing for gas leaks within the rings of steel casings (annuli). Within this special testing zone, 15.5 percent of wells (3,205 of 20,725) leaked gas, and the incidence of gas leaks was four times percent higher in horizontal or deviated wells than in vertical wells.¹²¹
- Autumn 2003 – Schlumberger, one of the world’s largest companies specializing in hydraulic fracturing and other oilfield services, reported in its in-house publication, *Oilfield Review*, that more than 40 percent of approximately 15,500 wells in the outer continental shelf area in the Gulf of Mexico were leaking gas. These included actively producing wells, in addition to shut-in and temporarily abandoned wells. In many cases, the gas leaked through the spaces (annuli) between layers of steel casing that drilling companies had injected with cement precisely to prevent such gas leaks. Leakage rates increased dramatically with age: about five percent of the wells leaked immediately; 50 percent were leaking after 15 years; and 60 percent were leaking after about 30 years.¹²² Gas leaks pose serious risks including loss of life from explosions and migration of gas and associated contaminants into drinking water supplies. Leaks also allow the venting of raw methane into the atmosphere where it acts as a powerful greenhouse gas.
- November 2000 – Maurice Dusseault, a professor at the University of Waterloo in Ontario who specializes in rock mechanics, and two co-authors presented a paper published by the Society of Petroleum Engineers, in which they reported that oil and natural gas wells routinely leak gas through cracks in their cement casings, likely caused by cement shrinkage over time and exacerbated by upward pressure from natural gas. According to their paper, in Alberta, it is common for wells to leak natural gas into aquifers. “Because of the nature of the mechanism, the problem is unlikely to attenuate,” they wrote, “and the concentration of the gases in the shallow aquifers will increase with time.”¹²³

Radioactive releases

¹²⁰New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (2-1, Rep.).

¹²¹ Watson, T. L., & Bachu, S. (2009). Evaluation of the potential for gas and CO₂ leakage along wellbores, society of petroleum engineers. *SPE Drilling & Completion*, 115-126.

¹²² Brufatto, C. (2003). From mud to cement - Building gas wells. *Oilfield Review*, 15(3). Retrieved June 10, 2014, from http://www.slb.com/resources/publications/industry_articles/oilfield_review/2003/or2003aut06_building_gas_wells.aspx

¹²³ Dusseault, M. B., Gray, M. N., & Nawrocki, P. A. (2000). Why oilwells leak: Cement behavior and long-term consequences. *Society of Petroleum Engineers*. Retrieved June 10, 2014, from <http://www.hydrorelief.org/frackdata/references/65704543-Casing-Leaks.pdf>

- May 8, 2014 – A group of leading medical experts and the American Lung Association of the Northeast detailed research and growing concerns about potential health impacts of radon and radium associated with natural gas production and the Marcellus Shale, in particular. High levels of radiation in the Marcellus Shale could pose health threats if high concentrations of radon and its decay products travel with natural gas, a problem compounded by the short distance Marcellus gas could travel in pipelines to people’s homes.¹²⁴
- March 24, 2014 – A team led by toxicology researchers at the University of Iowa identified high levels of radioactivity in fracking wastewater as a significant concern and noted that the testing methods used and recommended by state regulators in the Marcellus Shale region can dramatically underestimate the amount of radioactivity—specifically radium—in fracking wastewater.¹²⁵ Results obtained using EPA-recommended protocols can be obscured by a mix of other contaminants present. Regarding the use of EPA protocols with fracking wastewater or other highly saline solutions, Avner Vengosh, a geochemist at Duke University, noted, “People have to know that this EPA method is not updated.”¹²⁶
- October 2, 2013 – A peer-reviewed study of the impacts of drilling wastewater treated and discharged into a creek by a wastewater facility in western Pennsylvania documented radium levels approximately 200 times greater in sediment samples near the discharge location than in sediment samples collected upstream of the plant or elsewhere in western Pennsylvania. “The absolute levels that we found are much higher than what you allow in the U.S. for any place to dump radioactive material,” one of the authors told *Bloomberg News*. The pollution occurred despite the fact that the treatment plant removed a substantial amount of the radium from the drilling wastewater before discharging it. The researchers wrote that the accumulation of radium in sludge removed from the wastewater “could pose significant exposure risks if not properly managed.”^{127 128}
- February 2013 – In an analysis of fracking sludge samples from Pennsylvania, researchers “... confirmed the presence of alpha, beta, and gamma radiation in the soil and water in reserve pits located on agricultural land.” Total beta radiation exceeded

¹²⁴ Campbell, J. (2014, May 8). Fracking critics keep pushing for state-backed health study. *Politics on the Hudson*. Retrieved June 9, 2014, from <http://polhudson.lohudblogs.com/2014/05/08/fracking-critics-keep-pushing-state-backed-health-study/>

¹²⁵ Nelson, A. W., May, D., Knight, A. W., Eitrheim, E. S., Mehrhoff, M., Shannon, R., ... Schultz, M. K. (2014). Matrix complications in the determination of radium levels in hydraulic fracturing flowback water from Marcellus shale. *Environmental Science & Technology*, *1*(3), 204-208. doi: 10.1021/ez5000379

¹²⁶ Kelly, S. (2014, March 24). Research shows some test methods miss 99 percent of radium in fracking waste. *Desmogblog.com*. Retrieved June 9, 2014, from <http://www.desmogblog.com/2014/03/23/some-testing-methods-can-miss-99-percent-radium-fracking-waste-new-research-reports>

¹²⁷ Warner, N. R., Christie, C. A., Jackson, R. B., & Vengosh, A. (2013). Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania. *Environmental Science & Technology*, *47*(20), 11849-11857. doi: 10.1021/es402165b

¹²⁸ Efstathiou, J., Jr. (2013, October 2). Radiation in Pennsylvania creek seen as legacy of fracking. *Bloomberg*. Retrieved June 11, 2014, from <http://www.bloomberg.com/news/2013-10-02/radiation-in-pennsylvania-creek-seen-as-legacy-of-frackin.html>

regulatory guideline values by more than 800 percent, and elevated levels of some of the radioactive constituents remained in a vacated pit that had been drained and leveled. It is imperative, the research team concluded, “that we obtain better knowledge of the quantity of radioactive material and the specific radioisotopes being brought to the earth’s surface from these mining processes.”¹²⁹

- January 11, 2012 – In its review of the New York State DEC’s SGEIS on high-volume fracturing, the EPA expressed concerns about the diffusion of responsibility for the ultimate disposal of radioactive wastes generated by treatment or pretreatment of drilling wastewater. The EPA also raised concerns about the lack of analysis of radon and other radiation exposure. “Who is responsible for addressing the potential health and safety issues and associated monitoring related to external radiation and the inhalation of radon and its decay products?” the EPA asked. “Such potential concerns need to be addressed.”¹³⁰
- 2012 – Responding to concern about radon in natural gas produced from the Marcellus Shale, the U.S. Geological Survey analyzed ten samples of gas collected near the wellheads of three Pennsylvania gas wells. The agency found radon levels ranging from 1 to 79 picocuries per liter, with an average of 36 and a median of 32. (The highest radon activity reported here would decay to 19.8 pCi/L in approximately a week; by comparison, the EPA’s threshold for indoor air remediation is 4 pCi/L.) Asserting they knew of no previous published measurements of radon in natural gas from the Appalachian Basin, which contains the Marcellus Shale, agency scientists concluded that the number of samples “is too small to... yield statistically valid results” and urged “collection and interpretation of additional data.”¹³¹
- September 7, 2011 – The U.S. Geological Survey reported that radium levels in wastewater from oil and gas wells in New York and Pennsylvania, including those in the Marcellus Shale, “have a distinctly higher median... than reported for other formations in the Appalachian Basin, and range to higher values than reported in other basins.” The median level of radium found in Marcellus Shale wastewater in New York, 5,490 picocuries per liter, is almost 1,100 times the maximum contaminant level for drinking water, which is five picocuries per liter. In other words, if a million gallons of Marcellus Shale wastewater contaminated with the median level of radium found in New York were to spill into a waterway, 1.1 billion gallons of water would be required to dilute the

¹²⁹ Rich, A. L., & Crosby, E. C. (2013). Analysis of Reserve Pit Sludge from Unconventional Natural Gas Hydraulic Fracturing and Drilling Operations for the Presence of Technologically Enhanced Naturally Occurring Radioactive Material (TENORM). *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*, 23(1), 117-135. doi: 10.2190/NS.23.1.h

¹³⁰ Environmental Protection Agency. (2012, January 11). *EPA comments on revised draft NYSDEC revised dSGEIS for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* [Press release]. Retrieved June 10, 2014, from <http://www.epa.gov/region2/newsevents/pdf/EPA%20R2%20Comments%20Revised%20dSGEIS%20Enclosure.pdf>

¹³¹ Rowan, E. L., & Kraemer, T. F. (2012). *Radon - 222 content of natural gas samples from upper and middle Devonian sandstone and shale reservoirs in Pennsylvania: Preliminary data* (Rep.). Retrieved June 10, 2014, from United States Geological Survey website: <http://pubs.usgs.gov/of/2012/1159/ofr2012-1159.pdf>

radium to the maximum legal level.¹³² (The EPA's health-based goal for radium in drinking water is zero.) Over time, radium naturally decays into radioactive radon gas. Thus, higher radium levels also suggest that higher levels of radon may also be present in natural gas produced from the Marcellus Shale.

- February 27, 2011 – *The New York Times* reported on the threat to drinking water from Pennsylvania drilling waste due to the presence of chemical contaminants, including high levels of radioactivity. The investigation found that sewage treatment plants were neither testing for nor capable of removing that radioactivity, which was subsequently discharged into waterways that supply drinking water. Drillers sent some of this waste to New York State. The article states:

*In December 2009, these very risks led E.P.A. scientists to advise in a letter to New York that sewage treatment plants not accept drilling waste with radium levels 12 or more times as high as the drinking-water standard. The Times found wastewater containing radium levels that were hundreds of times this standard. The scientists also said that the plants should never discharge radioactive contaminants at levels higher than the drinking-water standard.*¹³³

- 2008-2009 –The New York State DEC found that wastewater from 11 of 13 vertical wells drilled in New York's Marcellus Shale in 2008 and 2009 contained radium levels ranging from 400 times to nearly 3,400 times EPA's safe level for radium in drinking water. These figures later informed the 2011 study of radium in drilling wastewater conducted by the U.S. Geological Survey.¹³⁴

Occupational health and safety hazards

- May 19, 2014 – Underscoring the dangerous nature of chemicals used in fracking operations, the National Institute for Occupational Safety and Health reported that at least four gasfield workers have died since 2010 from acute chemical exposures during flowback operations. They note that research is underway and that significantly more is needed. The National Institute for Occupational Safety and Health reported that flowback operations can “result in elevated concentrations of volatile hydrocarbons in the work environment that could be acute exposure hazards.” The agency further noted that such

¹³² Rowan, E. L., Engle, M. A., Kirby, C. S., & Kraemer, T. F. (2011, September 7). *Radium content of oil- and gas-field produced waters in the northern Appalachian basin (USA): Summary and discussion of data* (Rep.). Retrieved June 10, 2014, from United States Geological Survey website: <http://pubs.usgs.gov/sir/2011/5135/>
<http://water.epa.gov/drink/contaminants/basicinformation/radionuclides.cfm>.

¹³³ Urbina, I. (2011, February 26). Regulation lax as gas wells' tainted water hits rivers. *The New York Times*. Retrieved June 10, 2014, from http://www.nytimes.com/2011/02/27/us/27gas.html?pagewanted=all&_r=0

¹³⁴ New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (5-133, 5-141, 7-60, Appendix 12, Appendix 13, Rep.).

volatile hydrocarbons “can affect the eyes, breathing, and the nervous system and at high concentrations may also affect the heart causing abnormal rhythms.”^{135 136}

- May 16, 2013 – A National Institute for Occupational Safety and Health study revealed that worker exposure to crystalline silica—or “frac sand” —exceeded “relevant occupational health criteria” at all eleven tested sites, and the magnitude of some exposures exceeded National Institute for Occupational Safety and Health limits by a factor of 10 or more. “[P]ersonal respiratory protection alone is not sufficient to adequately protect against workplace exposures.” Inhalation of crystalline silica can cause incurable silicosis, lung cancer, chronic obstructive pulmonary disease, kidney disease and autoimmune diseases.¹³⁷ Although community exposures distant from mines are possible, there are no federal or state standards for silica in ambient air. A first-ever study on public health risks from “frac sand” is now in progress.¹³⁸
- May 8, 2014 – A report by the AFL-CIO found that the fracking boom has made North Dakota the most dangerous state for U.S. workers—with a fatality rate five times higher than the national average—and that North Dakota’s fatality rate has doubled since 2007. The AFL-CIO called North Dakota “an exceptionally dangerous and deadly place to work.” U.S. Secretary of Labor Thomas E. Perez called the rising rate of workplace deaths suffered in the oil and gas sector “unacceptable.”¹³⁹
- April 24, 2014 – A University of Texas San Antonio report commissioned by the Methodist Healthcare Ministries found that many oil and gas field workers in the Eagle Ford Shale are uninsured or underinsured and that “the most noticeable health impacts so far are work-related illnesses and injuries: heat exhaustion, dehydration, sleep deprivation, exposure to oil and gas spills and accidents.” The study also noted that oil and gas production has put strain on healthcare facilities.¹⁴⁰

¹³⁵ Snawder, J., Esswein, E., King, B., Breitenstein, M., Alexander-Scott, M., Retzer, K., ... Hill, R. (2014, May 19). Reports of worker fatalities during flowback operations [Web log post]. *NIOSH Science Blog*. Retrieved June 9, 2014, from <http://blogs.cdc.gov/niosh-science-blog/2014/05/19/flowback/>

¹³⁶ Iafolla, R. (2014, May 20). Four fatalities linked to used fracking fluid exposure during 'flowback,' NIOSH reports. *Bloomberg BNA*. Retrieved June 9, 2014, from <http://www.bna.com/four-fatalities-linked-n17179890610/>

¹³⁷ Esswein, E. J., Breitenstein, M., Snawder, J., Kiefer, M., & Sieber, W. K. (2013). Occupational Exposures to Respirable Crystalline Silica During Hydraulic Fracturing. *Journal of Occupational and Environmental Hygiene*, *10*(7), 347-356. doi: 10.1080/15459624.2013.788352

¹³⁸ University of Iowa Environmental Health Sciences Research Center. (2012). Exposure assessment and outreach to engage the public on health risks from frac sand mining. Retrieved June 10, 2014, from <http://cph.uiowa.edu/ehsrc/fracsand.html>

¹³⁹ Picchi, A. (2014, May 8). The most dangerous U.S. state for workers. *CBS News*. Retrieved June 10, 2014, from <http://www.cbsnews.com/news/the-most-dangerous-us-state-for-workers/>

¹⁴⁰ Ghahremani, Y. (2014, April 24). Fractured Healthcare: Pumping Resources Back into the Eagle For Shale Communities/Executive Summary: Methodist Healthcare Ministries and Center for Community and Business Research at the University of Texas San Antonio. Retrieved June 20, 2014, from <http://www.joomag.com/en/newsstand/fractured-healthcare-pumping-resources-back-into-the-eagle-ford-shale-communities-apr-2014/0368470001398347080>

- April 10, 2014 –West Virginia University researcher Michael McCawley reported that some of the nation’s highest rates of silicosis are in heavily drilled areas within the Northern Panhandle of West Virginia and southwestern Pennsylvania. A disease that hardens the lungs through inflammation and development of scar tissue, silicosis is entirely attributable to exposure to silica dust, a known occupational hazard at drilling and fracking operations. Two years earlier, the Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health issued a joint “Hazard Alert” to warn fracking workers of the health hazards of exposure to silica dust, including silicosis.¹⁴¹
- February 25, 2014 – A year-long investigation by the *Houston Chronicle* found that fracking jobs are deadly, with high fatality rates and high rates of serious injury. Within just one year in Texas, 65 oil and gas workers died, 79 lost limbs, 82 were crushed, 92 suffered burns and 675 broke bones. From 2007 to 2012, at least 664 US workers were killed in oil and gas fields.¹⁴²¹⁴³
- December 27, 2013 –National Public Radio (NPR) reported spiking rates of fatalities related to oil and gas drilling operations, which had increased more than 100 percent since 2009. NPR noted that in the previous year, 138 workers were killed on the job, making the fatality rate among oil and gas workers nearly eight times higher than the all-average rate of 3.2 deaths for every 100,000 workers across all industries.¹⁴⁴
- October 30, 2012 – In a policy statement, the American Public Health Association (APHA) asserted that, high-volume horizontal hydraulic fracturing (HVHF) “poses potential risks to public health and the environment, including groundwater and surface water contamination, climate change, air pollution, and worker health.” The statement also noted that the public health perspective has been inadequately represented in policy processes related to HVHF.¹⁴⁵ The policy statement added:

[H]ydraulic fracturing workers are potentially exposed to inhalation health hazards from dust containing silica. There may also be impacts on workers and communities affected by the vastly increased production and transport of sand for HVHF.

¹⁴¹ Hicks, I. (2014, April 10). Gas workers risk silica exposure. *The Intelligencer, Wheeling News-Register*. Retrieved June 10, 2014, from <http://www.news-register.net/page/content.detail/id/598589/Gas-Workers-at-Risk-Of-Silica-Ex---.html>

¹⁴² Olsen, L. (2014, February 22). Houston Chronicle exclusive: Drilling boom, deadly legacy. Retrieved June 10, 2014, from <http://www.houstonchronicle.com/news/special-reports/article/Houston-Chronicle-exclusive-Drilling-boom-5259311.php#0>

¹⁴³ Hsieh, S. (2014, February 25). Why are so many workers dying in oil fields? Retrieved June 10, 2014, from <http://www.thenation.com/blog/178523/why-are-so-many-workers-dying-oil-fields>

¹⁴⁴ Schneider, A., & Geewax, M. (2013, December 27). On-the-job deaths spiking as oil drilling quickly expands. Retrieved June 10, 2014, from <http://www.npr.org/2013/12/27/250807226/on-the-job-deaths-spiking-as-oil-drilling-quickly-expands>

¹⁴⁵ American Public Health Association. (2012, October 30). The environmental and occupational health impacts of high-volume hydraulic fracturing of unconventional gas reserves. Retrieved June 10, 2014, from <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1439>

Inhalation of fine dusts of respirable crystalline silica can cause silicosis. Crystalline silica has also been determined to be an occupational lung carcinogen.

- 2005 – A researcher at Stanford University examined hazards associated with oil and gas extraction from exposure to radiation and determined that inhalation of high-levels of radon gas is a serious concern to workers and those living nearby. “[G]aseous radon (222Rn) is concentrated in ethane and propane fractions due to the fact that the boiling point of radon lies between those of propane and ethane. Elevated Rn activity concentration values have been measured at several processing plant sites.... It is well known that the radiological impact of the oil and gas-extracting and processing industry is not negligible.”¹⁴⁶

Noise pollution, light pollution and stress

- June 20, 2014 – In its discussion of “Oil and Gas Drilling/Development Impacts,” the U.S. Office of Indian Energy and Economic Development detailed noise pollution from bulldozers, drill rigs, diesel engines, vehicular traffic, blasting, and flaring of gas. “If noise-producing activities occur near a residential area, noise levels from blasting, drilling, and other activities could exceed the EPA guidelines. The movement of heavy vehicles and drilling could result in frequent-to-continuous noise.... Drilling noise would occur continuously for 24 hours per day for one to two months or more depending on the depth of the formation.”¹⁴⁷ Exposure to chronic noise can be deadly. The World Health Organization has documented the connection between environmental noise and health effects, including cardiovascular disease, cognitive impairment, sleep disturbance, and tinnitus. At least one million “healthy life years” are lost every year from traffic-related noise in the western part of Europe.¹⁴⁸
- February 24, 2014 – In a review of the health effects from unconventional gas extraction published in the journal *Environmental Science & Technology*, leading researchers noted, “Noise exposure is a significant hazard due to the presence of multiple sources, including heavy equipment, compressors, and diesel powered generators. Loud continuous noise has health effects in working populations. It is likely that exposure to noise is substantial for many workers, and this is potentially important for health because drilling and servicing operations are exempt from some sections of the Occupational Safety and Health Administration noise standard.” They noted that research should investigate stressors such as noise and light in the context of drilling and fracking operations in order to understand the overall effect of chemical and physical stressors together.¹⁴⁹

¹⁴⁶ Steinhäusler, F. (2005). Radiological Impact on Man and the Environment from the Oil and Gas Industry: Risk Assessment for the Critical Group. *Nato Science Series: IV: Earth and Environmental Sciences*. DOI: 10.1007/1-4020-2378-2_19. http://rd.springer.com/chapter/10.1007/1-4020-2378-2_19

¹⁴⁷ Oil and Gas Drilling/Development Impacts. (n.d.). *Oil and Gas Drilling/Development Impacts*. Retrieved June 20, 2014, from <http://teeic.indianaffairs.gov/er/oilgas/impact/drilldev/index.htm>

¹⁴⁸ Rodier, G. (2011, June 1). Burden of disease from environmental noise - Quantification of healthy life years lost in Europe. *WHO*. Retrieved June 20, 2014, from http://www.who.int/quantifying_ehimpacts/publications/e94888/en/

¹⁴⁹ Adgate, J. L., Goldstein, B. D., & McKenzie, L. M. (2014). Potential public health hazards, exposures and health effects from unconventional natural gas development [Abstract]. *Environmental Science & Technology*. doi: 10.1021/es404621d

May 30, 2014 – *The Denver Post* reported that in order to help meet Colorado’s noise limits for fracking operations in suburban neighborhoods (and partially block the glare of floodlights), Encana Oil and Gas erected 4-inch-thick polyvinyl walls up to 32 feet high and 800 feet long. Residents said that the plastic walls do not completely solve the problem.¹⁵⁰

- October 25, 2013 – An analysis of well location and census data by the *Wall Street Journal* revealed that at least 15.3 million Americans now live within a mile of a well that has been drilled since 2000. According to this investigation, the fracking boom has ushered in “unprecedented industrialization” of communities across wide swaths of the nation and, with it, “24/7” industrial noise, stadium lighting, earth-moving equipment, and truck traffic.¹⁵¹
- April 16, 2013 – In a presentation on oil field light pollution for a conference on “Sustainable Environment and Energy: Searching for Synergies,” Roland Dechesne of the Royal Astronomical Society of Canada described problems of “light trespass,” glare, and poorly-aimed fixtures in oil fields in Alberta. He described resulting “mass waterfowl mortality” linked to artificial illumination and other biochemical impacts of light pollution on wildlife, as well as the possibility of these effects on humans, including circadian disruption, melatonin suppression and possible resulting hormonally-linked diseases.¹⁵² Known to have ecological impacts, outdoor light pollution from drilling and fracking operations may also be linked to artificial light-associated health effects documented in humans, including breast cancer.¹⁵³
- April, 2013 – Led by the University of Pittsburgh Graduate School of Public Health, a study of community members living in proximity to Marcellus Shale drilling in Pennsylvania found adverse impacts to mental health, with stress the most frequently-reported symptom. At least half of all respondents in each set of interviews reported these specific stressors, including: being taken advantage of; health concerns; concerns/complaints ignored; corruption; denied information or provided with false information. Many also reported the desire to move or leave community, estrangement from community, and financial damages. Researchers noted that stress can result in direct health impacts.¹⁵⁴ Notably, mounting evidence indicates that chronic stress magnifies

¹⁵⁰ Finley, B. (2014, May 29). Oil and gas industry building giant walls to try to ease impact. *The Denver Post*. Retrieved June 20, 2014, from http://www.denverpost.com/ci_25859469/oil-and-gas-industry-building-giant-walls-try

¹⁵¹ Gold, R. and McGinty T. (2014, Oct. 25). Energy boom puts wells in America’s backyards. *The Wall Street Journal*. Retrieved June 21, 2014, from

<http://online.wsj.com/news/articles/SB10001424052702303672404579149432365326304>.

¹⁵² Dechesne, R. (2013). Limiting Oil Field Light Pollution for Safety and the Environment. Sustainable Environment and Energy CPANS 2013 Conference. Retrieved June 20, 2014, from <http://www.cpans.org/assets/Uploads/Presentations/NewFolder/Session-46Roland-Dechesne.pdf>

¹⁵³ Chepesiuk, R. (2009). Missing the Dark: Health Effects of Light Pollution. *Environ Health Perspect.* 117(1): A20–A27.

¹⁵⁴ Ferrar, K.J., Kriesky, J., Christen, C.L., Marshall, L.P., Malone, S.L., Sharma, R.K., Michanowicz, D.R., Goldstein, B.D. (2013). Assessment and longitudinal analysis of health impacts and stressors perceived to result

individuals' susceptibility to effects of pollution; for children, this interactive effect can begin during prenatal life.¹⁵⁵

- September 7, 2011 – A study by researchers at Boise State University and Colorado State University at Fort Collins modeled the potential impacts of compressor station noise from oil and gas operations on Mesa Verde National Park in Colorado. The study found the sound of 64 compressors outside Mesa Verde elevated the sound level within the park by 34.8 decibels on average, and by 56.8 decibels on the side of the park located closest to the compressors. According to the EPA, 55 decibels is the highest “safe noise level” to avoid damage to the human ear.¹⁵⁶

Earthquakes and seismic activity

- May 2, 2014 – The U.S. Geological Survey and Oklahoma Geological Survey jointly issued an official earthquake warning for Oklahoma, pointing out that the number of earthquakes in the state has risen 50 percent since just October—when the two agencies had issued a prior warning. The advisory stated that this dramatic increase in the frequency of small earthquakes “significantly increases the chance for a damaging quake in central Oklahoma.” Injection wells used for the disposal of liquid fracking waste have been implicated as the presumptive cause of the earthquake swarm. According to the Oklahoma Geological Survey, about 80 percent of the state of Oklahoma is closer than ten miles from an injection well.¹⁵⁷ Since the joint earthquake advisory was released in May, the number of earthquakes in Oklahoma has continued to rise. During the first four months of 2014, Oklahoma had experienced 109 earthquakes of magnitude 3 or higher on the Richter scale. By mid-June, the number of earthquakes had topped 200, exceeding the frequency of earthquakes in California.¹⁵⁸
- May 2, 2014 – At the annual meeting of the Seismological Society of America, leading geologists warned that the risks and impacts of earthquakes from fracking and injection wells are even more significant than previously thought, pointing out that such earthquakes could occur tens of miles away from wells themselves, including quakes greater than 5.0 magnitude on the Richter scale. Justin Rubinstein, a research geophysicist at the U.S. Geological Survey said, “This demonstrates there is a significant

from unconventional shale gas development in the Marcellus Shale region. *Int J Occup Environ Health*. Apr-Jun;19(2):104-112. doi: 10.1179/2049396713Y.0000000024.

¹⁵⁵ Cooney, C.M. (2011). Stress–Pollution Interactions: An Emerging Issue in Children’s Health Research. *Environ Health Perspect* 119:a430-a435. <http://dx.doi.org/10.1289/ehp.119-a430>

¹⁵⁶ Barber, J.R., C.L. Burdett, S.E. Reed, K.A. Warner, C. Formichella, K.R. Crooks, D.M. Theobald, and K.M. Fristrup (2011). Anthropogenic noise exposure in protected natural areas: estimating the scale of ecological consequences. *Landscape Ecology* 26(9),1281-1295.

¹⁵⁷ Geological Survey Joint Statement. (2014, May 2). Record Number of Oklahoma Tremors Raises Possibility of Damaging Earthquakes. United States Geological Survey. Retrieved June 23, 2014, from http://earthquake.usgs.gov/regional/ceus/products/newsrelease_05022014.php

¹⁵⁸ Branson-Potts, H. (2014, June 17). Oklahoma coming to terms with unprecedented surge in earthquakes. *Los Angeles Times*. Retrieved June 23, 2014, from <http://www.latimes.com/nation/la-na-oklahoma-earthquakes-20140618-story.html#page=1>

hazard. We need to address ongoing seismicity.”¹⁵⁹ Seismologist Gail Atkinson reported, “We don’t know how to evaluate the likelihood that a [fracking or wastewater] operation will be a seismic source in advance.”¹⁶⁰

- April 11, 2014 – State geologists reported a link between fracking and a spate of earthquakes in Ohio, prompting the Ohio Department of Natural Resources to place a moratorium on drilling in certain areas and to require greater seismic monitoring.¹⁶¹
- April 3, 2014 – Researchers in Mexico linked earthquakes to fracking in the Eagle Ford Shale. They also noted a statistical correlation between seismic activity and fracking, particularly in Nuevo Leon, which registered at least 31 quakes between 3.1 and 4.3 on the Richter scale.¹⁶²
- March 7, 2014 – U.S. Geological Survey researchers published a study confirming that Oklahoma’s damaging 5.7 magnitude earthquake in 2011 was caused by fracking wastewater injection.¹⁶³ The author of the study, seismologist Elizabeth Cochran with the U.S. Geological Survey, noted, “Even if wastewater injection only directly affects a low-hazard fault, those smaller events could trigger an event on a larger fault nearby.”¹⁶⁴
- January 30, 2014 – A U.S. Geological Survey research team linked the rise in earthquakes in Colorado to fracking wastewater injection wells and announced that a study will be published in six to nine months.¹⁶⁵
- December 12, 2013 – *The New York Times* detailed the growing link between fracking wastewater injection wells and earthquakes, as well as between fracking itself and earthquakes, with a focus on Oklahoma and a recent magnitude 4.5 earthquake there. As *The New York Times* noted, “Oklahoma has never been known as earthquake country, with a yearly average of about 50 tremors, almost all of them minor. But in the past three years, the state has had thousands of quakes. This year has been the most active, with

¹⁵⁹ Walsh, B. (2014, May 1). The seismic link between fracking and earthquakes. *Time*. Retrieved June 9, 2014, from <http://time.com/84225/fracking-and-earthquake-link/>

¹⁶⁰ Kiger, P. J. (2014, May 02). Scientists warn of quake risk from fracking operations. *National Geographic*. Retrieved June 9, 2014, from <http://news.nationalgeographic.com/news/energy/2014/05/140502-scientists-warn-of-quake-risk-from-fracking-operations/>

¹⁶¹ Dave, P. (2014, April 12). Ohio finds link between fracking and sudden burst of earthquakes. *Los Angeles Times*. Retrieved June 9, 2014, from <http://www.latimes.com/nation/nationnow/la-na-nn-ohio-finds-link-fracking-earthquakes-20140411-story.html#axzz2yrnpHW1h>

¹⁶² Godoy, E. (2014, April 3). Fracking, seismic activity grow hand in hand in Mexico. *Inter Press Service*. Retrieved June 9, 2014, from <http://www.ipsnews.net/2014/04/fracking-seismic-activity-grow-hand-hand-mexico/>

¹⁶³ Sumy, D. F., Cochran, E. S., Keranen, K. M., Wei, M., & Abers, G. A. (2013). Observations of static Coulomb stress triggering of the November 2011 M5.7 Oklahoma earthquake sequence [Abstract]. *Journal of Geophysical Research: Solid Earth*, 119(3), 1904-1923. doi: 10.1002/2013JB010612

¹⁶⁴ Oskin, B. (2014, March 07). Wastewater injection triggered Oklahoma's earthquake cascade. *Live Science*. Retrieved June 9, 2014, from <http://www.livescience.com/43953-wastewater-injection-earthquake-triggering.html>

¹⁶⁵ McClurg, L. (2014, January 30). Earthquakes in southern Colorado linked to oil and gas production. *Colorado Public Radio*. Retrieved June 9, 2014, from <http://www.cpr.org/news/story/earthquakes-southern-colorado-linked-oil-and-gas-production#sthash.UVvw0JWe.UQwWtYJS.dpuf>

more than 2,600 so far, including 87 last week.... State officials say they are concerned, and residents accustomed to tornadoes and hail are now talking about buying earthquake insurance.”¹⁶⁶

- November 19, 2013 – *Reuters* reported that a series of Oklahoma earthquakes in September of 2013 damaged several homes, and that more scientists in a number of states are concerned about earthquakes related to oil and gas development. Seismologist Austin Holland with the University of Oklahoma said, “This is a dramatic new rate of seismicity.”¹⁶⁷
- July 19, 2013 – A study from the Lamont-Doherty Earth Observatory linked 109 earthquakes in Youngstown, Ohio to fracking wastewater disposal.¹⁶⁸¹⁶⁹
- July 11, 2013 – A study in *Science* by Columbia University’s Lamont-Doherty Earth Observatory showed that deep-well injection of fracking waste can stress geological faults in ways that make them vulnerable to slipping. The research shows that distant natural earthquakes triggered swarms of smaller earthquakes on critically stressed faults. The researchers wrote, “The fluids [in wastewater injection wells] are driving the faults to their tipping point.... Areas with suspected anthropogenic earthquakes are more susceptible to earthquake-triggering from natural transient stresses generated by the seismic waves of large remote earthquakes.”¹⁷⁰
- April 2013 – A group of British researchers stated that hydraulic fracturing itself was the likely cause of at least three earthquakes powerful enough to be felt by human beings at the surface. The researchers proposed that increases in the fluid pressure in fault zones were the causal mechanism for these three known instances of “felt seismicity” in the United States, Canada and the United Kingdom. The largest of these earthquakes was a magnitude 3.8 in the Horn River Basin, Canada.¹⁷¹
- March 27, 2013 – Scientists from the University of Oklahoma, Columbia University and the U.S. Geological Survey linked a 2011 swarm of earthquakes in Oklahoma to fracking

¹⁶⁶ Fountain, H. (2013, December 12). Experts eye oil and gas industry as quakes shake Oklahoma. *The New York Times*. Retrieved June 9, 2014, from <http://www.nytimes.com/2013/12/13/science/earth/as-quakes-shake-oklahoma-scientists-eye-oil-and-gas-industry.html>

¹⁶⁷ Gillam, C. (2013, November 19). In Oklahoma, water, fracking - and a swarm of quakes. *Reuters*. Retrieved June 9, 2014, from <http://www.reuters.com/article/2013/11/19/us-usa-earthquakes-fracking-oklahoma-idUSBRE9AI12W20131119>

¹⁶⁸ Kim, W. (2013). Induced seismicity associated with fluid injection into a deep well in Youngstown, Ohio. *Journal of Geophysical Research: Solid Earth*, 118(7), 3506-3518. doi: 10.1002/jgrb.50247

¹⁶⁹ Chameides, B. (2013, September 5). Fracking waste wells linked to Ohio earthquakes. *Scientific American*. Retrieved June 9, 2014, from <http://www.scientificamerican.com/article/fracking-waste-wells-linked-to-ohio-earthquakes/>

¹⁷⁰ Begley, S. (2013, July 11). Study raises new concern about earthquakes and fracking fluids. *Reuters*. Retrieved June 9, 2014, from <http://www.reuters.com/article/2013/07/11/us-science-fracking-earthquakes-idUSBRE96A0TZ20130711>

¹⁷¹ Davies, R., Foulger, G., Bindley, A., & Styles, P. (2013). Induced seismicity and hydraulic fracturing for the recovery of hydrocarbons. *Marine and Petroleum Geology*, 45, 171-185. doi: 10.1016/j.marpetgeo.2013.03.016.

waste disposal in that state.¹⁷² This included a magnitude 5.7 earthquake—the largest ever triggered by wastewater injection—that injured two people, destroyed 14 homes, and was felt across 17 states.¹⁷³

- December 14, 2012 – At a 2012 American Geophysical Union meeting, scientists presented data and concluded that some U.S. states, including Oklahoma, Texas and Colorado, have experienced a significant rise in seismic activity coinciding with a boom in gas drilling, fracking and wastewater disposal. Scientists further found that Oklahoma has seen a significant increase in earthquakes linked to wastewater injection, that a 5.3 earthquake in New Mexico was linked to wastewater injection, and that earthquakes were increasingly common within two miles of injection wells in the Barnett Shale region of Texas. Art McGarr, a researcher at the U.S. Geological Survey Earthquake Science Center, concluded that, “The future probably holds a lot more in induced earthquakes as the gas boom expands.”¹⁷⁴
- November 30, 2012, January 11, 2012, December 22, 2009 – In three sets of comments on proposed fracking guidelines and regulations, citing scientific reports linking oil and gas infrastructure to seismic activity, the NYC DEP raised serious concerns about the impacts of potential seismic activity from fracking-related activities on New York City’s water supply infrastructure.^{175 176 177} The NYC DEP has consistently raised concerns that seismic activity surrounding New York City’s aquifers and watershed infrastructure could threaten the city’s drinking water supply. For instance, DEP wrote that,

Given the similar geological mechanisms, the City has further investigated the risk that seismic activity from shale gas drilling poses to our tunnels and, based on that investigation, has concluded that the proposed protections do not go far enough to protect the integrity of the tunnels. Seismic activity from natural gas

¹⁷² Drajem, M., & Efstathiou, J., Jr. (2013, March 26). Quake tied to oil-drilling waste adds pressure for rules. *Bloomberg*. Retrieved June 9, 2014, from <http://www.bloomberg.com/news/2013-03-26/oklahoma-earthquake-in-2011-tied-to-wastewater-wells-in-fracking.html>

¹⁷³ Behar, M. (2013, March/April). Fracking’s latest scandal? Earthquake swarms. *Mother Jones*. Retrieved June 9, 2014, from <http://www.motherjones.com/environment/2013/03/does-fracking-cause-earthquakes-wastewater-dewatering?page=1>

¹⁷⁴ Leber, J. (2012, December 14). Studies link earthquakes to wastewater from fracking. *MIT Technology Review*. Retrieved June 9, 2014, from <http://www.technologyreview.com/news/508151/studies-link-earthquakes-to-wastewater-from-fracking/>

¹⁷⁵ New York City Department of Environmental Protection. (2009, December 22). *New York City comments on: Draft supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program - Well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus Shale and other low-permeability gas reservoirs* (Rep.). Retrieved June 9, 2014, from http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/nycdep_comments_final_12-22-09.pdf

¹⁷⁶ New York City Department of Environmental Protection. (2012, January 11). *Comments on the revised draft supplemental generic environmental impact statement* (Rep.). Retrieved June 11, 2014, from http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/nycdep_comments_on_rdsgeis_for_hvhf_20120111.pdf

¹⁷⁷ New York City Department of Environmental Protection. (2012, November 30). *Comments on the revised high-volume hydraulic fracturing regulations* (Rep.). Retrieved June 9, 2014, from http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/revise_high_volume_hydraulic_fracturing_regulations_comments_letter_010713.pdf

*drilling can be divided into two categories: hydraulic fracturing microseismicity and small induced earthquakes.*¹⁷⁸

NYC DEP went on to discuss cases in Blackpool, England and Oklahoma, concluding that,

*The Blackpool earthquakes and probably the Oklahoma earthquakes demonstrate that hydraulic fracturing fluids can reach a nearby fault and can trigger a seismic event. It should be noted that the natural gas wells in both of these cases were vertical, not horizontal, and neither well directly intercepted a fault. Nevertheless, the earthquakes generated were several miles away from the well. Horizontal wells, in contrast, have an even greater chance of directly intercepting a fault and, the distance from a well pad in which HVHF could reactivate a fault is therefore greater.... Thus, the RDSGEIS conclusion that induced seismic activity is not a significant impact is not supported by the evidence.*¹⁷⁹

- September 6, 2012 – The British Columbia Oil and Gas Commission determined that fracking itself causes earthquakes, pointing to the results of a probe into 38 seismic events near fracking operations in the Horn River Basin. The report noted that no quakes had been recorded in the area prior to April, 2009, before fracking activities began. The report recommended that the link between fracking and seismic activity be further examined.¹⁸⁰
- March 29, 2012 – The U.S. Geological Survey found that between 2001 and 2011, there was a six-fold increase in earthquakes greater than magnitude 3.0 in the middle of the United States that “are almost certainly manmade.” The agency reported that the increase appears to be linked to oil and gas production and deep injection of drilling wastewater.^{181 182}

¹⁷⁸New York City Department of Environmental Protection. (2012, November 30). *Comments on the revised high-volume hydraulic fracturing regulations* (Rep.). 7. Retrieved June 9, 2014, from http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/revised_high_volume_hydraulic_fracturing_regulations_comments_letter_010713.pdf

¹⁷⁹New York City Department of Environmental Protection. (2012, November 30). *Comments on the revised high-volume hydraulic fracturing regulations* (Rep.). 28. Retrieved June 9, 2014, from http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/revised_high_volume_hydraulic_fracturing_regulations_comments_letter_010713.pdf

¹⁸⁰The Canadian Press. (2012, September 06). Fracking causes minor earthquakes, B.C. regulator says. *CBC News*. Retrieved June 9, 2014, from <http://www.cbc.ca/news/canada/british-columbia/fracking-causes-minor-earthquakes-b-c-regulator-says-1.1209063>

¹⁸¹Ellsworth, W. (2011, April 18). Are seismicity rate changes in the midcontinent natural or manmade? Retrieved June 9, 2014, from http://www2.seismosoc.org/FMPro?-db=Abstract_Submission_12&-sortfield=PresDay&-sortorder=ascending&-sortfield=Special+Session+Name+Calc&-sortorder=ascending&-sortfield=PresTimeSort&-sortorder=ascending&-op=gt&PresStatus=0&-lop=and&-token.1=ShowSession&-token.2=ShowHeading&-recid=224&-format=%2Fmeetings%2F2012%2Fabstracts%2Fsessionabstractdetail.html&-lay=MtgList&-find

¹⁸²Soraghan, M. (2012, March 29). 'Remarkable' spate of man-made quakes linked to drilling, USGS team says. *E&E Publishing, LLC*. Retrieved June 11, 2014, from <http://www.eenews.net/stories/1059962190>

- July 31, 2011 – Numerous earthquakes in Arkansas motivated the Arkansas Oil and Gas Commission to shut down a disposal well and enact a permanent moratorium on future disposal wells in a nearly 1,200 square-mile area of the Fayetteville Shale.¹⁸³
- March 10, 2010 – In Texas, a 2008-2009 swarm of earthquakes in the Dallas-Fort Worth area, where the Barnett Shale is being developed, was linked to produced water disposal wells.¹⁸⁴
- June 12, 2009 – *The Wall Street Journal* reported that earthquakes shook Cleburne, Texas, a small town at the epicenter of fracking activity, including a number of earthquake clusters in the Dallas-Fort Worth area. The U.S. Geological Survey noted that more earthquakes were detected during that period of fracking activity than in the previous 30 years combined.¹⁸⁵

Abandoned and active oil and natural gas wells (as pathways for gas and fluid migration)

- June 19, 2014 – A doctoral thesis (under review for journal publication) by a Princeton University engineering student suggests that abandoned oil and gas wells in Pennsylvania, left over from prior decades of conventional drilling, leak significantly more methane than previously thought. Between 280,000 and 970,000 abandoned oil and gas wells are located in Pennsylvania, and many go unchecked and unmonitored for leaks. Based on measurements from 19 such wells, the study estimated that the methane leaks from abandoned wells alone could account for between 4 and 13 percent of human-caused methane emissions in the state.^{186 187}
- December 1, 2013 – An analysis of reports from the NY DEC found that three-quarters of the state's abandoned oil and gas wells were never plugged. New York State has approximately 48,000 such wells; many of their locations remain unknown.¹⁸⁸
- Aug. 4, 2011 – A report from the U.S. EPA to Congress in 1987—and discovered by *The New York Times*—concluded that abandoned natural gas wells may have served as a

¹⁸³ Zilk, C. (2011, July 31). Permanent disposal-well moratorium issued. *Arkansas Online*. Retrieved June 9, 2014, from <http://www.arkansasonline.com/news/2011/jul/31/permanent-disposal-well-moratorium-issued-20110731/>

¹⁸⁴ Frohlich, C., Hayward, C., Stump, B., & Potter, E. (2011). The Dallas-Fort Worth Earthquake Sequence: October 2008 through May 2009. *Bulletin of the Seismological Society of America*, 101(1), 327-340. doi: 10.1785/0120100131

¹⁸⁵ Casselman, B. (2009, June 12). Temblors rattle texas town. *The Wall Street Journal*. Retrieved June 9, 2014, from <http://online.wsj.com/news/articles/SB124476331270108225>

¹⁸⁶ Kang, M. (2014, June 17). CO₂, Methane, and Brine Leakage Through Subsurface Pathways: Exploring Modeling, Measurement, and Policy Options. Princeton University Academic dissertations. Retrieved June 20, 2014, from <http://arks.princeton.edu/ark:/88435/dsp019s1616326>.

¹⁸⁷ Magill, B. (2014, June 19). Derelict Oil Wells May Be Major Methane Emitters | Climate Central. *Derelict Oil Wells May Be Major Methane Emitters | Climate Central*. Retrieved June 20, 2014, from <http://www.climatecentral.org/news/abandoned-oil-wells-methane-emissions-17575>

¹⁸⁸ Bishop, R. E. Historical Analysis of Oil and Gas Well Plugging in New York: Is the Regulatory System Working?. *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*, 21, 103-116. Retrieved June 16, 2014, from <http://baywood.metapress.com/media/16ut607yqgl1yrw9ydad3/contributions/b/0/4/7/b047j34r87552325.pdf>

pathway for hydraulic fracturing fluids to migrate underground from a shale gas well to a water well in West Virginia. In noting that the water well was polluted due to hydraulic fracturing and that such contamination was “illustrative” of contamination from oil and natural gas drilling, the report suggested that additional cases of groundwater contamination from hydraulic fracturing may exist.¹⁸⁹

- April 4, 2011 – *ProPublica* reported that abandoned wells have caused problems across the nation including contamination of drinking water in Colorado, Kentucky, Michigan, New York, Texas and other states. *ProPublica* also found that a draft report from the Pennsylvania DEP described a 2008 incident in Pennsylvania in which a person died in an explosion triggered by lighting a candle in a bathroom after natural gas had seeped into a septic system from an abandoned well. The same draft report documented at least two dozen additional cases in which gas leaked from old wells, and three in which gas from new wells migrated into old wells, seeping into water supplies and requiring the evacuation of homes.¹⁹⁰
- May 20, 2010 – The British Columbia Oil and Gas Commission issued a safety advisory after hydraulic fracturing caused a large “kick,” or unintentional entry of fluid or gas, into a nearby gas well. The commission reported that it knew of 18 incidents in British Columbia and one in Western Alberta in which hydraulic fractures had entered nearby gas wells. “Large kicks resulted in volumes up to 80 cubic meters [about 100 cubic yards] of fluids produced to surface. Invading fluids have included water, carbon dioxide, nitrogen, sand, drilling mud, other stimulation fluids and small amounts of gas.” These cases occurred in horizontal wells with a distance between wellbores of up to 2,300 feet. The Commission wrote, “It is recommended that operators cooperate through notifications and monitoring of all drilling and completion operations where fracturing takes place within 1000m [3,280 feet] of well bores existing or currently being drilled.” Such communication between active wells raises the potential that similar communication can occur between active wells and abandoned wells.¹⁹¹
- 2010 – The NY DEC cautioned that “abandoned wells can leak oil, gas and/or brine; underground leaks may go undiscovered for years. These fluids can contaminate ground and surface water, kill vegetation, and cause public safety and health problems.” As the agency reported, “DEC has at least partial records on 40,000 wells, but estimates that over 75,000 oil and gas wells have been drilled in the State since the 1820s. Most of the wells date from before New York established a regulatory program. Many of these old wells were never properly plugged or were plugged using older techniques that were less reliable and long-lasting than modern methods.”¹⁹² The NY DEC published similar

¹⁸⁹ Urbina, I. (2011, August 4). A tainted water well, and concern there may be more. Retrieved June 11, 2014, from <http://www.nytimes.com/2011/08/04/us/04natgas.html>

¹⁹⁰ Kusnetz, N. (2011, April 4). Danger in honeycomb of old wells. *Pittsburgh Post-Gazette*. Retrieved June 11, 2014, from <http://www.post-gazette.com/nation/2011/04/04/Danger-in-honeycomb-of-old-wells/stories/201104040149>

¹⁹¹ British Columbia Oil & Gas Commission. (2010, May 20). Safety advisory: communication during fracture stimulation. Retrieved July 3, 2014, from <https://www.bcogc.ca/node/5806/download>

¹⁹² New York State Department of Environmental Conservation. (2014). New York oil, gas and mineral resources annual reports. Retrieved June 11, 2014, from <http://www.dec.ny.gov/pubs/36033.html>

comments in 2008 and 2009.

- January 2009 – Drilling industry consultant M.C. Vincent wrote an article published by the Society of Petroleum Engineers in which he reported that fractures from hydraulically fractured wells can intersect with nearby wells:

Contrary to common expectations, there are numerous examples of fractures intersecting offset wells [existing oil or natural gas wells near the well being fractured] but subsequently providing little or no sustained hydraulic connection between the wells. There is an understandable reluctance to publish reports documenting the intersection of adjacent wellbores with hydraulic fractures. Such information could unnecessarily alarm regulators or adjacent leaseholders who may infer that well spacing or fracture treatments are allowing unexpected capture of reserves.¹⁹³

Vincent added, “Although computing tools have improved, as an industry we remain incapable of fully describing the complexity of the fracture, reservoir, and fluid flow regimes.” The article’s findings raise the possibility that there could be similar communications between existing fracked wells that are fractured and abandoned wells and that operators cannot accurately predict how these will interact.

- 2005 – M.K. Fisher, vice president of Business Management at Pinnacle, a service of Halliburton that specializes in hydraulic fracturing, reported in an article published by the Society of Petroleum Engineers that a single fracture produced during a fracking operation in the Texas Barnett Shale had unexpectedly spread 2,500 feet laterally in two directions. He also described fractures in the Barnett Shale as “extremely complex.”¹⁹⁴ These findings raise the possibility that well communication over very large distances could occur due to fractures that spread “unexpectedly.”
- October 1999 – The U.S. Department of Energy reported that there were approximately 2.5 million abandoned oil and gas wells in the U.S.¹⁹⁵
- Early 1990s – An underground waste disposal well in McKean County, Pennsylvania, contaminated groundwater when the wastewater traveled up a nearby abandoned, unmapped and unplugged oil well. Owners of private water wells that were contaminated in the incident eventually had to be connected to a public water system.¹⁹⁶

¹⁹³ Vincent, M. (2009, January 19). *Examining our assumptions – Have oversimplifications jeopardized our ability to design optimal fracture treatments?* Lecture presented at Society of petroleum engineers hydraulic fracturing technology conference in The Woodlands, Texas.

¹⁹⁴ Fisher, M., Wright, C., Davidson, B., Steinsberger, N., Buckler, W., Goodwin, A., & Fielder, E. (2005). Integrating Fracture-Mapping Technologies To Improve Stimulations in the Barnett Shale. *SPE Production & Facilities*, 20(2). doi: 10.2118/77441-PA

¹⁹⁵ United States Department of Energy, Office of Fossil Energy. (1999, October 5). *Environmental benefits of advanced oil and gas exploration and production technology* (Rep.). Retrieved June 11, 2014, from <http://www.netl.doe.gov/kmd/cds/disk25/oilandgas.pdf>

¹⁹⁶ Hopey, D. (2012, January 3). Wastewater disposal wells under scrutiny following Irvin leak. *Pittsburgh Post-Gazette*. Retrieved June 11, 2014, from <http://www.post-gazette.com/news/environment/2012/01/03/Wastewater-disposal-wells-under-scrutiny-following-Irvin-leak.html>

- July 1989 –In the past, the investigative agency for Congress, the U.S. General Accounting Office [now the Government Accountability Office] studied oil and natural gas underground injection disposal wells and found serious cases of contamination. The agency reported that, in several cases, wastewater from oil and natural gas operations had migrated up into abandoned oil and natural gas wells, contaminating underground water supplies. The GAO found that “if these abandoned wells are not properly plugged—that is, sealed off—and have cracked casings, they can serve as pathways for injected brines [waste fluids from natural gas and oil drilling] to enter drinking water...Because groundwater moves very slowly, any contaminants that enter it will remain concentrated for long periods of time, and cleanup, if it is technically feasible, can be prohibitively costly.”¹⁹⁷
- December 1987 – The EPA submitted a report to Congress on oil and natural gas wastes in which the agency cautioned:

*... [T]o avoid degradation of ground water and surface water, it is vital that abandoned wells be properly plugged. Plugging involves the placement of cement over portions of a wellbore to permanently block or seal formations containing hydrocarbons or high-chloride waters (native brines). Lack of plugging or improper plugging of a well may allow native brines or injected wastes [from a waste fluid disposal well] to migrate to freshwater aquifers or to come to the surface through the wellbore. The potential for this is highest where brines originate from a naturally pressurized formation such as the Coleman Junction formation found in West Texas... Proper well plugging is essential for protection of ground water and surface water in all oil and gas production areas.*¹⁹⁸

While the EPA did not address the potential for contamination through abandoned wells as a result of hydraulic fracturing, both hydraulic fracturing and underground injection disposal wells require underground injection of fluid under pressure, raising the potential that there is a similar risk of groundwater contamination when hydraulic fracturing occurs near abandoned wells.

- 1985 – In an investigation of 4,658 complaints due to oil and natural gas production, the Texas Department of Agriculture found that “when a water well is experiencing an oilfield pollution problem (typically, high chlorides), the pollution source is often difficult to track down. The source could be a leak in the casing of a disposal well, leakage behind the casing due to poor cement bond, old saltwater evaporation pits, or, most often, transport of contaminants through an *improperly plugged abandoned well*” (emphasis in original). The agency found more than a dozen confirmed or suspected

¹⁹⁷ United States Government Accountability Office. (1989, July 5). Drinking water: Safeguards are not preventing contamination from injected oil and gas wastes. Retrieved June 10, 2014, from <http://www.gao.gov/products/RCED-89-97>. (2, 4, Rep.).

¹⁹⁸ U.S. Environmental Protection Agency. (1987). *Report to Congress: Management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy* (Rep.). Retrieved June 11, 2014, from <http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=20012D4P.PDF>. (III-47, Rep.).

cases in which pollutants had migrated up abandoned wells and contaminated groundwater. In one case, drilling wastewater migrated up an abandoned well a half mile away from where the wastewater was injected underground for disposal.¹⁹⁹

- November 1978 – In a report later cited by the EPA in its 1987 report to Congress (cited above), the state of Illinois Environmental Protection Agency found that oil and natural gas wastes injected underground could migrate through abandoned oil and natural gas wells and contaminate groundwater. The agency wrote, “In old production areas, abandoned wells may pose a serious threat to ground water quality. Unplugged or improperly plugged wells provide possible vertical communication between saline and fresh water aquifers.”²⁰⁰

Flood risks

- June 20, 2014 –*The Coloradoan* reported that Noble Energy storage tanks damaged by spring flooding in Colorado dumped 7,500 gallons of crude oil, fracking chemicals, and fracking wastewater into the Poudre River, which is both a National Heritage area and a habitat for Colorado’s only self-sustaining population of wild trout. Recent high river flows had undercut the bank where the oil tank was located, which caused the tank to drop and break a valve.²⁰¹
- September 2013 – An extraordinary flood that struck the Front Range of Colorado killed ten people, forced the evacuation of 18,000 more, destroyed more than 1850 homes, and damaged roads, bridges, and farmland throughout the state. More than 2650 oil and gas wells and associated facilities were also affected, with 1614 wells lying directly within the flood impact zone. Many of these storm-damaged facilities and storage tanks leaked uncontrollably. In a later accounting, Matt Lepore, director of the Colorado Oil and Gas Conservation Commission, estimated the flooding had resulted in the release to the environment of 48,250 gallons of oil or condensate and 43,479 gallons of fracking wastewater from 50 different spill sites across the state. In Colorado, more than 20,850 oil and gas wells lie within 500 feet of a river, stream, or other drainage. According to Commissioner Lepore, setback requirements that keep drilling and fracking operations away from residential areas inadvertently encourage operators to drill in unoccupied floodplains. At the same time, oil and gas operators prefer locations close to supplies of water for use in fracking. These twin factors result in a clustering of drilling and fracking operations in low-lying areas prone to catastrophic flooding.²⁰²

¹⁹⁹ Texas Department of Agriculture, Department of Natural Resources. (1985). *Agricultural land and water contamination: From injection wells, disposal pits, and abandoned wells used in oil and gas production* (pp. 5, 12-15). Austin, TX: Dept. of Agriculture, Office of Natural Resources.

²⁰⁰ Illinois Environmental Protection Agency, Water Quality Management Planning. (1978). *Illinois oil field brine disposal assessment* (pp. 44-45, Rep.).

²⁰¹ Handy, R. (2014, June 20). Crude oil spills into Poudre near Windsor. *The Coloradoan*. Retrieved June 23, 2014, from <http://www.coloradoan.com/story/news/local/2014/06/20/crude-oil-spills-poudre-near-windsor/11161379/>

²⁰² Lepore, M. (2014, March). “Lessons Learned” in the front range flood of September 2013: a staff report to the commissioners of the Colorado Oil and Gas Conservation Commission. Retrieved July 7, 2012, from the Colorado Oil and Gas Conservation Commission website:

http://cogcc.state.co.us/Announcements/Hot_Topics/Flood2013/FinalStaffReportLessonsLearned20140314.pdf

- 2004-2013 – In at least six of the last ten years (2004, 2005, 2006, 2009, 2011 and 2013), several counties where shale gas drilling is most likely to occur in New York State have experienced serious flooding. These include the counties of Albany, Broome, Cattaraugus, Chautauqua, Chenango, Delaware, Erie, Greene, Madison, Orange, Otsego, Schoharie, Sullivan and Ulster. In at least five of the past 10 years (2004, 2005, 2006, 2009 and 2011), floods have exceeded 100-year levels in at least some of the counties.^{203 204 205 206 207 208 209}
- February 7, 2013 – In its 2012 annual report to investors, oil and natural gas drilling company Noble Energy stated, “Our operations are subject to hazards and risks inherent in the drilling, production and transportation of crude oil and natural gas, including ... flooding which could affect our operations in low-lying areas such as the Marcellus Shale.”²¹⁰
- September 7, 2011 – The NYS DEC’s draft shale gas drilling plan recommended that drilling be prohibited within 100-year floodplains but acknowledged that many areas in the Delaware and Susquehanna River basins that were affected by flooding in 2004 and 2006 were located outside of officially designated flood zones.²¹¹ In 2004, 2005, 2006, 2009 and 2011, flooding in New York exceeded 100-year levels in at least some of the counties where drilling and fracking may occur.
- 1992 – In its Generic Environmental Impact Statement (GEIS) for oil and natural gas drilling, the New York State DEC raised concerns that storage tanks holding drilling wastewater, spent hydraulic fracturing fluid or other contaminants could be damaged by flooding and leak. At the time, the GEIS called for at least some of these tanks to be

²⁰³ Brooks, L. T. (2005). *Flood of September 18-19, 2004 in the upper Delaware River basin, New York* (Rep.). Retrieved June 11, 2014, from United States Geological Survey website: <http://ny.water.usgs.gov/pubs/of/of051166/>

²⁰⁴ Suro, T. P., & Firda, G. D. (2006). *Flood of April 2–3, 2005, Neversink River basin, New York* (Rep.). Retrieved June 11, 2014, from United States Geological Survey website: <http://pubs.usgs.gov/of/2006/1319/>

²⁰⁵ Suro, T. P., Firda, G. D., & Szabo, C. O. (2009). *Flood of June 26–29, 2006, Mohawk, Delaware and Susquehanna River basins, New York* (Rep.). Retrieved June 11, 2014, from United States Geological Survey website: <http://pubs.usgs.gov/of/2009/1063/pdf/ofr2009-1063.pdf>

²⁰⁶ Szabo, C. O., Coon, W. F., & Nizioł, T. A. (2010). *Flash floods of August 10, 2009, in the villages of Gowanda and Silver Creek, New York* (Rep.). Retrieved June 11, 2014, from United States Geological Survey website: <http://pubs.usgs.gov/sir/2010/5259/pdf/SIR%202010-5259.pdf>

²⁰⁷ Szabo, L. (2011, September 8). *Remnants of Tropical Storm Lee cause record flooding in the Susquehanna River basin* (Rep.). Retrieved June 11, 2014, from United States Geological Survey website: <http://ny.water.usgs.gov/leeindex.html>

²⁰⁸ Giordano, S. (2013, January 29). Several eastern counties in central New York under water after heavy flooding. *Syracuse Post-Standard*. Retrieved June 11, 2014, from http://www.syracuse.com/news/index.ssf/2013/06/several_eastern_counties_in_ce.html

²⁰⁹ New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (2-32, 33, Rep.).

²¹⁰ Noble Energy, Annual Report (Form 10-K) (Feb. 7, 2013) at 42.

²¹¹ New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (ES-22, 2-32, 33, Rep.).

properly secured.²¹² However, if horizontal high-volume hydraulic fracturing (HVHF) is approved, shale gas operations will require many more storage tanks for fracking fluids and wastewater than conventional drilling operations anticipated by the DEC twenty years ago. In 1992, the agency anticipated that oil and gas wells in the state would require between 20,000 and 80,000 gallons of fracking fluid.²¹³ As of 2011, the agency anticipated that HVHF shale gas wells will require between 2.4 and 7.8 million gallons of fluid.²¹⁴

Threats to agriculture and soil quality

- May 4, 2014 – In an analysis of state data from Colorado, the *Denver Post* reported that fracking related to oil and gas drilling is putting soil quality and farmlands at risk due to significant amounts of toxic fluids penetrating the soil. According to the *Denver Post* 578 spills were reported in 2013, which means that, on average in the state, a gallon of toxic liquid penetrates soil every eight minutes. Eugene Kelly, professor of Soil and Crop Sciences at Colorado State University, said that the overall impact of the oil and gas boom “is like a death sentence for soil.”²¹⁵
- November 28, 2012 – In conjunction with the Food & Environment Reporting Network, *The Nation* reported that serious risks to agriculture caused by fracking are increasing across the country and linked these concerns to risks to human health.²¹⁶
- January, 2012 – A study of gas drilling’s impacts on human and animal health concluded that the drilling process may lead to health problems. The study reported and analyzed a number of case studies, including dead and sick animals in several states that had been exposed to drilling or hydraulic fracturing fluids, wastewater, or contaminated ground or surface water.²¹⁷ The researchers cited 24 cases in six states where animals and their owners potentially affected by gas drilling. In one case a farmer separated 96 head of cattle into three areas, one along a creek where fracking wastewater was allegedly dumped and the remainder in fields without access to the contaminated creek; the farmer

²¹² New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (8-42, 8-43, 9-35, Rep.).

²¹³ New York State Department of Environmental Conservation. (1992). *Generic environmental impact statement on the oil, gas and solution mining regulatory program* (Rep.). Retrieved June 11, 2014, from http://www.dec.ny.gov/docs/materials_minerals_pdf/dgeisv1ch8.pdf (9-26, Rep.).

²¹⁴ New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (ES-8, Rep.).

²¹⁵ Finley, B. (2014, May 4). Colorado faces oil boom "death sentence" for soil, eyes microbe fix. *The Denver Post*. Retrieved June 11, 2014, from http://www.denverpost.com/environment/ci_25692049/colorado-faces-oil-boom-death-sentence-soil-eyes

²¹⁶ Royte, E. (2012, November 28). Fracking our food supply. *The Nation*. Retrieved June 11, 2014, from <http://www.thenation.com/article/171504/fracking-our-food-supply>

²¹⁷ Bamberger, M., & Oswald, R. E. (2012). Impacts of gas drilling on human and animal health. *New Solutions: A Journal of Environmental and Occupational Health Policy*, 22(1), 51-77. doi: 10.2190/NS.22.1.e

found that, of the 60 head exposed to the creek, 21 died and 16 failed to produce, whereas the unexposed cattle experienced no unusual health problems. In another case, a farmer reported that of 140 head of cattle that were exposed to fracking wastewater, about 70 died, and there was a high incidence of stillborn and stunted calves in the remaining cattle.²¹⁸

- January 2011 – U.S. Forest Service researchers reported dramatic negative effects on vegetation caused by the drilling and fracking of a natural gas well in an experimental forest in northeastern West Virginia.²¹⁹ In June 2008, the researchers found browning of foliage near the well pad, a lack of ground foliage and that many trees nearby had dropped their foliage. They attributed these impacts to the loss of control of the well bore on May 29, 2008, which caused an aerial release of materials from the well. Trees showed no apparent symptoms the following summer.²²⁰ However, the researchers also found “dramatic impacts on vegetation” where drilling and fracking wastewater had been sprayed on the land as a disposal technique following completion of the well. Just after the spraying of approximately 60,000 gallons of wastewater at the first disposal site, the Forest Service researchers found 115 damaged trees and other evidence of harm. This figure grew to 147 trees almost a year later.²²¹ At a second site, where about 20,000 gallons of wastewater was sprayed, the damage was less dramatic, yet the researchers still found “considerable leaf browning and mortality of young northern red oak seedlings.”²²² The researchers concluded that the spraying of the drilling fluids resulted in an “extreme” dose of chlorides to the forest.²²³
- May 2010 – Pennsylvania’s Department of Agriculture quarantined 28 cows in Tioga County after the animals wandered through a spill of drilling wastewater and may have ingested some of it. The Department was concerned that beef eventually produced from

²¹⁸ Ramanujan, K. (2012, March 7). Study suggests hydrofracking is killing farm animals, pets. *Cornell Chronicle*. Retrieved June 11, 2014, from <http://www.news.cornell.edu/stories/2012/03/reproductive-problems-death-animals-exposed-fracking>

²¹⁹ Adams, M., Edwards, P. J., Ford, W. M., Johnson, J. B., Schuler, T. M., Thomas-Van Gundy, M., & Wood, F. (2011, January). *Effects of development of a natural gas well and associated pipeline on the natural and scientific resources of the Fernow experimental forest* (Rep.). Retrieved June 11, 2014, from United States Department of Agriculture website: http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs76.pdf. (1-4, Rep.)

²²⁰ Adams, M., Edwards, P. J., Ford, W. M., Johnson, J. B., Schuler, T. M., Thomas-Van Gundy, M., & Wood, F. (2011, January). *Effects of development of a natural gas well and associated pipeline on the natural and scientific resources of the Fernow experimental forest* (Rep.). Retrieved June 11, 2014, from United States Department of Agriculture website: http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs76.pdf. (10-11, Rep.)

²²¹ Adams, M., Edwards, P. J., Ford, W. M., Johnson, J. B., Schuler, T. M., Thomas-Van Gundy, M., & Wood, F. (2011, January). *Effects of development of a natural gas well and associated pipeline on the natural and scientific resources of the Fernow experimental forest* (Rep.). Retrieved June 11, 2014, from United States Department of Agriculture website: http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs76.pdf. (11-15, Rep.)

²²² Adams, M., Edwards, P. J., Ford, W. M., Johnson, J. B., Schuler, T. M., Thomas-Van Gundy, M., & Wood, F. (2011, January). *Effects of development of a natural gas well and associated pipeline on the natural and scientific resources of the Fernow experimental forest* (Rep.). Retrieved June 11, 2014, from United States Department of Agriculture website: http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs76.pdf. (15, Rep.)

²²³ Adams, M., Edwards, P. J., Ford, W. M., Johnson, J. B., Schuler, T. M., Thomas-Van Gundy, M., & Wood, F. (2011, January). *Effects of development of a natural gas well and associated pipeline on the natural and scientific resources of the Fernow experimental forest* (Rep.). Retrieved June 11, 2014, from United States Department of Agriculture website: http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs76.pdf. (17, Rep.)

the cows could be contaminated as a result of any exposure. In May 2011, only ten yearlings were still quarantined, but the farmer who owned the cows, Carol Johnson, told National Public Radio that of 17 calves born to the quarantined cows in the spring of 2011, only six survived, and many of the calves that were lost were stillborn. “They were born dead or extremely weak. It’s highly unusual,” she said, continuing, “I might lose one or two calves a year, but I don’t lose eight out of eleven.”²²⁴

- March 2010 – A Pennsylvania State Extension analysis of dairy farms in the state found a decline in the number of dairy cows in areas of the state where fracking was prevalent. Pennsylvania counties that had both more than 10,000 dairy cows and more than 150 Marcellus Shale wells experienced a 16-percent decline in dairy cows between 2007 and 2010.²²⁵
- April 28, 2009 – Seventeen cows in Caddo Parish, Louisiana died within one hour after apparently ingesting hydraulic fracturing fluids spilled at a well that was being fractured. “It seemed obvious the cattle had died acutely from an ingested toxin that had drained from the ‘fracking’ operation going on at the property,” Mike Barrington, a state veterinarian said in a document obtained from the state Department of Environmental Quality by the *New Orleans Times-Picayune*.^{226 227}

Threats to the climate system

- May 15, 2014 – A recent review of existing data on lifecycle emissions of methane from natural gas systems concluded that, as a strategy for addressing climate change, natural gas is a “bridge to nowhere.” The review found that, over a 20-year time frame, natural gas is as bad as or worse than coal and oil as a driver of climate change.²²⁸ Referencing this review and other recent studies, *Bloomberg Business News* reported that the EPA has underestimated the impact of methane leakage resulting from the production transmission, and distribution of natural gas and is using outdated estimates of methane’s

²²⁴ Phillips, S. (2011, September 27). Burning questions: Quarantined cows give birth to dead calves. *StateImpact*. Retrieved June 11, 2014, from <http://stateimpact.npr.org/pennsylvania/2011/09/27/burning-questions-quarantined-cows-give-birth-to-dead-calves/>

²²⁵ Penn State Extension. (2010, March). *Pennsylvania dairy farms and Marcellus shale, 2007–2010* (Rep.). Retrieved June 11, 2014, from Penn State website: <http://cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PA%20Dairy%20Farms%20and%20Marcellus%202007%20to%202010.pdf>

²²⁶ Schleifstein, M. (2011, March 27). Haynesville natural gas field is the most productive in the U.S. *The Times-Picayune*. Retrieved June 11, 2014, from http://www.nola.com/politics/index.ssf/2011/03/haynesville_natural_gas_field.html.

²²⁷ KSLA. (2009, April 28). Cows in Caddo Parish fall dead near gas well. *KSLA News*. Retrieved June 11, 2014, from <http://www.ksla.com/Global/story.asp?S=10268585>

²²⁸ Howarth, R. W. (2014). A bridge to nowhere: Methane emissions and the greenhouse gas footprint of natural gas [Abstract]. *Energy Science & Engineering*. doi: 10.1002/ese3.35

potency compared to more recent estimates from the Intergovernmental Panel on Climate Change (IPCC).²²⁹

- April 25, 2014 – A reassessment of the heat-trapping potential of greenhouse gases revealed that current methods of accounting underestimate the climate-damaging impact of methane pollution from all sources, including drilling and fracking operations.²³⁰
- April 14, 2014 – A study from researchers at Purdue University, NOAA, Cornell University, University of Colorado at Boulder and Pennsylvania State University, published in *Proceedings of the National Academy of Sciences* found very high levels of methane emissions above many wells being drilled at fracking sites in Pennsylvania. Levels were 100 to 1,000 times above the estimates of federal regulators, who have always assumed very low methane emissions as wells are drilled.^{231 232}
- February 26, 2014 – The United Nations’ top environmental official—Achim Steiner, who heads the UN Environmental Programme (UNEP)—argued that the shale gas rush is ‘a liability’ in efforts to slow climate change and that a switch from coal to natural gas is delaying critical energy transition to renewables.²³³
- February 13, 2014 – A major study in *Science* by Stanford University, Massachusetts Institute of Technology and the U.S. Department of Energy found that methane leaks negate any climate benefits of natural gas as a fuel for vehicles, and that the EPA is significantly underestimating methane in the atmosphere.²³⁴ Lead author Adam R. Brandt told *The New York Times*, “Switching from diesel to natural gas, that’s not a good policy from a climate perspective.”²³⁵ This study also concluded that the national methane leakage rate is likely between 3.6 and 7.2 percent of production.

²²⁹ Childers, A. (2014, May 9). EPA underestimates fracking's impact on climate change. *Bloomberg*. Retrieved June 10, 2014, from <http://www.bloomberg.com/news/2014-05-09/epa-underestimates-fracking-s-impact-on-climate-change.html>

²³⁰ Edwards, M.R. and Trancik, J.E. (2014). Climate impacts of energy technologies depend on emissions timing. *Nature Climate Change* 4: 348-352. doi: 10.1038/NCLIMATE2204

²³¹ Caulton, D. R., Shepson, P. B., Santoro, R. L., Sparks, J. P., Howarth, R. W., Ingraffea, A. R., ... Miller, B. R. (2014). Toward a better understanding and quantification of methane emissions from shale gas development. *Proceedings of the National Academy of Sciences of the United States of America*. doi: 10.1073/pnas.1316546111

²³² Banjeree, N. (2014, April 14). EPA drastically underestimates methane released at drilling sites. *Los Angeles Times*. Retrieved June 10, 2014, from <http://www.latimes.com/science/sciencenow/la-sci-sn-methane-emissions-natural-gas-fracking-20140414,0,2417418.story>

²³³ Goldenberg, S. (2014, February 26). Achim Steiner: Shale gas rush 'a liability' in efforts slow climate change. *The Guardian*. Retrieved June 10, 2014, from <http://www.theguardian.com/environment/2014/feb/26/achim-steiner-shale-gas-rush-climate-change-energy>

²³⁴ Brandt, A. R., Heath, G. A., Kort, E. A., O'Sullivan, F., Petron, G., Jordaan, S. M., ... Harriss, R. (2014). Methane leaks from North American natural gas systems. *Energy and Environment*, 343(6172), 733-735. doi: 10.1126/science.1247045

²³⁵ Davenport, C. (2014, February 13). Study finds methane leaks negate benefits of natural gas as a fuel for vehicles. *The New York Times*. Retrieved June 10, 2014, from <http://www.nytimes.com/2014/02/14/us/study-finds-methane-leaks-negate-climate-benefits-of-natural-gas.html?smid=tw-share>

- January 15, 2014 – The *Guardian* reported that even a new a study by BP found that “Shale gas will not cause a decline in greenhouse gases” and will do little to cut carbon emissions.²³⁶
- December 30, 2013 – An analysis of fracking-related truck transportation in the Susquehanna River Basin, Pennsylvania found that greenhouse gas emissions from frack water and waste hauling operations were 70–157 metric tons of CO₂ equivalent per gas well.²³⁷
- November 11, 2013 – In a letter to California Governor Jerry Brown, twenty of the nation’s top climate scientists warned that pro-fracking policies will worsen climate disruption and harm California’s efforts to be a leader in reducing greenhouse gas emissions. The letter called on Governor Brown to place a moratorium on fracking.²³⁸ On November 21, 2013, a group of Governor Brown’s former policy and campaign advisors made a similar request in light of concerns about the effects of fracking on climate change and water pollution.²³⁹
- October 18, 2013 – A team of researchers from multiple institutions including Harvard, the University of Michigan and NOAA reported that methane emissions due to drilling activities in the south-central U.S. may be almost five times greater than reported by the world’s most comprehensive methane inventory. “These results cast doubt on the US EPA’s recent decision to downscale its estimate of national natural gas emissions by 25-30 percent,” the authors wrote.²⁴⁰ As *The New York Times* reported, “The analysis also said that methane discharges in Texas and Oklahoma, where oil and gas production was concentrated at the time, were 2.7 times greater than conventional estimates. Emissions from oil and gas activity alone could be five times greater than the prevailing estimate.”²⁴¹
- October 18, 2013 – A major study spearheaded by Stanford University’s Energy Modeling Forum concluded that fracking and the shale gas revolution will have no long-

²³⁶ Harvey, F., & Macalister, T. (2014, January 16). BP study predicts greenhouse emissions will rise by almost a third in 20 years. *The Guardian*. Retrieved June 10, 2014, from

http://www.theguardian.com/business/2014/jan/15/bp-predicts-greenhouse-emissions-rise-third?CMP=tw_t_gu

²³⁷ Gilmore, K. R., Hupp, R. L., & Glathar, J. (2014). Transport of Hydraulic Fracturing Water and Wastes in the Susquehanna River Basin, Pennsylvania. *Journal of Environmental Engineering*, 140. doi: 10.1061/(ASCE)EE.1943-7870.0000810

²³⁸ Rogers, P. (2013, November 12). Top climate scientists call for fracking ban in letter to Gov. Jerry Brown. *San Jose Mercury News*. Retrieved June 10, 2014, from http://www.mercurynews.com/ci_24509392/top-climate-scientists-call-fracking-ban-letter-gov

²³⁹ McNary, S. (2013, November 21). Former advisors to Gov. Brown request fracking ban. *Southern California Public Radio*. Retrieved June 10, 2014, from <http://www.scpr.org/blogs/politics/2013/11/21/15248/former-advisors-to-gov-brown-request-fracking-ban/>

²⁴⁰ Miller, S. M., Wofsy, S. C., Michalak, A. M., Kort, E. A., Andrews, A. E., Biraud, S. C., ... Sweeney, C. (2013). Anthropogenic emissions of methane in the United States. *Proceedings of the National Academy of Sciences*, 110(50), 20018-20022. doi: 10.1073/pnas.1314392110

²⁴¹ Wines, M. (2013, November 25). Emissions of methane in U.S. exceed estimates, study finds. *The New York Times*. Retrieved June 10, 2014, from http://www.nytimes.com/2013/11/26/us/emissions-of-methane-in-us-exceed-estimates-study-finds.html?_r=0

term climate benefit. The study brought together a working group of about 50 experts and advisors from companies, government agencies and universities, and modeling teams from 14 organizations. The study also found that build-out of infrastructure for fracking and natural gas will discourage efforts to conserve energy and boost efficiency. The study did not examine methane leaks in order to weigh in on the short-term climate impacts of natural gas.²⁴²

- October 11, 2013 – As reported in the *Guardian*, key climate scientists argued that the growth in fracking across the United States is hurting the United States’ credibility on climate change.²⁴³
- October 2, 2013 – Updated measurements from the IPCC determined that methane is even worse for the climate than previously thought. The IPCC determined that methane is 34 times more potent as a greenhouse gas in the atmosphere than CO₂ over a 100-year timeframe, and 86 times more potent over a 20-year timeframe.²⁴⁴
- September 27, 2013 – The IPCC formally embraced an upper limit on greenhouse gases for the first time, warning that the world will exceed those levels and face irreversible climatic changes in a matter of decades unless steps are taken soon to reduce emissions. The IPCC reported that humanity faces a “carbon budget”—a limit on the amount of greenhouse gases that can be produced by industrial activity before irreversible, damaging consequences—of burning about a trillion metric tons of carbon. The world is on track to hit that by around 2040 at the current rate of energy consumption.²⁴⁵
- August 12, 2013 – A *New Scientist* review of the science on fracking and global warming concluded that fracking could accelerate climate change rather than slow it.²⁴⁶

²⁴² Huntington, H. (2013). Changing the game? Emissions and market implications of new natural gas supplies. *Energy Modeling Forum, 1*. Retrieved June 10, 2014, from <https://emf.stanford.edu/publications/emf-26-changing-game-emissions-and-market-implications-new-natural-gas-supplies>.

²⁴³ Magill, B. (2013, October 11). Fracking hurts US climate change credibility, say scientists. *The Guardian*. Retrieved June 10, 2014, from <http://www.theguardian.com/environment/2013/oct/11/fracking-us-climate-credibility-shale-gas>

²⁴⁴ Romm, J. (2013, October 2). More bad news for fracking: IPCC warns methane traps much more heat than we thought. *Climate Progress*. Retrieved June 10, 2014, from <http://thinkprogress.org/climate/2013/10/02/2708911/fracking-ipcc-methane/>

²⁴⁵ Gillis, J. (2013, September 27). U.N. climate panel endorses ceiling on global emissions. *The New York Times*. Retrieved June 10, 2014, from <http://www.nytimes.com/2013/09/28/science/global-climate-change-report.html?pagewanted=all>

²⁴⁶ Pearce, F. (2013, August 12). Fracking could accelerate global warming. *New Scientist*. Retrieved June 10, 2014, from <http://www.newscientist.com/article/dn24029-fracking-could-accelerate-global-warming.html#.UpEWqsQ3uSo>

- May 28, 2013 – A research team led by Jeff Peischl, an associate scientist at NOAA’s Cooperative Institute for Research in Environmental Sciences, estimated that the methane leak rate from Los Angeles-area oil and gas operations was about 17 percent.^{247 248}
- May, 2013 – A group of scientists and journalists studying climate change, led by Eric Larson, a scientist with Princeton University and Climate Central, reported that the often-purported 50 percent climate advantage of natural gas over coal is unlikely to be achieved over the next three to four decades given methane leaks and other factors.²⁴⁹ The 50 percent claim is based on the fact that natural gas produces half as much carbon dioxide when burned than coal, but it ignores the significant greenhouse gas impacts of methane leakage that occurs throughout the life-cycle of natural gas production, transmission and distribution.
- January 2, 2013 – A NOAA study found methane emissions from oil and gas fields in Utah to be as high as nine percent of production. These levels are considered extremely damaging to the climate.²⁵⁰
- November, 2012 – A review by the United Nations Environment Programme found that emissions from fracking, as well as other non-conventional natural gas extraction methods, could increase global warming in the short term and be comparable to coal over a 100-year timeframe.²⁵¹
- November, 2012 – The International Energy Agency found that a large natural gas boom—even with improvements in place to reduce leakage—would eventually lead to greenhouse gas concentrations of 650 parts per million and a global temperature rise of 3.5 degrees Celsius, far exceeding the 2 degree Celsius limit which the Plan concedes is critical to avoid the most severe effects of climate change.²⁵²
- May 29, 2012 – The *Guardian* summarized a special report on natural gas by the International Energy Agency: “A ‘golden age of gas’ spurred by a tripling of shale gas from fracking and other sources of unconventional gas by 2035 will stop renewable energy in its tracks if governments do not take action.”²⁵³

²⁴⁷ Peischl, J., Ryerson, T. B., Brioude, J., Aikin, K. C., Andrews, A. E., Atlas, E., ... Parrish, D. D. (2013). Quantifying sources of methane using light alkanes in the Los Angeles basin, California. *Journal of Geophysical Research: Atmospheres*, 118(10), 4974-4990. doi: 10.1002/jgrd.50413

²⁴⁸ Ogburn, S. (2014, May 15). Solving the Case of California's Extra Methane. *Scientific American Global RSS*. Retrieved July 3, 2014, from <http://www.scientificamerican.com/article/solving-the-case-of-californias-extra-machine/>

²⁴⁹ Larson, E. D. (2013). Natural gas & climate change. *Climate Central*. Retrieved June 10, 2014, from <http://assets.climatecentral.org/pdfs/NaturalGas-and-ClimateChange.pdf>

²⁵⁰ Tollefson, J. (2013). Methane leaks erode green credentials of natural gas. *Nature*, 493(7430), 12-12. doi: 10.1038/493012a

²⁵¹ Global Environmental Alert Service. (2012). Gas fracking: Can we safely squeeze the rocks? United Nations Environmental Programme. Retrieved June 10, 2014, from http://www.unep.org/pdf/UNEP-GEAS_NOV_2012.pdf

²⁵² World Energy Outlook 2012, (November 2012). *Golden Rules for a Golden Age of Natural Gas—World Energy Outlook Special Report on Unconventional Gas*, International Energy Agency. Retrieved July 9, 2014, from <http://www.iea.org/publications/freepublications/publication/name,27408,en.html>.

²⁵³ Harvey, F. (2012, May 29). 'Golden age of gas' threatens renewable energy, IEA warns. *The Guardian*. Retrieved June 10, 2014, from <http://www.theguardian.com/environment/2012/may/29/gas-boom-renewables-agency-warns>

- February, 2012 – A study found that the carbon dioxide emitted from the burning of natural gas—even neglecting the impacts of methane leakage—contributes significantly to greenhouse gas emissions that are driving climate change.²⁵⁴
- February 7, 2012 – A NOAA study of Colorado gas fields measured methane emissions of about four percent, a significant percentage that could be very damaging to the climate.²⁵⁵
- December 29, 2011 – As reported by *The New York Times*, levels of methane in the atmosphere have been steadily rising since 2007—coinciding with the onset of the fracking boom and posing a serious threat to the Earth’s climate.²⁵⁶
- October, 2011 – A study from the National Center for Atmospheric Research concluded that substituting the use of natural gas for coal will increase rather than decrease the rate of global warming for many decades.²⁵⁷
- July 6, 2011 – According to the U.S. Energy Information Administration and other research, significant amounts of methane are leaking from aging gas pipelines and infrastructure.²⁵⁸
- April, 2011 – A comprehensive analysis of the greenhouse gas footprint of natural gas from shale formations found that between 3.6 percent to 7.9 percent of the methane from natural gas production wells escapes into the atmosphere, rather than being combusted, thereby undermining any climate benefits of gas over coal as a source of energy.^{259 260}

Inaccurate jobs claims, increased crime rates, and threats to property value and mortgages

- May 27, 2014 – A *Bloomberg News* analysis of 61 shale drilling companies found that the economic picture of shale oil and gas is unstable. Shale debt has almost doubled over the last four years while revenue has gained just 5.6 percent. For the 61 companies in their analysis, *Bloomberg News* reported: “In a measure of the shale industry’s financial burden, debt hit \$163.6 billion in the first quarter.” Further, *Bloomberg News* noted that drillers are caught in a bind because they must keep borrowing to pay for exploration needed to “offset steep production declines typical of shale wells.... For companies that

²⁵⁴ Myhrvold, N. P., & Caldeira, K. (2012). Greenhouse gases, climate change and the transition from coal to low-carbon electricity. *Environmental Research Letters*, 7(1). doi: 10.1088/1748-9326/7/1/014019

²⁵⁵ Tollefson, J. (2012, February 7). Air sampling reveals high emissions from gas field. *Nature*. Retrieved June 10, 2014, from <http://www.nature.com/news/air-sampling-reveals-high-emissions-from-gas-field-1.9982>

²⁵⁶ Gillis, J. (2011, December 29). The puzzle of rising methane. *The New York Times*. Retrieved June 10, 2014, from <http://green.blogs.nytimes.com/2011/12/29/the-puzzle-of-rising-methane/>

²⁵⁷ Wigley, T. M. (2011). Coal to gas: The influence of methane leakage. *Climatic Change*, 108(3), 601-608. doi: 10.1007/s10584-011-0217-3

²⁵⁸ McKenna, P. (2011, July 6). Thousands of gas leaks under Boston and San Francisco. *New Scientist*. Retrieved June 10, 2014, from <http://www.newscientist.com/article/mg21128203.800-thousands-of-gas-leaks-under-boston-and-san-francisco.html#.UpEbbMQ3uSp>

²⁵⁹ Howarth, R. W., Santoro, R., & Ingraffea, A. (2011). Methane and the greenhouse-gas footprint of natural gas from shale formations. *Climatic Change*, 106(4), 679-690. doi: 10.1007/s10584-011-0061-5

²⁶⁰ Howarth, R. W., Santoro, R., & Ingraffea, A. (2012). Venting and leaking of methane from shale gas development: Response to Cathles et al. *Climatic Change*, 113(2), 537-549. doi: 10.1007/s10584-012-0401-0

can't afford to keep drilling, less oil coming out means less money coming in, accelerating the financial tailspin."²⁶¹

- May 5, 2014 – An Associated Press analysis found that traffic fatalities have spiked in heavily drilled areas of six states whereas most other roads in the nation have become safer even as population has grown. In North Dakota drilling counties, for instance, traffic fatalities have increased 350 percent.²⁶²
- April 16, 2014 – A comprehensive article in the *Albany Law Review* concluded that the risks inherent with fracking are not covered by homeowner's insurance, not fully insured by the oil and gas industry and threaten mortgages and property value.²⁶³
- April 2014 – A report by the Multi-State Shale Research Collaborative, "Assessing the Impacts of Shale Drilling: Four Community Case Studies," documented economic, community, government and human services impact of fracking on four rural communities. The study found that fracking led to a rapid influx of out-of-state workers and, although some new jobs were created, these were accompanied by additional costs for police, emergency services, road damage, and social services. In addition, increased rents, and a shortage of affordable housing accompanied the fracking boom. Unemployment rose after one county's "boom" ended and, in another county, stayed above the state average throughout.²⁶⁴
- March 27, 2014 – A report by researchers at Rand Corp. determined that each shale gas well in Pennsylvania causes between \$5,400 and \$10,000 in damage to state roads. The report did not calculate damage to local roads, which is also significant. Researchers used estimates of truck trips that are significantly below the number estimated for New York by the NYS DEC.^{265 266}
- February 15, 2014 – *The Los Angeles Times* detailed steep increases in crime that have accompanied fracking in parts of the Eagle Ford Shale in Texas, including sexual assaults

²⁶¹ Loder, A. (2014, May 27). Shakeout threatens shale patch as frackers go for broke. *Bloomberg*. Retrieved June 10, 2014, from <http://www.bloomberg.com/news/2014-05-26/shakeout-threatens-shale-patch-as-frackers-go-for-broke.html>

²⁶² Begos, K., & Fahey, J. (2014, May 5). AP impact: Deadly side effect to fracking boom. *Associated Press*. Retrieved June 10, 2014, from <http://bigstory.ap.org/article/ap-impact-deadly-side-effect-fracking-boom-0>

²⁶³ Radow, E.L. (2014). At the Intersection of Wall Street and Main: Impacts of Hydraulic Fracturing on Residential Property Interests, Risk Allocation, and Implications for the Secondary Mortgage Market. *Albany Law Review* 77(2) 673-704.

²⁶⁴ Multi-State Shale Research Collaborative. (2014, April 10). *Assessing the impacts of shale drilling county case studies* (Rep.). Retrieved June 10, 2014, from <https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbntdWx0aXN0YXRlc2hhbGV8Z3g6NGU4MjIyNWU5ZjFhZjM4Yg>

²⁶⁵ Cusick, M. (2014, March 27). Report finds each Marcellus gas well costs thousands in road damage. *StateImpact*. Retrieved June 10, 2014, from <http://stateimpact.npr.org/pennsylvania/2014/03/27/report-finds-each-marcellus-gas-well-costs-thousands-in-road-damage/>

²⁶⁶ Abramzon, S., Samaras, C., Curtright, A., Litovitz, A., & Burger, N. (2014). Estimating the consumptive use costs of shale natural gas extraction on Pennsylvania roadways. *Journal of Infrastructure Systems*. Retrieved June 10, 2014, from <http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29IS.1943-555X.0000203>

and thefts.²⁶⁷

- February 14, 2014 – Pennsylvania landowners with fracking leases rallied in Bradford County against gas companies for precipitous drops in royalty payments.²⁶⁸
- December 20, 2013 – The National Association of Realtors' *RealtorMag* summarized a growing body of research showing that fracking and gas drilling threaten property values, including a University of Denver survey and a *Reuters* analysis.²⁶⁹
- December 12, 2013 – A *Reuters* analysis discussed how oil and gas drilling has made making some properties “unsellable” and researched the link between drilling and property value declines. The analysis highlighted a Duke University working paper that finds shale gas drilling near homes can decrease property values by an average of 16.7 percent if the house depends on well water.²⁷⁰
- December 10, 2013 – Pennsylvania's *The Daily Review* reported that more gas companies are shifting costs to leaseholders and that royalty payments are drastically shrinking. The story quoted Bradford County commissioner Doug McLinko saying that some gas companies “are robbing our landowners” and that the problem of royalty payments being significantly reduced by deductions for post-production costs “is widespread throughout our county.”²⁷¹
- November 30, 2013 – *The New York Times* reported striking increases in crime in Montana and North Dakota where the oil and gas boom is prevalent, as well as challenges faced by local residents from the influx of out-of-area workers and the accompanying costs. The *New York Times* reported, “‘It just feels like the modern-day Wild West,’ said Sgt. Kylan Klauzer, an investigator in Dickinson, in western North Dakota. The Dickinson police handled 41 violent crimes last year, up from seven only five years ago.”²⁷²
- November 21, 2013 – The Multi-State Shale Research Collaborative released a six-state collaborative report demonstrating that the oil and gas industry has greatly exaggerated

²⁶⁷ Hennessy-Fiske, M. (2014, February 15). Fracking brings oil boom to south Texas town, for a price. Retrieved June 10, 2014, from <http://www.latimes.com/nation/la-na-texas-oil-boom-20140216%2C0%2C7621618.story#ixzz30Iw9FXoz>.

²⁶⁸ Marshall, J. (2014, February 14). Landowners rally for royalties from gas companies. Retrieved June 10, 2014, from <http://www.wbng.com/news/local/Landowners-rally-for-245596511.html>

²⁶⁹ Daily Real Estate News. (2013, December 20). ‘Fracking’ sparks concern over nearby home values. *National Association of Realtors*. Retrieved June 10, 2014, from <http://realtormag.realtor.org/daily-news/2013/12/20/fracking-sparks-concern-over-nearby-home-values#.UrmdlIPmVu8.twitter>

²⁷⁰ Conlin, M. (2013, December 12). Gas drilling is killing property values for some Americans. *Reuters*. Retrieved June 10, 2014, from <http://www.businessinsider.com/drilling-can-make-some-properties-unsellable-2013-12#ixzz2nMgFv8FU>

²⁷¹ Loewenstein, J. (2013, December 10). Shrinking royalty checks. *TheDailyReview.com*. Retrieved June 10, 2014, from <http://thedailyreview.com/news/shrinking-royalty-checks-1.1598195>

²⁷² Healy, J. (2013, November 30). As oil floods plains towns, crime pours in. *The New York Times*. Retrieved June 10, 2014, from http://www.nytimes.com/2013/12/01/us/as-oil-floods-plains-towns-crime-pours-in.html?smid=tw-share&_r=0

the number of jobs created by drilling and fracking in shale formations. The report found that far from the industry's claims of 31 direct jobs created per well, only four jobs are created for each well. It also demonstrated that almost all of the hundreds of thousands of 'ancillary' jobs that the drilling industry claims are related to shale drilling existed before such drilling occurred. As Frank Mauro, executive director of the Fiscal Policy Institute put it, "Industry supporters have exaggerated the jobs impact in order to minimize or avoid altogether taxation, regulation, and even careful examination of shale drilling."²⁷³

- November 12, 2013 – *The American Banker* reported that the "Fracking Boom Gives Banks Mortgage Headaches," with a number of financial institutions refusing to make mortgages on land where oil and gas rights have been sold to an energy company. The article stated that the uniform New York state mortgage agreement used by Fannie Mae and Freddie Mac requires that homeowners not permit any hazardous materials to be used or located on their property. Fracking is therefore a problem because it is just such a hazardous activity with use of hazardous materials.²⁷⁴
- September 25, 2013 – A report found that fracking is linked to significant road damage, increased truck traffic, crime, and strain on municipal and social services. Data from the past ten years on the social costs of fracking including truck accidents, arrests, and higher rates of sexually transmitted diseases are all causes for alarm.²⁷⁵
- September 12, 2013 – In a feature titled "Pa. fracking boom goes bust," *The Philadelphia Inquirer* presented data from the independent Keystone Research Center detailing "flat at best" job growth and declines in production and royalty payments.²⁷⁶
- August 22, 2013 – A University of Denver study in the *Journal of Real Estate Literature* found a 5 percent to 15 percent reduction in bid value for homes near gas drilling sites.²⁷⁷

²⁷³ Campbell, J. (2013, November 21). Report: Industry-backed studies exaggerate fracking job estimates. *Politics on the Hudson*. Retrieved June 10, 2014, from <http://polHUDSON.lohudblogs.com/2013/11/21/report-industry-backed-studies-exaggerate-fracking-job-estimates/>

²⁷⁴ Peters, A. (2013, November 12). Fracking boom gives banks mortgage headaches. *American Banker*. Retrieved June 10, 2014, from http://www.americanbanker.com/issues/178_218/fracking-boom-gives-banks-mortgage-headaches-1063561-1.html

²⁷⁵ Gibbons, B. S. (2013, September 25). Environmental groups calculate social cost of natural gas boom. *The Times-Tribune*. Retrieved June 10, 2014, from <http://thetimes-tribune.com/news/environmental-groups-calculate-social-cost-of-natural-gas-boom-1.1558186>

²⁷⁶ Bunch, W. (2013, September 12). Pa. fracking boom goes bust. *Philly.com*. Retrieved June 10, 2014, from http://articles.philly.com/2013-09-12/news/41974274_1_fracking-boom-penn-state-marcellus-center-marcellus-shale

²⁷⁷ Downing, B. (2013, April 22). Survey says home values hurt by fracking at drill sites. *Ohio.com*. Retrieved June 10, 2014, from <http://www.ohio.com/blogs/drilling/ohio-utica-shale-1.291290/survey-says-home-values-hurt-by-fracking-at-drill-sites-1.422838>

- August 21, 2013 – *The Atlantic Cities* and *MSN Money* reported that fracking operations may be damaging property values and may impair mortgages or the ability to obtain property insurance.^{278 279}
- August 13, 2013 – A *ProPublica* investigative analysis found that Chesapeake Energy is coping with its financial difficulties in Pennsylvania by shifting costs to landowners who are now receiving drastically reduced royalty payments.²⁸⁰
- August 4, 2013 – In a survey of West Virginia landowners with shale wells on their property, more than half reported problems including damage to the land, decline in property values, truck traffic and lack of compensation by the oil and gas company.²⁸¹
- May 24, 2013 – Pennsylvania Department of Transportation Secretary Allen D. Buihler, P.E., and Pennsylvania State Police Commissioner Frank Pawlowski said that gas drilling has led to increases in truck traffic, traffic violations, crime, demand for social services, and the number of miles of roads that are in need of repairs. They noted that drilling companies that committed to repairing roads have not kept pace with the roads they damage. Police Commissioner Pawlowski reported that 56 percent of 194 trucks checked were over the legal weight limit and 50 percent were also cited for safety violations.²⁸²
- May 4, 2013 – Pennsylvania’s *Beaver County Times* asked “What boom?” in pointing to Keystone Research Center data showing that the number of jobs numbers created by shale gas extraction do not add up to what the gas industry claims, noting that unemployment has increased and the state actually fell to 49th in the nation for job creation.²⁸³
- April 2, 2013 – *The New York Times* reported that manufacturing jobs resulting from an abundance of shale gas have not appeared. “The promised job gains, other than in the petrochemical industry, have been slow to materialize,” the *New York Times* reported.

²⁷⁸ Drouin, R. (2013, August 19). How the fracking boom could lead to a housing bust. *Citylab*. Retrieved June 10, 2014, from <http://www.theatlanticcities.com/politics/2013/08/how-fracking-boom-could-lead-housing-bust/6588/>

²⁷⁹ Notte, J. (2013, August 21). Fracking leaves property values tapped out. *MSN Money*. Retrieved June 10, 2014, from <http://money.msn.com/now/post--fracking-leaves-property-values-tapped-out>

²⁸⁰ Lustgarten, A. (2013, August 13). Unfair share: How oil and gas drillers avoid paying royalties. *ProPublica*. Retrieved June 10, 2014, from <http://www.propublica.org/article/unfair-share-how-oil-and-gas-drillers-avoid-paying-royalties>

²⁸¹ Collins, A. R., & Nkansah, K. (2013, August 4). *Divided rights, expanded conflict : The impact of split estates in natural gas production* [Scholarly project]. Retrieved June 10, 2014, from http://ageconsearch.umn.edu/bitstream/150128/2/Collins_Nkansah_Split%20estate.pdf

²⁸² PR Newswire. (2014, May 24). Increased gas drilling activities bringing new challenges to local governments in Pennsylvania. *PR Newswire*. Retrieved June 10, 2014, from <http://www.prnewswire.com/news-releases/increased-gas-drilling-activities-bringing-new-challenges-to-local-governments-in-pennsylvania-94774764.html>

²⁸³ Morgan, R. (2013, May 4). Beaver County Times: What boom? Industry pundits claim thousands of jobs will be created, but numbers don't quite add up. *Keystone Research Center*. Retrieved June 10, 2014, from <http://keystoneresearch.org/media-center/media-coverage/beaver-county-times-what-boom-industry-pundits-claim-thousands-jobs-will>

The article suggested that increased automation has made it unlikely that manufacturers will add many jobs.²⁸⁴

- March 19, 2013 – The *Wall Street Journal* reported that the shale gas boom has not had a big impact on U.S. manufacturing because lower energy prices are only one factor in a company's decision on where to locate factories, and not always the most important factor. "Cheap energy flowing from the U.S. shale-gas boom is often touted as a 'game changer' for manufacturing," the *Journal* reported. "Despite the benefits of lower energy costs, however, the game hasn't changed for most American manufacturers."²⁸⁵
- February, 2013 – A peer-reviewed analysis of industry-funded and independent studies on the economics of fracking found that it is unlikely that fracking will lead to long-term economic prosperity for communities. The analysis noted that shale gas development brings a number of negative externalities including the potential for water, air and land contamination; negative impacts on public health; wear and tear on roads and other infrastructure; and costs to communities due to increased demand for services such as police, fire departments, emergency responders, and hospitals.²⁸⁶
- November 16, 2012 – A Duke University study showed a drop in home values near fracking for properties that rely on groundwater.²⁸⁷
- September 27, 2012 – *The New York Times* reported that the prospect of fracking has hindered home sales in the Catskills and raised concerns about drops in property values, according to real estate agents and would-be buyers.²⁸⁸
- August 17, 2012 – A study by the state agencies, the Montana All Threat Intelligence Center and the North Dakota State and Local Intelligence Center, found that crime rose by 32 percent since 2005 in communities at the center of the oil and gas boom.²⁸⁹

²⁸⁴ Schwartz, N. D. (2013, April 01). Rumors of a cheap-energy jobs boom remain just that. *The New York Times*. Retrieved June 11, 2014, from http://www.nytimes.com/2013/04/02/business/economy/rumors-of-a-cheap-energy-jobs-boom-remain-just-that.html?_r=0

²⁸⁵ Hagerty, J. R. (2013, March 19). Shale-gas boom alone won't propel U.S. industry. *The Wall Street Journal*. Retrieved June 10, 2014, from <http://online.wsj.com/news/articles/SB10001424127887324392804578362781776519720>

²⁸⁶ Barth, J. M. (2013). The Economic Impact of Shale Gas Development on State and Local Economies: Benefits, Costs, and Uncertainties. *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*, 23(1), 85-101. doi: 10.2190/NS.23.1.f

²⁸⁷ Muoio, D. (2012, November 16). Duke researchers show dip in home value caused by nearby fracking. *The Chronicle*. Retrieved June 10, 2014, from <http://www.dukechronicle.com/articles/2012/11/16/duke-researchers-show-dip-home-value-caused-nearby-fracking>

²⁸⁸ Navarro, M. (2012, September 27). Gas drilling jitters unsettle catskills sales. *The New York Times*. Retrieved June 10, 2014, from <http://www.nytimes.com/2012/09/30/realestate/fracking-fears-hurt-second-home-sales-in-catskills.html?pagewanted=1>

²⁸⁹ Montana All Threat Intelligence Center, & North Dakota State and Local Intelligence Center. (2012, August 17). *Impact of population growth on law enforcement in the Williston Basin region* (Rep.). Retrieved June 10, 2014, from <http://www.ag.nd.gov/reports/JOINTPRODUCTFINAL.pdf>

- October 30, 2011 – A comprehensive article in the *New York State Bar Association Journal* concluded that the risks inherent with fracking threaten mortgages.²⁹⁰
- October 26, 2011 – The Associated Press reported that areas with significant fracking activity, including Pennsylvania, Wyoming North Dakota and Texas, are “seeing a sharp increase in drunken driving, bar fights and other hell-raising.”²⁹¹
- October 19, 2011 – A *New York Times* investigation found that fracking can create conflicts with mortgages, and that “bankers are concerned because many leases allow drillers to operate in ways that violate rules in landowners’ mortgages,” and further that “[f]earful of just such a possibility, some banks have become reluctant to grant mortgages on properties leased for gas drilling. At least eight local or national banks do not typically issue mortgages on such properties, lenders say.”²⁹²
- September 7, 2011 – The NYS DEC estimated that 77 percent of the workforce on initial shale gas drilling projects would consist of transient workers from out of state. Not until the thirtieth year of shale gas development would 90 percent of the workforce be comprised of New York residents.²⁹³
- August 15, 2011 – The *Pittsburgh Post-Gazette* reported that increases in crime followed the Pennsylvania gas drilling boom, noting, for instance, that drunken driving arrests in Bradford County were up 60 percent, DUI arrests were up 50 percent in Towanda, and criminal sentencing was up 35 percent in 2010.²⁹⁴
- July 26, 2011 – A New York State Department of Transportation document estimated that fracking in New York could result in the need for road repairs and reconstruction costing \$211 million to \$378 million each year.²⁹⁵
- June 20, 2011 – A Keystone Research Center study found that the gas industry’s claim of 48,000 jobs created between 2007 and 2010 as a result of natural gas drilling in

²⁹⁰ Radow, E. N. (2011). Homeowners and gas drilling leases: Boon or bust? *New York State Bar Association Journal*, 83(9). Retrieved June 10, 2014, from http://www.s-oacc.org/resources/NYSBA_Journal_nov-dec2011_lead_article_with_reprint_info.pdf

²⁹¹ Levy, M. (2011, October 26). Towns see crime, carousing surge amid gas boom. *Associated Press*. Retrieved June 10, 2014, from <http://news.yahoo.com/towns-see-crime-carousing-surge-amid-gas-boom-135643480.html>

²⁹² Urbina, I. (2011, October 19). A rush to sign leases for gas runs into mortgage restriction. *The New York Times*. Retrieved June 11, 2014, from http://www.nytimes.com/2011/10/20/us/rush-to-drill-for-gas-creates-mortgage-conflicts.html?_r=2&hp&

²⁹³ New York State Department of Environmental Conservation. (2011). *Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program, well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus shale and other low-permeability gas reservoirs* (6-233, 234, Rep.).

²⁹⁴ Needles, Z. (2011, August 15). Must crime follow Pennsylvania's gas drilling boom? *Pittsburgh Post-Gazette*. Retrieved June 10, 2014, from <http://www.post-gazette.com/stories/business/legal/must-crime-follow-pennsylvanias-gas-drilling-boom-310373/>

²⁹⁵ Reilly, S. (2011, July 26). Document estimates fracking's toll on N.Y. roads. *Pressconnects.com*. Retrieved June 10, 2014, from <http://www.pressconnects.com/article/20110726/NEWS01/107260384/Document-estimates-fracking-s-toll-N-Y-roads>

Pennsylvania is a far cry from the actual number of only 5,669 jobs—many of which were out-of-state hires.²⁹⁶

- May 9, 2011 – A study in the *Journal of Town & City Management* found that shale gas development can impose “significant short- and long-term costs” to local communities. The study noted that shale gas development creates a wide range of potential environmental hazards and stressors, all of which can adversely impact regional economies, including tourism and agriculture sectors.²⁹⁷
- November 30, 2010 – The *Dallas Morning News* featured a story, “Drilling Can Dig into Land Value,” reporting that the Wise County Central Appraisal District Appraisal Review Board found that a drilling company had caused an “extraordinary reduction” in property value, by 75 percent.²⁹⁸
- November 28, 2010 – The Texas’ *Wise County Messenger* reported that some landowners near fracking operations experience excessive noise, exposure to diesel fumes, and problems with trespassing by workers.²⁹⁹

Inflated estimates of oil and gas reserves and profitability

- April 10, 2014 – A report by a petroleum geologist and petroleum engineer concluded the 100-year supply of shale gas is a myth, distinguished between what is technically recoverable and economically recoverable shale gas, and asserted that at current prices, New York State has no economically recoverable shale gas.³⁰⁰
- February 28, 2014 – The chief of the International Energy Agency reported that there is only a decade left in the US shale oil and gas boom, noting that the growth would not last and that production would soon flatten out and go down.³⁰¹
- December 18, 2013 – A University of Texas study in *Proceedings of the National Academy of Sciences* found that fracking well production drops sharply with time, which

²⁹⁶ Herzenberg, S. (2011). Drilling deeper into job claims. *Keystone Research Center*. Retrieved June 10, 2014, from http://keystoneresearch.org/sites/keystoneresearch.org/files/Drilling-Deeper-into-Jobs-Claims-6-20-2011_0.pdf

²⁹⁷ Christopherson, S., & Rightor, N. (2011). How shale gas extraction affects drilling localities: Lessons for regional and city policy makers. *Journal of Town & City Management*, 2(4), 1-20. Retrieved June 10, 2014, from http://www.greenchoices.cornell.edu/downloads/development/shale/Economic_Effects_on_Drilling_Localities.pdf

²⁹⁸ Heinkel-Wolfe, P. (2010, September 18). Drilling can dig into land value. *Dallas News*. Retrieved June 10, 2014, from <http://www.dallasnews.com/incoming/20100918-Drilling-can-dig-into-land-value-9345.ece>

²⁹⁹ Evans, B. (2010, November 28). Rising volume: ‘Fracking’ has bolstered economies, but noise still echoes around drilling. *WCMessenger.com*. Retrieved June 10, 2014, from <http://www.wcmessenger.com/2010/news/rising-volume-fracking-has-bolstered-economies-but-noise-still-echoes-around-drilling/>

³⁰⁰ Labyrinth Consulting Services, Inc., Berman, A., and Pittinger, L. (2014). Resource Assessment of Potentially Producing Natural Gas Volumes From the Marcellus Shale, State of New York. Retrieved from: <http://www.lwvny.org/>

³⁰¹ Unger, D. J. (2014, February 28). IEA chief: Only a decade left in US shale oil boom. *The Christian Science Monitor*. Retrieved June 10, 2014, from <http://www.csmonitor.com/Environment/Energy-Voices/2014/0228/IEA-chief-Only-a-decade-left-in-US-shale-oil-boom>

undercuts the oil and gas industry's economic projections.³⁰² In an interview about the study with *StateImpact NPR* in Texas, Tad Patzek, chair of the Department of Petroleum and Geosystems Engineering at University of Texas at Austin, noted that fracking “also interferes now more and more with daily lives of people. Drilling is coming to your neighborhood, and most people abhor the thought of having somebody drilling a well in their neighborhood.”³⁰³

- August 18, 2013 – *Bloomberg News* reported that low gas prices and disappointing wells have led major companies to devalue oil and gas shale assets by billions of dollars.³⁰⁴
- October 21, 2012 – *The New York Times* reported that many gas drilling companies overproduced natural gas backed by creative financing and now “are committed to spending far more to produce gas than they can earn selling it.” “We are all losing our shirts today,” said Exxon CEO Rex Tillerson in the summer of 2012.³⁰⁵
- July 13, 2012 – *The Wall Street Journal* reported that ITG Investment Research, at the request of institutional investors, evaluated the reserves of Chesapeake Energy Corp.'s shale gas reserves in the Barnett and Haynesville formations and found them to be only 70 percent of estimates by Chesapeake's engineering consultant for the company's 2011 annual report. Chesapeake and its consultant defended their figures.³⁰⁶
- August 23, 2011 – The U.S. Geological Survey cut the government's estimates of natural gas in the Marcellus Shale from 410 trillion cubic feet to 84 trillion cubic feet, equivalent to a reduction from approximately 16 years of U.S. consumption at current levels of natural gas use, to approximately 3.3 years of consumption. The U.S. Geological Survey's updated estimate was for natural gas that is technically recoverable, irrespective of economic considerations such as the price of natural gas or the cost of extracting it.³⁰⁷
- June 26-27, 2011 – As reported in two *New York Times* stories, hundreds of emails, internal documents, and analyses of data from thousands of wells from drilling industry employees combined with documents from federal energy officials raised concerns that shale gas companies were overstating the amount of gas in their reserves and the

³⁰² Patzek, T. W., Male, F., & Marder, M. (2013). Gas production in the Barnett Shale obeys a simple scaling theory. *Proceedings of the National Academy of Sciences*, 110(49), 19731-19736. doi: 10.1073/pnas.1313380110

³⁰³ Buchele, M. (2013, December 18). New study shows how gas production from “fracked” wells slows over time. *StateImpact*. Retrieved June 10, 2014, from <http://stateimpact.npr.org/texas/2013/12/18/new-study-shows-how-gas-production-from-fracked-wells-slows-over-time/>

³⁰⁴ Monks, M., Penty, R., & De Vynck, G. (2013, August 18). Shale grab in U.S. stalls as falling values repel buyers. *Bloomberg*. Retrieved June 10, 2014, from <http://www.bloomberg.com/news/2013-08-18/shale-grab-in-u-s-stalls-as-falling-values-repel-buyers.html>

³⁰⁵ Krauss, C., & Lipton, E. (2012, October 20). After the boom in natural gas. *The New York Times*. Retrieved June 10, 2014, from <http://www.nytimes.com/2012/10/21/business/energy-environment/in-a-natural-gas-glut-big-winners-and-losers.html?pagewanted=all>

³⁰⁶ Wirz, M. (2013, July 13). Chesapeake reserve doubted. *The Wall Street Journal*. Retrieved June 10, 2014, from <http://online.wsj.com/news/articles/SB10001424052702303644004577523411723501548>

³⁰⁷ United States Geological Survey. (2011, August 23). USGS releases new assessment of gas resources in the Marcellus shale, Appalachian Basin. *USGS Newsroom*. Retrieved June 10, 2014, from http://www.usgs.gov/newsroom/article.asp?ID=2893&from=rss_home#.Uok0mGRO_GA.

profitability of their operations.^{308 309 310} The *New York Times*' public editor criticized the stories, but offered no evidence that the major findings were wrong.³¹¹ The *New York Times*' news editors publicly defended both stories against the public editor's criticism.³¹²
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Disclosure of serious risks to investors

A snapshot of the dangers posed by natural gas drilling and fracking pose can be found in an annual Form 10-K that oil and natural gas companies are required to disclose annually to the U.S. Securities and Exchange Commission (SEC). Federal law requires that companies offering stock to the public disclose in their Form 10-K, among other things, the "most significant factors that make the offering speculative or risky."³¹⁴

In a review of the most recent Form 10-Ks available on the SEC's website, oil and natural gas companies routinely warned of drilling's serious risks. In the words of Exxon Mobil Corp.'s subsidiary XTO Energy Corp., these included "hazards and risks inherent in drilling"³¹⁵; or in the language of Range Resources Corp., "natural gas, NGLs [natural gas liquids] and oil operations are subject to many risks."³¹⁶

Such hazards and risks include leaks, spills, explosions, blowouts, environmental damage, property damage, injury and death. Chesapeake Energy Corporation, which has been interested in drilling in New York, has stated that "horizontal and deep drilling activities involve greater risk of mechanical problems than vertical and shallow drilling

³⁰⁸ Urbina, I. (2011, June 25). Insiders sound an alarm amid a natural gas rush. *The New York Times*. Retrieved June 10, 2014, from <http://www.nytimes.com/2011/06/26/us/26gas.html?pagewanted=all>

³⁰⁹ U.S. Energy Information Administration. (2014, May 30). U.S. Natural Gas Summary. Retrieved June 10, 2014, from http://www.eia.gov/dnav/ng/ng_sum_lsum_dcu_nus_a.htm

³¹⁰ Urbina, I. (2011, August 24). Geologists sharply cut estimate of shale gas. *The New York Times*. Retrieved June 10, 2014, from <http://www.nytimes.com/2011/08/25/us/25gas.html>

³¹¹ Brisbane, A. S. (2011, July 16). Clashing views on the future of natural gas. *The New York Times*. Retrieved June 10, 2014, from http://www.nytimes.com/2011/07/17/opinion/sunday/17pubed.html?gwh=7D408242717755A0E06B0D265498E177&gwt=pay&assetType=opinion&_r=0

³¹² Brisbane, A. S. (2011, July 17). Times editors respond to my shale gas column. *The New York Times*. Retrieved June 10, 2014, from <http://publiceditor.blogs.nytimes.com/2011/07/17/times-editors-respond-to-my-shale-gas-column/>

³¹³ Brisbane, A. S. (2011, July 30). Times editors respond to column on redactions. *The New York Times*. Retrieved June 10, 2014, from <http://publiceditor.blogs.nytimes.com/2011/07/30/times-editors-respond-to-column-on-redactions/>

³¹⁴ See 17 C.F.R. § 229.503(c) (companies must disclose the "most significant" risks); 17 C.F.R. § 230.405 ("the term material, when used to qualify a requirement for the furnishing of information as to any subject, limits the information required to those matters to which there is a substantial likelihood that a reasonable investor would attach importance in determining whether to purchase the security registered"); 17 C.F.R. § 240.10b-5 (it is illegal "to make any untrue statement of a material fact or to omit to state a material fact . . . in connection with the purchase or sale of any security"); 17 C.F.R. 249.310 (requiring Form 10-K, "for annual and transition reports pursuant to sections 13 or 15(d) of the Securities Exchange Act of 1934.")

³¹⁵ XTO Energy Corp., Annual Report (Form 10-K) (Feb. 25, 2010) at 25.

³¹⁶ Range Resources, Corp., Annual Report (Form 10-K) (Feb. 27, 2013) at 23.

operations.”³¹⁷ Companies want to use horizontal drilling and fracking to extract shale gas in New York State.

The companies also routinely warn of inadequate insurance to cover drilling harms. XTO Energy Corporation, which holds thousands of acres of natural gas leases in New York, states that “we are not fully insured against all environmental risks, and no coverage is maintained with respect to any penalty or fine required to be paid by us.”³¹⁸

Houston-based Noble Energy provides a representative example of the risks that at least several drilling companies include in their annual reports. Noble states:

Our operations are subject to hazards and risks inherent in the drilling, production and transportation of crude oil and natural gas, including:

- *injuries and/or deaths of employees, supplier personnel, or other individuals;*
- *pipeline ruptures and spills;*
- *fires, explosions, blowouts and well cratering;*
- *equipment malfunctions and/or mechanical failure on high-volume, high-impact wells;*
- *leaks or spills occurring during the transfer of hydrocarbons from an FPSO to an oil tanker;*
- *loss of product occurring as a result of transfer to a rail car or train derailments;*
- *formations with abnormal pressures and basin subsidence;*
- *release of pollutants;*
- *surface spillage of, or contamination of groundwater by, fluids used in hydraulic fracturing operations;*
- *security breaches, cyber attacks, piracy, or terroristic acts;*
- *theft or vandalism of oilfield equipment and supplies, especially in areas of increased activity such as the DJ Basin and Marcellus Shale;*
- *hurricanes, cyclones, windstorms, or “superstorms,” such as Hurricane Sandy which occurred in 2012, which could affect our operations in areas such as the Gulf Coast, deepwater Gulf of Mexico, Marcellus Shale, Eastern Mediterranean or offshore China;*
- *winter storms and snow which could affect our operations in the Rocky Mountain areas;*
- *unseasonably warm weather, which could affect third party gathering and processing facilities, such as occurred in the Rocky Mountain areas during 2012;*
- *volcanoes which could affect our operations offshore Equatorial Guinea;*
- *flooding which could affect our operations in low-lying areas such as the Marcellus Shale;*
- *harsh weather and rough seas offshore the Falkland Islands, which could limit certain exploration activities; and*
- *other natural disasters.*

³¹⁷ Chesapeake Energy Corp., Annual Report (Form 10-K) (Mar. 1, 2013) at 21.

³¹⁸ XTO Energy Corp., Annual Report (Form 10-K) (Feb. 25, 2010) at 17.

*Any of these can result in loss of hydrocarbons, environmental pollution and other damage to our properties or the properties of others.*³¹⁹

Noble has language similar to that found in other companies' annual reports about inadequate insurance and adds, "coverage is generally limited or not available to us for pollution events that are considered gradual."³²⁰

The risks identified by Noble and other drilling companies are not just hypothetical. Many, if not all of these risks have become realities as illustrated in the other sections of this compendium.

Medical and scientific calls for more study and more transparency

- June 30, 2014 – In a letter to the Pennsylvania Department of Environmental Protection, director of the Mid-Atlantic Center for Children's Health and the Environment, Jerome A. Paulson, MD, called for industry disclosure of all ingredients of fracking fluid; thorough study of all air contaminants released from drilling and fracking operations and their protected dispersal patterns; and study and disclosure of fracking-related water contamination and its mechanisms. Dr. Paulson said:

*In summary, neither the industry, nor government agencies, nor other researchers have ever documented that [unconventional gas extraction] can be performed in a manner that minimizes risks to human health. There is now some evidence that these risks that many have been concerned about for a number of years are real risks. There is also much data to indicate that there are a number of toxic chemicals used or derived from the process, known or plausible routes of exposure of those chemicals to humans; and therefore, reason to place extreme limits on [unconventional gas extraction]*³²¹.

- June 20, 2014 – Highlighting preliminary studies in the United States that suggest an increased risk of adverse health problems among individuals living within ten miles of shale gas operations, a commentary in the British medical journal *The Lancet* called for a precautionary approach to gas drilling in the United Kingdom. According the commentary, "It may be irresponsible to consider any further fracking in the UK (exploratory or otherwise) until these prospective studies have been completed and the health impacts of fracking have been determined."³²²
- June 20, 2014 – Led by an occupational and environmental medicine physician, a Pennsylvania-based medical and environmental science research team documented "... the substantial concern about adverse health effects of [unconventional natural gas development] among Pennsylvania Marcellus Shale residents, and that these concerns

³¹⁹ Noble Energy, Annual Report (Form 10-K) (Feb. 7, 2013) at 41-42.

³²⁰ Noble Energy. Annual Report (Form 10-K) (Feb 7, 2013) at 41-42.

³²¹ Paulson, J.A. (2014, June 30). <http://concernedhealthny.org/letter-from-dr-jerome-a-paulson-to-the-pennsylvania-department-of-environmental-protection/>.

³²² Hill, M. (2014, June 20). Shale gas regulation in the UK and health implications of fracking. *The Lancet*. Early Online Publication, doi:10.1016/S0140-6736(14)60888-6

may not be adequately represented in medical records.” The teams identified the continued need to pursue environmental, clinical and epidemiological studies to better understand associations between fracking, medical outcomes, and residents’ ongoing concerns.³²³

- June 17, 2014 – A discussion paper by the Nova Scotia Deputy Chief Medical Officer and a panel of experts identified potential economic benefits as well as public health concerns from unconventional oil and gas development. On the health impacts, they wrote, “uncertainties around long term environmental effects, particularly those related to climate change and its impact on the health of both current and future generations, are considerable and should inform government decision making.” The report noted potential dangers including contamination of groundwater, air pollution, surface spills, increased truck traffic, noise pollution, occupational health hazards and the generation of greenhouse gases. It also noted that proximity of potential fracking sites to human habitation should give regulators pause and called for a health impact assessment and study of long-term impacts.³²⁴ Responding to the report, the Environmental Health Association of Nova Scotia applauded the go-slow approach and called for a 10-year moratorium on fracking.³²⁵
- May 29, 2014 – In New York State, more than 250 medical organizations and health professionals released a letter detailing emerging trends in the data on fracking that show significant risk to public health, air quality, water, as well as other impacts. With signatories including the American Academy of Pediatrics, District II, the American Lung Association in New York, Physicians for Social Responsibility, and many leading researchers examining the impacts of fracking, they wrote, “The totality of the science — which now encompasses hundreds of peer-reviewed studies and hundreds of additional reports and case examples—shows that permitting fracking in New York would pose significant threats to the air, water, health and safety of New Yorkers.”^{326 327}
- May 9, 2014 – In a peer-reviewed analysis, leading toxicologists outlined some of the potential harm and uncertainty relating to the toxicity of the chemical and physical agents associated with fracking, individually and in combination. While acknowledging the need for more research and greater involvement of toxicologists, they noted the potential for

³²³ Saberi, P., Propert, K.J., Powers, M. Emmett, E. and Green-McKenzie, J. (2014). Field Survey of Health Perception and Complaints of Pennsylvania Residents in the Marcellus Shale Region. *International Journal of Environmental Research and Public Health* 11(6), 6517-6527.

³²⁴ Atherton, F. (2014, June 17). Discussion Paper: Hydraulic Fracturing and Public Health in Nova Scotia . Nova Scotia Hydraulic Fracturing Independent Review and Public Engagement Process.

³²⁵ Macdonald, M. (2014, June 17). Nova Scotia expert calls for go-slow approach for hydraulic fracturing. *The Canadian Press*. Retrieved June 20, 2014, from <http://www.calgaryherald.com/health/Health+studies+needed+hydraulic+fracturing+approved+Nova+Scotia/9946368/story.html>

³²⁶ Concerned Health Professionals of NY. (2014, May 29). Letter to Governor Cuomo and acting Health Commissioner Zucker [Letter to Governor Andrew M. Cuomo & Acting Health Commissioner Howard A. Zucker]. New York City, New York.

³²⁷ Hughes, K. (2014, May 29). NY fracking opponents call for moratorium of 3 to 5 years. *Daily Freeman*. Retrieved June 11, 2014, from <http://www.dailyfreeman.com/general-news/20140529/ny-fracking-opponents-call-for-moratorium-of-3-to-5-years>

surface and groundwater contamination from fracking, growing concerns about air pollution particularly in the aggregate, and occupational exposures that pose a series of potential hazards to worker health.^{328 329}

- May 1, 2014 – A 292-page report from a panel of top Canadian scientists urged caution on fracking, noting that it poses “the possibility of major adverse impacts on people and ecosystems” and that significantly more study is necessary to understand the full extent of the risks and impacts.³³⁰ The *Financial Post* reported that the panel of experts “found significant uncertainty on the risks to the environment and human health, which include possible contamination of ground water as well as exposure to poorly understood combinations of chemicals.”³³¹
- April 30, 2014 – Medical professionals spoke out on the dearth of public health information collected and lack of long-term study five years into Pennsylvania’s fracking boom. Walter Tsou, MD, MPH, of Physicians for Social Responsibility and former health commissioner of Philadelphia commented, “That kind of study from a rigorous scientific perspective has never been done.” Other experts added, “There has been more health research involving fracking in recent years, but every study seems to consider a different aspect, and...there is no coordination.”³³²
- April 17, 2014 – In the preeminent *British Medical Journal*, authors of a commentary, including an endocrinologist and a professor of clinical public health, wrote, “Rigorous, quantitative epidemiological research is needed to assess the risks to public health, and data are just starting to emerge. As investigations of shale gas extraction in the US have continually suggested, assurances of safety are no proxy for adequate protection.”³³³
- April 15, 2014 – The *Canadian Medical Association Journal* reported on the increasing legitimacy of concerns about fracking on health: “While scientists and area residents have been sounding the alarm about the health impacts of shale gas drilling for years, recent

³²⁸ Society of Toxicology. (2014). Toxicologists outline key health and environmental concerns associated with hydraulic fracturing. *ScienceDaily*. Retrieved June 11, 2014, from <http://www.sciencedaily.com/releases/2014/05/140509172545.htm>

³²⁹ Goldstein, B. D., Brooks, B. W., Cohen, S. D., Gates, A. E., Honeycutt, M. E., Morris, J. B., ... Snawder, J. (2014). The role of toxicological science in meeting the challenges and opportunities of hydraulic fracturing [Abstract]. *Toxicological Sciences*, 139(2). doi: 10.1093/toxsci/kfu061

³³⁰ The Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction. (2014). Environmental Impacts of Hurricane Mitch. *Council of Canadian Academies*. Retrieved June 11, 2014, from http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/shale%20gas/shalegas_fullreporten.pdf

³³¹ Canadian Press. (2014, May 1). Top Canadian scientists urge cautious approach to fracking until more known of impact. *Financial Post*. Retrieved June 11, 2014, from http://business.financialpost.com/2014/05/01/top-canadian-scientists-urge-cautious-approach-to-fracking-until-more-known-of-impact/?_lsa=3b44-76a1

³³² Khan, N. (2014, April 30). Health impact of gas fracking left in the dark. *Pocono Record*. Retrieved June 11, 2014, from <http://www.poconorecord.com/apps/pbcs.dll/article?AID=/20140430/NEWS90/404300301/-1/NEWS01>

³³³ Law, A., Hays, J., Shonkoff, S. B., & Finkel, M. L. (2014). Public Health England’s draft report on shale gas extraction [Abstract]. *BMJ*, 1840. doi: <http://dx.doi.org/10.1136/bmj.g2728>

studies, a legal decision and public health advocates are bringing greater legitimacy to concerns.”³³⁴

- March 3, 2014 – In the *Medical Journal of Australia*, researchers and a physician published a strongly worded statement, “Harms unknown: health uncertainties cast doubt on the role of unconventional gas in Australia’s energy future.” They cited knowledge to date on air, water, and soil pollution, and expressed concern about “environmental, social and psychological factors that have more indirect effects on health, and important social justice implications” yet to be understood. They wrote in summary:

*The uncertainties surrounding the health implications of unconventional gas, when considered together with doubts surrounding its greenhouse gas profile and cost, weigh heavily against proceeding with proposed future developments. While the health effects associated with fracturing chemicals have attracted considerable public attention, risks posed by wastewater, community disruption and the interaction between exposures are of also of concern.*³³⁵

- March 1, 2014 – In the prestigious British medical journal *The Lancet*, researchers summarized workshops and research about the health impacts of fracking:

*Scientific study of the health effects of fracking is in its infancy ... but findings suggest that this form of extraction might increase health risks compared with conventional oil and gas wells because of the larger surface footprints of fracking sites [due to the large number of well pads being developed]; their close proximity to locations where people live, work, and play; and the need to transport and store large volumes of materials.*³³⁶

- February 24, 2014 – In a review of the health effects of unconventional natural gas extraction published in the journal *Environmental Science & Technology*, leading researchers identified a range of impacts and exposure pathways that can be detrimental to human health. Noting how fracking disrupts communities, the review states, “For communities near development and production sites the major stressors are air pollutants, ground and surface water contamination, truck traffic and noise pollution, accidents and malfunctions, and psychosocial stress associated with community change.” They concluded, “Overall, the current scientific literature suggests that there are both substantial public concerns and major uncertainties to address.”³³⁷

³³⁴ Glauser, W. (2014). New legitimacy to concerns about fracking and health. *Canadian Medical Association Journal*, 186(8), E245-E246. doi: 10.1503/cmaj.109-4725

³³⁵ Coram, A., Moss, J., & Blashki, G. (2014). Harms unknown: Health uncertainties cast doubt on the role of unconventional gas in Australia's energy future. *The Medical Journal of Australia*, 200(4), 210-213. doi: 10.5694/mja13.11023

³³⁶ Kovats, S., Depledge, M., Haines, A., Fleming, L. E., Wilkinson, P., Shonkoff, S. B., & Scovronick, N. (2014). The health implications of fracking. *The Lancet*, 383(9919), 757-758. doi: 10.1016/S0140-6736(13)62700-2

³³⁷ Adgate, J. L., Goldstein, B. D., & McKenzie, L. M. (2014). Potential public health hazards, exposures and health effects from unconventional natural gas development [Abstract]. *Environmental Science & Technology*. doi: 10.1021/es404621d

- August 30, 2013 – A summary of a 2012 workshop by the Institute of Medicine Roundtable on Environmental Health Sciences, Research, and Medicine featured various experts who discussed health and environmental concerns about fracking and the need for more research. The report in summary of the workshop stated, "The governmental public health system, which retains primary responsibility for health, was not an early participant in discussions about shale gas extraction; thus public health is lacking critical information about environmental health impacts of these technologies and is limited in its ability to address concerns raised by regulators at the federal and state levels, communities, and workers employed in the shale gas extraction industry."³³⁸
- April 22, 2013 – In one of the first peer-reviewed nursing articles summarizing the known health and community risks of fracking, Professor Margaret Rafferty, Chair of the Department of Nursing at New York City College of Technology wrote, "Any initiation or further expansion of unconventional gas drilling must be preceded by a comprehensive Health Impact Assessment (HIA)."³³⁹
- May 10, 2011 - In the *American Journal of Public Health*, two medical experts cautioned that fracking "poses a threat to the environment and to the public's health. There is evidence that many of the chemicals used in fracking can damage the lungs, liver, kidneys, blood, and brain." The authors urged that it would be prudent to invoke the precautionary principle in order to protect public health and the environment.³⁴⁰

Conclusion

All together, the findings from the scientific, medical, and journalistic investigations indicate that fracking poses significant threats to air, water, health, public safety, and long-term economic vitality. Concerned both by the rapidly expanding evidence of harm and by the fundamental data gaps still remaining, Concerned Health Professionals considers a moratorium on unconventional oil and natural gas extraction (fracking) the only appropriate and ethical course of action while scientific and medical knowledge on the impacts of fracking continues to emerge.

³³⁸ Coussens, C., & Martinez, R. (2013). *Health impact assessment of shale gas extraction: workshop summary*. Washington: THE NATIONAL ACADEMIES PRESS. Retrieved June 16, 2014, from <http://www.iom.edu/Reports/2013/Health-Impact-Assessment-of-Shale-Gas-Extraction.aspx>

³³⁹ Rafferty, M. A., & Limonik, E. (2013). Is Shale Gas Drilling an Energy Solution or Public Health Crisis? *Public Health Nursing*, 30(5), 454-462. doi: 10.1111/phn.12036

³⁴⁰ Law, A. The Rush to Drill for Natural Gas: A Public Health Cautionary Tale. *American Journal of Public Health*, 101, 784-785. Retrieved June 16, 2014, from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3076392/>



APPENDIX B

Report of the Independent Expert on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment, John H. Knox



General Assembly

Distr.: General
30 December 2013

Original: English

Human Rights Council

Twenty-fifth session

Agenda item 3

**Promotion and protection of all human rights, civil,
political, economic, social and cultural rights,
including the right to development**

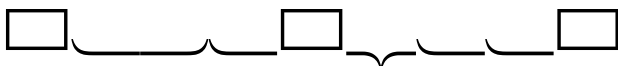
Report of the Independent Expert on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment, John H. Knox

Mapping report

Summary

This report of the Independent Expert on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment is submitted to the Human Rights Council in accordance with Council resolution 19/10.

The report maps human rights obligations relating to the environment, on the basis of an extensive review of global and regional sources. The Independent Expert describes procedural obligations of States to assess environmental impacts on human rights and to make environmental information public, to facilitate participation in environmental decision-making, and to provide access to remedies for environmental harm. He describes States' substantive obligations to adopt legal and institutional frameworks that protect against environmental harm that interferes with the enjoyment of human rights, including harm caused by private actors. Finally, he outlines obligations relating to the protection of members of groups in vulnerable situations, including women, children and indigenous peoples.



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I. Introduction

1. In its resolution 19/10, the Human Rights Council decided to appoint an Independent Expert on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment. In March 2013, the Independent Expert submitted a scoping report to the Council that described the evolution of the relationship between human rights and the environment (A/HRC/22/43). The report explained that the principal goal of the Independent Expert in the second year of his mandate would be to map human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment.

2. To that end, the Independent Expert carried out extensive research and held four regional consultations, in Nairobi, Geneva, Panama City and Copenhagen. (The Copenhagen consultation was with individuals from countries in Asia and Europe.) The consultations enabled the Independent Expert to hear the views of interested stakeholders, including Governments, international bodies, national human rights institutions, civil society organizations, the private sector and academic institutions. Each of the consultations addressed a particular theme: procedural rights and duties, substantive rights and duties, members of groups in vulnerable situations, and the integration of human rights and the environment into international institutions.

3. Section II of the present document describes the mapping process in more detail, section III identifies human rights threatened by environmental harm, and section IV describes human rights obligations relating to the environment.

4. The Independent Expert also addressed the other aspects of the mandate in 2013. He worked with the United Nations Environment Programme and the Office of the United Nations High Commissioner for Human Rights (OHCHR) as they developed an inter-agency programme to identify and disseminate information about good practices in the use of human rights obligations relating to environmental protection.¹ The four regional consultations all discussed good practices as well as obligations. A country visit to Costa Rica in September 2013 also identified good practices, which are described in the separate report on that visit. Further consultations on good practices are planned for 2014 in South Africa, Thailand and the United States of America.² Good practices will also be identified through other methods, such as sending a questionnaire to interested stakeholders. The goal is to prepare a compendium of good practices by March 2015.

5. The Independent Expert has contributed a human rights perspective to follow-up processes to the 2012 United Nations Conference on Sustainable Development and has made recommendations towards realization of the Millennium Development Goals, by participating in the post-2015 global thematic consultation on environmental sustainability, and in a side-event on human rights and the environment held on 12 December 2013 at the sixth session of the Open Working Group on Sustainable Development Goals. He has recommended that the Sustainable Development Goals incorporate a human rights-based approach to environmental protection.

¹ The inter-agency programme prefers the term “good practice” to “best practice”, recognizing that in many situations it will not be possible to identify a single “best” approach. In order for a practice to be considered “good”, it must integrate human rights and environmental standards in an exemplary manner.

² The consultation in the United States will be held at Yale University, in conjunction the United Nations Institute for Training and Research.

6. The Independent Expert has also supported the efforts of others working to integrate human rights and environmental considerations. He participated in the Asia-Europe Meeting seminar on human rights and the environment, addressed the International Bar Association and met with its working group on human rights and climate change, and spoke to a meeting of the countries in Latin America and the Caribbean considering a regional agreement on implementation of principle 10 of the Rio Declaration on Environment and Development. He has worked with the Harvard Human Rights Center as it develops a “knowledge platform” to describe cases in which human rights were brought to bear on environmental issues, and with the Universal Rights Group to develop a programme of meetings and reports highlighting the issues facing environmental human rights defenders.

II. Mapping human rights obligations relating to the environment

7. In order to fulfil the request made by the Human Rights Council in its resolution 19/10 that the Independent Expert “study the human rights obligations, including non-discrimination obligations, relating to the enjoyment of a safe, clean, healthy and sustainable environment,” he reviewed a wide range of sources of human rights law. Scholars had previously examined some, but not all, of these sources. While recognizing the importance of the previous scholarly work, the Independent Expert undertook a fresh examination of the primary materials. To ensure that the study was as thorough as possible, he sought and received substantial pro bono assistance from academics and international law firms. With their help, thousands of pages of materials were reviewed, including texts of agreements, declarations and resolutions; statements by international organizations and States; and interpretations by tribunals and treaty bodies.

8. The relevant statements are described in 14 reports, each devoted to a particular source or set of sources. Before being finalized, the reports were edited in light of the regional consultations and were reviewed by outside experts. The reports are available both at the OHCHR website³ and the Independent Expert’s personal website.⁴

9. The reports fall into four major categories: (a) United Nations human rights bodies and mechanisms; (b) global human rights treaties; (c) regional human rights systems; and (d) international environmental instruments.

10. Under the category of United Nations human rights bodies and mechanisms, three reports were prepared. The first report examines statements made by States through General Assembly and Human Rights Council resolutions and through the universal periodic review process.⁵ A second report reviews statements and reports by 11 special procedures of the Human Rights Council whose mandates are particularly relevant to the nexus of human rights and the environment.⁶ They are:

- The Special Rapporteur on adequate housing as a component of the right to an adequate standard of living, and on the right to non-discrimination in this context
- The Special Rapporteur on the right to education

³ <http://www.ohchr.org/EN/Issues/Environment/IEEnvironment/Pages/IEenvironmentIndex.aspx>

⁴ <http://ieenvironment.org>

⁵ Individual report on the General Assembly and the Human Rights Council, including the universal periodic review process.

⁶ Individual report on the special procedures of the Human Rights Council (Report on special procedures).

- The Special Rapporteur on extreme poverty and human rights
- The Special Rapporteur on the right to food
- The Special Rapporteur on the right of everyone to the enjoyment of the highest attainable standard of physical and mental health
- The Special Rapporteur on the situation of human rights defenders
- The Special Rapporteur on the human rights of internally displaced persons
- The Independent Expert on minority issues
- The Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes
- The Special Representative of the Secretary-General on the issue of human rights and transnational corporations and other business enterprises, and the Working Group on this issue, and
- The Special Rapporteur on the human right to safe drinking water and sanitation.

11. The third report in this category examines the work of the Special Rapporteur on the rights of indigenous peoples, including his application of the two most important international instruments on the rights of indigenous peoples — the United Nations Declaration on the Rights of Indigenous Peoples, and the International Labour Organization’s convention No. 169 (Indigenous and Tribal Peoples Convention, 1989).⁷

12. The second category of sources comprises global human rights treaties. The five reports in this category examine the International Covenant on Economic, Social and Cultural Rights, the International Covenant on Civil and Political Rights, the International Convention on the Elimination of All Forms of Racial Discrimination, the Convention on the Elimination of All Forms of Discrimination against Women, and the Convention on the Rights of the Child.⁸ In addition to the text of the agreements, the reports examine relevant interpretations of the treaty bodies via the general comments, country reports and views on communications.

13. The third category — regional human rights systems — includes three reports. One report examines the jurisprudence of the European Court of Human Rights applying the European Convention for the Protection of Human Rights and Fundamental Freedoms to environmental issues.⁹ Another describes the relevant decisions of the Inter-American Commission on Human Rights and the Inter-American Court of Human Rights in interpreting the American Declaration of the Rights and Duties of Man and the American Convention on Human Rights.¹⁰ The third report includes the other major regional human rights systems, based on the African Charter on Human and Peoples’ Rights, the Arab

⁷ Individual report on the rights of indigenous peoples (Report on indigenous peoples).

⁸ These reports are abbreviated according to the name of the treaty reviewed, for example the “ICESCR report” (pertaining to the International Covenant on Economic, Social and Cultural Rights). The International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families and the Convention on the Rights of Persons with Disabilities were also reviewed, but the review did not produce enough relevant information to justify separate reports.

⁹ Report on European perspectives on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment (European report), prepared by researchers at the Global Studies Institute, University of Geneva. Another important source of information is the *Manual on Human Rights and the Environment*, second edition (2012), published by the Council of Europe.

¹⁰ Individual report on the inter-American human rights agreements (Inter-American report).

Charter on Human Rights, the ASEAN Human Rights Declaration, and the European Social Charter.¹¹

14. The fourth category covers international environmental instruments. It includes a report on global and regional environmental agreements, a report on non-binding environmental declarations, and a report on the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention). These instruments include duties owed to individuals that sometimes correspond to, and reveal practice consistent with, human rights obligations.

15. Each of the 14 individual reports follows the same template. After an introduction that describes its scope, the report sets out the human rights threatened by environmental harm, and the human rights obligations identified by the source relating to environmental protection. The obligations are organized into three sections: procedural obligations, substantive obligations, and obligations relating to members of groups in vulnerable situations. Finally, the report examines cross-cutting issues, such as transboundary environmental harm and the role of non-State actors.

16. The following sections summarize the findings of the subsidiary reports. Section III describes human rights threatened by environmental harm and section IV sets out human rights obligations relating to environmental protection, as identified by the sources reviewed.

III. Human rights threatened by environmental harm

17. In his first report, the Independent Expert stated that one “firmly established” aspect of the relationship between human rights and the environment is that “environmental degradation can and does adversely affect the enjoyment of a broad range of human rights” (A/HRC/22/43, para. 34). As the Human Rights Council itself has stated, “environmental damage can have negative implications, both direct and indirect, for the effective enjoyment of human rights” (resolution 16/11). The mapping project provides overwhelming support for this statement. Virtually every source reviewed identifies rights whose enjoyment is infringed or threatened by environmental harm.

18. For example, in the universal periodic review process, 45 States discussed the right to a healthy environment as recognized in their constitutions, and several identified threats to the enjoyment of this right, including climate change, desertification, and particular mining operations.¹² In addition, African tribunals have held that large-scale oil development infringed the right to a satisfactory environment as protected by the African Charter.¹³

19. The Human Rights Committee has asked States to describe measures they have taken to protect the right to life from the risk of nuclear disaster and other environmental pollution.¹⁴ This right, like others, can be affected by natural causes as well as by human actions: the European Court of Human Rights has decided cases involving infringement of

¹¹ Individual report on the African Charter, the Arab Charter, the ASEAN Human Rights Declaration and the European Social Charter (Regional agreements report).

¹² Individual report on the General Assembly and the Human Rights Council, including the universal periodic review process, sect. III.A.

¹³ Communication No. 155/96, *Social and Economic Rights Action Centre v. Nigeria* (Ogoniland case); *SERAP v. Nigeria*, Court of Justice of the Economic Community of West African States, Judgement No. ECW/CCJ/JUD/18/12 (14 December 2012).

¹⁴ International Covenant on Civil and Political Rights (ICCPR) report, sect. II.

the right to life that occurred as a result of natural disasters and also as a result of improper maintenance of a municipal rubbish tip that caused a massive explosion.¹⁵

20. Many sources, including the Human Rights Council, the Committee on Economic, Social and Cultural Rights, the special rapporteurs, the African Commission and the European Committee of Social Rights have identified environmental threats to the right to the enjoyment of the highest attainable standard of physical and mental health. Examples include the improper disposal of toxic wastes (Human Rights Council resolution 9/1; E/CN.4/2004/46, para. 79), exposure to radiation and harmful chemicals (Committee on Economic, Social and Cultural Rights, general comment No. 14 (2000), para. 15), oil pollution (African Commission, *Ogoniland* case, para. 54), and large-scale water pollution.¹⁶

21. In addition, many sources have identified environmental threats to the right to an adequate standard of living and its components. For example, the Committee on Economic, Social and Cultural Rights has identified the improper use of pesticides as a threat to the right to food,¹⁷ while the Special Rapporteur on the right to food has found that right to be threatened by pollution and habitat loss (A/67/268, paras. 17–19). The Special Rapporteur on hazardous substances and wastes has indicated that waste from extractive industries can infringe the right to water (A/HRC/21/48, para. 39), and the Special Rapporteur on adequate housing as a component of the right to an adequate standard of living, and on the right to non-discrimination in this context has described how that right is threatened by climate change (A/64/255).

22. Indeed, special rapporteurs have explained how climate change threatens a wide range of rights, including the rights to health, water and food.¹⁸ An OHCHR report describes the implications of climate change for those rights and others, including the right of self-determination for peoples living in small island States (A/HRC/10/61). The Human Rights Council took note of the report and expressed its concern that “climate change poses an immediate and far-reaching threat to people and communities around the world and has adverse implications for the full enjoyment of human rights” (resolution 18/22).

23. The Human Rights Council has recognized that “environmental damage is felt most acutely by those segments of the population already in vulnerable situations” (resolution 16/11). The sources reviewed provide examples of environmental harm that particularly affects such groups. For example, the Committee on the Elimination of Discrimination against Women has identified many types of environmental harm, including natural disasters, climate change, nuclear contamination and water pollution, that can adversely affect rights protected under the Convention on the Elimination of All Forms of Discrimination against Women.¹⁹ The Special Rapporteur on hazardous substances and wastes has highlighted the particular dangers that exposure to mercury through artisanal mining poses to women in respect of their right to health (A/HRC/21/48, paras. 32, 33).

24. The rights of children, too, may be particularly affected by environmental degradation. The Convention on the Rights of the Child states that environmental pollution

¹⁵ European report, pp. 4–5; and Council of Europe, *Manual*, pp. 35–37.

¹⁶ European Committee of Social Rights, complaint No. 72/2011, *International Federation for Human Rights (FIDH) v. Greece* (2013).

¹⁷ ICESCR report, sect. II.

¹⁸ Report on special procedures, sect. II. See also the joint statement by the special procedures mandate holders regarding the United Nations Climate Change Conference, available at <http://www.ohchr.org/en/NewsEvents/Pages/DisplayNews.aspx?NewsID=9667&LangID=E>.

¹⁹ Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) report, sect. II.

poses “dangers and risks” to nutritious foods and clean drinking water (art. 24, para. 2(c)). In its concluding observations on country reports, the Committee on the Rights of the Child regularly addresses environmental hazards as barriers to the realization of the right to health and other rights.²⁰ The Special Rapporteur on hazardous substances and wastes has emphasized the harm to children’s rights to health caused by exposure to mercury and other hazardous substances in extractive industries (A/HRC/21/48, paras. 28–30).

25. Because of the close relationship that indigenous peoples have with nature, they can be uniquely vulnerable to environmental degradation. The Special Rapporteur on the rights of indigenous peoples has emphasized that “extractive industry activities generate effects that often infringe upon indigenous peoples’ rights” (A/HRC/18/35, para. 26), and has detailed many examples of such infringement, including on their rights to life, health and property.²¹

IV. Human rights obligations relating to the environment

26. This section sets out human rights obligations relating to the environment as they have been described by international agreements and the bodies charged with interpreting them. Although only some of these agreements explicitly refer to the environment, human rights bodies have increasingly applied them to environmental issues in recent years as our knowledge of the dangers of environmental degradation has increased. The result is a large and growing number of legal statements that together create a body of human rights norms relating to the environment.

27. The Independent Expert understands that not all States have formally accepted all of these norms. While some of the statements cited are from treaties, or from tribunals that have the authority to issue decisions that bind the States subject to their jurisdiction, other statements are interpretations by experts that do not in themselves have binding effect. Despite the diversity of the sources from which they arise, however, the statements are remarkably coherent. Taken together, they provide strong evidence of converging trends towards greater uniformity and certainty in the human rights obligations relating to the environment. These trends are further supported by State practice reflected in the universal periodic review process and international environmental instruments.

28. In this light, the Independent Expert encourages States to accept these statements as evidence of actual or emerging international law. At a minimum, they should be seen as best practices that States should move to adopt as expeditiously as possible.

A. Procedural obligations

29. One of the most striking results of the mapping exercise is the agreement among the sources reviewed that human rights law imposes certain procedural obligations on States in relation to environmental protection. They include duties (a) to assess environmental impacts and make environmental information public; (b) to facilitate public participation in environmental decision-making, including by protecting the rights of expression and association; and (c) to provide access to remedies for harm. These obligations have bases in civil and political rights, but they have been clarified and extended in the environmental context on the basis of the entire range of human rights at risk from environmental harm.

²⁰ Convention on the Rights of the Child (CRC) report, sect. II.

²¹ Report on indigenous peoples, sect. II. See also the International Convention on the Elimination of All Forms of Racial Discrimination (ICERD) report, sect. II; and Inter-American report, sect. III.C.

1. Duties to assess environmental impacts and make information public

30. The Universal Declaration of Human Rights (art. 19) and the International Covenant on Civil and Political Rights (art. 19) state that the right to freedom of expression includes the freedom “to seek, receive and impart information”. The right to information is also critical to the exercise of other rights, including rights of participation. In the words of the then Special Rapporteur on the adverse effects of the illicit movement and dumping of toxic and dangerous products and wastes on the enjoyment of human rights, the rights to information and participation are “both rights in themselves and essential tools for the exercise of other rights, such as the right to life, the right to the highest attainable standard of health, the right to adequate housing and others” (A/HRC/7/21, p. 2).

31. Human rights bodies have repeatedly stated that in order to protect human rights from infringement through environmental harm, States should provide access to environmental information and provide for the assessment of environmental impacts that may interfere with the enjoyment of human rights.

32. For example, in its general comment No. 15 (2002) on the right to water, the Committee on Economic, Social and Cultural Rights stated that individuals should be given full and equal access to information concerning water and the environment (para. 48), and in its responses to country reports, it has urged States to assess the impacts of actions that may have adverse environmental effects on the right to health and other rights within its purview.²² Similarly, the Special Rapporteur on the situation of human rights defenders has stated that information relating to large-scale development projects should be publicly available and accessible (A/68/262, para. 62), and the Special Rapporteur on the human right to safe drinking water and sanitation has stated that States need to conduct impact assessments “in line with human rights standards” when they plan projects that may have an impact on water quality (A/68/264, para. 73).²³

33. Regional bodies have also concluded that States must provide environmental information and provide for assessments of environmental impacts on human rights. For example, on the basis of the right to respect for private and family life as set out in the European Convention on Human Rights (art. 8), the European Court has stated:

Where a State must determine complex issues of environmental and economic policy, the decision-making process must firstly involve appropriate investigations and studies in order to allow them to predict and evaluate in advance the effects of those activities which might damage the environment and infringe individuals’ rights and to enable them to strike a fair balance between the various conflicting interests at stake. The importance of public access to the conclusions of such studies and to information which would enable members of the public to assess the danger to which they are exposed is beyond question.²⁴

34. International instruments illustrate the importance of providing environmental information to the public. Principle 10 of the Rio Declaration states: “At the national level, each individual shall have appropriate access to information concerning the environment

²² ICESCR report, sect. III.A.1.

²³ For other statements by special rapporteurs on access to information and assessment of environmental impacts, see Report on special procedures, sect. III.A.1.

²⁴ *Taşkin v. Turkey*, 2004-X European Court of Human Rights 179, para. 119. See also *Öneryıldız v. Turkey*, 2004-XII European Court of Human Rights 1, para. 90 (applying the right to information in connection with the right to life); *Ogoniland* case, para. 53 (deriving obligations from the right to health and the right to a healthy environment); Inter-American Court, *Claude-Reyes et al. v. Chile*, Judgement of 19 September 2006 (ordering State to adopt necessary measures to ensure right of access to State-held information).

that is held by public authorities, including information on hazardous materials and activities in their communities... States shall facilitate and encourage public awareness and participation by making information widely available.”²⁵ Many environmental treaties, including the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (art. 15), the Stockholm Convention on Persistent Organic Pollutants (art. 10), and the United Nations Framework Convention on Climate Change (art. 6(a)), require environmental information to be provided to the public. The Aarhus Convention includes particularly detailed obligations.²⁶ Illustrating the link between its obligations and those of human rights law, many Aarhus parties have discussed their compliance with that agreement in their reports under the universal periodic review process.²⁷

35. Most States have adopted environmental impact assessment laws, in accordance with principle 17 of the Rio Declaration, which states that “environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.” The World Bank requires environmental assessment of all Bank-financed projects to “ensure that they are environmentally sound and sustainable”.²⁸

2. Duties to facilitate public participation in environmental decision-making

36. The baseline rights of everyone to take part in the government of their country and in the conduct of public affairs are recognized in the Universal Declaration of Human Rights (art. 21) and the International Covenant on Civil and Political Rights (art. 25), respectively. Again, human rights bodies have built on this baseline in the environmental context, elaborating a duty to facilitate public participation in environmental decision-making in order to safeguard a wide spectrum of rights from environmental harm.

37. The Special Rapporteur on hazardous substances and wastes and the Special Rapporteur on the situation of human rights defenders have stated that governments must facilitate the right to participation in environmental decision-making (see A/HRC/7/21 and A/68/262).²⁹ The Committee on Economic, Social and Cultural Rights has encouraged States to consult with stakeholders in the course of environmental impact assessments, and has underlined that before any action is taken that interferes with the right to water, the relevant authorities must provide an opportunity for “genuine consultation with those affected” (general comment No. 15 (2002), para. 56). Regional human rights tribunals agree that individuals should have meaningful opportunities to participate in decisions concerning their environment.³⁰

38. The need for public participation is reflected in many international environmental instruments. Principle 10 of the Rio Declaration states: “Environmental issues are best

²⁵ See also: “Guidelines for the development of national legislation on access to information, public participation and access to justice in environmental matters” adopted at the eleventh special session of the United Nations Environment Programme Governing Council/Global Ministerial Environmental Forum.

²⁶ For other examples, see the Multilateral environment agreements (MEA) report, sect. III.A.1.

²⁷ Individual report on the General Assembly and the Human Rights Council, including the universal periodic review process, sect. III.

²⁸ World Bank Operational Policy 4.01, para. 1. See also: World Bank Inspection Panel, Report No. 40746-ZR, 31 August 2007, para. 346 (finding that the failure to prepare an environmental assessment violated the Operational Policy).

²⁹ For statements by other special rapporteurs, see Report on special procedures, sect. III.A.2.

³⁰ Regional agreements report, sect. II.B.1; Inter-American report, sect. III.A.2.

handled with participation of all concerned citizens, at the relevant level... Each individual shall have... the opportunity to participate in decision-making processes.” In 2012, in *The Future We Want*, the outcome document of the United Nations Conference on Sustainable Development (Rio+20 Conference), States recognized that “opportunities for people to influence their lives and future, participate in decision-making and voice their concerns are fundamental for sustainable development” (A/CONF.216/16, para. 13). Environmental treaties that provide for public participation include the Stockholm Convention on Persistent Organic Pollutants (art. 10), the Convention on Biological Diversity (art. 14(1)), the United Nations Convention to Combat Desertification (arts. 3 and 5), and the United Nations Framework Convention on Climate Change (art. 6(a)). The Aarhus Convention has particularly detailed requirements (arts. 6–8).³¹

39. The rights of freedom of expression and association are of special importance in relation to public participation in environmental decision-making. The Special Rapporteur on the situation of human rights defenders has said that those working on land rights and natural resources are the second-largest group of defenders at risk of being killed (A/HRC/4/37), and that their situation appears to have worsened since 2007 (A/68/262, para. 18). Her last report described the extraordinary risks, including threats, harassment, and physical violence, faced by those defending the rights of local communities when they oppose projects that have a direct impact on natural resources, the land or the environment (A/68/262, para. 15).

40. States have obligations not only to refrain from violating the rights of free expression and association directly, but also to protect the life, liberty and security of individuals exercising those rights.³² There can be no doubt that these obligations apply to those exercising their rights in connection with environmental concerns. The Special Rapporteur on the situation of human rights defenders has underlined these obligations in that context (A/68/262, paras. 16 and 30), as has the Special Rapporteur on the rights of indigenous peoples (A/HRC/24/41, para. 21), the Committee on Economic, Social and Cultural Rights,³³ the Inter-American Court of Human Rights,³⁴ and the Commission on Human Rights, which called upon States “to take all necessary measures to protect the legitimate exercise of everyone’s human rights when promoting environmental protection and sustainable development” (resolution 2003/71).

3. Duty to provide access to legal remedies

41. From the Universal Declaration of Human Rights onward, human rights agreements have established the principle that States should provide for an “effective remedy” for violations of their protected rights. Human rights bodies have applied that principle to human rights infringed by environmental harm. For example, the Committee on Economic, Social and Cultural Rights has urged States to provide for “adequate compensation and/or alternative accommodation and land for cultivation” to indigenous communities and local farmers whose land is flooded by large infrastructure projects, and “just compensation [to] and resettlement” of indigenous peoples displaced by forestation.³⁵ The Special Rapporteur on the situation of human rights defenders has stated that States must implement

³¹ MEA report, sect. III.A.2.

³² International Covenant on Civil and Political Rights, art. 2; Declaration on the Right and Responsibility of Individuals, Groups and Organs of Society to Promote and Protect Universally Recognized Human Rights and Fundamental Freedoms, arts. 2, 9 and 12.

³³ ICESCR report, sect. III.A.4.

³⁴ For example, *Kawas Fernández v. Honduras*, Merits, Reparations and Costs, Judgement dated 3 April 2009 (Ser. C No. 196). For other cases, see Inter-American report, sect. III.A.4.

³⁵ ICESCR report, sect. III.A.3.

mechanisms that allow defenders to communicate their grievances, claim responsibilities, and obtain effective redress for violations, without fear of intimidation (A/68/262, paras. 70–73). Other special rapporteurs, including those for housing, education, and hazardous substances and wastes, have also emphasized the importance of access to remedies within the scope of their mandates.³⁶

42. At the regional level, the European Court has stated that individuals must “be able to appeal to the courts against any decision, act or omission where they consider that their interests or their comments have not been given sufficient weight in the decision-making process.”³⁷ More generally, the Inter-American Commission on Human Rights and the Inter-American Court of Human Rights have stated that the American Convention on Human Rights requires States to provide access to judicial recourse for claims alleging the violation of their rights as a result of environmental harm.³⁸ The Court of Justice of the Economic Community of West African States has stressed the need for the State to hold accountable actors who infringe human rights through oil pollution, and to ensure adequate reparation for victims.³⁹

43. International environmental instruments support an obligation to provide for effective remedies. Principle 10 of the Rio Declaration states: “Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.” Many environmental treaties establish obligations for States to provide for remedies in specific areas. For instance, the United Nations Convention on the Law of the Sea requires States to ensure that recourse is available within their legal systems to natural or juridical persons for prompt and adequate compensation or other relief for damage caused by pollution of the marine environment (art. 235). Some agreements establish detailed liability regimes; a leading example is the International Convention on Civil Liability for Oil Pollution Damage.⁴⁰

B. Substantive obligations

44. States have obligations to protect against environmental harm that interferes with the enjoyment of human rights. As section II explains, environmental harm may threaten a very broad spectrum of human rights, including the rights to life and health. The content of States’ specific obligations to protect against environmental harm therefore depends on the content of their duties with respect to the particular rights threatened by the harm.

45. Those duties may vary from right to right. For example, States have general obligations to respect and ensure rights under the International Covenant on Civil and Political Rights (art. 2, para. 1), the Convention on the Rights of the Child (art. 2, para. 1) and the American Convention on Human Rights (art. 1), to take steps towards the full realization of the rights recognized in the International Covenant on Economic, Social and Cultural Rights, to secure the rights in the European Convention on Human Rights (art. 1), and to recognize and give effect to the rights in the African Charter (art. 1). When environmental harm threatens or infringes the enjoyment of a right protected by one or more of these agreements, States’ general obligations relating to the right (e.g. to respect and ensure it, or to take steps towards its full realization) apply with respect to the environmental threat or infringement.

³⁶ Report on special procedures, sect. III.A.3.

³⁷ *Taşkin v. Turkey*, para. 119.

³⁸ Inter-American report, sect. III.A.3.

³⁹ *SERAP v. Nigeria*, para. 97.

⁴⁰ See generally MEA report, sect. III.A.3.

46. Despite differences in the language setting out the general obligations, however, they have given rise to remarkably similar interpretations when applied to environmental issues. Although the contours of the specific environmental obligations are still evolving, some of their principal characteristics have become clear. In particular, States have obligations (a) to adopt and implement legal frameworks to protect against environmental harm that may infringe on enjoyment of human rights; and (b) to regulate private actors to protect against such environmental harm.

1. **Obligation to adopt and implement legal framework**

47. States have obligations to adopt legal and institutional frameworks that protect against, and respond to, environmental harm that may or does interfere with the enjoyment of human rights. These obligations have been derived from a number of human rights, including the rights to life and health.

48. The Human Rights Committee has long held the view that the right to life protected by the International Covenant on Civil and Political Rights “cannot properly be understood in a restrictive manner, and the protection of this right requires that States adopt positive measures” (general comment No. 6 (1982) on the right to life, para. 5). Although the Committee has not described in detail the steps required to protect the right to life from environmental harm, other human rights bodies have. In particular, the European Court has held that States have a primary duty to put in place a legislative and administrative framework that protects against and responds to infringements of the right to life as a result of natural disasters and of dangerous activities, including the operation of chemical factories and waste-collection sites.⁴¹ The Inter-American Commission on Human Rights has also urged States to adopt environmental protection measures in order to comply with their obligations to protect rights, including the rights to life and health.⁴²

49. With respect to the right to health, the International Covenant on Economic, Social and Cultural Rights (art. 12, para. 2(b)) provides that the steps to be taken by States to achieve the full realization of that right “shall include those necessary for... the improvement of all aspects of environmental and industrial hygiene”. Interpreting this language in its general comment No. 14 (2000), the Committee on Economic, Social and Cultural Rights has stated that “the right to health embraces a wide range of socioeconomic factors that promote conditions in which people can lead a healthy life, and extends to the underlying determinants of health, such as... a healthy environment” (para. 4). The Committee has interpreted the phrase “the improvement of all aspects of environmental and industrial hygiene” in article 12.2(b) to include “the prevention and reduction of the population’s exposure to harmful substances such as radiation and harmful chemicals or other detrimental environmental conditions that directly or indirectly impact upon human health” (para. 15). To that end, States are required to adopt measures against environmental health hazards, including by formulating and implementing policies “aimed at reducing and eliminating pollution of air, water and soil” (para. 36). Where environmental harm to human rights occurs, including from natural disasters, States are obliged to respond by assisting the victims.⁴³

⁴¹ Council of Europe, *Manual*, pp. 18, 36–40. See, for example, *Öneriyıldız v. Turkey*, No. 48939/99, 30 November 2004; and *Budayeva and others v. Russia*, No. 15339/02, 20 March 2008. The European Court has also derived such an obligation from the right to private and family life; see *Tatar v. Romania*, No. 67021/01, 6 July 2009, para. 88.

⁴² See Inter-American report, sect. III.B.

⁴³ See generally ICESCR report, sect. III.B.

50. Similarly, special rapporteurs have addressed the obligations of States in relation to environmental harm to human rights.⁴⁴ The Special Rapporteur on the human right to safe drinking water and sanitation, for example, has stated (A/68/264, para. 48):

To curb water pollution effectively, regulation must target all sectors and cover the whole country, giving priority to the elimination of the most urgent and serious challenges, which vary from country to country and within countries. They might stem from the use of pesticides and fertilizers in agriculture in rural areas, the non-confinement and non-treatment of sludge and septage in densely populated urban areas, or from industrial wastewater in areas that experience sudden economic growth. States have to assess the situation at the micro level and prioritize addressing the most urgent challenges.

51. The Special Rapporteur on hazardous substances and wastes has issued a series of reports identifying obligations of States in relation to such substances. To take one example, a 2006 report on the human rights impact of the widespread exposure of individuals and communities to toxic chemicals in food and household goods (E/CN.4/2006/42, para. 45) states:

The duties of States in this regard translate into obligations to take steps to regulate carefully the production, storage and use of hazardous chemicals in a way that prevents a level of exposure to hazardous chemicals which may result in human rights violations. States must also provide effective remedies and restitution to victims of those violations occurring as a result of exposure to hazardous chemicals. In other words, States must regulate the production and use of chemicals in a way which is consistent with the full spectrum of their obligations under international human rights law.

52. States have recognized the importance of incorporating human rights considerations into environmental laws. The Human Rights Council has affirmed that “human rights obligations and commitments have the potential to inform and strengthen international, regional and national policymaking in the area of environmental protection” and urged States “to take human rights into consideration when developing their environmental policies” (resolution 16/11). The Council, as well as the parties to the United Nations Framework Convention on Climate Change, has stated that States should, in all climate change-related actions, fully respect human rights (resolution 18/22; and FCCC/CP/2010/7/Add.1, decision 1/CP.16). In the universal periodic review process, many States have described the steps they have taken to create institutions and adopt policies and laws to address environmental protection.⁴⁵

53. The obligation to protect human rights from environmental harm does not require the cessation of all activities that may cause any environmental degradation. The African Commission, for example, has made it clear that the African Charter does not require States to forego all oil development.⁴⁶ The European Court has held that States have discretion to strike a balance between environmental protection and other issues of societal importance, such as economic development and the rights of others.⁴⁷ But the balance cannot be unreasonable, or result in unjustified, foreseeable infringements of human rights. In the *Ogoniland* case, the African Commission cited the enormous environmental harm to the

⁴⁴ See generally Report on special procedures, sect. III.B.

⁴⁵ Individual report on the General Assembly and the Human Rights Council, including the universal periodic review process, sect. IV.B.1.

⁴⁶ *Ogoniland* case, para. 54.

⁴⁷ Council of Europe, *Manual*, p. 20. See, for example, *Hatton and others v. United Kingdom*, No. 360022/97, 8 July 2003, para. 98.

rights of those in the Niger delta region in finding that “the care that should have been taken”, including by taking reasonable measures to prevent pollution and ecological degradation from oil production, “was not taken.”⁴⁸ Similarly, the European Court has decided cases in which it held that States failed to strike a fair balance between protecting rights from environmental harm and protecting other interests.⁴⁹

54. In this respect, national and international health standards may be particularly relevant. For example, in deciding whether a State had failed to comply with its obligations under the European Social Charter with respect to the right to health, the European Committee of Social Rights evaluated the danger posed by water pollution in light of water safety standards set by the World Health Organization (WHO) and other public bodies.⁵⁰ The European Court has also considered national and WHO health and safety standards in deciding whether States have reached a fair balance between environmental protection and other interests.⁵¹

55. Another relevant factor in deciding whether an environmental law meets human rights obligations is whether it is retrogressive. The Committee on Economic, Social and Cultural Rights has strongly discouraged retrogressive actions with respect to fulfilment of the rights protected by the International Covenant, in light of the obligation in the Covenant to move as expeditiously as possible towards full realization of the rights. The Committee stated in its general comment on the right to the highest attainable standard of health that “as with all other rights in the Covenant, there is a strong presumption that retrogressive measures taken in relation to the right to health are not permissible.” If States do take deliberately retrogressive measures, then they have the burden of proving that they first carefully considered all alternatives, and that the measures “are duly justified by reference to the totality of the rights provided for in the Covenant in the context of the full use of the State party’s maximum available resources” (para. 32).⁵²

56. Finally, after a State has adopted environmental standards into its law, it must implement and comply with those standards. As the European Court has stated: “Regulations to protect guaranteed rights serve little purpose if they are not duly enforced.”⁵³ Interpreting the African Charter, the Court of Justice of the Economic Community of West African States has held that it is not enough to adopt measures “if these measures just remain on paper and are not accompanied by additional and concrete measures aimed at preventing the occurrence of damage or ensuring accountability, with the effective reparation of the environmental damage suffered.”⁵⁴ In addition, the Committee on Economic, Social and Cultural Rights has made clear that the Covenant obliges States to refrain from “unlawfully polluting air, water and soil, e.g. through industrial waste from State-owned facilities” (general comment No. 14, para. 34) and to refrain from “unlawfully diminishing or polluting water” (general comment No. 15, para. 21).

⁴⁸ *Ogoniland* case, para. 54.

⁴⁹ See, for example, *López Ostra v. Spain*, No. 16798/90, 9 December 1994; *Tatar v. Romania*, No. 67021/01, 27 January 2009.

⁵⁰ *International Federation for Human Rights (FIDH) v. Greece*, No. 72/2011, 23 January 2013, paras. 42–44, 148.

⁵¹ See, for example, *Dubetska and others v. Ukraine*, No. 30499/03, 10 May 2011, para. 107 (national standards); *Fägerskiöld v. Sweden*, No. 37664/04, 26 February 2008 (WHO standards).

⁵² See also the Committee’s general comment No. 15, para. 19.

⁵³ *Moreno Gómez v. Spain*, No. 4143/02, 16 February 2005, para. 61. See also *Giacomelli v. Italy*, No. 59909/00, 26 March 2007, para. 93.

⁵⁴ *SERAP v. Nigeria*, para. 105.

57. Again, special rapporteurs have taken equivalent positions with respect to rights within the scope of their mandates.⁵⁵ For example, the Special Rapporteur on the human right to safe drinking water and sanitation has emphasized that “successful regulation depends not only on standard-setting, but also on strong independent regulators... Regulators need to have the capacity, in terms of human resources, skills, funding and independence from interference, to monitor whether regulations are being complied with, carry out on-site inspections, and impose fines and penalties in the case of breaches” (A/68/264, para. 52).

2. Obligations to protect against environmental harm from private actors

58. As the then Special Representative of the Secretary-General on business and human rights explained, “the State duty to protect against non-State abuses is part of the very foundation of the international human rights regime. The duty requires States to play a key role in regulating and adjudicating abuse by business enterprises, or risk breaching their international obligations” (A/HRC/4/35, para. 18). Such abuses can include environmental harm that infringes human rights. The Special Representative reviewed 320 cases of alleged corporate-related human rights abuses and found that nearly one third of the cases alleged environmental harm that affected human rights, including the rights to life, health, food and housing. Most of the cases of direct harm to communities involved environmental impacts (A/HRC/8/5/Add.2, para. 67).

59. The Guiding Principles on Business and Human Rights endorsed by the Human Rights Council in 2011 state that States are required, *inter alia*, to “protect against human rights abuse within their territory and/or jurisdiction by third parties, including business enterprises,” including by “taking appropriate steps to prevent, investigate, punish and redress such abuse through effective policies, legislation, regulations and adjudication” (A/HRC/17/31, principle 1). The Guiding Principles also make it clear that States have an obligation to provide for remedies for human rights abuses caused by corporations, and that corporations themselves have a responsibility to respect human rights. These three pillars of the normative framework all apply to environmental human rights abuses such as those described in the earlier report of the Special Representative.

60. Many other human rights bodies have explicitly connected States’ duty to protect against human rights abuses by non-State actors to such abuses caused by pollution or other environmental harm. The Committee on Economic, Social and Cultural Rights has stated that “corporate activities can adversely affect the enjoyment of Covenant rights”, including through harmful impacts on the natural environment, and reiterated the “obligation of States Parties to ensure that all economic, social and cultural rights laid down in the Covenant are fully respected and rights holders adequately protected in the context of corporate activities” (E/C.12/2011/1, para. 1). In the context of the right to water, the Committee has made it clear that the duty to protect extends to adopting and enforcing effective measures to restrain third parties from infringing the right through pollution of water sources (general comment No. 15 (2002), paras. 23 and 44(b)).⁵⁶

61. The African Commission has stated that “Governments have a duty to protect their citizens, not only through appropriate legislation and effective enforcement but also by protecting them from damaging acts that may be perpetrated by private parties”, and has held that by allowing oil companies “to devastatingly affect the well-being of the Ogonis”,

⁵⁵ Report on special procedures, sect. III.B (citing statements relating to rights to health, water, food and housing).

⁵⁶ For other statements by the Committee, see ICESCR report, sect. IV.B. For statements by the special procedures, see Report on special procedures, sect. IV.

the State had “fallen short of the minimum conduct expected of governments.”⁵⁷ The Inter-American Commission on Human Rights has stated that “effective enforcement of the environmental protection measures in relation to private parties, particularly extractive companies and industries... is essential to avoid the State’s international responsibility for violating the human rights of the communities affected by activities detrimental to the environment.”⁵⁸ And the European Court has held that States are obligated to take positive steps to protect against environmental harm to the right to private and family life, whether the pollution was caused by governmental or private action. In either case, “the applicable principles are broadly similar.”⁵⁹

3. Obligations relating to transboundary environmental harm

62. Many grave threats to the enjoyment of human rights are due to transboundary environmental harm, including problems of global scope such as ozone depletion and climate change. This raises the question of whether States have obligations to protect human rights against the extraterritorial environmental effects of actions taken within their territory.

63. There is no obvious reason why a State should not bear responsibility for actions that otherwise would violate its human rights obligations, merely because the harm was felt beyond its borders. Nevertheless, the application of human rights obligations to transboundary environmental harm is not always clear. One difficulty is that human rights instruments address jurisdiction in different ways. Some, such as the Universal Declaration of Human Rights and the African Charter, contain no explicit jurisdictional limitations, and the International Covenant on Economic, Social and Cultural Rights may even provide an explicit basis for extraterritorial obligations (art. 2, para. 1). But other treaties, including the International Covenant on Civil and Political Rights, the Convention on the Rights of the Child, the European Convention on Human Rights and the American Convention on Human Rights, limit at least some of their protections to individuals subject to or within the jurisdiction of the State, leaving it unclear how far their protections extend beyond the State’s territory. Another problem is that many human rights bodies have not addressed extraterritoriality in the context of environmental harm.⁶⁰

64. Nevertheless, most of the sources reviewed that have addressed the issue do indicate that States have obligations to protect human rights, particularly economic, social and cultural rights, from the extraterritorial environmental effects of actions taken within their territory. The Committee on Economic, Social and Cultural Rights has interpreted the International Covenant on Economic, Social and Cultural Rights as requiring its parties “to refrain from actions that interfere, directly or indirectly, with the enjoyment of the right to water in other countries” (general comment No. 15, para. 31), and has stated that parties should also take steps to prevent third parties within their jurisdiction, such as their own citizens and companies, from violating the rights to water and health in other countries (general comment No. 15, para. 33; and general comment No. 14, para. 39). Several special rapporteurs have adopted similar interpretations. In 2011, the Special Rapporteur on the right to food and the Special Rapporteur on extreme poverty and human rights joined with

⁵⁷ *Ogoniland* case, paras. 57, 58.

⁵⁸ Inter-American Commission on Human Rights. Second report on the situation of human rights defenders in the Americas, 2011, para. 315. Available at <https://www.oas.org/en/iachr/defenders/docs/pdf/defenders2011.pdf>. See generally IACHR report, sect. IV.A.

⁵⁹ *Lopez Ostra v. Spain*, No. 16798/90, 9 December 1994, para. 51; *Hatton v. United Kingdom*, No. 36022/97, 8 July 2003, para. 98.

⁶⁰ See, for example, Council of Europe, *Manual*, p. 25.

scholars and activists to adopt the Maastricht Principles on Extraterritorial Obligations of States in the area of Economic, Social and Cultural Rights.⁶¹ The Special Rapporteur on the human right to safe drinking water and sanitation recently cited those Principles as underscoring “the obligation of States to avoid causing harm extraterritorially” and affirming “the obligation of States to protect human rights extraterritorially, i.e., to take necessary measures to ensure that non-State actors do not nullify or impair the enjoyment of economic, social and cultural rights. This translates into an obligation to avoid contamination of watercourses in other jurisdictions and to regulate non-State actors accordingly” (A/68/264, para. 46).

65. Such interpretations are in accord with the fundamental obligation of States to carry out their treaty commitments in good faith,⁶² which requires them to avoid taking actions calculated to frustrate the object and purpose of the treaty.⁶³ The International Court of Justice has read this principle of *pacta sunt servanda* as requiring the parties to a treaty to apply it “in a reasonable way and in such a manner that its purpose can be realized”.⁶⁴ This suggests that parties to a human rights treaty should not engage in conduct that makes it harder for other parties to fulfil their own obligations under the treaty.⁶⁵

66. Other sources, such as the Special Representative of the Secretary-General on business and human rights, have taken a more restrictive view of the scope of extraterritorial human rights obligations. The Special Representative also stated, however, that “there is increasing encouragement at the international level... for home States to take regulatory action to prevent abuse by their companies overseas” (A/HRC/8/5, para. 19), and urged States to do more to prevent corporations from abusing human rights abroad (A/HRC/14/27).

67. Although work remains to be done to clarify the content of extraterritorial human rights obligations pertaining to the environment, the lack of complete clarity should not obscure a basic point: States have an obligation of international cooperation with respect to human rights, which is contained not only in treaties such as the International Covenant on Economic, Social and Cultural Rights (art. 2, para. 1), but also in the Charter of the United Nations itself (arts. 55 and 56). This obligation is of particular relevance to global environmental threats to human rights, such as climate change (A/HRC/10/61, para. 99). As the Human Rights Council noted in its resolution 16/11, principle 7 of the Rio Declaration states that “States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth’s ecosystem.”

68. Indeed, much of international environmental law reflects efforts by States to cooperate in the face of transboundary and global challenges. Further work to clarify extraterritorial obligations in respect of environmental harm to human rights can receive guidance from international environmental instruments, many of which include specific provisions designed to identify and protect the rights of those affected by such harm.⁶⁶

⁶¹ http://www.etoconsortium.org/nc/en/library/maastricht-principles/?tx_drblob_pi1%5BdownloadUid%5D=23

⁶² Vienna Convention on the Law of Treaties, art. 26.

⁶³ Mark E. Villiger, Commentary on the 1969 Vienna Convention on the Law of Treaties (2009), p. 367.

⁶⁴ Case concerning the Gabcikovo-Nagymaros project (Hungary/Slovakia), 1997 International Court of Justice 7, para. 142.

⁶⁵ See Maastricht Principles, principle 20.

⁶⁶ See MEA report, sect. IV.A; and Aarhus report.

C. Obligations relating to members of groups in vulnerable situations

69. The human rights obligations relating to the environment include a general obligation of non-discrimination in their application. In particular, the right to equal protection under the law, which is protected by the Universal Declaration of Human Rights (art. 7) and many human rights agreements, includes equal protection under environmental law.⁶⁷ States have additional obligations with respect to groups particularly vulnerable to environmental harm. The following sections describe obligations specific to three groups in particular: women, children and indigenous peoples.⁶⁸

1. Women

70. In construing the Convention on the Elimination of All Forms of Discrimination against Women, the Committee on the Elimination of Discrimination against Women has emphasized that States should ensure that public participation in environmental decision-making, including with respect to climate policy, includes the concerns and participation of women.⁶⁹ Similarly, the Special Rapporteur on the right to health has stated that “even though women bear a disproportionate burden in the collection of water and disposal of family wastewater, they are often excluded from relevant decision-making processes. States should therefore take measures to ensure that women are not excluded from decision-making processes concerning water and sanitation management” (A/62/214, para. 84).

71. With respect to substantive obligations to develop and implement policies to protect human rights from environmental harm, the Committee has called on States to ensure that the policies are aimed at protecting the rights of women to health, to property and to development. Moreover, it has urged States to conduct research on the adverse effects of environmental contamination of women, and to provide sex-disaggregated data on the effects.⁷⁰ Where environmental harm has disproportionate effects on women, States are obliged to adopt and implement programmes accordingly. The Special Rapporteur on hazardous substances and wastes, for example, has stated that “due to the harmful effects of mercury on the female reproduction function, international human rights law requires States parties to put in place preventive measures and programmes to protect women of childbearing age from mercury exposure” (A/HRC/21/48, para. 33, citing the Convention, art. 11, para. 1 (f)).

72. Some groups of women are particularly vulnerable for various reasons, including because they are poor, older, disabled and/or of minority status, which may give rise to the need for additional protection. For example, in its general recommendation No. 27 (2010) on older women and protection of their human rights, the Committee found that they are particularly vulnerable to natural disasters and climate change (para. 25), and stated that therefore “States parties should ensure that climate change and disaster risk-reduction measures are gender-responsive and sensitive to the needs and vulnerabilities of older women. States parties should also facilitate the participation of older women in decision-making for climate change mitigation and adaptation” (para. 35).

⁶⁷ See Inter-American Commission on Human Rights, *Mossville Action Now v. United States*, No. 43/10, 17 March 2010 (construing article II of the American Declaration).

⁶⁸ This should not be taken as an exhaustive list of groups in vulnerable situations; on the contrary, other such groups could include minorities, those in extreme poverty and displaced persons. However, these groups have been the subject of the most detailed attention from the sources reviewed.

⁶⁹ CEDAW report, sect. III.A.1.

⁷⁰ CEDAW report, sect. III.A.2 and III.B.

2. Children

73. The Convention on the Rights of the Child provides that in all actions concerning children, including those taken by administrative authorities and legislative bodies, “the best interests of the child shall be a primary consideration” (art. 3, para. 1). In its general comment No. 14 (2013), the Committee on the Rights of the Child has made it clear that this provision applies to actions, such as environmental regulation, that affect children as well as other population groups, and it has stated that where decisions “will have a major impact” on children, “a greater level of protection and detailed procedures to consider their best interests is appropriate” (paras. 19, 20).

74. More specifically, article 24.2(c) of the Convention provides that States Parties shall pursue full implementation of the right of the child to the enjoyment of the highest attainable standard of health and, in particular, shall take appropriate measures “to combat disease and malnutrition... through the provision of adequate nutritious foods and clean drinking water, taking into consideration the dangers and risks of environmental pollution.” In its general comment No. 15 (2013), the Committee stated that under article 24.2(c), “States should take measures to address the dangers and risks that local environmental pollution poses to children’s health,” should “regulate and monitor the environmental impact of business activities that may compromise children’s right to health, food security and access to safe drinking water and to sanitation,” and should “put children’s health concerns at the centre of their climate change adaptation and mitigation strategies” (paras. 49, 50). The Committee has emphasized elsewhere as well the importance of regulation of business in order to protect children’s rights, including from the effects of environmental harm (e.g. general comment No. 16 (2013), para. 31).

75. In its general comment No. 9 (2006) on the rights of children with disabilities, the Committee stated that “countries should establish and implement policies to prevent dumping of hazardous materials and other means of polluting the environment. Furthermore, strict guidelines and safeguards should also be established to prevent radiation accidents” (para. 54). The Committee has also urged States to collect and submit information on the possible effects of environmental pollution on children’s health, and to address particular environmental problems, in its concluding observations on country reports.⁷¹ Finally, the Convention states that the States Parties agree that the education of the child shall be directed, inter alia, to “the development of respect for the natural environment” (art. 29, para. 1(e)).

3. Indigenous peoples

76. Because of their close relationship with the environment, indigenous peoples are particularly vulnerable to impairment of their rights through environmental harm. As the Special Rapporteur on the rights of indigenous peoples has stated, “the implementation of natural resource extraction and other development projects on or near indigenous territories has become one of the foremost concerns of indigenous peoples worldwide, and possibly also the most pervasive source of the challenges to the full exercise of their rights” (A/HRC/18/35, para. 57).

77. International Labour Organization convention 169 and the United Nations Declaration on the Rights of Indigenous Peoples are designed to protect the rights of indigenous peoples, but human rights bodies have also interpreted other human rights agreements to protect those rights. The interpretations have reached generally congruent

⁷¹ The Committee has also based such recommendations on other rights under the Convention on the Rights of the Child, including the rights to an adequate standard of living (art. 27) and to rest, leisure and play (art. 31). See CRC report, sect. III.

conclusions about the obligations of States to protect against environmental harm to the rights of indigenous peoples. In his reports, the Special Rapporteur on the rights of indigenous peoples has described in detail the duties of States to protect those rights.⁷² This section therefore only outlines certain main points.⁷³

78. Firstly, States have a duty to recognize the rights of indigenous peoples with respect to the territory that they have traditionally occupied, including the natural resources on which they rely. Secondly, States are obliged to facilitate the participation of indigenous peoples in decisions that concern them. The Special Rapporteur has stated that the general rule is that “extractive activities should not take place within the territories of indigenous peoples without their free, prior and informed consent,” subject only to narrowly defined exceptions (A/HRC/24/41, para. 27). Thirdly, before development activities on indigenous lands are allowed to proceed, States must provide for an assessment of the activities’ environmental impacts. Fourthly, States must guarantee that the indigenous community affected receives a reasonable benefit from any such development. Finally, States must provide access to remedies, including compensation, for harm caused by the activities.

V. Conclusions and recommendations

79. Human rights law includes obligations relating to the environment. Those obligations include procedural obligations of States to assess environmental impacts on human rights and to make environmental information public, to facilitate participation in environmental decision-making, and to provide access to remedies. The obligation to facilitate public participation includes obligations to safeguard the rights of freedom of expression and association against threats, harassment and violence.

80. The human rights obligations relating to the environment also include substantive obligations to adopt legal and institutional frameworks that protect against environmental harm that interferes with the enjoyment of human rights, including harm caused by private actors. The obligation to protect human rights from environmental harm does not require States to prohibit all activities that may cause any environmental degradation; States have discretion to strike a balance between environmental protection and other legitimate societal interests. But the balance cannot be unreasonable, or result in unjustified, foreseeable infringements of human rights. In assessing whether a balance is reasonable, national and international health standards may be particularly relevant. In addition, there is a strong presumption against retrogressive measures.

81. In addition to a general requirement of non-discrimination in the application of environmental laws, States may have additional obligations to members of groups particularly vulnerable to environmental harm. Such obligations have been developed in some detail with respect to women, children and indigenous peoples, but work remains to be done to clarify the obligations pertaining to other groups.

82. Other issues deserve greater attention as well. Although it is clear that States have an obligation of international cooperation, which is of obvious relevance to global environmental problems such as climate change, clarification of the content of extraterritorial human rights obligations pertaining to the environment is still needed.

⁷² See Report on indigenous peoples.

⁷³ In addition to the reports of the Special Rapporteur, this summary draws on the ICESCR report, sect. III.C; ICCPR report, sect. III.A; ICERD report, sect. III.B; and Inter-American report, sect. III.C.

83. In other areas, the obligations are clear but there are failures to meet them. In particular, the Independent Expert is troubled by the many reports of failures to protect environmental human rights defenders. He intends to examine good practices in this area in the hope of identifying exemplary models of effective protection.

84. Human rights obligations relating to the environment are continuing to be developed in many forums, and the Independent Expert urges States to support their further development and clarification. But the obligations are already clear enough to provide guidance to States and all those interested in promoting and protecting human rights and environmental protection. His main recommendation, therefore, is that States and others take these human rights obligations into account in the development and implementation of their environmental policies.
