



Environmental Health Association of Nova Scotia

Health Impacts of Fracking:

Submission to Review of Hydraulic Fracturing for Shale Gas in Nova Scotia

June 5, 2011

I am writing on behalf of the Environmental Health Association of Nova Scotia (EHANS). EHANS is a province wide organization that focuses on environmental impacts on human health and promoting actions and policies to prevent environmentally related illnesses. For 25 years, EHANS has focused on four fundamental necessities for health -- clean air, clean food, clean water and less toxic products. Fracking threatens two of these essentials – clean air and clean water.

EHANS believes fracking and shale gas development present risks to health that are serious, widespread and long lasting. We believe that fracking, however it is conducted, poses serious risks to public health and the environment, and that these risks at this time outweigh any possible benefit. Clean air and clean water are our most basic resources. There are no alternative sources of clean air or clean water.

The government's proposed review of fracking does not even mention health impacts. This is a major omission. There are serious, immediate and long-term health risks from fracking and shale gas development. Some of these risks include:

- Smog measured at higher levels than in major urban centers in fracking areas, and benzene and other carcinogenic chemicals measured at levels far beyond safe levels in air in fracking areas.
- Use of volatile carcinogenic compounds in fracking fluids which can impact health through air pollution as well as pollution of drinking water.
- Volatile organic compounds and other toxic chemicals released from condensate tanks and wastewater holding ponds.
- Volatile organic compounds and other toxic chemicals released in the drilling, mining, flare-off, transfer and transport stages of shale gas drilling

- and fracking.
- Pollutants which are known to cause respiratory damage, and evidence of above normal respiratory problems in areas where fracking has taken place
 - Risk of ingestion of contaminated water **before it reaches levels where problems are evident.** Known carcinogens and endocrine disrupters are among the chemicals used in fracking, and they may be present in drinking water and other household water before they become noticeable by taste or smell. Although it is believed that methane in drinking water is not a health risk, this has never been studied.
 - Exposure to contaminants in wastewater in holding ponds, including fracking fluid chemicals as well as heavy metals, radioactive materials and other materials which are released by fracking the shale layer, and return to the surface in the frack water.
 - Contaminated water released into the environment after “treatment,” with levels of toxins accumulating with each release.
 - Radioactive material is often freed from the shale via fracking. There is already evidence of some potential routes of exposure including via wastewater holding ponds, via release into waterways after wastewater goes through “treatment” facilities. It is also possible that radioactive material may seep into wells undetected, or into homes and other buildings as radon. In Nova Scotia, where uranium is present in many areas of the province, the risk must be considered.
 - Now that it has been proven that methane leaks from the shale layer into wells,¹ it is logical to assume that fracking chemicals and other toxins released by fracking will also migrate and eventually enter aquifers, even if this does not take place for a number of years. Until there is evidence that gas companies can stop all leaks of methane into wells, we must assume that wells are also at risk of contamination from fracking fluids.
 - Sour gas release is a health risk to workers and communities.²
 - Fracking fluid spills, whether from ponds or trucks, create risks from both soluble chemicals which can contaminate soil and water, and volatile chemicals.
 - Risk of chemical sensitization from multiple toxic chemical exposures.

Any evaluation of health risks from fracking must consider that:

- Safe levels of exposure are normally determined by levels determined safe for healthy adult males exposed 8 hours a day, while citizens who will be exposed to fracking and shale gas pollutants will be exposed 24 hours a day, 7 days a week, and will include vulnerable populations such as

¹ Jackson et al, *Research and Policy Recommendations for Hydraulic Fracturing and Shale-Gas Extraction*, 2011, Center on Global Change, Duke University, Durham, NC.

² Ben Parfitt, Vancouver Sun, March 9, 2011

- children, pregnant women, and other vulnerable groups.
- Many of the chemicals in use have not been tested for safety in humans, especially for long-term effects such as endocrine disruption.
 - In most places where fracking has been conducted, the chemical composition of fracking fluids has remained secret, which means there has been little ability to study connections between fracking and health impacts in surrounding communities.
 - Exposure to a cocktail of chemicals in areas where shale gas development and fracking is taking place is involuntary and unavoidable – outdoor air naturally penetrates inside houses, so exposure to VOCs in interior air will be unavoidable. There is no warning given when activities which may release high levels of chemicals are to take place.
 - Some health impacts may be immediately evident, others may not occur for years or decades or until the next generation.
 - Now that methane has been proven to seep from the shale layer into wells up to a mile away from drill site ³, it is reasonable to assume that fracking chemicals may do so also, although because they are not gases this may take years before it is seen. How can monitoring for this risk conceivably be done – there would need to be monthly tests for hundreds or thousands of homes for many decades.
 - There is risk of exposure in drinking water before water problems are detectable. Low level exposures can have significant impacts, especially with endocrine disrupting chemicals, and especially with vulnerable populations and at particular windows of development where effects have greater impact.

Air pollution and related health impacts

The proposed review ignores the issue of air pollution, a known problem with shale gas development and one of the major ways in which health can be compromised. It would be less than honest to argue that air pollution is not related to fracking, when air pollution is associated with many stages of the operation, including volatile chemical emissions from condensate tanks and holding ponds, trucks transporting waste water, and smog resulting from increased ozone levels.

Evidence is mounting which documents serious risks of health impacts from fracking and from the process of shale gas development. Some of these health impacts are already evident in areas where fracking is taking place, while others may not be evident for decades or until the next generation, including cancers, and multiple effects of endocrine disruption including reproductive effects.

³ Jackson et al

One of the results of industrialization of rural areas from fracking and shale gas development has is air pollution, which has been documented in some rural areas as higher than levels in major urban centers, and above established safe levels.

After residents of Dish, Texas began reporting a range of symptoms including nosebleeds, headaches, and dizziness, the company “investigated” and reported that everything was normal, that there were no emissions detectable to the human nose. The town spent 15% of its budget to hire Wolf Eagle Environmental, an independent laboratory, to conduct air quality tests. Test results found **high levels of 15 chemicals, including benzene, xylene, naphthalene and carbon disulfide** at five of seven test sites. In some cases the levels were **10 times the recommended level** for short-term exposure, and some levels were high enough to be an **immediate danger**, according to the study.⁴

“Laboratory results confirmed the presence of multiple Recognized and Suspected Human Carcinogens in fugitive air emissions present on several locations tested in the Town of DISH.

The compounds identified are commonly known to emanate from industrial processes directly related to the natural gas industrial processes of exploration, drilling, flaring and compression. The laboratory results confirmed levels in excess of TCEQ's Short Term and Long Term ESLs. In addition, several locations confirmed exceedences in a chemical identified by TCEQ with the capability for 'disaster potential'. (See Section - Laboratory Results)

The Town of DISH has virtually no heavy industry other than the compression stations. There is no other facility with the capability to produce the volume of air toxins present within miles of the Town. Fugitive emission sources of hazardous air pollutants emanating from the oil and gas sector include emissions from pumps, compressors, engine exhaust and oil/condensate tanks, pressure relief devices, sampling connections systems, well drilling (hydraulic fracturing), engines, well completions, gas processing and transmissions as well a mobile vehicle transportation emissions. Along with hazardous air pollutants (HAPs) and known carcinogenic compounds, air toxic compounds that contribute to smog formation were identified and are a known emission of gas industrial exploration, compression, processing and distribution.

Many chemicals identified in laboratory results at several locations

⁴ <http://txsharon.blogspot.com/2009/09/star-telegram-reports-on-dish-texas-air.html>

tested were found to exceed TCEQ's ESL's. These chemicals include Benzene, Dimethyl disulfide, Methyl ethyl disulphide, Ethyl-methylethyl disulfide, Trimethyl benzene, Diethyl benzene, Methyl-methylethyl benzene, Tetramethyl benzene, Naphthalene, 1,2,4-Trimethyl benzene, m&p Xylenes, Carbonyl sulfide, Carbon disulfide, Methyl pyridine, and Diemethyl pyridine.”⁵

Later testing by the Texas Committee on Environmental Quality confirmed these results.

On March 9, 2011, the Associated Press (AP) reported that in rural Wyoming, home to shale gas development, “residents are complaining of watery eyes, shortness of breath and bloody noses.” The cause: ozone levels higher than the worst days in Los Angeles all last year. AP reported that the region’s ozone levels the previous week had reached 124 parts per billion, two-thirds higher than the EPA’s maximum healthy limit of 75ppb.

These levels were reached in spite of the fact that gas industry officials reported that they had been trying to curb smog, and claimed that there were fewer emissions contributing to smog than in 2008, according to AP. This means the smog problem, with related health impacts, had been recognized, and continuing, for at least 4 years.⁶

Air pollution from fracking operations is not only localized. Smog pollution from drilling can travel up to 200 miles from the gas production area, causing widespread damage to human and environmental health.⁷

We are not only all downstream, but downwind, from the health risks of natural gas drilling. Major portions of the province would likely suffer deteriorated air quality from shale gas development.

Water contamination and health

Water is clearly a critical issue – and the scope outline includes water issues. But the omission of any mention of health risks does not encourage confidence in this review. In the US, critical information about the chemical composition of fracking fluids has remained secret. *Natural Gas Operations from a Public Health Perspective*⁸, written by Dr. Theo Colborn, an international expert on endocrine

⁵ *Town of Dish, Texas, Air Monitoring Analysis, Final Report*, p. 6, Wolf Eagle Environmental, http://townofdish.com/objects/DISH_-_final_report_revised.pdf

⁶ <http://content.usatoday.com/communities/greenhouse/post/2011/03/wyomings-smog-exceeds-los-angeles-due-to-gas-drilling>

⁷ http://www.endocrinedisruption.com/files/NaturalGasManuscriptPDF09_13_10.pdf , quoted in Desmogblog, *Fracking the Future*

⁸ *Natural Gas Operations from a Public Health Perspective*, Colborn et al, accepted for

disruption, studies the risks of chemicals used in drilling and fracking and their potential health impacts. Colborn reports that forty three per cent of products used in natural gas operations disclosed less than 1% of their ingredients. (Appendix A) Of the ingredients disclosed, 126 volatile chemicals and 206 soluble chemicals identified have multiple health impacts, including impacts on respiratory, brain and nervous system, immune, and kidney function, as well as endocrine disruption, cancers and mutagenic effects. (Appendix B.) Colborn also documents the possible health effects of 40 chemicals in six New Mexico drilling evaporation pits. (Appendix C)

Endocrine disrupting chemicals can have serious impacts even in minute quantities. “These chemicals at low concentrations can be dangerous. Believe me, it is the part per billion and the part per trillion of chemicals that can undermine your health and especially if they get into the drinking water of a woman who is pregnant or in the drinking water of our children,” states Colborn, in an interview with BBC Newsnight.⁹

This information is likely just the tip of the iceberg, as evidenced by the number of chemicals in fracking fluids which remained unidentified at the time Colborn’s paper was written.

There is also risk of water contamination from spills from holding ponds and trucks, which risk increases with extreme weather conditions, from contaminants contained in post-treatment water, and from other sources, given that the fracking process involves the purposeful contamination of millions of gallons of water.

Regulation cannot provide sufficient protection. Too much is still unknown. EHANS believes that the review outlined by the Departments of Natural Resources and Environment is completely insufficient. We do not see this as a review of fracking, but rather a limited review of regulations. The scope of this review implies that the government has already decided that fracking is an acceptable practice, despite the fact that evidence points to huge information gaps and huge risks.

The “unconventional gas” industry has been extremely effective in gaining exemptions from regulation, most notably from sections of the Clean Air Act and Clean Water Act in the US. Why would the industry lobby so hard for years to gain exemptions to these basic protections, unless they were aware that their practices had a good chance of contaminating air and water beyond acceptable

publication in International Journal of Human and Ecological Risk Assessment, September 4, 2010. Expected publication: September-October 2011.

<http://www.endocrinedisruption.com/files/Oct2011HERA10-48forweb3-3-11.pdf>

⁹ BBC Newsnight, December 2, 2010,

http://www.bbc.co.uk/blogs/newsnight/susanwatts/2010/12/how_is_fracking_stacking.html

levels?

In a situation where so much is at stake, too much is still unknown. “Best industry practices” cannot be assumed to be safe industry practices. No independent studies have shown the full risks and potential impacts of many of the practices used in fracking. There may be industry practices which appear less risky than others, but for many practices, **no research evidence shows whether even the best practices are good enough to prevent serious and irreversible harm.**

Take the example of what to do with toxic, radioactive wastewater. According to Jackson et al in *Research and Policy Recommendations for Hydraulic Fracturing and Shale-Gas Extraction*, 2011, **“there is, to our knowledge, no comprehensive evaluation of the long-term impacts of wastewater disposal.”**¹⁰

“Hydraulic fracturing produces saline and toxic waste waters (including some with potentially high naturally occurring radioactivity) that flow out of the gas wells. Currently, wastewaters originating from hydraulic fracturing and gas production are disposed of by

- (1) transport to wastewater and/or brine treatment centers, where they are treated and released to local surface water;
- (2) injection into deep geological formations that are presumably disconnected from the overlying shallow drinking water aquifers;
- (3) recycled using a variety of treatment technologies and re-injected as fracturing fluid; and
- (4) spread on local roads for dust suppression”¹¹

Whichever of these four methods industry claims to be “industry best practice,” the long-term impact has never been evaluated for safety. **That is a BIG information gap, where millions of gallons of contaminated, radioactive water are concerned.**

This is only one example of the serious lack of information about practices which may contaminate water, an invaluable resource, and compromise health and the environment for many generations.

Many of the effects of fracking and related processes cannot be effectively regulated. Accepted methods of regulation are, in many cases, inappropriate to the situation. How can the cumulative impact of multiple fractures be regulated? What about the cumulative impact of water use, water contamination, air pollution from hundreds of wells and their associated condensate tanks, holding tanks,

¹⁰ Jackson et al

¹¹ Jackson et al

truck traffic and other operations on a small geographic area. Regulating operations one by one will not provide sufficient protection. For example, Triangle's production lease application of 2009, approved by the province, foresees drilling up to 100 wells in the first two years, with an additional 80 wells per year for 7 years – over 650 wells, plus associated pipelines, separators, storage tanks, processing plants, compressors and truck traffic.¹² Each of those wells could be fracked up to 17 times. The cumulative impact in a small province like Nova Scotia would be significant, as it has been even in larger areas such as Texas, Wyoming and other states.

Regulations are only as effective as their enforcement

Even if regulations could be effective in reducing harm, they will only be as effective as their enforcement.

On December 3, 2010, BBC's Newsnight interviewed Pennsylvania Department of Environmental Protection (DEP) Secretary, John Hagnar.

BBC: John Hagnar is locked in a bitter legal battle with Cabot. He says he has strong scientific evidence that links the escaped gas to their wells.

Hagnar: The results ruled out that this was biogenic gas, or pre-existing gas, and in fact the gas was tied specifically to wells that Cabot had, so we have sophisticated testing, it's the equivalent to fingerprinting gas, and we've got Cabot's fingerprints all over the gas.

BBC: He showed us consent agreements signed by Cabot setting out problems with the cement casings in some of their wells, and accepting responsibility for methane pollution of private water. Now the company says they signed only under duress.

Hagnar: It is an amazing claim by Cabot, and it underlines one more time what kind of company we are dealing with, that they would make this amazing claim. ... They have an armada of attorneys which frankly they have let loose on the state like a plague of locusts...¹³

To be protective, enforcement of regulations also has to be timely. In Wyoming, identified problems with smog have not been corrected for years, as mentioned above. Sharon Wilson of the Texas Oil and Gas Accountability Project presented information to EPA hearings that, "In 2003, atmospheric researchers from the

¹² Development Plan Application for Oil & Natural Gas Development Project, Windsor Block, Exploration Agreement 99-09-15-02, June 2008, <http://www.gov.ns.ca/energy/resources/RA/onshore/Elmworth-Development-Application-Main-Document.pdf>

¹³ <http://news.bbc.co.uk/2/hi/programmes/newsnight/9255520.stm>, starting at 5.21 minutes

University of California were surprised to find extraordinarily high hydrocarbon levels in North Texas at concentrations higher than what they expected for the entire country.”¹⁴ Six years later, Wilson reports, “A 2009 study by SMU found that emissions from Barnett Shale natural gas extraction were as much as vehicular emissions in the entire Dallas-Fort Worth region.”¹⁵

Much larger and more powerful jurisdictions than Nova Scotia, including the US EPA, have had little success reining in the deep-pocketed oil and gas companies, backed by a powerful industry lobby. How can we imagine that Nova Scotia will do better?

Recently, EHANS was part of a coalition on another environmental health issue. The coalition was told by a representative of the Department of Environment that a particular clause could not be included in regulations because the province did not have the capacity to enforce it. Enforcing this regulation would have been child’s play, compared to enforcing regulations relating to protection of water, air, and soil from complex fracking related operations.

Given all these factors, we do not believe that regulation and enforcement can provide reliable protection from the risks posed by fracking.

Not just another mineral extraction

Shale gas development and fracking cannot be treated as just another type of mineral extraction, to be regulated and remediated like a coal mine. The risks are much higher, more widespread, and more subtle. Contaminating water supplies is not remediable. Once rural areas have been industrialized, they cannot be restored.

Site restoration is one of the topics listed in the scope document. Implying that site restoration will be an acceptable way of dealing with problems is not logical. How can there be restoration once toxins have escaped into the environment, to go who knows where, carried underground in waterways, or into air. At the N-14-A well, near Noel Lake in the Kennetcook area, 85% of drilling fluids were never recovered from a frack. Apparently, they disappeared underground, and no one knows why or where. How can that site be restored, except on the surface? This seems to happen more often than one might expect in fracking operations, because what is underground is often unpredictable, according to rock fracture expert Dr. Tony Ingraffea.

Take a precautionary approach

¹⁴ <http://www.youtube.com/watch?v=RCbNNUSE4jk> , Appendix D

¹⁵ <http://www.youtube.com/watch?v=RCbNNUSE4jk> , Appendix D

Independent research is revealing that in spite of the spread of fracking across the US, there has been little or no study of the impacts of fracking and shale gas development in the short term and even less information about long term, cumulative risks.

Fracking is an issue where an ounce of prevention is worth a ton of cure. The precautionary principle is enshrined in the Nova Scotia Environment Act for a good reason. It must be the foundation for how the government evaluates any development of onshore gas, especially involving fracking.

Nova Scotia needs to take a precautionary approach. There is too much at stake to proceed at this time. We believe that there is sufficient evidence now to ban fracking outright. At a minimum, the only other responsible step would be to place an immediate moratorium on fracking for a minimum of 5 years, with a commitment that the moratorium would not be lifted unless there is sufficient independent research to prove it is safe.

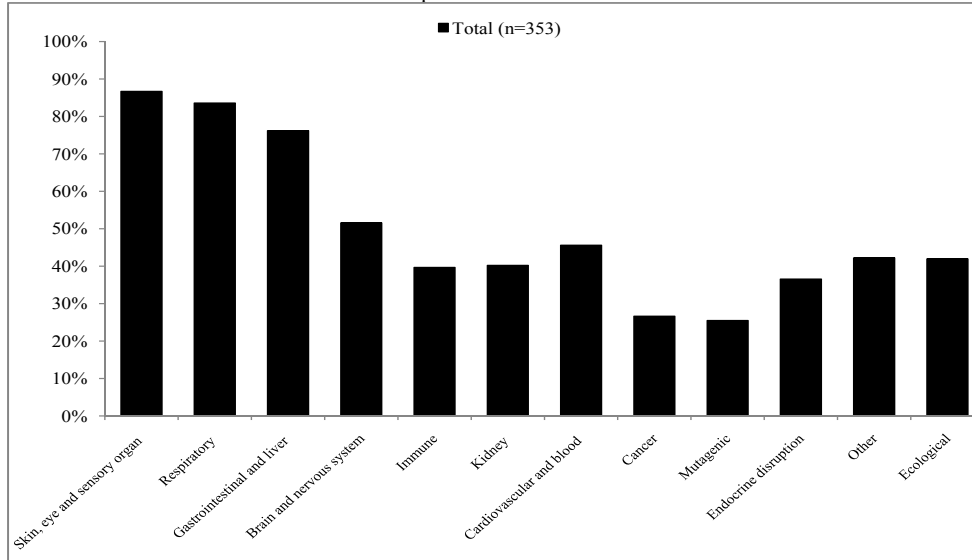
EHANS appreciates the opportunity to make this submission. We hope that the review team heeds public opinion, and looks at fracking with the clear sightedness required to protect our water, our health, and our environment.

Sincerely,

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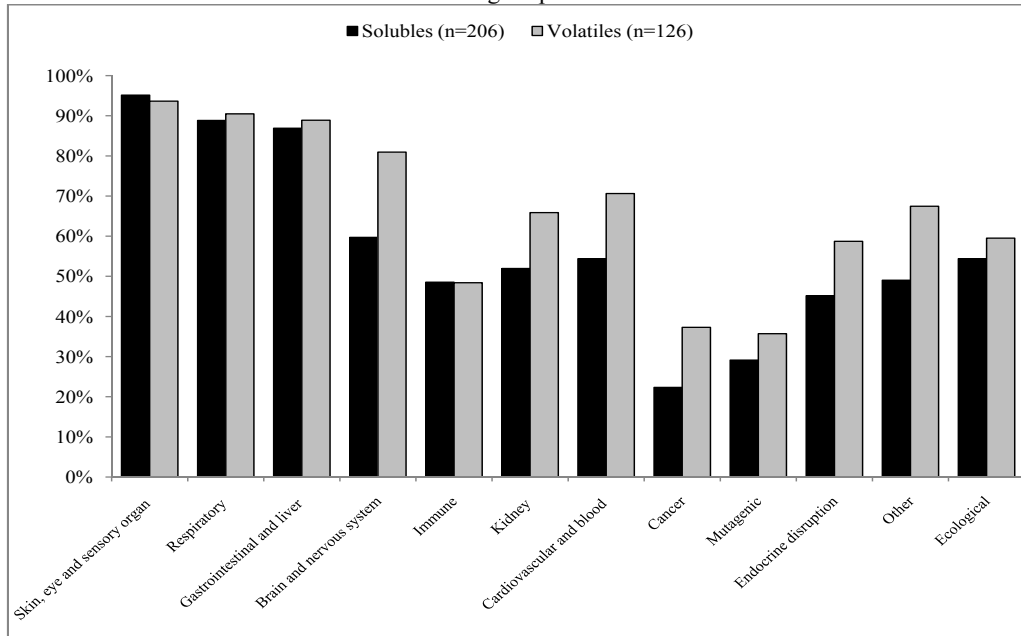
Appendix A
Natural Gas Operations from a Public Health Perspective
Theo Colborn, Carol Kwiatkowski, Kim Schultz, and Mary Bachran
TEDX, The Endocrine Disruption Exchange, Paonia, CO, USA

Figure 2. Profile of possible health effects of chemicals with CAS numbers used in natural gas operations



Appendix B
Natural Gas Operations from a Public Health Perspective
Theo Colborn, Carol Kwiatkowski, Kim Schultz, and Mary Bachran
TEDX, The Endocrine Disruption Exchange, Paonia, CO, USA

Figure 3. Profile of possible health effects of soluble and volatile chemicals with CAS numbers used in natural gas operations.



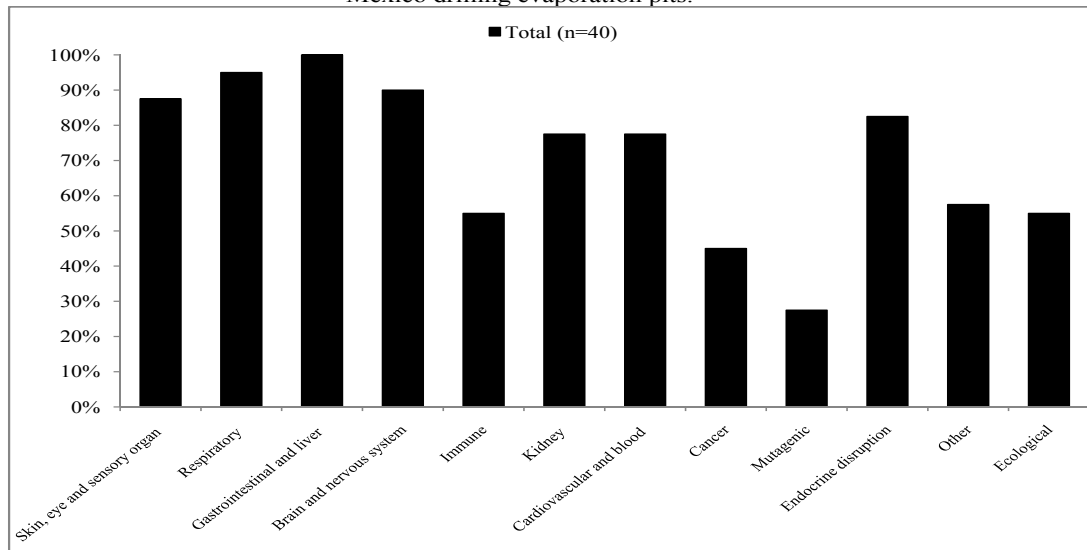
Appendix C

Natural Gas Operations from a Public Health Perspective

Theo Colborn, Carol Kwiatkowski, Kim Schultz, and Mary Bachran

TEDX, The Endocrine Disruption Exchange, Paonia, CO, USA

Figure 5. Profile of possible health effects of chemicals with CAS numbers found in six New Mexico drilling evaporation pits.



Appendix D: Transcript of YouTube video, Sharon Wilson testimony to EPA Public Hearing, March 2010

Hello. My name is Sharon Wilson. This afternoon, I'm making a joint statement on behalf of the Texas Oil and Gas Accountability project and Fort Worth Citizens Against Neighborhood Drilling Operations. Texas Oil and Gas Accountability Project has put forth Drill-Right Texas, the best oil and gas development practices for Texas. Texas OGAP considers the new ozone standard one of several essential tools needed in a regional plan to clean our air. Tougher standards will prevent natural gas extraction from continuing to foul our air and harm our health. A 2009 study by SMU found that emissions from Barnett Shale natural gas extraction were as much as vehicular emissions in the entire Dallas-Fort Worth region. This study was based on textbook examples but the reality could be a much worse picture. Researchers at Rice University followed the SMU study to see whether Barnett Shale gas production could be affecting our air quality. Using both condensate production data and ambient air data from Denton County, those researchers found a strong correlation between natural gas production and what was showing up in the air. This really isn't news. In 2003, atmospheric researchers from the University of California were surprised to find extraordinarily high hydrocarbon levels in North Texas at concentrations higher than what they expected for the entire country. We know that fugitive emissions occur at every stage of production from flow lines and gathering lines, from vents and condensate tanks, dehydrators and compressors, metering stations and valves. A single compression facility can emit six times the volatile organic compounds as a cement plant. Natural gas is methane and methane is the most powerful greenhouse gas—at least 20 times more potent than carbon dioxide. And methane is a surrogate gas that carries a host of bad guy carcinogens and neurotoxins with it. From cradle to grave, the extraction process is filthy and brings with it its own intense source of on-road and off-road diesel and NOx emissions. In Texas, the permit by rule process is abused allowing all these emissions to go unchecked. 11 compression stations and 4 metering stations operate side-by-side in Dish, Texas, each considered a separate source. Residents suffer a host of ailments including irritated skin, eyes, nose throat and lungs, headaches, dizziness, nausea, vomiting, skin rashes, weakness and irregular heartbeats. A whopping 61% of those health effects were directly attributed to the emissions. And throughout the Shale, children suffer stunning asthma rates -- 25% of 8 and 9 year-olds have asthma -- compared to 7 percent of children statewide. TCEQ knows our air is bad! When asked about the Texas Commission on Environmental Quality's testing in the Barnett Shale, Shannon Ethridge, TCEQ Toxicologist said they had seen some of

the highest benzene concentrations we have monitored in the state. She compared the DFW area emissions to those found in the highly industrialized Houston Ship Channel area. Michael Honeycutt, chief of TCEQ's toxicology division, told Channel 8 News that air samplings around some gas wells revealed high levels of cancerous toxins. "That would be equivalent to opening a can of gasoline and holding it up under your nose." He added that a year or more of exposure to benzene can lead to health problems including anemia, immune disorders and leukemia. We are way past that one year mark. The technology is there to reduce the emissions and industry can afford to implement it but they won't unless it's mandated. We are depending on you to protect public health by mandating and enforcing vigorous new regional ozone standards. Thank you.

<http://www.youtube.com/watch?v=RCbNNUSE4jk>