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OGAP is a program of EARTHWORKS (www.earthworksaction.org)

June 14, 2006

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Brian Macke
Director
Oil and Gas Conservation Commission
Colorado Department of Natural Resources
1120 Lincoln Street, Suite 801
Denver, CO 80203

Re: Disclosure of chemicals used in all phases of oil and gas development

Dear Directors Baughman, Perkins, Gunderson and Macke:

I am writing on behalf of the San Juan Citizens Alliance, the Western Colorado Congress, Grand Valley Citizens Alliance, Western Slope Environmental Resource Council and the Oil & Gas Accountability Project

(OGAP) to make two requests. First, the groups request that your agencies require the disclosure of the complete make-up and volumes of the chemicals in products used in all phases of oil and gas development. Second, where potentially toxic chemicals are used during oil and gas exploration and development operations, the groups believe that monitoring for the levels and effects of these chemicals should be required by your agencies.

Reasons for requiring disclosure and monitoring

The groups believe such complete disclosure and monitoring requirements are necessary for a number of reasons.

1. Toxic chemicals with known health effects are being used.

Many of the products used in the exploration, drilling and production phases of Colorado's natural gas and oil industry are made up of toxic chemicals with known human health effects. Without regulators requiring oil and gas companies to disclose the complete make-up and volumes of chemicals in the products they use, a realistic evaluation of their immediate and long-term effects on health and the environment cannot be made. Nor can acutely impacted individuals living in the oil- or gas-patch readily or realistically assess their exposures.

A recent analysis of products and ingredients used in natural gas development in western Colorado by TEDX, Inc., shows that there are toxic chemicals used throughout the development process. Fifty four percent of the 192 chemicals on the list cause respiratory problems, 53% are toxic to skin and sense organs, 48% cause gastrointestinal and liver damage, and 43% are neurotoxic. More than 26% of the chemicals are reproductive, kidney, or cardiovascular/blood toxicants, and 22% are carcinogens. I have included a summary of the TEDX analysis with this letter.

The TEDX analysis revealed, in particular, that air pollution during the early stages of natural gas development poses an immediate risk to human health that heretofore had been overlooked. Specific ingredients of particular concern in air and water include 2-BE, 2MBT, 2-(2-methoxyethoxy)ethanol and nonylphenols.

2-BE (2-butoxyethanol; ethylene glycol monobutyl ether) – linked to liver cancer, testicular degeneration, reproductive problems, and blood disorders that include destruction of red blood cells causing bloody urine;

2MBT (2-mercaptobenzothiazole) – linked to pituitary and adrenal cancer, fetotoxin, inhibits reproductive function, and associated with various tumors and mutations;

2-(2-methoxyethoxy) ethanol, diethylene glycol monomethyl ether – suspected carcinogen, known to cause fetal deformities and organ malformations, reduces male fertility;

Nonylphenols (ethoxylated nonylphenol) – estrogenic-like activity, interferes with male development and reproductive ability, impedes brain development, and causes atrophy of the thymus, a critical component of the immune system. The effects on invertebrates and fish in aquatic systems at extremely low concentrations of the nonylphenols has led to their ban in several European countries.

These four chemicals are capable of migration because they don't bind to organic material. They also can persist underground, i.e., they don't break down or they break down into a toxic compound(s). This, in combination with their mobility, means that these chemicals can travel great distances, over short and long periods of time before reappearing.

2. No disclosure of these chemicals is currently being required.

Despite the widespread use of toxic chemicals, emergency preparedness staff, state environmental staff, medical professionals, health departments, and people living in close proximity to oil and gas facilities do not have a complete picture of what chemicals are being transported through, stored, and used in their communities or on their private property. Currently, it is difficult, if not impossible, to obtain specific information about a product's chemical ingredients, and the proportions or combinations of these chemicals present. It is difficult, as well, to find out what volumes of chemicals are being used during various oil and gas drilling, completion and production operations. Without such information, not only are communities and citizens kept in the dark about potential health impacts, but also the regulatory agencies cannot know what chemicals to sample for, in the event of a spill or release.

The OGCC's 300 and 900 series rules largely do not require disclosure prior to a spill or release. The only OGCC forms that provide a space for such disclosure are 5A (Completed Interval Report: "Formation Treatment" line) and 15 (Earthen Pit Report/Permit). Based upon OGAP's review of many of these forms, as a matter of practice, operators simply list "fracking gel" or some equivalent general term when filling in these forms. They almost

never list specific chemical ingredients of the fracturing fluids used, for example.

OGCC Forms 19 (Spill Release), 22 (Accident Report), 24 (Soil Analysis) and 27 (Site Investigation and Remediation Workplan) address post-spill or release situations. These forms are consistently uninformative, as they are mostly 'self-reported' by the operator and typically just list "frac fluid" or "drilling mud", which does not tell local officials or citizens anything about what specific chemicals were released to the environment during the spills. In addition, OGCC Forms 25 (Water Analysis Report) and 31 (Underground Injection Formation Permit Application) request limited categories of information regarding produced water and other injected fluids.

3. The chemicals are being released to the environment.

The members of the above groups are concerned about both the need for disclosure of the chemicals being used, and monitoring for their presence in the environment, because the chemicals can, and do, escape into the environment via a number of pathways. For example, spills release chemicals into the air through volatilization, and spills can enter the water and soil. Chemicals injected into the ground may come in contact with drinking water aquifers. Surfacing toxic elements (metals) and polyaromatic hydrocarbons (PAHS) loosened underground in recovery fluids can be released to the air and water. Chemicals in recovery fluids stored or placed in pits or tanks on the surface may escape (e.g., volatilize, leak, or leach) into the air, water or soil. Additionally, flammable chemicals may burn, releasing a host of toxic by-products into the air.

A review by OGAP of the OGCC database of spills shows 924 spills since June of 2002, more than 20% of which (182) have affected groundwater or surface water. In Weld County alone, nearly 50% of the 283 spills listed in the database have impacted groundwater or surface water. The database also provided four examples of the variety of ways in which primary oil and gas operations are releasing toxic chemicals into the environment:

- In October of 2005, drilling mud containing bentonite, three types of crystalline silica (cristobalite, tridymite and quartz) and lime surfaced 1/4 mile away from the drilling site and impacted Battlement Creek for at least three and a half miles.

- In October of 2005, between 168 and 210 gallons of hydraulic fracturing fluids sprayed off-site, with between 15 to 20 gallons entering a surface irrigation ditch. The fluids contained a host of potentially toxic substances, including ethoxylated nonylphenol (15-40%); trimethylbenzene (3-7 %), light aromatic naphtha (3-13%);

oxyalkylated phenolic resin (15-40%); ethylbenzene (0-2%); xylene (3-13 %); and isobutyl alcohol (10-30%).

•In October of 2005, fluids from an unlined reserve pit infiltrated into the shallow groundwater, flowed downhill 350 feet and impacted an adjoining landowner's water well. Water quality samples from this landowner's well revealed elevated concentrations of calcium, chloride and total dissolved solids compared to neighboring water wells, and concentrations of chlorides that exceeded Colorado water quality standards. During the cementing process for the gas well, calcium chloride and Halad 344 were added. Halad-344 is a Halliburton fluid loss additive containing both acrylonitrile and N,N-dimethylformamide. Acrylonitrile is a recognized carcinogen, and suspected toxicant with respect to numerous physiological systems (respiratory, liver, immune, blood, etc.). N,N-dimethylformamide is also a suspected toxicant for many physiological systems (respiratory, skin, eyes, liver, cardiovascular, and several others). It is not known whether any of the other cementing fluid additives were present in the water well; or whether COGCC asked that the water samples be analyzed for the constituents in Halad 344.

•Between September and December of 2005, the OGCC received 10 complaints from eight separate households related to odors and emissions emanating from wells being drilled and completed by one operator. Although OGCC never undertook air sampling, an air quality sample taken by Garfield County in close proximity to the wells showed that benzene and xylenes exceeded the U.S. Environmental Protection Agency's "non-cancer risk levels" for these compounds – at 67 µg/m3, benzene was present at more than double the risk level. Other detectable compounds included acetone, toluene and ethylbenzene.

A more detailed description of these four spills is attached.

<u>4. No single agency has comprehensive jurisdiction over disclosure and monitoring of the chemicals in products used in all phases of oil and gas development.</u>

Current practice in the field is that the OGCC nominally has oversight of the chemicals used in primary operations, based upon voluntary reporting by the operators. A review of the Colorado Oil and Gas Act indicates that C.R.S., § 34-60-106 (1)(b), (2)(b) and (d) and (10) could provide a basis for the OGCC to require <u>full</u> disclosure for chemicals used, or otherwise involved, in the exploration for, and production of, oil and gas. However, as

discussed above, OGCC rules do not explicitly require any disclosure of chemicals used. Nor does the OGCC require monitoring when toxic chemicals are used during oil and gas operations.

The OGCC does have rules regarding disposal of toxic fluids. Yet, in practice, the OGCC allows drilling fluids to be trucked to a disposal site, injected underground, to undergo "land treatment", to be burned, or to evaporate through exposure to the air, regardless of the chemicals present. The OGCC also does not require additional setback distances from residences when toxic chemicals are used during oil and gas operations. Without requiring the disclosure of information about what is in the drilling fluids, adequate monitoring or compliance with disposal regulations is impossible.

Even if the OGCC required comprehensive disclosure of all chemicals used, or otherwise involved in, primary oil and gas field operations, other agencies may have jurisdiction over such disclosure. The Hazardous Materials and Waste Management Division (HMWD), of the Department of Public Health and Environment, has produced a guidance document, Information Regarding the Management of Petroleum Contaminated Soils, which discusses in detail the other agencies that may have regulatory authority over oil and gas wastes, depending upon their source, type of contamination and location. As that document suggests, the exact lines between HMWD, the WQCC, and the OGCC jurisdiction remain complex and unclear.

We are aware of the 2000 Memorandum of Understanding (MOU) between the HMWD and the OGCC regarding the disposal of exploration and production wastes in commercial Class II injection wells. We are also aware of the 2000 Memorandum of Agreement between the WQCD and the OGCC regarding responses to spills/releases to surface water. However, neither of these interagency agreements addresses disclosure of chemicals used during oil and gas exploration and production or monitoring for these chemicals.

We also know from the case law under RCRA that citizens can, in certain circumstances, sue oil and gas well operators for releasing production wastes into the environment. These specific situations include allowing waste to contaminate groundwater or surface waters, burning waste, creating a fire or explosion hazard through release of combustible waste, leaving waste in a publicly accessible area, and damaging an endangered species or its critical habitat through exposure to waste. Furthermore, under the solid waste provisions of RCRA, we believe that the HMWD, and not OGCC, has jurisdiction over these types of releases to the environment.

In at least one other area of primary oil and gas field operations, the Air Quality Control Division has jurisdiction: well site condensate tanks and tank batteries. VOCs, benzene and n-Hexane are the pollutants of interest here. I have not found an MOU between the AQCD and the OGCC on this

matter, and the AQCD website makes no reference to OGCC authority in this area.

We are also familiar with the Emergency Planning and Community Right-to-Know Act (SARA Title III) reporting program, housed within the DPHE's Environmental Sustainability Program. However, the information on the volumes of chemicals "stored" that is available (the Tier II reports), based upon our requests to local repositories of the reports so far, is very general, covers mainly larger storage sites, and does not contain well specific information. The information also can be very difficult to access, as in one instance, OGAP has had to contact a city attorney's office to confirm our legal right to access the information.

Under federal OSHA regulations, Material Safety Data Sheets are required to be kept for each well site. However, MSDS's are not available to the public at large. State and local emergency preparedness staff can request this information, but it is not automatically submitted to these staff in every county in Colorado. Moreover, the sheets are not always up to date or complete. They often state that the mixture of chemicals is proprietary or they list less than 100% of the chemicals in the product. For some of the chemicals, studies often have not been done to determine either their short-term toxicity or their long term or delayed health effects. Therefore, the information regarding the chemicals used in oil and gas exploration and development that is contained in the MSDS's is seriously incomplete.

As a consequence of the above mix of jurisdictions, with both overlap and gaps, it is unclear which agency should appropriately address the questions of requiring (1) disclosure of the complete make-up and volumes of the chemicals in products used in oil and gas development; and (2) monitoring for levels of, and impacts from, these chemicals. From our perspective, issues of staffing levels, expertise with health impacts and cradle to grave coverage suggest that the DPHE would be the more appropriate location for such regulation. The OGCC may, under the Oil and Gas Act, assign its functions in this area to another agency through an interagency agreement. Such an assignment would allow for much more complete and efficient disclosure, which we view as essential to making disclosure and monitoring most beneficial to the citizens of Colorado.

Summary of requests

The above groups believe that protection of public health and safety requires full disclosure of the complete make-up and volumes of the chemicals in products used in oil and gas development, and the monitoring of their use. The groups believe their request is justified because chemicals with known human toxicity are being used by the oil and gas industry in Colorado. No disclosure of these chemicals is currently being required, either by agency rule or practice. These chemicals are frequently being

released to the environment, with unknown impacts on human health. Inadequate agency regulation of the industry has prevented cradle to grave disclosure of these chemicals and monitoring for their effects.

Therefore, on behalf of the above groups, I would like a written response as to how to best to move forward with these requests.

I look forward to hearing from you in the near future.

Sincerely,

Bruce Baizel
Staff Attorney

Attachments

Cc: Matt Sura, WCC
Gwen Lachelt, OGAP
Josh Joshwick, SJCA
Peggy Utesch, GVCA
Peggy Baxter, WSERC
Theo Colborn, TEDX
Howard Roitman, CDPHE

ATTACHMENT 1

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CHEMICALS USED IN NATURAL GAS DEVELOPMENT

Introduction, Analysis and Comments

April 25, 2006

Introduction

This project was designed to explore the health effects of the products and chemicals used in drilling, fracturing ("frac'ing"), and recovery of natural gas. It provides a glimpse at the pattern(s) of possible health hazards for those living in proximity to gas development. In the process of researching the literature, we discovered that drilling companies have access to hundreds of products, the components of which are in many cases unavailable for public scrutiny. This spreadsheet addresses only those chemicals and products for which there is evidence that they are or have been used in western Colorado, and for which there were data about their health effects. We make no claim that this list is complete.

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1. The four most common adverse health effects for the chemicals in the spreadsheet are neurotoxicity, skin/sense organ toxicity, respiratory problems, and gastrointestinal/liver damage.

2. Only a fraction of the chemicals used by the natural gas industry is covered in this spreadsheet. For example, in the course of our investigations, we discovered a list of 910 "frac'ing" products and chemicals compiled by the Canadian government.

3. Many of the citations used in the spreadsheet are old. In some of those cases we were able to get data only from an abstract. In other cases, we were able to get quotations about the health effect(s) from only toxic chemical databases, such as TOXNET, HAZMET, etc. For some of the older products and/or chemicals since the 60's or 70's we found no new studies.

4. Several reasons led to the lack of data about the health effects of some of the products and chemicals on the spread sheet:

   (a) We found no health effect data for a particular chemical or product.
   (b) Some product labels have no ingredients listed.
   (c) Some product labels provide only a general heading such as "plasticizer", "cross-linker" etc.
   (d) Some product labels state only "proprietary" or provide only the name of one or two ingredients plus "proprietary".

5. This spreadsheet provides no clues to the volumes of material injected underground during natural gas development. However, typical drilling and stimulation activities use up to 150,000 to 500,000 gallons of fluid at each frac'ing. What chemicals constitute these liquids, and at what concentrations, is unknown.

6. This spreadsheet provides only a hint of the combinations and permutations of mixtures possible and the possible aggregate exposure.

7. Materials Safety Data Sheets (MSDS) are designed to provide information to protect those who handle, ship, and use the product(s). The sheets are also designed to protect emergency response crews in case of accidents or spills. The data in the MSDSs do not take into consideration the health impacts resulting from chronic or long-term, continual, and/or intermittent exposure.

8. The MSDSs are often sketchy and provide health effects information for only one or two chemicals in a product. In the case of mixtures, the health effects warnings are often not chemical specific.

9. The following figures are based on the data in the Chemicals Used in Natural Gas Development Spreadsheet. They are presented to define a pattern of the possible toxicity of the chemicals and products that are being used. Of the 190 chemicals on the list:

* 51% can cause skin/sensory organ toxicity
* 49% can cause respiratory problems
* 38 % are neurotoxicants
* 44% are gastro-intestinal/ liver toxicants
* 28% are reproductive toxicants
* 26% are kidney toxicants
* 27% are cardio/vascular/blood toxicants
* 22% are carcinogens
* 19% are immune system toxicants
* 18% are developmental toxicants
* 8% are endocrine disruptors
* 7% cause mutations
* 8% are wildlife toxicants.

10. Of the 39 (21%) of the chemicals on the list that are soluble, or miscible:

* 72% are skin and sensory organ toxicants
* 64 % are gastro-intestinal/liver toxicants
* 67% are respiratory toxicants
* 44% are neurotoxicants
* 36% are cardiovascular toxicants
* 31% are kidney toxicants
* 28% are reproductive toxicants

* 28% are immune system toxicants
* 26% are developmental toxicants
* 13% cause cancer
* 10% are endocrine disruptors
* 10% are wildlife toxicants
* 5% cause mutations

Of the 73 (38%) of the chemicals on the list that can vaporize:

* 63% are neurotoxicants
* 63% are skin and sensory organ toxicants
* 56% are gastro-intestinal/liver toxicants
* 58% are respiratory toxicants
* 42% are reproductive toxicants
* 41% are cardiovascular/blood toxicants
* 38% are kidney toxicants
* 32% are developmental toxicants
* 26% are carcinogens
* 25% are immuno-toxicants
* 12% are endocrine disruptors
* 7% cause mutations
* 11% are wildlife toxicants

11. Of the chemicals on the list, 12% are contained in specifically designated biocide products.

Comments

Many of the chemicals on this list have been tested for lethality and acute toxicity. The majority have never been tested for low dose, long term effects that may not be expressed until long after exposure. Nor have adequate ecological studies been done. For example, most of the chemicals have not been tested for their effects on terrestrial wildlife or fish, birds, and invertebrates. It is reasonable to assume that the health endpoints listed above could very well be seen in wildlife, domestic animals, and pets.

The products labeled as biocides are among the most lethal in the spreadsheet, and with good reason. Bacterial activity in well casings, pipes and joints can be highly corrosive, costly, and dangerous. Nonetheless, when these products return to the surface through the retrieval process they pose a significant danger to workers and those living near the well and evaporation ponds.

The use of respirators, goggles and gloves is advised on many of the MSDSs for the products on this list. This indicates serious, acute toxicity problems that are not being addressed in the recovery process when the chemicals come back to the surface. It raises concern over possible hazards posed to those living in proximity to well pads as the chemicals evaporate or penetrate water and soil.

Industry claims that 70% of the material it injects underground is retrieved. While the fate of the remaining 30% is unknown, the recovered product is placed in holding pits on the surface and allowed to evaporate. This results in many highly toxic chemicals being released into the air, as well as being dispersed into local surface waters. The condensed residues remaining in the pits are taken off-site and re-injected in the ground posing concerns for aquifers.

After development ceases on the well pad and the well goes into production, the evaporation pits containing highly concentrated, lethal residues are bulldozed over. It is impossible to predict how long the buried chemicals will remain in place. Chemicals like MTBE that are highly persistent could migrate into underground water resources.

Prior to use, these products must be shipped to and stored somewhere in our counties before being transported to the well site. They pose a hazard on our highways, roads, and rail systems, as well as to people living and working near the storage facilities.

Recently, in our efforts to get lists of the chemicals or products used or stored for natural gas development, we were told that the information may no longer be available because it could aid and abet terrorists. The fact that these chemicals are considered so dangerous underlines how important it is to be aware of their presence in our watersheds. The necessity for full disclosure cannot be emphasized enough if we are to protect our watersheds and public health. Proper monitoring of air and water cannot be designed without knowing what to look for.

Some of the chemicals on the list, such as citric acid or polysaccharide, are frequently found in the environment or household products and generally do not cause harm. Polysaccharides are found in almost all plant material and are often defined as complex sugars of which there are vast numbers. However, they appear in this spreadsheet because they are an ingredient and are included on the MSDS sheet for the product with warnings attached, such as “may cause eye, skin and respiratory irritation…” However, there is no way to know whether the polysaccharide has been modified to become toxic.

Other chemicals, such as citric acid, can be toxic when encountered in high concentration, or, perhaps, during certain exposures (such as inhalation versus skin contact). Because only a small percentage of the total composition of most of the products in this spreadsheet is available, we cannot say for certain whether such chemicals are harmless in their application. Under the present system, there are not enough data to determine the safety of products that contain mixtures of relatively “benign” ingredients and unknown chemicals, when the actual percentage composition is not provided.

As we have added products to the spreadsheet the percentages of toxic effects occasionally shifted. Changes such as this will continue as more products and chemicals are entered into the database. Thus far, despite small increases or decreases in percentage, the top four health effects of concern have remained the same. They are neurological, skin and sensory organ, gastro-intestinal/liver, and respiratory system damage.

ATTACMENT 2

Summary of Recent Incidents Involving the Release of Chemicals

Prepared by: Lisa Sumi, Research Director, OGAP June 14, 2006

PRESCO DRILLING MUD DAYLIGHTS IN STREAM: In October of 2005, PRESCO, Inc. (PRESCO) was drilling a well on Battlement Mesa, in Garfield County. While drilling a borehole to set the surface casing for the BM 36-23 well, the drilling mud "daylighted." According to the company, the borehole apparently intersected a fracture, which conveyed the drilling mud to the ground surface.[1] The leak was first discovered coming out of a natural spring, on a hillside approximately 1/4 mile from the drilling rig.

According to a report sent by Cordilleran Compliance Services, Inc. to Robert Chesson of the COGCC, "the drilling mud leak eventually made its way to Battlement Creek causing a visible, 'milky-white' color change in the creek due to the turbidity. The effects of the mud leak were visible for at least 3 1⁄2 miles down stream."[2]

According to Cordilleran, the drilling mud consisted of "fresh water, bentonite gel, polymer, and lime."[3] The Material Safety Data Sheet (MSDS) for the drilling mud Quik-Gel, supplied to Cordilleran, showed that in addition to bentonite, the drilling mud contained three types of crystalline silica (cristobalite, tridymite and quartz). There was no mention of lime in the MSDS.[4]

The National Lime Association's Fact Sheet *Lime Safety Precautions* states that "care should be taken to avoid accidental mixing of quicklime and water (in any form, including chemicals containing water of hydration) to avoid creating excessive heat. Heat released by this reaction can ignite combustible materials or cause thermal damage to property or person."[5]

The COGCC issued a notice of alleged violation (NOAV) on November 21, 2005, for an "unpermitted discharge of any fluids into water of the State." On the NOAV, the COGCC required the company to describe all operational changes Presco will implement on future drilling operations to mitigate uncontrolled release of E&P fluids from drillsites, including contingency plans to manage a release without resulting in an uncontrolled discharge into surface water of the State.[6] The COGCC case regarding this spill was closed on the same date.[7]

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[1] Colorado Oil and Gas Information System (COGIS) Spill report. 10/14/2005. Filed by PRESCO Inc. for the Battlement Mesa 36-23 well; and COGIS Field Inspection Report, 10/14/2005, for Battlement Mesa #36-23 well.
[2] February 7, 2006. Letter from Cordilleran Compliance Services, Inc. (Cordilleran) to Robert Chesson, COGCC, Re: Notice of Alleged Violation for Uncontrolled and Uncontained Drilling Mud at the PRESCO, Inc. Battlement Mesa 36-23 Gas Well Site that Occurred on 14 October 2005 – Cordilleran Project #E04243. http://ogcc.viis.state.co.us/cgi-bin/search?id=0&classid=26&120=200078321.
[3] February 7, 2006. Letter from Cordilleran to Robert Chesson, COGCC. p. 2.
[4] Halliburton. Material Safety Data Sheet for Quick-Gel ®. Included in February 7, 2006. Letter from Cordilleran to Robert Chesson, COGCC.
[5] National Lime Association. http://www.lime.org/faqs.html Fact Sheet *Lime Safety Precautions* http://www.lime.org/FactSafety12403.pdf.
[6] COGIS- NOAV Report. 10/21/2005. Issued to Presco, Inc. for Battlement Mesa #36-23 well.
[7] COGIS- NOAV Report. 10/21/2005. Issued to Presco, Inc. for Battlement Mesa #36-23 well.

KERR McGEE FRACKING FLUID AFFECTS SOIL AND IRRIGATION DITCH: On October 4, 2005, a valve on a the wellhead of Cannon Land 7-35 well failed, resulting in the spraying of between 168-210 gallons of fluids returning to the surface from an hydraulic fracturing operation. The fluid sprayed into the air and drifted offsite, primarily onto pasture land, resulting in a visible coating that was as much as 1/2 inch thick.[8] The company estimated that 15-20 gallons of the fluid entered the Platteville Lateral irrigation ditch, which contained some standing water but was not flowing at the time that the fluids entered it.

The fracturing fluid contained Potassium Chloride (2%), as well as a surfactant (DWP-931, run at 1.5 gallons/1000 gallons of water), and friction reducer (DWP-601, run at 0.5 gallons/1000 gallons of water).[9] DWP-931 contains a host of potentially toxic substances, including ethoxylated nonylphenol (15-40%); trimethylbenzene (3-7 %), light aromatic naphtha (3-13%); oxyalkylated phenolic resin (15-40%); ethylbenzene (0-2%); xylene (3-13 %); and isobutyl alcohol (10-30%).[10] DWP-601 contains 1-5% ethoxylated nonylphenol.[11]

According to an Oct. 4, 2005 email from COGCC to the Water Quality Control Division of CDPHE, this spill/release "would be classified as non-significant."[12]

MARALEX DRILLING FLUIDS IN DRINKING WATER: On October 30, 2005, a landowner contacted COGCC regarding potential contamination of his water well by fluids in a nearby drilling reserve pit. The unlined reserve pit for the Keegan Patrick 33-7-11 #2A well, which was operated by Maralex Resources, Inc., was located about 350 feet uphill from the affected water well. Based on information collected by COGCC, "it appears that fluids from the unlined reserve pit infiltrated into the shallow groundwater, flowed downhill and impacted the . . . water well."[13]

Water quality samples from the landowner's well revealed elevated concentrations of calcium, chloride and total dissolved solids compared to neighboring water wells, and concentrations of chlorides that exceeded Colorado water quality standards.

No information on the composition of the drilling mud is available on the COGCC web site. According to Steve Lindblom of COGCC, the COGCC requested copies of the MSDSs for the various products used during the Maralex drilling process. COGCC received the MSDSs, but

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[8] Oct. 7, 2005. Letter from Paul Schneider, Kerr-McGee to Forrest Vaughn, Colorado Department of Public Health and Environment.
[9] *ibid*.
[10] Cal-frac Well Services Ltd. May 14, 2004. Material Safety Data Sheet for DWP-931 Fracturing fluid additive. Included in Oct. 7, 2005 letter from Kerr-McGee to CDPHE.
[11] Cal-frac Well Services Ltd. Sept 19, 2002. Material Safety Data Sheet for DWP-601 Oilfield additive. Included in Oct. 7, 2005 letter from Kerr-McGee to CDPHE.
[12] October 5, 2005. Email from Randall Ferguson, COGCC, to Jeffrey Coombe and BethAnne Williams. Electronic document in COGCC Remediation Project 3641.
[13] Notice of Alleged Violation Report. 10/30/2005. Issued by COGCC to Maralex Resources Inc. COGIS document number 200085988. http://oil-gas.state.co.us/cogis/NOAVReport.asp?doc_num=200085988.

Lindblom did not have the resources to send OGAP copies. They will eventually be posted to the COGCC web site.[14]

The COGCC web site does contain some general information on the well cementing program at the Keegan well. During the cementing process, calcium chloride[15] and other additives, like Halad 344, were added to the cement at different phases.[16] It is unclear whether the calcium chloride present in the water well originated from the drilling fluids or the cementing operation. It is also not known whether any of the other cementing fluid additives were present in the water well; or whether COGCC asked that the water samples be analyzed for the constituents in Halad 344.

Halad-344 is a Halliburton fluid loss additive. According to information contained in the patenting information for other Halliburton chemicals, Halad 344 is described as:

- a copolymer of **N,N-dimethylformamide** and **2-acrylamido-2-methylpropane sulfonic acid**.[17]
- grafted polymers prepared by the polymerization of monomers or salts of monomers of **N,N-dimethylacrylamide**, **2-acrylamido-2-methylpropanesulfonic acid** and **acrylonitrile** having a lignine or lignite or other backbone, and are commercially available from Halliburton Energy Services, Duncan, Okla.[18]
- a random copolymer of **2-acrylamide-2-propane sulfonic acid** and **N,N-dimethyl acrylamide**.[19]

Acrylonitrile is a recognized carcinogen, and suspected toxicant with respect to numerous physiological systems (respiratory, liver, immune, blood, etc.). N,N-dimethylformamide is also a suspected toxicant for many physiological systems (respiratory, skin, eyes, liver, cardiovascular, and several others).[20]

BARRETT CONDENSATE AND FLOWBACK PRODUCTS IN AIR:

Citizen Complaints

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[14] Pers. Communication between Steve Lindblom and Lisa Sumi. 06/05/2006.
[15] Sundry Notice, Form 4, submitted to COGCC by Maralex Resources Inc. Report of work completed on Keegan Patrick 33-7-11 #2A well, 07/27/2005. (Halliburton Job Summary attached to Sundry notice).
[16] Sundry Notice, Form 4, submitted to COGCC by Maralex Resources Inc. Report of work completed on Keegan Patrick 33-7-11 #2A 08/09/2005. Halliburton Job Summary attached. COGIS web site.
[17] US Patent and Trademark Office. August 28, 2003. United States Patent Application 20030159625. Reddy, B. Raghava et al. http://appft1.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PG01&p=1&u=%2Fnetahtml%2FPTO%2Fsrchnum.html&r=1&f=G&l=1&s1='20030159625'.PGNR.&OS=DN/20030159625&RS=DN/20030159625.
[18] US Patent and Trademark Office. April 14, 2005. United States Patent Application 20050080161 Tare, Uday A. et al. http://appft1.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=2&p=1&f=G&l=50&d=PG01&S1=halad-344&OS=halad-344&RS=halad-344.
[19] *ibid.*
[20] Scorecard. Acrylonitrile (CAS 107-13-1) and N,N-dimethylformamide (CAS 68-12-2). http://www.scorecard.org/chemical-profiles/.

Between September and December, 2005, the COGCC documented 10 complaints from eight separate households related to odors emanating from wells being drilled and completed by Bill Barrett Corporation ("Barrett").

9/16/2005: Elizabeth Vath, Gayle Hartop and Teran Hughes complained separately to the COGCC about smoke/haze/odors from a nearby well pad. The COGIS Complaint report for this incident stated that additional cementing work had to be done on a Barrett well, so pressure in the well was released. Typically, Barrett would sparge the accumulated gases through reserve pit fluid. In this case, however, because the pit was almost empty, the gases were vented directly to the atmosphere. There was no mention of any air quality monitoring occurring at the complainants' homes or at the well site.

9/22/2005: Oni Butterfly, a landowner living near Barrett's Louthan well, complained of fumes/odors that left her "gagging." The "stench" was so bad that she found it difficult to be at home, especially outside.[21]

10/18/2005: Dion and Debbie Enslow complained about odors from a Barrett wellpad upwind from their home. The pad had four wells that were undergoing completion/hydraulic fracturing. COGCC staff investigated and found flowback in one half of the unlined pit. The other side of the pit was "really dark and oily in appearance." The complaint report states that the "Enlow residence is down in a hollow, 1/4 miles or so from well-pad. Fumes and such can accumulate there. . . [Barrett is] trying to complete this loc[ation] ASAP."[22] According to Dion Enlow, he complained to the company that the smell was so bad that "I can't go outside and breathe." Enlow was not aware of either the company or any agencies actually sampling the air quality in response to his complaints.[23]

10/19/2005: Oni Butterfly filed another complaint about the odors from the Barrett wells. There had recently been a problem with a nearby well location, with tanks overflowing.[24] According to the COGCC Complaint report on this incident,[25] Garfield County environment staff would install monitoring equipment at her house to take a monthly air quality reading, and leave a Suma air sampler so that Ms. Butterfly could take an air sample when the odors were especially bad. This is the only example, in these COGCC complaints, of air samples being taken in response to odors from Barrett pits.

10/25:2006: COGCC was called by the Enslow family, who related that odors were so severe that they could not remain outside to cook on their grill. Debbie Enslow also said that she and her husband were "not prone to headaches but have been getting them due to pit odor/vapors," and that they were also "feeling rundown and listless." Jay Krabacher of COGCC and a Barrett representative went to the Enslow residence and according to Krabacher, "we all could smell intermittent (but persistent) odors." Krabacher investigated options for mitigating pit odors, and was told that "Schlumberger and BJ [Services] have 'industrial strength' powdered bleach

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[21] COGIS Complaint Report. Complaint date 9/22/2005. Document number 200081430.
[22] COGIS Complaint Report. Complalint date 10/18/2005. Document number 200082039.
[23] Pers. Communication between Dion Enslow and Lisa Sumi. 06/06/2006.
[24] COGIS Complaint Report. Complaint date 10/19/2005. Document number 200081429.
[25] *ibid.*

which, when added to the pit fluid, is pumped and circulated. . . works quickly." Krabacher visited the Wilson pad near the Enslows and stuck a finger in the pit; in the complaint report he notes that "there was a slight condensate odor – which could be detected on my finger hours later." [26]

11/1/2005: Sherry Tardiff contacted the COGCC regarding "nauseating odors from Anchondo pad." COGCC staff, Jay Krabacher, went to the location to "sniff around," and detected a "slight odor." He was told by a Barrett employee that Anchondo was a "real active well," and that during the day the gas was being vented under the pit surface to a tank. Krabacher also reports that that hot flowback water "becomes very steamy upon hitting surface, and there was some odor."[27]

11/1/2005: Dion Enslow reported "a large cloud of steam/vapor" extending for approximately 1/4 mile from the Wilson pad, which was undergoing a workover prior to hydraulic fracturing. The Enslows were "somewhat apprehensive" of the contents of the cloud. The crew foreman speculated that the steam cloud could be the result of hot (170 - 190º F) produced water hitting the cold air, which sounded "reasonable" to Krabacher and the Enslows. There was no investigation into what compounds might be volatilizing when the hot produced water hit the surface.

11/15/2005: The Enslows left a message for COGCC at 5:30 in the morning, stating that the "odor [is] worse than it's been." Enslow had gone up to the Wilson pad location and had observed "gnarly/oily" fluid in the pit. Barrett had just completed its final hydraulic fracturing flowback operation at that site. The well had been hydraulic fractured with "slickwater,"[28] which according to Jennifer Miskimins of the Colorado School of Mines, may contain chemicals such as "a friction reducer, surfactants, and clay stabilizers."[29] Jay Krabacher of COGCC noticed a "slight odor" at the Wilson well pad, and was assured by the company that the location would be completed and pit reclamation would begin soon thereafter. Enslow reports that the flow-tester working for Barrett assured him that if the Enslows had any problem he'd "take care of it."[30]

11/21/2005: Oni Butterfly contacted the COGCC several times to complain about odors from area wells. Ms. Butterfly asked about the "stuff" on the surface of the Louthan pit, and was given the "guar gum tutorial" by Jay Krabacker. She was told that the stuff on pit surfaces is "mostly environmentally benign," although sometimes "odiferous."

12/05 – 12/29/2005: Ms. Butterfly called the COGCC to complaint about "a different sort of stench, still very bad." The next day she called again, referring to it as a "benzene smell." She asked that the COGCC try to procure a full-time, outdoor air-monitoring device and an air pollution control device for the inside of her house. On the 29th of December, Ms. Butterfly

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[26] COGIS Complaint Report. Complaint date 10/25/2005. Document number 200082049.
[27] COGIS Complaint Report. Complaint date 11/1/2005. Document number 200081427.
[28] COGCC Form 5A. Complete interval report filed by Bill Barrett Corporation for the Wilson 33D-23-692 well. Processed 12/20/05. Document number 01526602.
[29] Petroleum Technology Transfer Council of the Rockies Newsletter. 2003. Vol.6;4. J. Miskimins. "Slickwater Fracs." http://www.mines.edu/Research/PTTC/newsletters/volume%206/v6n4p2.html.
[30] COGIS Complaint Report. Complaint date 11/15/2005. Document number 200082058.

called COGCC again, to report a strong odor experienced at 4:30 that morning. On December 30, Butterfly was informed by Garfield County that an air quality sample had been taken on Chipperfield Lane, which was fairly close to the Laughlin Pit, on October 25, 2005.[31] Results from the sampling showed that benzene and xylenes exceeded the U.S. Environmental Protection Agency's "non-cancer risk levels" for these compounds – at 67 µg/m3, benzene was present at more than double the risk level. Other detectable compounds included acetone, toluene and ethylbenzene.

Notices of Alleged Violation (NOAVs)

Between October 18 and December 28, 2005, Barrett was issued nine NOAVs. The violations included transporting condensate wastes offsite without a permit; burning wastes at a site not authorized as a waste disposal site; allowing fluids to fill pits above allowable levels; not reporting the spill of "frac flowback" fluid outside of a pit; and not removing condensate from the pit within 24 hours. Some well sites received a couple of NOAVs during this time period.

In one of the COGCC NOAV reports, it was documented that a Barrett employee said he was unaware that he was violating a COGCC rule by filling the pit too full.[32]

Burning the Condensate

One case, in particular, should be highlighted for its air quality issues. On or within a few days of December 24, 2005, condensate from a Barrett owned well was transported to the Werner 44A-23-692 well site and burned. According to COGCC rules, operators are not allowed to haul condensate from one pit to another for disposal purposes without a permit. Barrett had not obtained a permit to use the Werner site as a centralized location for waste disposal purposes. Barrett was issued a Notice of Alleged Violation for transporting the wastes to the Werner pit.

The burning of condensate created smoke that sparked complaints from nearby residents. Brian Macke, COGCC director, told the *Glenwood Springs Post Independent* (the Post) that burning condensate "does get rid of the odor problem quickly, which we thought was beneficial."[33] The Post also reported Garfield County environmental health manager as saying "I felt pretty good that there was no direct impacts to anybody in the area." [34]

Yet, despite the lack of concern on the part of the Garfield County staff, on December 29, the Air Pollution Control Division (APCD) of the Colorado Department of Public Health and Environment revoked the burning permits that it had issued to Barrett. According to the Post, this was done after the APCD learned of complaints made to Garfield County about the pit fires.[35] There is no information on whether the state agencies or Garfield County conducted air quality monitoring during the burn operations.

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[31] Letter and air quality test results sent from Garfield County to Oni Butterfly. 12/30/2005.
[32] COGCC NOAV Report. 12/12/2005. Document 200080875.
[33] Webb, D. 12/09/2006. "Tempers flare over Barrett pit fires." *Glenwood Springs Post Independent.*
[34] *ibid.*
[35] Gray, D. 01/04/06. "Fires not as bad as some report," *Glenwood Springs Post Independent.*