

Odor Assessment Studies in North Denver

Local residents are key resources in identifying odors. Combining odor identification by residents with chemical monitoring can be useful in identifying odor sources and taking action. Our study goal was to combine these methods to **assess industrial odors in the northern part of the Denver** metropolitan area, which has many factories and two major highways mixed with residential areas. Many health complaints from north Denver residents related to **strong industrial odors have been recorded**, including suffering from burning eyes and throat, headaches, skin irritation, coughing and breathing difficulties.



Based on our work, a regional cooperation to reduce odor problems in North Denver was highly recommended. After completion of our first study in 2016, Dr. Shelly Miller participated in the advisory board to the Denver Department of Public Health and Environment (DDPHE) to develop an **updated odor ordinance**. Instead of relying on an inspector and a scentometer, **they now require specific industries to develop and submit an odor control plan**, including marijuana growers and pet food manufacturers.

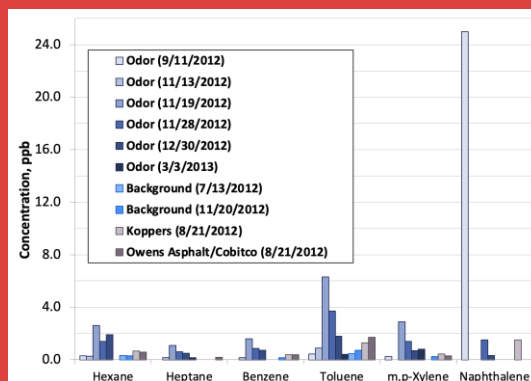
Also, **a facility must submit a plan if DDPHE has received five or more complaints** from individuals from separate households or businesses within a 30-day period.



Study 1: Tar odors: measuring contaminants and identifying sources

What we did: In response to complaints of a tar odor, we worked with Groundwork Denver on a study in the Globeville community in 2012-2015. Our work was funded by an EPA Environmental Justice Grant. Efforts to identify the odor and its potential sources included a door-to-door survey, meteorological correlations, and air quality sampling for volatile organic compounds (VOCs), sulfur gases, and polycyclic aromatic hydrocarbons (PAHs).

Odor, background, and industrial sample concentrations of compounds detected in air during Study 1.



What we learned: The area has industrial sources of harmful tar odors and we measured high levels of naphthalene, a carcinogen. The study recommended a more detailed investigation to explain the effects of odors in communities, to assess the relationship between odor exposure and well-being, and to understand the effect of odor mixtures.

Study 2: Subjective well-being is associated with poor air quality and odors

What we did: We investigated the effects of industrial odors on residential communities and explored whether there was an association with well-being as reported by residents in Globeville, Elyria-Swansea, Chaffee Park, Sunnyside, and Commerce City. Four Colorado communities with similar demography were included for comparison: Fort Lupton, Greeley, Fort Collins, and Pueblo. 350 participants, recruited through social media, completed surveys using a reporting smartphone app “Report Odor 1.” Participants were asked to take the online survey once every three months for a year. They also reported odors regularly whenever they noticed them in the app and they also lodged an official complaint with the city of Denver.

What we learned: Odor pollution was identified as a top priority of the community of North Denver. Results showed that participants who reported that the air is very fresh or the odor is very acceptable had higher levels of well-being. This association suggests that residents who live in areas exposed to strong industrial odors had lower levels of well-being. A comparison between the five communities showed that well-being levels were not significantly different, however, Pueblo had the lowest levels of well-being.

Study 3: Identifying odor sources using citizen science

What we did: We wanted to identify odor sources using wind direction and odor data collected by community participation. For over a year, residents across all 16 northern Denver neighborhoods and comparison areas (from study 2) reported time, date, locations and descriptions of odor occurrences through smartphone technology. The odor spatial distribution and wind direction and speed generated from local weather stations were used to identify odor sources. The majority of odor reports were from North Denver (57%) and Greeley (33%).

What we learned: North Denver analysis showed that one single pet food manufacturing facility was responsible for the pet food odor (the most reported odor: 81 reports). Dead animal and sewage odors were associated with a North Denver meat and grease recycling facility, and the Metro Wastewater treatment plant, respectively. Roofing tar odor was likely associated with a facility that treats crossties and utility poles with creosote, a wood preservative. Another odor that was often described as a refinery odor was less likely to be associated with the Denver oil refinery and more likely to be associated with one of the four facilities in the northwest area of Globeville that uses asphalt and creosote materials. In Greeley, most reports happened from the LaSalle area, identifying an offensive odor produced by a biogas facility east of the area.

Odor Study Links and Resources

- Denver Odor Ordinance: <https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Public-Health-Environment/Environmental-Quality/Odors>
- *Study 1:* Morgan, B., Hansgen, R., Hawthorne, W., & Miller, S. L. (2015). Industrial odor sources and air pollutant concentrations in Globeville, a Denver, Colorado neighborhood. *Journal of the Air & Waste Management Association*, 65(9), 1127-1140.
- *Study 2:* Eltarkawe, M. A., & Miller, S. L. (2018). The impact of industrial odors on the subjective well-being of communities in Colorado. *International journal of environmental research and public health*, 15(6), 1091.
- *Study 3:* Eltarkawe, M., & Miller, S. (2019). Industrial odor source identification based on wind direction and social participation. *International journal of environmental research and public health*, 16(7), 1242.

The learnings from these studies led by Dr. Shelly Miller (University of Colorado Boulder) contributed to the development of the current study in North Denver, Social Justice & Environmental Quality – Denver:
<https://www.sjeqdenver.com/>