Assessing the Effects of Oil and Gas Development on Community Water Sources in Colorado Using Data Collected by Colorado's Regulatory Agencies

Joseph N. Ryan[1], Shuhui Yang[1], Grady T. Colgan[1], Lisa M. McKenzie[2], John L. Adgate[2], William Allshouse[2], Rachel M. Day[2], Harihar Rararam[3], Rahul Samala[3], and Zherui Xu[3]

[1] *University of Colorado Boulder, Boulder, Colorado, U.S.A.*

[2] *University of Colorado Anschutz Medical Campus, Aurora, Colorado, U.S.A.*

[3] *Johns Hopkins University, Baltimore, Maryland, U.S.A.*

Background. The use of hydraulic fracturing and horizontal drilling has doubled production of oil and natural gas in the United States over the past decade. This increase has led to expansion of oil and gas development into areas of higher population density and residential land use. Residents of these areas have responded with concerns about noise, traffic, and air quality, but in rural areas, where most residents tap ground water for domestic and agricultural uses, water quality is a significant concern. Hence, there is a critical need to forecast the risk of contamination of water supplies for communities near oil and gas development. To address this need, we must better understand the temporal and spatial variability in community exposures to contaminants in surface and ground water near oil and gas development. We need to connect sources at oil and gas facilities with receptors in communities by identifying and evaluating exposure paths.

Methods. We are using existing data for water quality near oil and gas development and records of community water supplies and oil and gas operations to connect the sources with the receptors along exposure paths. We are (1) collecting data and records for the state of Colorado, where we have three types of oil and gas basins to examine (oil and gas, dry gas, and coal bed methane), (2) identifying exposure paths connecting the oil and gas sources to the community water supply receptors, and (3) evaluating the feasibility of these exposure paths using contaminant transport modeling. We have just begun to extend this data collection and analysis to New Mexico.

Results. In Colorado, we have examined nearly 9,000 analyses for surface and ground water samples collected by oil and gas operators near new drilling and extraction sites and found nineteen cases for which one of the BTEX compounds (benzene, toluene, ethylbenzene, and xylenes) have exceeded the Colorado drinking water standards. For these nineteen cases, we are investigating nearby oil and gas facilities for (1) construction and operation violations, indicators of problems with well integrity to identify likely "culprit" oil and gas facilities responsible for the water supply contamination and (2) feasibility of contaminant transport along an exposure path from oil and gas facility sources to water supply receptors. In addition, we are developing a screening public health risk assessment based on likelihood of exposure of water supplies near the contaminated water supply that have not been sampled. For New Mexico, we will attempt to perform the same analysis, but availability of water quality data will limit our results compared to what we have achieved in Colorado.

Conclusions. We expect our results to provide evidence a basis for evaluation of state regulations addressing protection of community water supplies. Our preliminary interpretation of the results suggests that our recommendations will include improvements in (1) required water quality monitoring protocols and (2) oil and gas well construction design and integrity testing.