

Executive Summary

The city of Fort Worth is home to extensive natural gas production and exploration as it lies on top of the Barnett Shale, a highly productive natural gas shale formation in north-central Texas. The Barnett Shale underlies 23 counties, including four (Tarrant, Denton, Wise, and Parker) that lie partly within the Fort Worth city boundaries. Over the last several years, natural gas production in the Barnett Shale has increased dramatically. This increase in activity has been brought about by advancements in drilling technologies, most notably hydraulic fracturing (fracking) and horizontal drilling.

As the Barnett Shale formation is located beneath a highly populated urban environment, extraction of natural gas from it has involved exploration and production operations in residential areas, near public roads and schools, and close to where the citizens of Fort Worth live and work. Due to the highly visible nature of natural gas drilling, fracturing, compression, and collection activities, many individual citizens and community groups in the Fort Worth area have become concerned that these activities could have an adverse effect on their quality of life.

In response to these concerns, on March 9, 2010, the Fort Worth City Council adopted Resolution 3866-03-2010 appointing a committee to review air quality issues associated with natural gas exploration and production. This committee was composed of private citizens, members of local community groups, members of environmental advocacy groups, and representatives from industry. The committee was charged to make recommendations to the City Council on a scope of work for a comprehensive air quality assessment to evaluate the impacts of natural gas exploration and production, to evaluate proposals submitted in response to a solicitation for conducting this study, and to ultimately choose a qualified organization to conduct the study.

Following an open bidding process, Eastern Research Group, Inc. (ERG) was selected to perform the Fort Worth Natural Gas Air Quality Study (FWNGAQS). ERG was asked to design a study that answered four key questions, originally established by the air quality committee. Since that time, ERG has completed extensive sampling activity throughout Fort Worth, and the sampling results support the following main conclusions:

- *How much air pollution is being released by natural gas exploration in Fort Worth?* ERG estimated emissions for 375 well pads, 8 compressor stations, one gas processing plant, a saltwater treatment facility, a drilling operation, a fracking operation, and a completion operation. Summed across all these sites, the total estimated emissions of organic compounds was 20,818 tons per year, with well pads accounting for more than three-fourths of those total emissions. The emissions contained dozens of pollutants with varying toxicities. Pollutants with relatively low toxicities (e.g., methane, ethane, propane, and butane) accounted for the overwhelming majority—approximately 98%—of the city-wide emissions. However, several pollutants with relatively high toxicities (e.g., benzene) were also emitted from these sites, though in considerably lower quantities. At a small subset of sites, the point source testing team noted signs of malfunctioning equipment that likely caused increased emissions. For example, some hatches atop tanks were ajar and not closed, and corrosion had apparently caused a hole to form on the roof of at least

one tank. Enhanced inspection and maintenance of equipment at the sites can help ensure that these preventable emissions are greatly reduced or eliminated. ERG also projected future emission rates based on an analysis of market forces, natural gas reserves, and other factors. This analysis found that city-wide emissions from the production of natural gas are projected to peak in 2012 and 2013 at 9% above 2010 levels. More detailed and technical information on emissions from natural gas sites is found in Sections 3 and 7 of this report.

- *Do sites comply with environmental regulation?* Numerous state and federal regulations could apply to natural gas production sites, but applicability of all regulations depends on site-specific nuances. The primary environmental regulation that would apply to natural gas extraction sites is TCEQ's oil and gas "permit-by-rule". This regulation is in the Texas Administrative Code and sets criteria for air permitting, based on the amount and type of emissions from a given facility. Based on the emission rates that ERG calculated for this project, five sites—a processing facility, three compressor stations, and one well pad—had overall emission rates that exceed regulatory thresholds that are supposed to trigger certain permitting requirements. Section 6 of this report identifies these five sites and presents their estimated emission rates.
- *How do releases from these sites affect off-site air pollution levels?* Scientists typically use two different methods when trying to understand how a given air pollution source affects local air quality. One approach is to conduct ambient air monitoring, which is directly measuring air pollution levels that people breathe. Another approach is to use dispersion modeling, which is estimating air pollution levels using models that predict how pollutants move through the air from the point where they are released. ERG used both approaches in the FWNGAQS. The ambient air monitoring program identified actual air pollution levels of nearly 140 pollutants at eight locations throughout the city, and the dispersion modeling study estimated air pollution levels at times when, and locations where, ambient monitoring did not take place.

A health-screening analysis of the measured and estimated air pollution levels identified three pollutants—acrolein, benzene, and formaldehyde—as the most important from a risk perspective. While Fort Worth residents are exposed to these and other pollutants released from natural gas sites, the measured and estimated air pollution levels did not reach levels that have been observed to cause adverse health effects. Further, the measured benzene and formaldehyde levels in Fort Worth were not unusually elevated when compared to levels currently measured by TCEQ elsewhere in Texas. There was insufficient data available to do a similar comparison for acrolein. ERG recommended focused additional study to ensure that these pollutants do not reach unhealthy levels in the future. Sections 2, 4, and 5 describe the monitoring, modeling, and health-screening analysis in greater technical detail.

- *Are the city's required setbacks for these sites adequate to protect public health?* For the overwhelming majority of sites considered in this study, the modeling analysis indicates that Fort Worth's 600-foot setback distance is adequate. For the relatively few sites with multiple, large line compressor engines, the modeling analysis found some areas beyond

the setbacks to have estimated acrolein and formaldehyde concentrations greater than protective health-based screening levels published by TCEQ. However, the estimated air pollution levels did not reach levels that have actually been found to cause symptoms or illness among exposed populations. Because the findings for these two pollutants are based entirely on estimated emission rates and modeled air quality impacts (as opposed to measured values), ERG recommends further evaluations of acrolein and formaldehyde at sites with multiple, large line engines to provide greater confidence in the adequacy and protectiveness of the city's setbacks. Some recent, short-term studies of limited scope have monitored for these pollutants, but a longer-term monitoring program is better suited for confirming this study's findings for acrolein and formaldehyde. Section 5 describes how ERG reached its conclusions regarding the adequacy of the city's setback distances.

Although this study did not reveal any significant health threats beyond setback distances, it is important to remember that the sources of concern for this project—natural gas exploration and production activity—are located in residential settings throughout a metropolitan area. Though the most toxic pollutants these sources emit are released in relatively low quantities, ERG fully supports implementing all reasonable precautions to reduce emissions from the well pads and compressor stations. Our recommendations in Section 8 of this report identify several specific opportunities for reducing emissions from natural gas production sites in Fort Worth.