

Boulder County Public Health

Review of Oil and Gas Air and Water Impacts Studies

(May 2018)

Ambient Non-Methane Hydrocarbon Levels Along Colorado’s Northern Front Range: Acute and Chronic Health Risks, Environ. Sci. Technol, March 27, 2018. Lisa M. McKenzie, Benjamin D. Blair, John Hughes, William B. Allshouse, Nicola Blake, Detlev Helmig, Pam Milmoe, Hannah Halliday, Donald R. Blake, and John L. Adgate. The study found that the lifetime cancer risk for people living within 500 feet of an oil and gas facility is eight times higher than the Environmental Protection Agency’s upper risk threshold (8.3 per 10,000 vs 1 per 10,000 population respectively). The findings indicate that state and federal regulatory policies may not protect the health of populations living near oil and gas facilities. In particular, the risk of negative health effects is significant even at the 500-foot setback between newly-drilled oil and gas wells and existing homes, as required by Colorado’s current regulations. The high benzene data points used are from 1-minute canister sampling conducted in 2014 as part of the FRAPPE study. The highest benzene concentration, taken near Platteville, was 120 ppb at a produced water disposal well. Benzene levels ranging from 30-60 ppb were also collected near an oil well waste dumping facility and a compressor facility. EPA’s 1 in 10,000 lifetime cancer risk level for benzene is 4-14 ppb.

Concerned Health Professionals of NY and Physicians for Social Responsibility, Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking, Fifth Edition, March 2018 (this is updated approximately annually). This is a fully referenced compilation of over 1200 peer-reviewed research articles outlining the risks and harms of oil and gas development. The March 13, 2018 Rolling Stone article “‘The Harms of Fracking’: New Report Details Increased Risks of Asthma, Birth Defects and Cancer,” refers to this report, quoting: “Our examination...uncovered no evidence that fracking can be practiced in a manner that does not threaten human health.” In addition to public health implications some studies in this compilation highlight risks to workers at oil and gas operations.

Independent Petroleum Association of America, Energy In-Depth, Review and Analysis of Key Public Health Indicators in Colorado’s Largest Oil and Gas Producing County, 2018. This study concluded that while oil and gas production has increased in Weld County, the rates of death from cancer, respiratory illness and heart disease decreased. This decrease in deaths from the aforementioned conditions occurred while the elderly population in Weld County nearly doubled, between 2002 and 2015.

Currie, Janet et al, Hydraulic Fracturing and Infant Health: New Evidence from Pennsylvania, Science Advances, Dec. 31, 2017. This study found evidence of negative health effects of in utero exposure to “fracking sites” within 3 km of a mother’s residence, with the largest health impacts seen for in utero exposure within 1 km of “fracking sites.” Negative health impacts found in this study include a greater incidence of low-birth weight babies as well as significant declines in average birth weight and in several other measures of infant health. While other sources of diesel particulates weren’t ruled out, the study was conducted in more rural areas, where diesel traffic (other than that associated with oil and gas) is likely lower.

Pfister, Gabrielle and Frank Flocke, NCAR (with contributions from NASA) Process-Based and Regional Source Impact Analysis for FRAPPE and Discover-AQ 2014, July 2017. Two major field campaigns – the National Science Foundation (NSF)/National Center for Atmospheric Research (NCAR) and State of Colorado Front Range Air Pollution and Photochemistry Experiment (FRAPPÉ) and the 4th deployment of

the National Aeronautics and Space Administration (NASA) Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality (DISCOVER-AQ) – were conducted jointly during the summer of 2014 to study summertime ozone pollution in the Northern Colorado Front Range Metropolitan Area (NFRMA). Results showed that mobile sources and oil and gas related emissions are the largest contributors to local ozone production in the NFRMA. On average, oil and gas emissions show a stronger influence in the northern part of the NFRMA and the northern foothills, while mobile emissions dominate farther south (Denver area) and in the southern foothills. Both sectors contribute, on average, 30-40% each to total NFRMA ozone production on high ozone days.

CDPHE, *Assessment of Potential Public Health Effects from Oil and Gas Operations in Colorado*, 21 February, 2017. CDPHE evaluated air monitoring data and concluded that the risk of harmful health effects is low for residents living near oil and gas operations. CDPHE also concluded that, “Studies of populations living near oil and gas operations provide limited evidence of the possibility for harmful health effects. This needs to be confirmed or disputed with higher quality studies. At this time, results from exposure and health effect studies do not indicate the need for immediate public health action, but rather indicate the need for more detailed exposure monitoring and systematic analyses of health effects of residents living near oil and gas operations.” As CDPHE noted in their report, additional data are needed for a higher quality study.

McKenzie, Lisa M., et al, *Childhood hematologic cancer and residential proximity to oil and gas development*, PLoS ONE 12(2), 2017. Oil and gas development emits hematological carcinogens (ex. benzene) and continues to move into residential areas. This study evaluated whether proximity to oil and gas development was associated with risk for hematological cancers using a registry based case-control study. Oil and gas development has the potential to expose populations to pollutants and more research is needed to fully understand the role of proximity to oil and gas development and negative health impacts due to exposure.

Tustin AW, et al, *Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania*, Environ Health Perspect 125:187-197, February 2017. This study looked at the potential association of oil and gas activities and nasal and sinus, migraines, and fatigue symptoms. Researchers used a self-administered questionnaire to gather information in Pennsylvania. The findings from the respondents did show evidence that unconventional oil and gas development is associated with nasal and sinus issues, migraines, and fatigue symptoms. This was a survey based study and further research into exposure and outcomes is needed prior to making assumptions of causality. The health issues evaluated in this study are common complaints associated with populations who live in close proximity to oil and gas production. This research is not a causal link, but can provide the groundwork for future research which may further evaluate these symptoms and exposure to pollutants associated with oil and gas production.

Collett, Jeffrey L., et al., *North Front Range Oil and Gas Air Pollutant Emission and Dispersion Study*, 2016. Colorado State University led this research which quantified emissions from oil and gas development activities. Researchers measured emissions during hydraulic fracturing, flowback, and production. Measured emissions included air toxics, ozone precursors, and methane and are currently being used to inform a health risk assessment due in July. Production emissions, which extend over a long timeframe, were found to be lower than shorter term emissions from hydraulic fracturing and flowback activities. Emissions were lower in the North Front Range when compared with a similar study conducted in Garfield County, but did contain heavier weight organics.

Cromar, Kevin R. et al, *Estimated Excess Morbidity and Mortality Caused by Air Pollution above American Thoracic Society–Recommended Standards, 2011–2013*, 2016. The American Thoracic Society (ATS) and Marron Institute of Urban Management used the ATS recommended standards for ozone (O₃) and particulate matter of 2.5 micrometers in size or smaller (PM_{2.5}) to evaluate increased morbidity and mortality due to exposure. They found that for all counties with valid design values (O₃-715 and PM_{2.5}-483) 91% had elevated O₃ concentrations and 14% had elevated PM_{2.5} concentrations when compared with the ATS recommended standard. The ATS recommended standard is more stringent than EPA standards. Results do show excess death, morbidities, and adversely impacted days attributable to O₃ and PM_{2.5} pollution exceeding the ATS recommended standard. This study further exemplifies the potential negative health impacts from exposure to elevated levels of O₃ and PM_{2.5}.

Frankenberg, Christian, et al., *Airborne methane remote measurements reveal heavytail flux distribution in Four Corners region*, PNAS, 2016. This study was a targeted follow up to the discovery of a methane hot spot in the Four Corners Region. Researchers conducted an airborne effort combined with teams on the ground to better understand the sources of methane in the area. Over 250 plumes of methane were identified from fossil fuel production, processing, and distribution infrastructure. The findings confirmed earlier assumptions that most of the enhanced methane is related to natural gas extraction and coal mining in the region. The study also showed the ability of airborne measurements over a widespread area to effectively monitor methane leakage.

Elliott, Elise G., et al, *A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and developmental toxicity*, Journal of Exposure Science and Environmental Epidemiology, 2016. This study conducted by the Yale School of Public Health evaluated 1021 chemicals associated with hydraulic fracturing fluids (925), oil and gas wastewater (132), or both (36) for potential reproductive and developmental toxicity and the potential for human health impacts. Further analysis was conducted for those chemicals with links to reproductive and developmental toxicity to identify those with water quality standards or guidelines. 240 chemicals had toxicity information- 103 for reproductive, 95 for developmental, and 41 for both. 67 of these chemicals had or were proposed for a Federal water quality standard or guideline. This study could help inform future drinking water exposure assessments and reproductive and developmental health studies.

Kassotis, Christopher D., et al, *Adverse Reproductive and Developmental Health Outcomes Following Prenatal Exposure to a Hydraulic Fracturing Chemical Mixture in Female C57Bl/6 Mice*, Environmental Health Perspectives, 2016. Researchers exposed female mice to 23 commonly used unconventional oil and gas chemicals through their drinking water. The findings suggest the potential for adverse developmental and reproductive health outcomes in humans and animals when exposed. Adverse outcomes were observed even in the lowest dosed group. The research focuses on exposure from drinking water and continues to highlight the need for tight protections of drinking water.

Petron et al, *A New Look at Methane and Nonmethane Hydrocarbon Emissions from Oil and Natural Gas Operations in the Colorado Denver-Julesburg Basin*, 2014. Methane emissions in the Denver-Julesburg Basin were estimated for 2 days in May 2012 using aircraft-based methane observations. Emissions were found to be 3 times higher than an hourly emission estimate based on EPA's GHG Reporting Program data for 2012. Results show that the state inventory for total VOCs emitted by O&G activities is at least a factor of 2 too low for May 2012. This top-down emission estimate also shows that benzene emissions from O&G activities are 7 times larger than in the state inventory. This aerial approach to emissions inventories, called a top-down inventory, is a useful component to getting a more accurate picture of total emissions. Recognizing that the state inventory may be incomplete, the Air

Pollution Control Division is currently in favor of researching aerial monitoring further as part of the Statewide Hydrocarbon Task Force (SHER Team).