TEDX
The Endocrine Disruption Exchange
P.O. Box 1407, Paonia, CO 81428
970-527-4082
www.endocrinedisruption.org
tedx@tds.net

CHEMICALS USED IN OIL AND NATURAL GAS OPERATIONS:

WYOMING

April 2009

INTRODUCTION

The following summaries are based on the possible health effects of the products and chemicals used in operations to produce oil and natural gas in Wyoming. They provide a profile of the possible health hazards for those living and working in regions where oil and natural gas activity is taking place. The names of the products and chemicals and their known or suspected health effects were entered in an EXCEL spreadsheet for easy sorting and searching. The health effects associated with the chemicals were listed under one or more of the 14 categories used in government toxicological literature.

TEDX compiled a list containing the names of 246 products containing 187 chemicals as of March 2009. Information about the products and the chemicals they contain came from a variety of sources including Material Data Safety Sheets (MSDSs), State Emergency Planning and Community Right-to-Know Act (EPCRA) Tier II reports, Environmental Impact Statement and Environmental Assessment Statement disclosures, Terracon Remediation reports and accident reports, etc. The quantity and quality of information varied among these data sources. TEDX makes no claim that the list of products and chemicals in this analysis is complete.

PRODUCT SUMMARY

Material Safety Data Sheets (MSDSs)

MSDSs are designed to inform those who handle, ship, and use the products about their physical and chemical characteristics, and their direct and/or immediate health effects, in order to prevent injury while working with the products. The sheets are also designed to inform emergency response crews in case of accidents or spills. The total reported composition of a product on an MSDS can be less than 0.1% up to 100%. MSDSs are not submitted to the Occupational Safety and Health Administration (OSHA) for review. The product manufacturers determine what is revealed on their MSDSs.

The health information on MSDSs most often warns of possible harm to the skin and eyes, gastrointestinal and respiratory tracts, followed by the nervous system and brain. Many MSDSs do not address the outcome of long term, intermittent or chronic exposures, or adverse health effects that may not be expressed until years after the exposure.

TEDX has obtained full or partial MSDSs for 140 of the 246 products known to be in use in Wyoming. Five of the MSDSs list either “no hazardous ingredients” or “proprietary” as the composition of the product.

Twenty-two MSDSs list at least one ingredient, but no CAS numbers[1], and 11 of these MSDSs provide no percent of composition. Of the 113 MSDSs that list at least one ingredient with a CAS number, 37 provide information on less than 50% of the total composition. Eleven MSDSs disclose over 95% of the product ingredients and all the CAS numbers.

State Tier II Reports

Tier II reports must be filed by storage facilities under EPCRA. The Act sets a minimum amount above which a product containing a hazardous substance has to be reported in a storage facility. Reporting requirements vary from state to state, and the amount of information included on the form also varies from county to county and company to company.

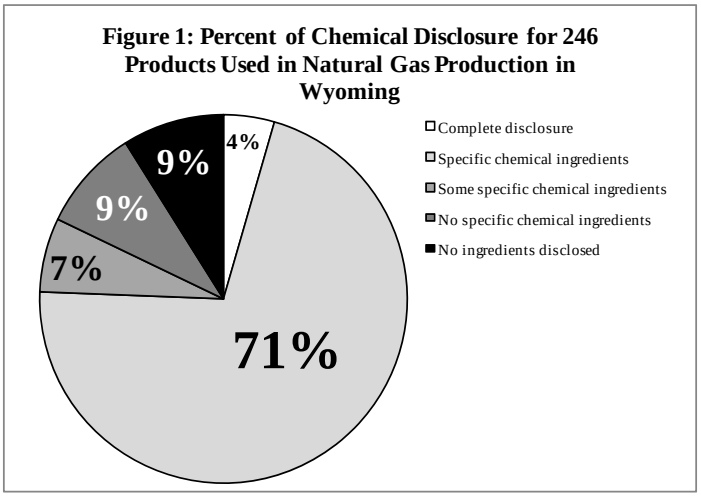
Information for 101 of the 246 products on the TEDX spreadsheet came from state Tier II report data. The descriptors on the forms received by TEDX ranged from a functional category name (e.g. weight materials, surfactant, etc.) with no product name, to the name of the product with specific chemical ingredients and CAS numbers. The percent of the total composition of the products is rarely included on these forms. Seventeen of the products listed on Tier II forms did not provide any ingredients, 83 listed one chemical with a CAS number and one listed two ingredients with a single CAS number.

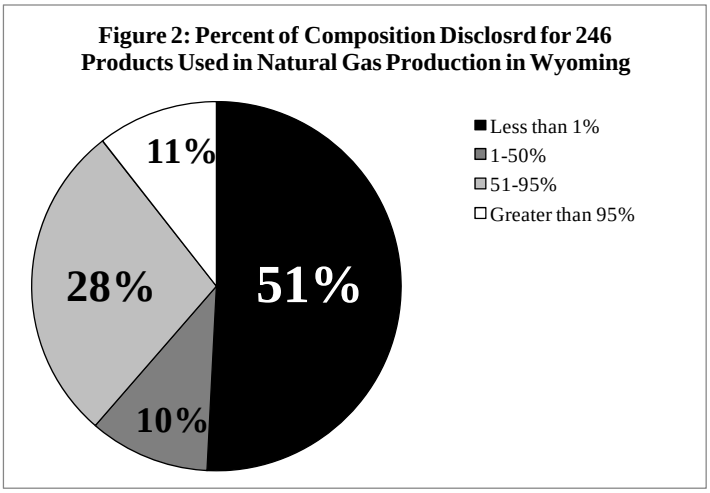
Other Sources of Information

The remaining 5 products on the TEDX list came from three Terracon Reports (Terracon Monitoring Report, April 2007, Terracon Remedial Investigation Work Plan – Amended Draft, dated July 2007, and Terracon Remedial Investigation Work Plan – Final Draft, September 2007) investigating a well blowout at the Crosby 25-3 well northwest of Clark, Park County, Wyoming. All of the products included one chemical with a CAS number. The source of information on only one product in this category provided complete information on the specific chemical makeup for 100% of the composition.

Evaluation of the information available about the 246 products

One hundred seventy-five (71%) products list specific chemical ingredients (Figure 1). Sixteen (7%) of the products (16) contain a combination of chemicals with and without CAS numbers, and 22 (9%) contain chemicals with only general or non-specific names. No information for 22 (9%) of the products was provided. The remaining 11 (4%) of the products disclose all of the ingredients.





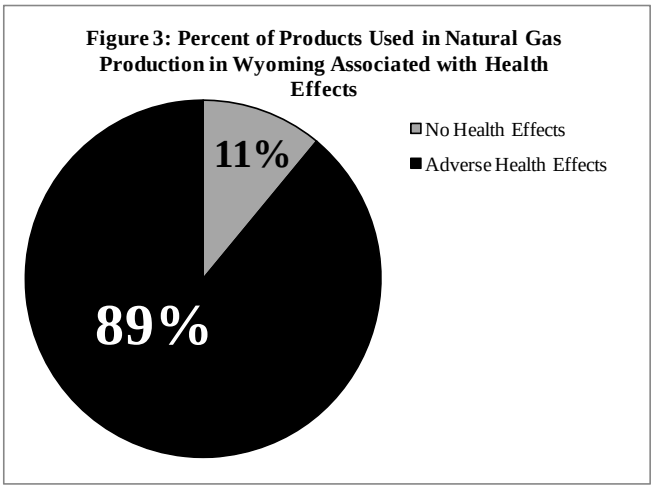
[1] CAS =Chemical Abstracts Service, provided by the American Chemical Society. This unique number is used to identify a specific substance. A single substance can have many different names, but only one CAS number. A substance may be a single chemical, an isomer of a chemical, a mixture of isomers, polymer, biological sequences, or a mixture of related chemicals.

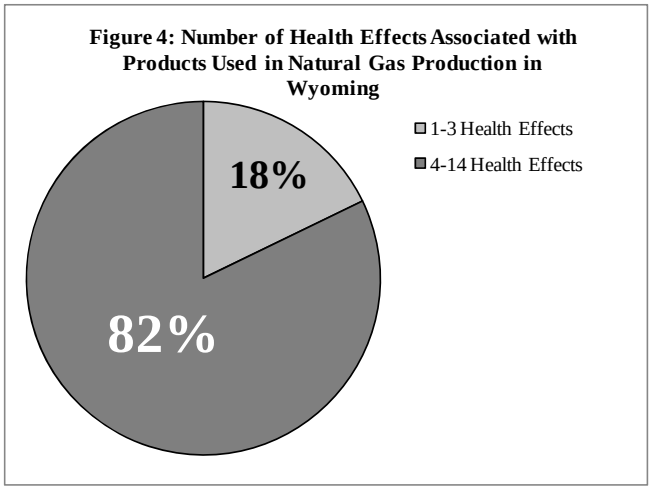
Less than 1% of the total composition is known for 125 (51%) of the 246 products in our spreadsheet (Figure 2). Less than 50% of the composition is known for 26 (10%) of the products, and between 51% and 95% of the composition is known for 69 (28%) of the products. Twenty-six (11%) of the products had information about more than 95% of their full composition.

Evaluation of the health effects associated with the 246 products

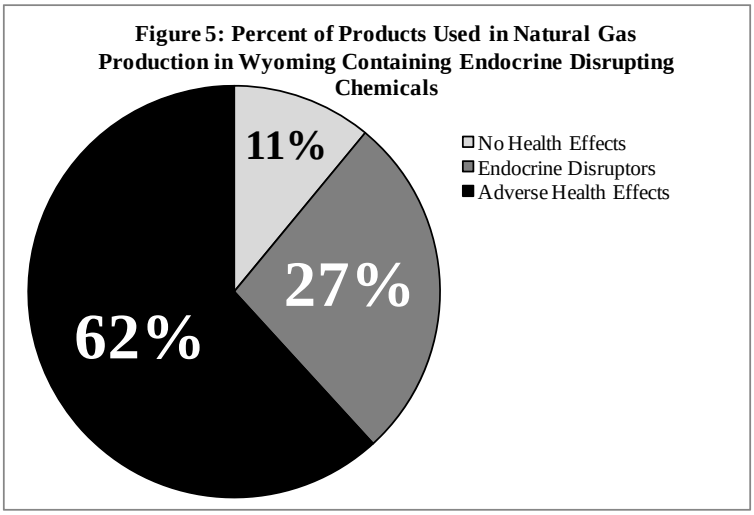
The health effects of the products with an MSDS that did not list specific ingredients (22 products) were determined by the information contained in the Hazards Identification (Section 6), Toxicological Information (Section 11) and Ecological Information (Section 12) portions of the MSDS. Because of the limitations inherent in some of the data sources, the health effects of the products and chemicals in the following summary will not be comprehensive.

For 11% of the products, no health effects were reported, while 89% reported at least one adverse health effect (Figure 3).





Of those 219 products that were associated with adverse health effects, 18% had one to three health effects, and 82% had between four and 14 health effects (Figure 4). Twenty-seven percent of the products contained one or more chemicals considered to be endocrine disruptors (Figure 5), chemicals that interfere with development and function.



CHEMICAL SUMMARY

Evaluation of the information available about the 187 chemicals

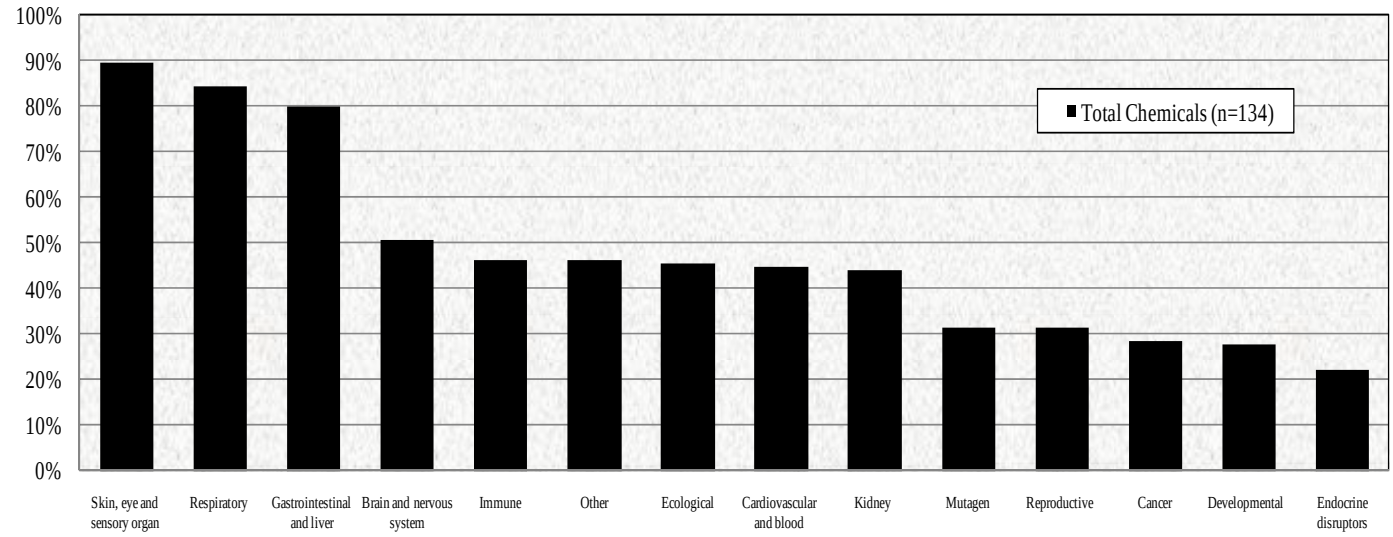
Products may contain more than one chemical, and a given chemical may occur in more than one product. In the 246 products identified above, there were a total of 187 chemicals. Specific chemical names and CAS numbers could not be determined for 53 (28%) of the 187 chemicals on TEDX's list. The names provided for the chemicals were too general (e.g. surfactant, polymer, etc.), or they were listed as "confidential," "proprietary," "mixtures," "unspecified," "various," or as containing no hazardous ingredients.

It was impossible to link 32 of the chemicals without CAS numbers to any health category aside from the health data reported on an MSDS. The limitations of MSDS data for possible health effects are noted above. Some health data was provided for one chemical, but for the remaining 20, no information could be found.

Summary of the health effects associated with the 134 chemicals with CAS numbers

Figure 6 shows the percentages of the 134 chemicals with CAS numbers associated with the general health categories used in government reports. Chemicals are often included in more than one category.

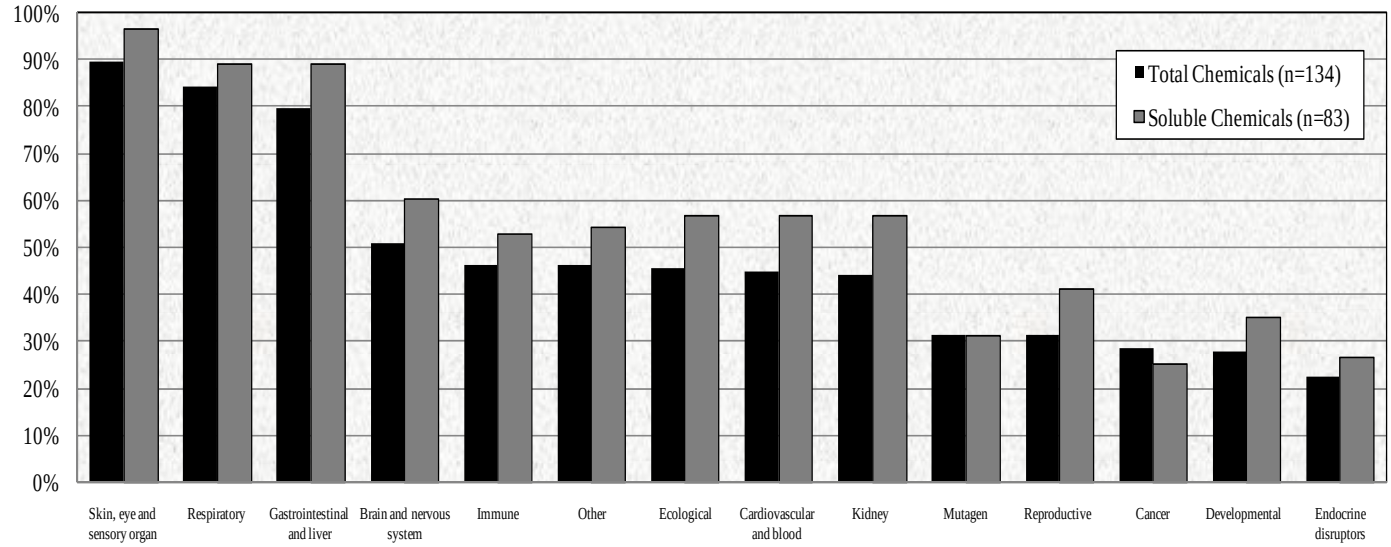
Figure 6: Profile of Health Effects of Chemicals with CAS Numbers Used in Natural Gas Production in Wyoming



When all of the chemicals with CAS numbers are combined, 90% are associated with skin, eye or sensory organ effects. Eighty-four percent can cause respiratory effects and 80%, gastrointestinal/liver effects. The brain and nervous system can be harmed by 50% of the chemicals, and over 40% can have ecological effects (harm to aquatic species, birds, amphibians or invertebrates), harm the immune system, cardiovascular system and blood, and/or the kidney. Forty-six percent of the chemicals have health effects in the 'Other' category. The 'Other' category includes such effects as changes in weight or effects on teeth or bones, for example, but the most often cited effect in this category is the ability of the chemical to cause death.

The health effects on the left side of the figure are those effects that are more likely to appear immediately or soon after exposure. These effects include symptoms such as burning eyes, rashes, coughs, nausea, vomiting and diarrhea. The health effects on the right side of the figure are long term and would tend to appear months or years later, such as some cancers, the results of organ damage, harm to the reproductive system, or developmental effects as the result of prenatal exposure, all of which were associated with over 25% of the chemicals in this analysis.

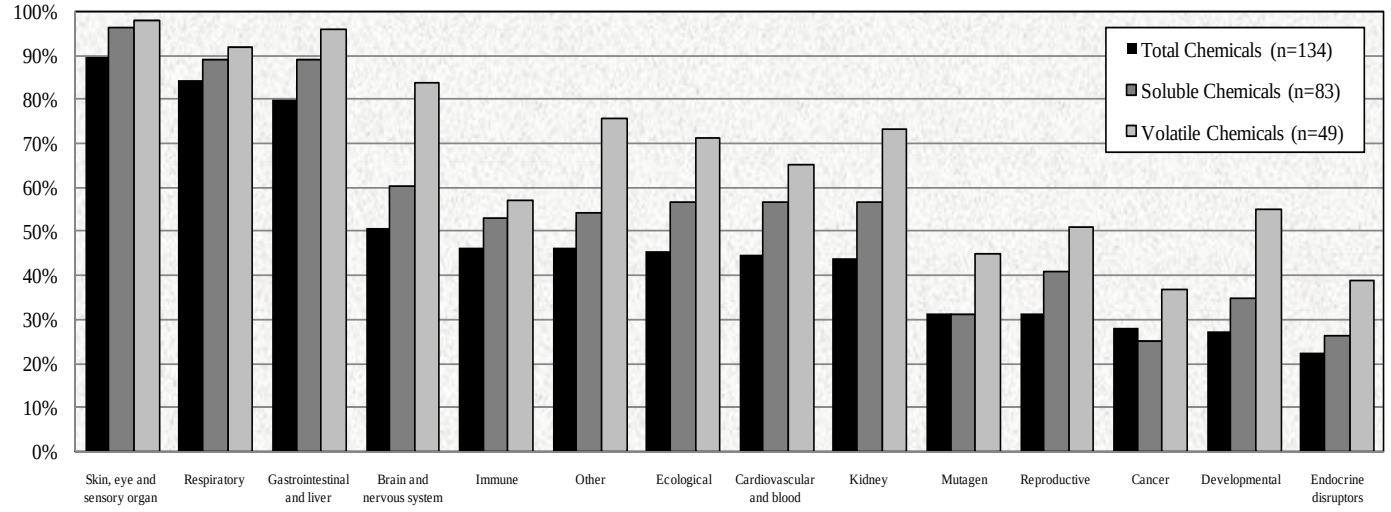
Figure 7: Profile of Health Effects of Soluble Chemicals with CAS Numbers Used in Natural Gas Production in Wyoming



Eighty-three (62%) of the chemicals with CAS numbers are water soluble. When examined alone (Figure 7), they produce a similar profile of health effects as all the chemicals combined, but with higher percentages in every category except Cancer. Notably, 98% of these chemicals can harm the skin, eyes or sensory organs.

Approximately 36% of the chemicals with CAS numbers are volatile (Figure 8); in other words, they can become airborne. Over 95% of these chemicals can harm the eyes, skin, sensory organs, and gastrointestinal tract or liver. Ninety-two percent are associated with respiratory effects. Compared with the soluble chemicals, far more of these chemicals (84%) can cause harm to the brain and nervous system. Seventy-three percent of the chemicals can harm the kidneys, and 65% can harm the cardiovascular system and blood. Overall, the volatile chemicals produce a different profile with higher percentages than the water soluble chemicals. Because they can readily become airborne and can be inhaled as well as swallowed, and can reach the skin, the potential for exposure to these chemicals is greater

Figure 8: Profile of Health Effects of Soluble & Volatile Chemicals with CAS Numbers Used in Natural Gas Production in Wyoming



COMMENTS

The health effects summary for the chemicals used in Wyoming is not a weighted analysis. Each chemical is included only once in the summary whether it is in only one product or in many. Some of the most prevalent chemicals are among those associated with the most health categories. Two of these are crystalline silica and 2-butoxyethanol.

Crystalline silica is reported in 26 products on this list, ranging from less than 1% to 100% of the total composition of the product. Silica poses hazard as a respirable dust that lodges permanently in the lungs, and can cause silicosis, emphysema, obstructive airway diseases, and lymph node fibrosis. It poses a long-term, delayed health hazard similar to asbestos that can turn rapidly into a malignant lung cancer. Silica is reported in both drilling and fracturing products and could become airborne as fines or dust, along with other toxic compounds, when deposited in pits or used to create berms around the pad.

The foamer and solvent, 2 butoxyethanol (2-BE), is reported in four products on the list, ranging from five to 30% of the total composition of each product. 2-BE is soluble (miscible) in water, colorless, tasteless and odorless at low concentrations, and evaporates at room temperature. It has a number of unusual health impacts that could baffle physicians and veterinarians, and also causes several kinds of cancers. If it were to penetrate a drinking water source, exposure could be through ingestion, inhalation, and the skin.

Six products on the Wyoming list are biocides. These products are extremely toxic, with good reason. Bacterial activity in well casings, pipes and joints can be highly corrosive, costly and dangerous. Bacteria can also alter the chemical structure of polymers and make them useless. Nonetheless, when these products return to the surface, either through deliberate retrieval processes or accidentally, they pose a significant danger to workers and those living near the pad and evaporation ponds. Biocides can also sterilize the soil and inhibit normal bacterial and plant growth for many years.

FOR FURTHER CONSIDERATION

Prior to use, these products must be shipped and stored before being transported to the well site. They pose a hazard on highways, roads and rail systems, as well as to communities near the storage facilities.

Fracturing, frac'ing, and stimulation are terms used to describe a process commonly used to facilitate the release of the gas and to improve production. In this process up to a million gallons or more of fluid under extremely high pressure are injected underground to open up fractures in the strata being mined. The gas industry claims that 70% of the material it injects underground is retrieved, but have provided no actual studies to confirm their estimate. At some locations, because of regional differences in geology and technology, 100% of the injected fracturing fluids may remain underground.

In addition to fracturing fluids, underground water, produced water that comes off the gas, drilling muds and cuttings of rock and debris from the well bore may be deposited into pits on the well pad. Evaporation allows toxic, volatile chemicals to be released into the air, and it concentrates the non-volatile chemicals in the pits. Technology is available to re-inject the recovered fluids on site, pipe it to a central re-injection well, or to use a closed loop system where the liquids are reused and not allowed to evaporate on site.

After development ceases on a pad and the wells go into production, the residues in the pits are often bulldozed over. It is impossible to predict how long the buried chemicals will remain in place. Highly persistent and mobile chemicals could migrate from these pits into underground water resources, or gradually surface over time. When the fluids evaporate from open pits, their condensed residuals are taken off-site and re-injected in the ground, or "land farmed" where they are incorporated into the soil through disking. Here, toxic metals and silica fines could continually build up in the disked soils and be mobilized on dust particles.

For the life of a gas well in most regions, water is stripped from the gas before it enters the delivery pipeline by an evaporation unit. These evaporation units are connected to condensate water tanks near the well heads where this contaminated water is stored. In some instances the condensate water is re-injected on site or piped to a central re-injection well. In other instances, water levels are monitored in the condensate tanks and the water trucked to large open-pit, waste facilities where the water and volatile chemicals escape into the air. This activity will continue until the well stops producing gas, which could be as long as 20 to 25 years.

Cumulative exposure impacts are not addressed in this analysis; however, the accompanying EXCEL spreadsheet provides a hint of the combinations and permutations of mixtures possible and the possible aggregate exposure. Each drilling and fracturing event is custom-designed depending on the geology, depth, and resources available. The chemicals and products used, and the amounts or volumes used, can differ from well to well. In addition, the fluids or vehicles that make up the balance of the full composition of a product frequently are not provided, and nowhere are there data accounting for the fluids that make up the million gallons of fluid used. Complete records for each well must be kept for a realistic picture of what is being introduced into watersheds, air, and soil. This information should include the exact location of the well (state, county, township, section, latitude, longitude, etc.), the complete formulation of every product used at each stage of development and production, the weight and or volume of each product used, the composition of the fluids comprising the total volume injected underground, the depths at which material/mixtures were injected, the amount and composition of the recovered liquids, and their disposal method and location. The hazard posed by natural gas operations to our health and the environment requires full disclosure of this information.