Health Consultation

Exposure Investigation

Natural Gas Ambient Air Quality Monitoring Initiative

BRIGICH COMPRESSOR STATION

CHARTIERS TOWNSHIP, WASHINGTON COUNTY, PENNSYLVANIA

COST RECOVERY NUMBER: A0ZH00

JANUARY 29, 2016

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared By:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry (ATSDR)
Division of Community Health Investigations
Eastern Branch

SUMMARY

Introduction:

Since 2010, ATSDR has received community concerns about air emissions and odors impacting residents near natural gas extraction, processing and transportation facilities. Residents identified a number of health symptoms in these complaints, including nausea, headache, lethargy, burning and irritation of upper respiratory tract, nose bleeds, stinging eyes, and metallic tastes on the tongue. The Agency for Toxic Substances and Disease Registry (ATSDR), in collaboration with the US Environmental Protection Agency Region 3 Air Protection Division (APD), conducted this exposure investigation to evaluate if residents living near a natural gas compressor station were being exposed to concentrations of carbonyls/aldehydes, reduced sulfur compounds (including hydrogen sulfide), particulate matter ($PM_{2.5}$), or volatile organic compounds (VOCs) in air that might cause health effects. For this effort, ATSDR and EPA jointly collected air samples from residential properties in the community surrounding the Brigich Compressor Station in Chartiers Township, Washington County, Pennsylvania in late summer and fall of 2012.

ATSDR's part of this investigation occurred in two phases. In the first phase, ATSDR, with assistance from environmental consultant Eastern Research Group (ERG), sampled five locations in the community near the Brigich Compressor Station for hydrogen sulfide (H_2S), reduced sulfur compounds, and 14 carbonyl compounds (i.e., 12 aldehydes and 2 ketones, hereafter referred to as "carbonyls"). ATSDR's Phase 1 sampling occurred from approximately July 7, 2012, through August 7, 2012. During the second phase of ATSDR's field activities, ATSDR, with assistance from EPA's Environmental Response Team (ERT), measured H_2S, the same carbonyl compounds assessed in the first phase (excluding 2-butanone), and 14 reduced sulfur compounds. ATSDR's Phase 2 sampling occurred from approximately August 11, 2012 to October 10, 2012._Across both phases, ATSDR completed a total of 41 days of sampling for carbonyl evaluation, 24 days of sampling for reduced sulfur compound evaluation, and a total of 91 days of monitoring and data logging for hydrogen sulfide.

EPA APD's part of this investigation occurred from August 4, 2012 to November 28, 2012. EPA APD sampled for particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$) at one downwind location, and for volatile organic compounds (VOCs) at three locations in the community near the Brigich Compressor Station.

Data collected by ATSDR and EPA APD are evaluated in this health consultation.

There are a number of sources of uncertainty for this Exposure Investigation:

- The air sampling information collected is limited in location and duration. It was not collected continuously from all breathing zone exposure points in the community and through each season of the year, making it difficult to determine accurate annual average concentrations.
- A number of nearby industrial sources, and particularly other natural gas-

	related facilities (impoundments, drill pads, compressors, gas processing plant), confound the data and make efforts to determine source of airborne contaminants difficult. Many of the analytes (e.g., VOCs, $PM_{2.5}$) assessed in this EI are frequently detected in regional air sampling programs and come from common sources such as automobiles and agricultural equipment. • The sampling conducted for this study may not have adequately captured uncommon but significant incidents when peak emissions (*e.g.* unscheduled facility incidents, blowdowns or flaring events) coincide with unfavorable meteorological conditions (e.g. air inversion) and downwind placement of active monitoring equipment. • Except for hydrogen sulfide, short-duration (e.g. less than 1 hour) sampling was not conducted. Therefore, elevated peak airborne chemical concentrations less than the 24-hour sample collection periods (e.g., for chemicals like glutaraldehyde) could not be identified. • The sampling equipment used in this investigation for reduced sulfur compounds did not perform as expected, and therefore these data were not evaluated in this report. Representative ambient air reduced sulfur compound data remains an important data gap at this location. • Currently, the science is limited for assessing the health impact from exposures to the complex mixtures of airborne toxic chemicals such as those presented in this data set, and particularly given the low concentrations detected.
CONCLUSIONS	ATSDR reached two (2) important conclusions for this site:
Conclusion 1	Exposure to the detected levels of chemicals in the ambient air from residences surrounding Brigich compressor is not expected to harm the health of the general population. However, some sensitive subpopulations (e.g., asthmatics, elderly) may experience harmful effects from exposures to hydrogen sulfide and $PM_{2.5}$. Some individuals may also be sensitive to aldehyde exposures, including glutaraldehyde.
Basis for Conclusion 1	Nine (9) chemicals were detected that exceeded health-based comparison values. Exposure concentrations for each of these chemicals were below non-cancer effect levels and the estimated excess lifetime cancer risks were within or below the EPA target risk range. Hydrogen sulfide - Short-term, peak concentrations of hydrogen sulfide may be of concern for sensitive subpopulations (e.g., asthmatics, elderly). On ten occasions (four times at Site 1 and six times at Site 3), H_2S levels remained above 20 ppb for 30 minutes or more at this site. Several studies have been conducted which show adverse health effects from low-level hydrogen sulfide exposures (Alborg 1951, CalEPA 2013). Peak concentrations are of concern, particularly for sensitive subpopulations (e.g. asthmatics, elderly). Particulate Matter ($PM_{2.5}$) - The World Health Organization notes that when annual mean concentrations are in the range of 11–15 $\mu g/m^3$, health effects can be expected (WHO 2006). Although the 4 month average determined during this EI was 12.4 $\mu g/m^3$, there is insufficient data to determine whether the annual $PM_{2.5}$

	concentration at this site would exceed the EPA annual primary standard of 12 µg/m^3. Carbonyls - Glutaraldehyde results from 24-hour sampling at residential locations were below levels known to cause adverse health effects from chronic exposures. However, there are insufficient short term data from this EI (i.e. less than 24 hour sampling periods) to determine whether peak exposures to carbonyls were high enough to cause health effects in some individuals, especially individuals sensitive to carbonyls. Crotonaldehyde and glutaraldehyde have caused sensitization in some individuals at occupational levels (which are higher than levels found during this EI), and both chemicals are known to produce acute respiratory symptoms from short and intermittent exposures (ATSDR 2002, NJDOH 2000, NLM 2012 and 2014).
Conclusion 2	There are significant limitations and site-specific variables associated with this Exposure Investigation (EI) and Health Consultation (HC). The data collected and analyzed in this Health Consultation represents air quality in the community surrounding the Brigich compressor station, with limitations, but should not be generalized to all natural gas compressor stations.
Basis for Conclusion 2	Although this study collected 24-hour samples on many dates over a number of months, there remains a lack of continuous ambient air data from all breathing zone exposure points in the community through each season of the year. This limits our ability to assess long-term chronic and short-term peak exposures. A number of nearby industrial sources, and particularly other natural gas-related facilities (impoundments, drill pads, compressors, gas processing plant), are present in the immediate area of the Brigich Compressor Station. This co-mingling of sources makes it infeasible to determine individual sources of the chemicals detected in the air during this investigation. Additionally, many analytes (e.g., VOCs, $PM_{2.5}$) are commonly detected in regional air sampling programs and come from common sources such as automobiles and agricultural equipment. The sampling conducted for this investigation attempted to capture the variety of conditions encountered in the community, but it may not have adequately captured uncommon but significant incidents when peak emissions (e.g. unscheduled facility incidents, blowdowns or flaring events) coincide with unfavorable meteorological conditions (e.g., an air inversion) and downwind placement of active monitoring equipment. Most of the data evaluated in this EI were from samples collected for 24-hour sampling periods on non-consecutive days. The sampling equipment used in this investigation for reduced sulfur compounds did not perform as expected, and therefore these data were not evaluated in this report. Representative ambient air reduced sulfur compound data remains an important data gap. Public health science is limited in its ability to assess the health impact from exposures to complex mixtures of airborne toxic chemicals.
Next Steps	The information from this health consultation will be shared with the community near Brigich Compressor Station and relevant state health and environmental

	agencies. ATSDR recommends reducing exposures to $PM_{2.5}$, carbonyls, and hydrogen sulfide in ambient air by taking steps to control releases from the emission sources of these chemicals to protect the health of sensitive populations living near the site. ATSDR recommends collecting emission source or fence-line samples for a wide range of chemicals (VOCs, carbonyls, PM, reduced sulfur compounds) by the appropriate environmental agency (PADEP, EPA) for long term and peak exposures. This information could be compared to the residential sampling summarized in this report, and it could be used in air modeling to further understand community exposures. ATSDR recommends air modeling, based on sufficient representative data of fugitive and combustion emissions at compressor stations, including but not limited to, carbonyls, volatiles, and hydrogen sulfide, as it may provide a more generalized understanding of ambient air quality near these types of facilities. When modeling is conducted, topographic and meteorological conditions should also be considered as important variables. If requested, ATSDR will provide technical assistance to the local community and local, state and federal agency stakeholders (e.g., assessing environmental sampling or modeling data, or the development of environmental monitoring strategies.)

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Purpose
Since 2010, the ATSDR Region 3 office has received a number of requests from Pennsylvania residents, particularly in Washington County, to assess impacts to air quality from newly developed natural gas infrastructure in their communities. After discovering there is limited data available to assess community air quality near these infrastructure, ATSDR initiated an Exposure Investigation (EI). The purpose of this EI was to

- Evaluate community exposures and potential health impacts from airborne contaminants in the community surrounding the Brigich Compressor Station (site) in Chartiers Township, Washington County, Pennsylvania. This area has seen a significant increase in development of compressor stations, impoundments and drilling pads servicing the natural gas industry;
- Determine the need to mitigate exposures and
- Determine whether additional air assessments or air modeling is needed to better evaluate public health impacts in the investigation area.

This investigation was not designed to conclusively determine the types and quantities of emissions from the Brigich Compressor Station or to determine the station's adherence to any regulatory standards (*e.g.* National Ambient Air Quality Standards) but instead to identify ambient airborne concentrations of specific contaminants in the residential community near this compressor station and to determine their public health significance.

The data collected through this joint ATSDR and EPA investigation allows ATSDR, within inherent data limitations, to evaluate whether people living near the Brigich Compressor Station are being exposed to concentrations of carbonyls, reduced sulfur compounds including hydrogen sulfide, particulate matter (PM 2.5), or volatile organic compounds (VOC) in air that may pose a health threat. ATSDR evaluated the data collected as part of this investigation for public health implications by considering the measured concentrations of the assessed compounds; the frequency, duration, and location of possible exposures; and meteorological conditions which might impact exposure scenarios.

Background
Since 2008, Pennsylvania has seen a rapid expansion in natural gas exploration and extraction activities. The Marcellus shale formation underlies much of Pennsylvania and is accessed by industry through modern horizontal drilling and hydraulic fracturing technological advances. The technological advances in oil and gas extraction have made the Marcellus shale gas economically accessible. The industry has expanded their operations into areas throughout Pennsylvania and in some cases, close to or within residential communities. With the increase in available natural gas resources, associated industrial sites have also been and continue to be developed, including natural gas processing plants, compressor stations and pipelines. Natural gas extraction infrastructure development can occur close to residential communities, such as in Chartiers Township, where 78 homes are within one mile and 30 within a ½ mile of the Brigich Compressor site (See Figures 1a and 1b). Additional upstream natural gas infrastructure and its associated vehicular traffic are located in close proximity to the same Chartiers Township homes, including surface impoundments (e.g. Worstell) for freshwater and hydraulic fracturing flowback, compressor stations, pipelines and drill pads.

Beginning in 2010, ATSDR Region 3 began logging citizen complaints received and referred to the

ATSDR regional office about natural gas-related sites. ATSDR's review of this information shows that about one third of the complaints (21 of 60 documented between 2010 and 2013) noted concerns about air emissions and odors impacting health. Specifically, these complaints identified a number of health symptoms, including nausea, headache, lethargy, burning and irritation of upper respiratory tract, nose bleeds, stinging eyes, and metallic tastes on the tongue. The ATSDR Region 3 office continues to receive complaints about air quality near natural gas-related sites.

In 2011, the Pennsylvania Department of Environmental Protection conducted environmental sampling at the fence lines and downwind of a number of natural gas industry-related sites, including drill pads, compressor stations, flares, and flowback impoundments. Fenceline data from these studies identified multiple chemicals that may be of public health concern, including reduced sulfur and volatile organic compounds. The PADEP studies captured snapshots of compressor station impacts to ambient air, providing valid data for which to develop a more comprehensive investigation for evaluating short and long term exposures to ambient air near compressor stations.

Exposure Investigation Defined

An exposure investigation (EI) is defined as the collection and analysis of site-specific information and biologic tests (when appropriate) to evaluate people's exposure to hazardous substances. An exposure investigation is an approach ATSDR uses to fill data gaps in evaluating community exposure pathways. Its purpose is to better characterize past, present, and possible future exposures to hazardous substances in the environment and to evaluate possible health effects related to those exposures.

Exposure investigations must meet four criteria:

1. Can an exposed population be identified?
2. Does a data gap exist that affects your ability to determine if a health hazard exists?
3. Can an exposure investigation be designed that will address this data gap?
4. Will the EI results impact the public health decision for the site?

An exposure investigation is NOT a study. Rather, it is a biased attempt at identifying the individuals most highly exposed and sampling their exposure. This exposure investigation is a public health service directed to individual participants in the assessed community and is not generalizable to other populations, although the information acquired in this EI may provide relevant background to public health scientists conducting additional investigations with similar environmental conditions.

Chemical Parameter Selection

Chemical parameter selection was a collaborative effort between ATSDR and EPA Region 3 Air Protection Division (APD). Concerns regarding emissions of BTEX compounds (benzene, toluene, ethylbenzene, and xylenes) from glycol dehydrators have been noted previously for fugitive emissions from these unit operations (EPA 1995), therefore VOCs were included in this investigation. EPA APD conducted air sampling for volatile organic compounds following the standard TO-15 method.Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) was also included in this investigation to incorporate fine particulate matter contributions from the compressor station. EPA APD conducted air sampling for $PM_{2.5}$ following the gravimetric method.

Based on a review of recent studies of natural gas compressors stations (see Appendix A), ATSDR also included two specific chemical classes that have not been traditionally assessed in natural gas compressor "host" communities:

- Carbonyls: 14 specific chemicals including 2,5-dimethylbenzaldehyde, 2-butanone (methyl ethyl ketone (MEK)), acetaldehyde, acetone (propanone), benzaldehyde, butyr/isobutyraldehyde, crotonaldehyde, formaldehyde, glutaraldehyde, hexaldehyde, isovaleraldehyde, propionaldehyde, tolualdehydes, and valeraldehyde
- Reduced sulfur compounds and hydrogen sulfide: carbonyl sulfide, methyl mercaptan, ethyl mercaptan, dimethyl sulfide, carbon disulfide, isopropyl mercaptan, ethyl methyl sulfide, n-propyl mercaptan, t-butyl mercaptan, methyl propanethiol, thiophene/2-methyl propanethiol, methyl isopropyl sulfide, and n-butyl mercaptan.

Site Description

The Brigich Compressor Station (site), located at 40.291° N latitude and -80.239° longitude), is situated on the top of a north/south aligned hill amidst crop fields that extend to the north, east and south. A small wooded area is located to the west of the station. The nearest residential community is located along Jaspen Way, about 1,500 feet east of and on grade with the Brigich Compressor Station. Residences are also located along Brigich Road to the north of the site, and along Plum Run Road to the west and south of the site. Residences along Plum Run Road are situated in a valley at a lower elevation than the compressor station, while homes along Brigich Road are on grade with the station. See Figure 1a and 1b for the site layout of the community surrounding the Brigich Compressor Station.

A number of natural gas related industrial sites are also located within a mile of the community near the Brigich Compressor Station, including 3 impoundments, seven or more drill pads and another compressor station, including Brigich. One impoundment, the Worstell impoundment, is used for storing, recycling and pre-treatment of hydraulic fracturing flowback fluids. The Houston Gas processing plant is located approximately 2 miles southwest (upwind) of the Brigich Compressor Station.

Brigich Compressor Station Details

The Brigich Compressor Station (see Table 1) is composed of 4 compressors, one dehydrator, one reboiler, 3 condensate tanks, 2 diesel generators and a blowdown vent silencer.

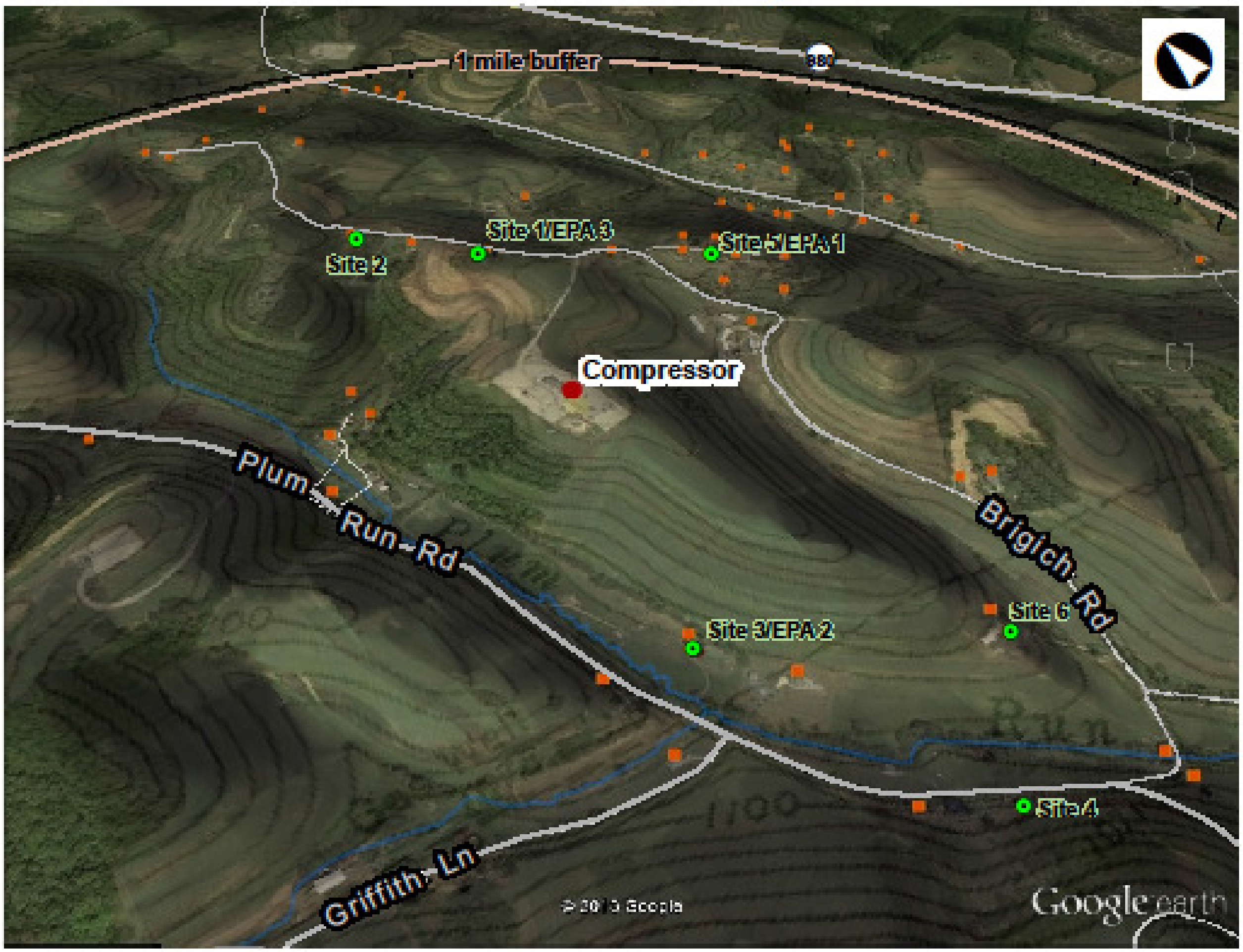
Table 1
Brigich Compressor Station Components

Component	Detail
3 Compressors	1,340 Horsepower (hp) with oxidation catalyst
1 Compressor	1,380 hp with oxidation catalyst
Dehydrator	30 MMscf/day
Reboiler	0.75 MMBtu/hr
3 Condensate tanks	440 bbl
2 Diesel generators	197 hp
Flare and Blowdown vent silencer	

Note: source: http://www.pabulletin.com/secure/data/vol40/40-22/993c.html; hp = horsepower; MMBtu/hr = million British thermal units per hour; MMscf/day = million standard cubic feet per day; bbl = 42 gallon barrel

Figure 1a - Exposure Investigation Site Map

Brigich Compressor Washington County, PA



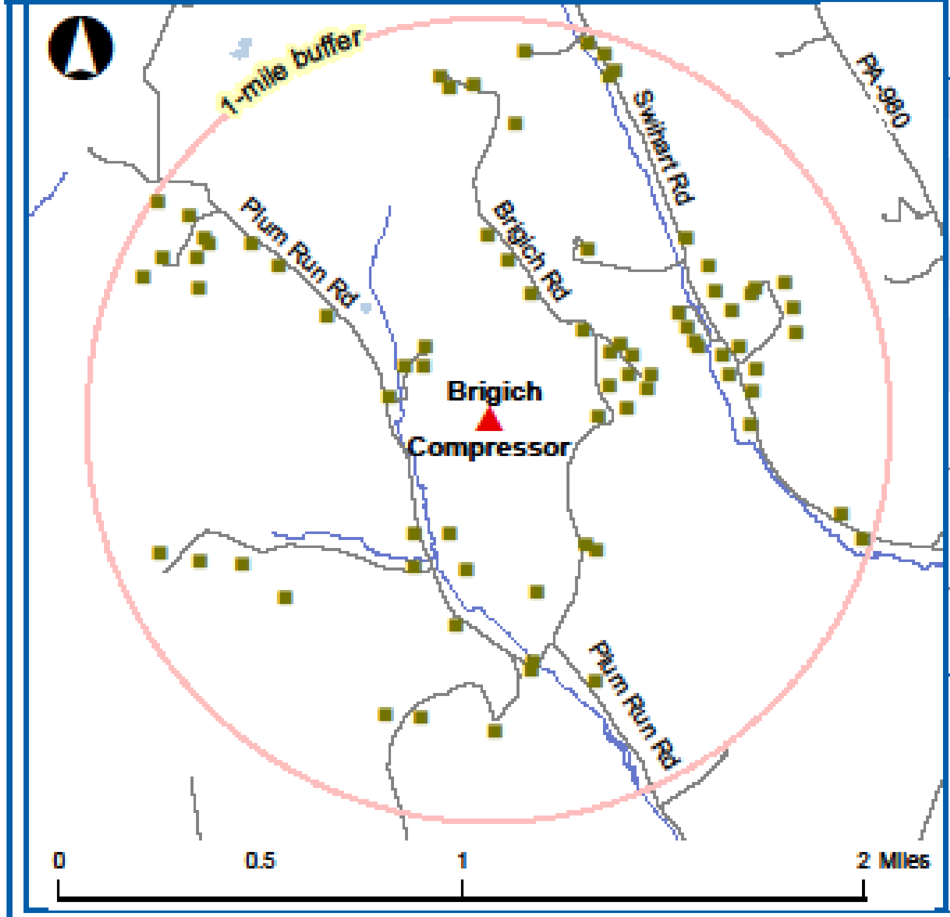
The Brigich compressor station is located in Washington County, in southwestern Pennsylvania . The compressor is situated near the ridgeline of a hill. This hillshade image depicts the compressor as seen looking from the southwest towards the northeast.

● Monitoring sites
■ Residential

Data Sources:
Imagery - Google Earth
Monitors - U.S. EPA

Figure 1b - Site Demographics Map

Brigich Compressor Washington County, PA



Demographic Statistics

Within 1 mile buffer of site boundary

Measure	Estimate
Total Population	191
White Alone	187
Black Alone	2
Am. Indian & Alaska Native Alone	1
Asian Alone	0
Native Hawaiian & Other Pacific Islander Alone	0
Some Other Race Alone	0
Two or More Races	1
Hispanic or Latino	0
Children Aged 6 and Younger	18
Adults Aged 65 and Older	26
Females Aged 15 to 44	27
Housing Units	78

Data Sources:

Demographic: U.S. Census (2010)

■ Residential dwellings: Digitized from ESRI World Imagery service

Basemap: TomTom

Map projection: Pennsylvania State Plane (South)

Demographics
Demographic parameters for the population within a mile radius of the Site is provided in Figure 1b (Site Demographic Map). Washington County, the location of the Site, is in southwestern Pennsylvania, near the Pennsylvania and West Virginia state boundaries. It is a medium sized county of approximately 207,820 people. The median household income for 2006-2010 in this area is $49,687 (U.S. Census Bureau, 2010).

Age and Gender
In Washington County there are 106,853 women (51.4%) and 100,709 men (48.5%). The median age is 43.2 years. Approximately 5.1% of the population is less than 5 years old and 17.5% of the population is older than 65 years (U.S. Census Bureau, 2012).

Race/ Ethnicity
The race/ethnicity of the population in Washington County is as follows: White (196,021), black or African American (6,822), American Indian and Alaska Native (213), and Asian (1,358) (U.S. Census Bureau, 2012).

Sensitive Populations
Pregnant women, children, the elderly, and people with chronic health conditions may have increased susceptibility to health effects from environmental chemical exposures than the general population. To address this concern, the EI will discuss specific exposure issues for these populations, when appropriate.

Exposure Investigation Overview

The objective of this assessment was to evaluate possible community exposures to and potential health impacts from airborne contaminants near the site. This EI was not designed to determine adherence to regulatory standards (e.g. National Ambient Air Quality Standards) but to specifically identify ambient airborne concentrations of specific contaminants in the residential community that are common emissions from natural gas compressor stations.

The data collected through this EI and the concurrent but separate EPA investigation allows ATSDR to determine, with limitations, whether people living near the Brigich compressor are being exposed to carbonyls, hydrogen sulfide, reduced sulfur compounds, particulate matter ($PM_{2.5}$), and volatile organic compounds at concentrations that could pose a public health hazard.

The ATSDR Division of Community Health Investigations (DCHI) was the lead for this EI. ATSDR collaborated with the Region 3 U.S. Environmental Protection Agency (EPA) Air Protection Division (APD), the EPA Environmental Response Team (ERT), and Eastern Research Group (ERG) on field activities and laboratory analyses.

Additional information about the project collaborators, site selection criteria, field sampling and analytical protocols, laboratory reporting limits and health-based based screening criteria are provided in the Appendix A.

Meteorological Data (Pennsylvania Department of Environmental Protection and EPA APD)

Wind speed and direction was collected during all phases of ATSDR and EPA air sampling and used to create 12- and 24-hour wind roses. These data were collected by the Pennsylvania Department of Environmental Protection (PADEP) with their portable meteorological station, located on Jaspen Way, in close proximity to sampling location "Site 5/EPA 1." The PADEP collected wind speed and direction using a stand-alone Climatronics Sonimometer™ with a Campbell Scientific CR200W datalogger and associated software. The monitor was mounted on a tripod to raise the anemometer to at least 2 meters above the ground, and was located in the front yard of a residence along Jaspen Way. Wind speed and direction was logged hourly and daily wind roses were developed with these data by EPA APD staff. EPA APD staff also reviewed the wind direction and speed data to determine the quality of the wind data. Suspect hourly weather data was removed from the overall data set and replaced by wind speed and direction data from the nearest permanent weather monitoring station, the Pittsburgh International Airport, located approximately 15 miles north of the site.

Exposure Pathways and ATSDR's Evaluation Process

ATSDR evaluates whether people may have come into contact with chemicals from a site by examining *exposure pathways*. Exposure pathways consist of five elements: a contamination *source*; *transport* of the contaminant through an environmental medium like air, soil, or water; an *exposure point* where people can come in contact with the contaminant; an *exposure route* whereby the contaminant can be taken into the body; and an *exposed population* of people actually coming in contact with site contaminants.

Completed exposure pathways are those for which all five pathway elements are evident. If one or more elements is missing or has been stopped (for example, by preventing transport of the chemical from the source to the exposure point), the pathway is *incomplete*. Exposure cannot occur for incomplete exposure pathways. For *potential* exposure pathways, exposure appears possible, but one or more of the elements is not clearly defined. A completed exposure pathway does not necessarily mean that harmful health effects will occur. A chemical's ability to harm health depends on many factors, including how much of the chemical is present, how long and how often a person is exposed to the chemical, and how toxic the chemical is. Further evaluation of the specific exposure occurring is needed to determine whether the exposure could cause harmful effects.

The process by which ATSDR evaluates the potential for adverse health effects to result from exposure to contaminants is described briefly below, focusing on the air pathway of concern for the community around the Brigich compressor station.

- ATSDR first screens air analytical results against chemical-specific comparison values (CVs). CVs are concentrations of chemicals in air below which no harmful health effects are expected to occur, even with continual exposure. If a chemical is present at a level higher than the corresponding CV, it does not mean that harmful health effects will occur, but the chemical is evaluated further. CVs may include values derived by ATSDR and values developed by other state, federal, or international organizations.
- For chemicals in air that exceed CVs, ATSDR compares the air concentrations with known health effect levels identified in ATSDR's toxicological profiles, EPA's Integrated Risk Information System, or other scientific literature. For cancer-causing substances, an

estimate of the increased risk of developing cancer from the exposure is calculated by multiplying the air concentration by an appropriate inhalation unit risk.

Analytical Data Review

Carbonyls (24-hour time-weighted sampling)

Schedule

Phase 1, carbonyl sampling was conducted every other day at six locations surrounding the site from July 7, 2012, through August 7, 2012, except at Site 2 and 6 where sampling began on July 13, 2012. Phase 1 collocated sampling at Site 1 began on July 10, 2012. Phase 2 carbonyl sampling was conducted on a twice-every-five-day schedule from August 11 to October 10, 2012 (see Appendix A for dates of sampling).

Completeness

Of the 259 total samples collected, only 111 sample results were validated, all from Phase 1 of sampling. Sixty-two (62) of the valid carbonyl sample results were field samples; the remaining sample results were analyzed as part of the Phase 1 quality assurance program. Based on the data quality objectives for this EI, the Phase 2 carbonyl data set failed to meet its target of 80% data capture or greater, due to the absence of valid analytical results. Therefore, ATSDR provides evaluations, conclusions and recommendations only for the valid carbonyl data captured in Phase 1, while recognizing limitations in interpreting temporally limited data due to the incomplete Phase 2 sampling program effort.

Carbonyl Results

ATSDR screened the maximum concentrations against health-based comparison values (CVs). Table 2 provides the maximum detected concentrations and health-based CVs. Appendix B provides graphs of carbonyl compound concentrations by date and sampling location.

Table 2
Carbonyl Results and Health-Based Comparison Values (ppb)

Carbonyl Compound	Maximum Concentration	Health-based CV	CV Source
Formaldehyde	5.83	0.06/8	ATSDR CREG/ Chron MRL
Glutaraldehyde	0.011	0.05	TCEQ Long ESL
Crotonaldehyde	0.632	0.3	TCEQ Long ESL
Isovaleraldehyde	0.012	50	TCEQ Long ESL
Propionaldehyde	0.282	3.4	EPA RfC
Acetaldehyde	1.41	0.25/5	ATSDR CREG/RfC
Hexaldehyde	0.104	200	TCEQ Long ESL
Tolualdehyde	0.103	2.1	TCEQ Long ESL
2-butanone (MEK)	0.322	1,700	RfC
2,5-dimethylbenzaldehyde	0.032	2	TCEQ Long ESL
Benzaldehyde	0.065	2	TCEQ Long ESL

Carbonyl Compound	Maximum Concentration	Health-based CV	CV Source
Valeraldehyde	0.064	50	TCEQ Long ESL
Butyraldehyde	0.203	10	TCEQ Long ESL
Acetone (propanone)	2.18	13,000	ATSDR Chron MRL

Notes: All results and CVs in parts per billion (ppb); CV = Health-based comparison value; CREG = ATSDR cancer risk evaluation guideline; Chron MRL = ATSDR chronic exposure minimal risk level TCEQ ESL = Texas Commission on Environmental Quality Effect Screening level; RfC = EPA reference concentration

Carbonyls Identified as Contaminants of Potential Concern (COPC)

Three carbonyls exceeded health-based CVs: acetaldehyde, crotonaldehyde, and formaldehyde. Specifically, acetaldehyde and formaldehyde exceeded their ATSDR CREGs of 0.25 and 0.06 ppb, respectively, and crotonaldehyde exceeded the TCEQ long-term ESL of 0.03 ppb. Average crotonaldehyde concentrations exceeded the TCEQ long-term ESL of 0.3 ppb at two sampling locations (Site 1 at 0.309 ppb and Site 2 at 0.301 ppb) and (2) average acetaldehyde and formaldehyde concentrations exceeded their respective ATSDR CREGs at all sampling locations. These chemicals are considered contaminants of potential public health concern (COPC) and are further evaluated in the Toxicological Implications section below.

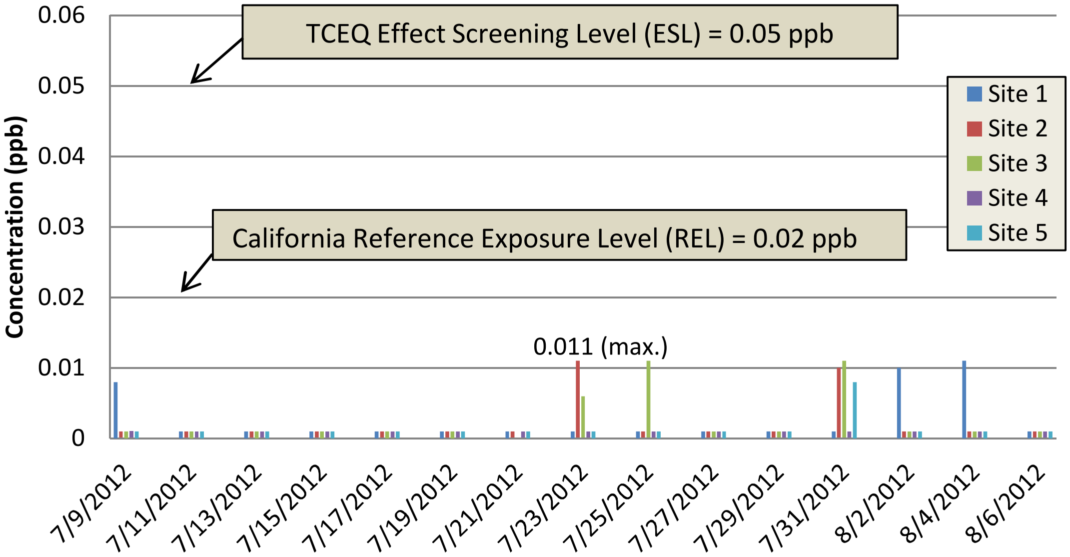
Glutaraldehyde

Glutaraldehyde was positively detected in 9 of the 64 field samples collected (14%) at the residential sampling locations. To screen the sampling results for this chemical, ATSDR used the TCEQ ESL of 0.05 ppb and the California Reference Exposure Level (REL) of 0.02 ppb for long-term/chronic exposures. The maximum 24-hour glutaraldehyde concentration detected during this investigation (0.011 ppb) is below these comparison values (see Figure 2).

Glutaraldehyde is a man-made chemical used commonly as a biocide by the upstream natural gas extraction industry (FracFocus 2014). It is known to produce acute respiratory symptoms from short and intermittent exposures (NJDOH 2000). NIOSH (2015) notes that airborne exposures to glutaraldehyde can cause eye, skin, and respiratory tract irritation; allergic response; shortness of breath; and headache. NIOSH also notes that glutaraldehyde exposures have been associated with the development of occupational asthma via sensitization, and cases of occupational asthma have occurred after exposure far below existing occupational exposure levels (<50-200 ppb). Some studies have shown that glutaraldehyde at concentrations less than 100 ppb are possible, but unlikely, to cause acute respiratory effects and chemical sensitization (NLM 2014). Residents living in close proximity to natural gas infrastructure (e.g. compressors) have reported experiencing transient respiratory symptoms (e.g. irritation, runny eyes and nose, bloody nose) consistent with acute exposures to carbonyls and this population may be sensitive to aldehyde (including glutaraldehyde) inhalation exposures. Sites 1 and 3 each had three detections of glutaraldehyde; site 2 had two detections and site 5 had one detection of glutaraldehyde. Due to (1) the abundance of natural gas infrastructure in the immediate area, and (2) no clear correlation between wind direction, positive offsite detections and direction from the compressor, it is not possible to conclusively identify the Brigich compressor as the source of glutaraldehyde detected in the ambient air during this investigation.

The maximum glutaraldehyde concentration detected in this data set was 0.011 ppb. As described above, glutaraldehyde can cause health effects from brief, intermittent exposures, though this is not expected from exposures to the low air concentrations detected during this EI. However, this EI did not determine air concentrations for time periods shorter than 24 hours for carbonyls, including glutaraldehyde. To determine the potential public health implications of glutaraldehyde in this community (given its presence has now been confirmed), further assessment is recommended because this EI has important limitations (e.g. 15 days of sampling during late summer/fall, 24 hour averaged sample results). Air modeling of the limited glutaraldehyde data set may also provide additional information about shorter duration peak ambient air exposures.

Figure 2
Glutaraldehyde Detections and Health-Based Comparison Value



Carbonyls Summary

The maximum one day combined carbonyls exposure concentration was 8.70 ppb, detected on August 4, 2012 at Site 1. On this date, formaldehyde was 5.83 ppb, comprising 67% of the total carbonyls exposure concentration. The maximum average combined carbonyls concentration for the 15 days of sampling was 5.74 ppb at Site 5.

Hydrogen Sulfide

Schedule

Hydrogen sulfide (H_2S) was continuously monitored during both phases of the EI, yielding 5-minute airborne H_2S concentrations. Except during brief time periods when monitors required maintenance, valid H_2S measurements were collected at all sites during both phases of the EI. For specific details on H2S monitor downtimes, see the EI Field Reports attached to this document.

Completeness

During phase 1, measurement completeness for H_2S ranged from 92.5% at Site 3-collocated to 99. 8% at Site 2, with an overall program completeness of 97.5%. The program data quality objective (DQO) of 80% data capture was exceeded for all monitoring locations during phase 1. During phase 2, measurement completeness for H_2S ranged from 79.0% at Site 2 to 99.8% at Site 1, with an overall program completeness of 92.8%. Except for Site 2, the program DQO of 80% data capture was exceeded for all monitoring locations throughout phase 2. Of the 412,687 possible H2S measurements, 396,148 measurements were considered valid for a 96% overall measurement completeness.

Hydrogen Sulfide Results

Hydrogen sulfide monitoring was performed in two phases using single point monitors with lower detection limits of 3 ppb and upper detection limits of 90 ppb. Concentrations below 3 ppb and above 90 ppb were reported during both phases of monitoring and these data are considered estimated concentrations. Estimated data below 3 ppb were included in calculating the average daily concentrations and overall site concentrations during both phases of monitoring. When determining average concentrations, non-detections reported as zero ppb were treated as zero ppb. It is important to note that the upper detection limit of 90 ppb was recorded on the monitors on at least 5 occasions, but only one time was the result considered valid. Four of the readings above 90 ppb were considered invalid after further review identified a fault in the monitoring equipment. On September 13, 2012, Site 3 monitor recorded a maximum H_2S concentration of 92.8 ppb, but the actual maximum concentration on this date is not known and could have been higher.

H_2S was detected at each site during Phase 1. The average H_2S concentration during the entire phase 1 time period for each site ranged from 0.53 to 0.89 ppb. Average 24-hour concentrations in phase 1 ranged from non-detect up to 2.77 ppb. The maximum 5-minute H_2S result of 55.8 ppb during Phase 1 was detected on July 25, 2012 at Site 3, also where the maximum 24-hour detection was identified. The maximum daily and overall average H_2S concentrations for each monitoring location are provided in Appendix B, Table 1 and Figure 19.

H_2S was detected at each site during Phase 2. The average H_2S concentration during the entire phase 2 time period for each site ranged from 0.13 to 1.16 ppb. Average 24-hour concentrations ranged from non-detect up to 13.8 ppb. The daily average H_2S concentration at Site 5 ranged from 1.46 to 1.61 ppb continuously for 10 straight days from August 12 to 21, 2012. The maximum instantaneous H_2S result of 92.8 ppb was detected on September 13, 2012 at Site 3, although this concentration exceeded the upper detection limit and the actual concentration may have been higher. This was the only occasion where there was a valid hydrogen sulfide concentration above 90 ppb (invalid 90 ppb exceedances were also recorded during equipment fault time periods. They are not included in this EI's data analysis). The maximum daily and overall average H_2S concentrations for each monitoring location are provided in Appendix B, Table 2 and Figure 20.

Average H_2S concentrations did not exceed the intermediate exposure CV (ATSDR MRL of 20 ppb for 15 to 364 days) or chronic exposure CV (EPA RfC of 1.4 ppb for over 364 days). Shorter duration peak concentrations were detected above the ATSDR acute MRL of 70 ppb at Sites 1 and 3. The PADEP 24-hour average concentration of 5 ppb was exceeded once (Site 1 on 9/5/2012 at 13.8 ppb). Based on exceedances of health-based comparison values, H_2S is considered a contaminant of concern and is further evaluated below.

Reduced Sulfur Compounds

Schedule

Reduced sulfur compound sampling capturing 24-hour average concentrations was conducted on a twice-every-five day schedule from August 7 to October 6, 2013. In total for Sites 1 through 5, there were 151 sulfur compound samples collected and analyzed, including primary samples, primary/collocated pairs and field/trip blanks. In addition, 8 judgmentally-based grab samples were collected and analyzed. The grab samples were collected based on hydrogen sulfide single point monitor (SPM) readings or conditions observed on site (i.e., odor, smoke/flame at Compressor Station).

Completeness

During phase 2 (the only phase of reduce sulfur compound assessment), there were 159 reduced sulfur compound samples collected including primary samples, primary/collocated pairs, field/trip blanks, and grab samples. All samples were analyzed and validated, yielding 100% measurement completeness for the EI program's sulfur compound samples. The 159 reduced sulfur compound samples included:

- 112 field samples
- 13 primary and collocated sample pairs (26 samples)
- 13 trip/field blanks
- 8 grab samples

Reduced Sulfur Compound Results

Of the 159 samples collected for sulfur compounds analysis, no compounds were detected above their reporting limits.

An important note about reduced sulfur compound analysis

Protocols for field sampling and for the evaluation and validation of analytical results were developed by EPA ERT specifically for this project. Since reduced sulfur compounds at or above the reporting limit were not detected, the relative percent difference (RPD) values, which is the measurement for precision, could not be calculated.

All of the samples collected in the Silonite-lined SUMMA canisters used in this investigation were collected, transported, and analyzed within the proposed 3-day holding time. However, due to the effect of humidity, the RSCs may not have recovered as efficiently as expected from the Silonite-lined SUMMA canisters. Even with short holding times, it has been shown that H_2S and mercaptans (both RSCs) are hard to recover from lined cans, even at humidities as low as 30% (Robinson 2011). Essentially, moisture can be problematic because RSCs can react with the canister lining, even lined canisters like those used in this EI. Thus, it is not certain whether the collected samples were representative of field conditions. Also, the laboratory reporting limits for 12 compounds were above the lowest CV, creating uncertainty about whether RSCs not detected above their detection limit actually exceeded a CV or not.

Therefore, ATSDR did not use the RSC data (non-detections) for public health conclusions in this report. Representative RSC data at low enough detection limits remain an important data gap for assessment of ambient air near the Brigich Compressor Station.

VOCs

Schedule

Volatile organic compound (VOC) sampling was completed by EPA APD over a 4 month period starting on August 4, 2012 and concluding on November 28, 2012. Valid samples were collected to determine average concentrations over 24-hour sampling periods from three locations surrounding the compressor on thirty-nine (40) days over the four month time period (see Appendix A, Table 5). Samples were shipped in 10 separate batches for laboratory analyses following EPA Method TO-15.

Completeness

The target for completeness set by the EPA APD in their site-specific quality assurance project plan (QAPP) was met when 30 valid samples were collected and analyzed for each site location. Although some samples were rejected because they did not meet field or laboratory quality control measures, EPA APD attained 100% measurement completeness for the NGAAMI program's volatile organic compounds assessment after samples collected on November 28, 2012 were analyzed and validated. A total of 148 valid VOC samples (by EPA method TO-15) were evaluated in this health consultation.

VOC Results

Sampling by APD identified a number of VOCs in air surrounding the Brigich compressor. A full summary of the positive detections is provided in Appendix B. A number of VOCs were also detected at the background sampling location (Florence, PA). Table 7 provides a summary of the VOCs that were detected in the field sample and exceed health-based comparison values. These chemicals are considered COPCs and are further evaluated in the Toxicological Implications section below. 1-Bromo-4-Fluorobenzene (bromofluorobenzene) was detected in each sample analyzed at the laboratory due to its use as a surrogate chemical by the laboratory. Although the concentration of this chemical exceeds the CV, it is not considered to be a positive detection from field sampling or a COPC, but simply a laboratory contaminant.

Table 3
VOCs exceeding comparison values (ppb)

Chemical	Maximum Concentration	CV	CV source	Number of CV exceedances (location)	
				Site	Background
Benzene	0.8	0.04/3	CREG/ Chron MRL	104	26
Carbon tetrachloride	0.2	0.03/30	CREG/ Chron MRL	7	1
Chloroform	0.6	0.009/20	CREG/ Chron MRL	4	1
1,2-Dichloroethane	1.2	0.0095/600	CREG/ Chron MRL	5	0
1-Methoxy-2-propanone	10	3.4	TCEQ Long Term ESL	3	2
1,1,2-Trichloroethane	0.2 J	0.01	CREG	1	0

Notes: ESL = Effect screening level; ppb = parts per billion; VOC = volatile organic compound; CREG = ATSDR cancer risk evaluation guideline; TCEQ = Texas Commission on Environmental Quality; CV = health-based were collected and analyzed. The grab samples were collected based on hydrogen sulfide single point monitor (SPM) readings or conditions observed on site (i.e., odor, smoke/flame at Compressor Station).

Completeness

During phase 2 (the only phase of reduce sulfur compound assessment), there were 159 reduced sulfur compound samples collected including primary samples, primary/collocated pairs, field/trip blanks, and grab samples. All samples were analyzed and validated, yielding 100% measurement completeness for the EI program's sulfur compound samples. The 159 reduced sulfur compound samples included:

- 112 field samples
- 13 primary and collocated sample pairs (26 samples)
- 13 trip/field blanks
- 8 grab samples

Reduced Sulfur Compound Results

Of the 159 samples collected for sulfur compounds analysis, no compounds were detected above their reporting limits.

An important note about reduced sulfur compound analysis

Protocols for field sampling and for the evaluation and validation of analytical results were developed by EPA ERT specifically for this project. Since reduced sulfur compounds at or above the reporting limit were not detected, the relative percent difference (RPD) values, which is the measurement for precision, could not be calculated.

All of the samples collected in the Silonite-lined SUMMA canisters used in this investigation were collected, transported, and analyzed within the proposed 3-day holding time. However, due to the effect of humidity, the RSCs may not have recovered as efficiently as expected from the Silonite-lined SUMMA canisters. Even with short holding times, it has been shown that H_2S and mercaptans (both RSCs) are hard to recover from lined cans, even at humidities as low as 30% (Robinson 2011). Essentially, moisture can be problematic because RSCs can react with the canister lining, even lined canisters like those used in this EI. Thus, it is not certain whether the collected samples were representative of field conditions. Also, the laboratory reporting limits for 12 compounds were above the lowest CV, creating uncertainty about whether RSCs not detected above their detection limit actually exceeded a CV or not.

Therefore, ATSDR did not use the RSC data (non-detections) for public health conclusions in this report. Representative RSC data at low enough detection limits remain an important data gap for assessment of ambient air near the Brigich Compressor Station.

comparison value; J = Compound detected, result is estimated; Chron MRL = ATSDR chronic minimal risk level

BTEX (Benzene, toluene, ethylbenzene, xylenes)

BTEX are commonly emitted from compressor stations as fugitive emissions and from combustion exhaust emissions from engines (e.g. farming equipment, automobiles) and equipment used on site (e.g. compressors, generators). Additionally, glycol dehydrators have been identified as a source of BTEX emissions at natural gas compressor stations. Therefore, BTEX compounds are of particular interest in this evaluation and further discussed below.

ATSDR compared the overall results from the three sampling points surrounding the Compressor Station to the results at the background site (Florence, PA) and found that each of the BTEX compounds were higher within the community than at the background site (see Table 8). Though none of the BTEX compounds exceed their respective non-cancer CVs, benzene exceeds its cancer-based CV and is further discussed in the Toxicological Implications section below.

Table 4
BTEX Summary for Site and Background
Average concentration of positive detections* (ppb)

Compound	Units	Average Concentration (Sites 1, 2, and 3)	Average Concentration (Background§)	Difference
Benzene	ppb	0.43 (n=120)	0.31 (n=25)	+0.12
Toluene	ppb	3.18 (n=140)	3.06 (n=31)	+0.12
Ethylbenzene	ppb	0.59 (n=9)	0.4 (n=2)	+0.19
m, p-Xylenes	ppb	1.09 (n=22)	0.77 (n=3)	+0.32
o-Xylene	ppb	0.41 (n=16)	0.40 (n=1)	+0.01

Notes: Includes estimated concentrations below detection limits. Difference is site concentration minus background concentration; BTEX = benzene, toluene, ethylbenzene, xylenes; n = number of samples, ppb = parts per billion, § Background is the Florence COPAMS location.

PM$_{2.5}$

Schedule

PM$_{2.5}$ sampling, to determine 24-hour average concentrations, was completed by EPA APD over a 4 month period starting on August 4, 2012 and concluding on November 25, 2012. Valid samples were collected on thirty-five days over the four month time period (see Table 11) from one sampling point (EPA 1/Site 2) located in the dominant downwind direction from the Compressor Station. Samples were delivered to the Allegheny County laboratory for weight analysis following the gravimetric method.

Completeness

The target for completeness set by the EPA APD in their site-specific QAPP was met when 30 valid samples were collected and analyzed. Although some samples were rejected because they did not meet field or laboratory quality control measures, EPA APD attained 100% measurement completeness for the PM$_{2.5}$ assessment after samples collected on November 15, 2012 were weighed and validated. A total of 35 valid PM$_{2.5}$ samples (see Table 11), following the gravimetric method, were evaluated in this health consultation.

PM$_{2.5}$ Results

PM$_{2.5}$ concentrations ranged from 1.0 to 26.5 µg/m^3 (see Table 11), with an average ambient air concentration of 12.4 µg/m^3 for all of the sampling days combined. There was no apparent correlation between wind direction and $PM_{2.5}$ concentration.

$PM_{2.5}$ daily concentrations did not exceed the EPA 24-hour standard of 35 µg/m^3. However, the overall average $PM_{2.5}$ concentration of 12.4 µg/m^3 documented over the four month sampling period numerically exceeded the EPA annual primary standard of 12 µg/m^3 (EPA 2012). For this reason, $PM_{2.5}$ is held as a COPC and is further discussed in the toxicological implications section.

Table 5
$PM_{2.5}$ Summary

Date	Concentration (µg/m^3)	Day of week	Primary Wind Directions (from)
8/4/2012	22.3	Saturday	80% South (S)
8/7/2012	17.7	Tuesday	80% West northwest (WNW)
8/10/2012	13.7	Friday	80% West (W)
8/13/2012	15.6	Monday	80% W
8/16/2012	21.4	Thursday	80% W
8/19/2012	1.0	Sunday	80% Northeast (NE)
8/22/2012	16.8	Wednesday	80% Northwest (NW)/NE
8/28/2012	15.2	Tuesday	80% NW
8/31/2012	15.8	Friday	80% W
9/3/2012	13.7	Monday	80% East (E)
9/6/2012	18.9	Thursday	80% WNW
9/9/2012	10.6	Sunday	80% NW
9/12/2012	13.9	Wednesday	Variable
9/15/2012	12.2	Saturday	40% NW, 40% NE
9/19/2012	6.4	Wednesday	75% WNW
9/22/2012	14.5	Saturday	80% W
9/25/2012	10.6	Tuesday	No data
9/28/2012	11.2	Friday	No data
9/30/2012	10.2	Sunday	75% East northeast (ENE)
10/3/2012	12.8	Wednesday	96% W
10/6/2012	5.8	Saturday	Variable
10/9/2012	10.0	Tuesday	40% Southwest (SW), 40% Southeast (SE)
10/12/2012	8.4	Friday	70% NE
10/15/2012	5.5	Monday	70% SE
10/17/2012	26.5	Wednesday	40% SW, 53% East southeast (ESE)
10/19/2012	9.1	Friday	Variable
10/22/2012	16.0	Monday	60% West southwest (WSW), 30% SE
10/25/2012	16.1	Thursday	75% SW, 25% E
10/28/2012	0.9	Sunday	100% ENE
10/31/2012	1.6	Wednesday	80% WSW
11/3/2012	5.0	Saturday	100% W
11/6/2012	10.2	Tuesday	Variable

Date	Concentration ($\mu g/m^3$)	Day of week	Primary Wind Directions (from)
11/9/2012	18.6	Friday	50% SE, 30% W
11/12/2012	11.2	Monday	53% SW, 32% SE
11/15/2012	15.9	Thursday	40% NW, 40% NE

Average Concentration: 12.4 $\mu g/m^3$

Discussion

Human Health Exposure Pathway
Exposure to environmental contamination cannot occur unless there is a completed exposure pathway. A completed exposure pathway exists when all of the following five elements are present: 1) a source of contamination; 2) transport through an environmental medium; 3) a point of exposure; 4) a route of human exposure; and 5) an exposed population. Based on the data available to ATSDR at this time, one relevant exposure pathway for residents living in Chartiers Township is inhalation of ambient air impacted by the Brigich Compressor Station. It is important to note here that this EI was not designed to exclusively evaluate the emissions from the Brigich Compressor Station, but instead to evaluate the overall air quality in the community surrounding it, with a specific focus on suspected contaminants which may be released by the Brigich Compressor Station.

ATSDR evaluates both non-cancer and cancer health effects. In order to evaluate the potential for non-cancer adverse health effects from exposure to contaminated media (i.e., soil, water, and air), a dose is estimated for each contaminant of concern. Doses are calculated for situations in which people might come into contact with the contaminated media. The estimated dose for each contaminant of concern under each situation is then compared to ATSDR's minimal risk level (MRL). For inhalation exposures, the concentration in air is compared to EPA's inhalation reference concentration (RfC) to determine if there is a potential for non-cancer adverse health effects. MRLs and RfCs are derived from toxic effects levels obtained from human and animal laboratory studies; they are not toxic effect levels themselves. Effects levels are expressed as either the lowest adverse effect level (LOAEL) or the no-observed adverse effect level (NOAEL). In human or animal studies, the LOAEL is the lowest dose at which an adverse effect is seen; the NOAEL is the highest dose that did not result in any adverse human health effect. To account for uncertainty, the toxic effect levels are divided by uncertainty factors (10, 100, or 1,000) to derive an MRL or RfC. If a dose exceeds the MRL or RfC, the potential for adverse health effects increases. However, it does not mean that an adverse effect may occur. In general, the higher the estimated dose is above the MRL or RfC, the closer it will be to an adverse effect level.

In order to estimate the risk of cancer from exposure to specific chemicals, ATSDR calculates an exposure dose as described above and multiplies that dose by the EPA cancer slope factor, resulting in an estimated excess lifetime cancer risk of 10^{-6}. Exposure to a chemical averaged over a 78 year lifetime that results in an estimated increased cancer risk of one additional cancer in a population of one million exposed people is considered an acceptable risk, and is the lower bound of EPA's target cancer risk range. The EPA target risk range falls between one excess cancer in 10,000 exposed individuals to one excess cancer in 1,000,000 exposed individuals. For reference, the American Cancer Society notes that U.S. women have a one in three chance (38%)

and U.S. men have a one in two (44%) chance of developing cancer in their lifetime (ACS 2013).

ATSDR compared the overall results from the three sampling points surrounding the Compressor Station to the results at the background site (Florence, PA) for VOCs and $PM_{2.5}$. Of these analytes, BTEX compounds were higher within the community than at the background site.

Health Implications of Exposure to COPCs

Nine (9) chemicals have been detected in ambient air during this EI that exceed their respective CVs, specifically the ATSDR CREG (acetaldehyde, benzene; formaldehyde; carbon tetrachloride; chloroform; 1,2-DCA; and, 1,1,2-Trichloroethane) or the TCEQ long-term Effect Screening Level or ESL (crotonaldehyde and 1-methoxy-2-propanone). The TCEQ long-term ESL is a health-based screening value based on chronic (one year or more) exposure scenarios. These chemicals are considered COPCs and the community's exposure and toxicological implications are assessed in this section.

Acetaldehyde

Acetaldehyde is produced and used in the manufacture of a variety of chemicals and also present in effluent from pulp mills, auto exhaust, tobacco smoke, and from power plants using fossil fuels, wood or trash (NLM 1995). Acetaldehyde is found in plants since it is an intermediate product of respiration in higher plants. Acetaldehyde is a natural product of combustion and photo-oxidation of hydrocarbons commonly found in the atmosphere; it also is an intermediate product in the metabolism of ethanol and sugars. Acetaldehyde is used in perfumes and fragrances, synthetic flavorings, food preservatives, aniline dyes, plastics, glue products, synthetic rubber, silvering mirrors, fuel mixtures, and cosmetics (NLM 1995). The primary adverse health effect associated with acetaldehyde is irritation of the eyes and respiratory tract. The non-cancer comparison value of 5 parts per billion (ppb) is based on studies where degeneration of the olfactory epithelium was observed in rats exposed to a human equivalent dose (HED) of 8,700 $\mu g/m^3$. Acetaldehyde is characterized by EPA as a probable human carcinogen based on an increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure (EPA 1991), and reasonably anticipated to be a carcinogen by the National Toxicology Program (NTP).

Acetaldehyde was detected at each sampling location during this EI, with 24-hour concentrations ranging from 0.24 to 1.41 ppb. The average concentration for each sampling location during this EI ranged from 0.64 ppb (Site 4) to 0.86 ppb (Site 5).

Non-Cancer Exposure Evaluation

The maximum concentration of acetaldehyde detected during this EI was below the CV of 5 ppb. Therefore, non-cancer health effects from the levels detected in this EI are not expected.

Cancer Exposure Evaluation

The ATSDR CREG for acetaldehyde is 0.25 ppb. Chronic exposures to acetaldehyde at or below 0.25 ppb are considered to be very low risk, which equates to less than one additional cancer among a population of one million exposed individuals. Chronic exposures to acetaldehyde at concentrations greater than 27 ppb would result in an estimated increased risk of one additional cancer per 10,000 exposed individuals. To estimate excess lifetime cancer risk from exposure to acetaldehyde at the levels detected during this EI, the average exposure concentration is multiplied by the EPA inhalation unit risk. The EPA inhalation unit risk for acetaldehyde is

0.0000022 $(\mu g/m^3)^{-1}$ (EPA 1991). Estimated excess lifetime cancer risk from exposures to acetaldehyde at the average levels detected at each sampling location during this EI (0.64 to 0.86 ppb) are slightly above one excess cancer in one million exposed individuals; a level which falls within the lower end of the EPA target cancer risk range. The cancer risk from exposure to acetaldehyde at the levels detected in this EI is not considered to be of public health concern.

Acetaldehyde excess cancer risk*

Acetaldehyde concentration x inhalation unit risk = excess lifetime cancer risk

0.86 ppb x 0.0000022 $(\mu g/m^3)^{-1}$ = 1.58 $\mu g/m^3$ x 0.0000022 $(\mu g/m^3)^{-1}$ = 0.0000019= 1.9×10^{-6}

Note: 0.86 ppb benzene is equal to 1.58 $\mu g/m^3$ benzene; *assumes 78 years of daily exposure for 24 hours per day; $\mu g/m^3$ = micrograms per cubic meter; ppb = parts per billion

Benzene

People are exposed to benzene in the outdoor environment, in the workplace, and in the home. Exposure of the general population to benzene mainly occurs through breathing air that contains benzene. The major sources of benzene exposure are tobacco smoke, gas station gas pump emissions, exhaust from motor vehicles, and industrial emissions (ATSDR 2007). Vapors (or gases) from products that contain benzene, such as glues, paints, furniture wax, and detergents, can also be a source of exposure. Automobile exhaust and industrial emissions account for about 20% of the total national exposure to benzene. As noted previously in this document, benzene is a common fugitive emission and combustion-byproduct at natural gas compressor stations. About half of the exposure to benzene in the United States results from smoking tobacco or from exposure to tobacco smoke. The average smoker (32 cigarettes per day) takes in about 1.8 milligrams (mg) of benzene per day. This amount is about 10 times the average daily intake of benzene by nonsmokers (ATSDR 2007).

Typically measured levels of benzene in outdoor air have ranged from 0.02 to 34 parts of benzene per billion parts of air (ppb). People living in cities or industrial areas are generally exposed to higher levels of benzene in air than those living in rural areas. Benzene levels in the home are usually higher than outdoor levels. People may be exposed to higher levels of benzene in air by living near hazardous waste sites, petroleum refining operations, petrochemical manufacturing sites, or gas stations (ATSDR 2007). In the community surrounding the Brigich Compressor Station, an average ambient benzene concentration was 0.432 ppb, based on a total of 120 positive detections from all sampling locations. At the background sampling location, the average benzene concentration was 0.313 ppb was calculated, based on 25 positive detections. Based on the data collected for this study, the Chartiers Township community's ambient benzene concentration was 0.119 ppb higher than the Florence regional air quality background location sampled during this EI.

ATSDR's current chronic EMEG/MRL for benzene is 3 ppb; this concentration of benzene in air is unlikely to be associated with any appreciable risk of adverse, non-cancer effects for more than one year of continuous exposure. For cancer effects, ATSDR has derived a benzene CREG of 0.04 ppb based primarily on studies of U.S. workers exposed to high levels of benzene (up to hundreds of thousands of ppb) during rubber manufacturing. It is based on an EPA-estimated cancer slope factor which is in turn based on the assumption of a linear dose-response relationship; that is, the proportion of effects seen at the high dose range will be the same at the low-dose range where the effects are not measurable.

Non-Cancer Exposure Evaluation

None of the detected benzene results exceed the ATSDR EMEG/MRL of 3 ppb. Therefore, non-cancer health effects from the levels detected in this EI are not expected and are not of public health concern.

Cancer Exposure Evaluation

Benzene is a known human carcinogen and is leukemogenic. Occupational-level benzene exposures have been specifically linked to acute myelocytic leukemia (AML). The lowest human effect levels reported in ATSDR's Toxicological Profile for Benzene (ATSDR 2007) are 300 ppb for leukemia (Ott et al. 1978) and 570 ppb for reduced white blood cell and platelet counts (Lan et al. 2004). These values (570 ppb and 300 ppb) represent the lowest measured concentrations in a range of workplace measurements from the two studies (300–35,000 ppb and 570–28,000 ppb, respectively). Use of the lowest measured concentration as an indicator of exposure in the facilities is conservative and underestimates actual exposures.

In some epidemiological and toxicological studies, estimates of benzene exposure were converted to 1000, ppb-years, i.e., average benzene levels in thousands of parts per billion (ppb), multiplied by exposure duration in years, to compare with reported occupational health effects on an equivalent basis. For example, a worker exposed to 2,000 ppb for 20 years and another one exposed to 20,000 ppb for 2 years both received the same cumulative exposure (i.e., 40,000 ppb-years). Epidemiologic data have suggested that there are thresholds for leukemia. Available studies indicate no detectable excess of leukemia below cumulative exposures of 40,000 ppb-years (Rinsky et al 1987). This would be numerically, if not biologically, equivalent to about 190 ppb, 24 hours a day, over a 70-year lifetime. However, this apparent threshold is most likely an underestimate because it is based on underestimated exposures and the inclusion of all leukemia, not just AML. When only AML is considered, the estimated threshold was found to be at least 200,000 ppb-years (numerically equivalent to 950 ppb, 24 hours a day, over a 70-year lifetime); note, however, that this is based on re-analysis by industry consultants of the original set of exposure estimates (Paustenbach et al 1992; Wong 1995).

The maximum exposure concentration of 0.8 ppb detected in this EI is well below the lowest human effect levels reported in ATSDR's benzene toxicological profile (300 ppb). Based on the average (0.432 ppb) and maximum (0.8 ppb) benzene concentrations detected in this EI, cumulative lifetime benzene exposures are 30.24 and 56 ppb-years, respectively. The calculated cumulative lifetime benzene exposures for this community are well below the threshold of 40,000 ppb-years discussed above for the "all leukemias" health end points.

To quantify the excess lifetime cancer for residents exposed to ambient benzene at the levels detected in this EI, the average concentration of benzene is multiplied by the inhalation unit risk. In this case the average concentration of 0.432 ppb (1.41 $\mu g/m^3$) is multiplied by 7.8E-06 $(\mu g/m^3)^{-1}$. The resulting estimated excess cancer risk value for 78 years of continuous exposure to the average benzene level detected is 1.1 additional cancers per 100,000 exposed individuals (1.09E-5). Just over one excess cancer per 100,000 exposed individuals falls within EPA's acceptable cancer risk range. Therefore, there is a low increased risk of carcinogenic effects from ambient air benzene exposures in this community.

Estimated benzene excess cancer risk*

Benzene concentration x inhalation unit risk = excess lifetime cancer risk

$$\mathbf{0.432\ ppb \times 0.0000078\ (\mu g/m^3)^{-1} = 1.41\ \mu g/m^3 \times 0.0000078\ (\mu g/m^3)^{-1} = 0.0000109 = 1.1\times10^{-5}}$$

Note: 0.432 ppb benzene is equal to 1.41 µg/m^3 benzene; *assumes 78 years of daily exposure for 24 hours per day; µg/m^3 = micrograms per cubic meter; ppb = parts per billion

Carbon Tetrachloride

Carbon tetrachloride is a clear liquid that evaporates very easily. Most carbon tetrachloride that escapes to the environment is therefore found as a gas. Carbon tetrachloride does not easily burn. Carbon tetrachloride has a sweet odor, and most people can begin to smell it in air when the concentration reaches 10,000 ppb or 10 parts per million (ppm). Carbon tetrachloride is a manufactured chemical and does not occur naturally in the environment. In the past, carbon tetrachloride was widely used as a cleaning fluid (in industry and dry cleaning establishments as a degreasing agent, and in households as a spot remover for clothing, furniture, and carpeting). Carbon tetrachloride was also used in fire extinguishers and as a fumigant to kill insects in grain. Most of these uses were discontinued in the mid-1960s. Until recently, carbon tetrachloride was used as a pesticide, but this was stopped in 1986 (ATSDR 2005).

Very low background levels of carbon tetrachloride are found in air, water, and soil because of past and present releases. Concentrations in air of 0.1 ppb are common around the world, with somewhat higher levels often found (0.2 - 0.6 ppb) in cities (ATSDR 2005).

Carbon tetrachloride was detected at 0.2 ppb seven times in site samples and once at the background sampling location. These concentrations fell between the detection limit of 0.015 ppb and the reporting limit of 0.5 ppb, resulting in all validated carbon tetrachloride results being qualified by the laboratory as approximate concentrations. The concentrations detected in all site samples are within the normal background concentrations found around the world and at the lower concentrations found in cities.

Non-Cancer Exposure Evaluation

The non-cancer CV for chronic exposure to carbon tetrachloride is 30 ppb. The maximum concentration detected during this EI was below the non-cancer chronic exposure CV of 30 ppb. Therefore, adverse non-cancer health effects are not expected from inhalation exposures to carbon tetrachloride at the levels detected in this EI.

Cancer Exposure Evaluation

The ATSDR CREG for carbon tetrachloride is 0.026 ppb. Chronic exposures to carbon tetrachloride at or below 0.026 ppb are considered to be very low risk (1 additional cancer among a population of one million exposed individuals). Chronic exposures to carbon tetrachloride at concentrations greater than 2.65 ppb would result in unacceptable cancer risk to the exposed population (greater than one cancer per 10,000 exposed individuals). Estimated excess lifetime cancer risk from exposures to carbon tetrachloride at the levels documented in this EI are between one excess cancer in one million and one excess cancer in 100,000 exposed individuals; a level which falls within the lower end of the acceptable EPA cancer risk range. Therefore, the cancer risk from exposure to carbon tetrachloride at the levels detected in this EI is not considered to be of public health concern.

Estimated carbon tetrachloride excess cancer risk[*]

Carbon tetrachloride concentration x inhalation unit risk = excess lifetime cancer risk

0.2 ppb x 0.000006 $(\mu g/m^3)^{-1}$ = 1.3 $\mu g/m^3$ x 0.000006 $(\mu g/m^3)^{-1}$ = 0.0000078= 7.8×10^{-6} = 1×10^{-5}

Note: 0.2 ppb carbon tetrachloride is equal to 1.3 $\mu g/m^3$ benzene; [*]assumes 78 years of daily exposure for 24 hours per day; $\mu g/m^3$ = micrograms per cubic meter; ppb = parts per billion

Chloroform

Chloroform is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. Most of the chloroform found in the environment comes from industry. It will only burn when it reaches very high temperatures. Chloroform was one of the first inhaled anesthetics to be used during surgery, but it is not used for anesthesia today. Chloroform enters the environment from chemical companies and paper mills. It is also found in waste water from sewage treatment plants and drinking water to which chlorine has been added. Chlorine is added to most drinking water and many waste waters to destroy bacteria. Chloroform can enter the air directly from factories that make or use it and by evaporating from water and soil that contain it. There are many ways for chloroform to enter the environment, so small amounts of it are likely to be found almost everywhere (ATSDR 1997).

Chloroform evaporates very quickly when exposed to air. Chloroform lasts for a long time in both the air and in groundwater. Most chloroform in the air eventually breaks down, but this process is slow. The breakdown products in air include phosgene, which is more toxic than chloroform, and hydrogen chloride, which is also toxic. Chloroform does not appear to build up in great amounts in plants and animals, but we may find some small amounts of chloroform in foods (ATSDR 1997).

In 1994, EPA reported the average chloroform background ambient air concentration of 0.04 ppb in the United States (Kelly *et al*. 1994).

During this EI, chloroform was detected in four of 118 samples (3.4%) ranging from 0.2 to 0.6 ppb (average concentration 0.38 ppb for positive detections) and once at the background sampling location (0.2 ppb). Each of these five results exceeded the ATSDR CREG of 0.009 ppb, but none exceeded the non-cancer CV of 20 ppb. The average site sampling concentration including all non-detect results (using 0.1 ppb to represent non-detection, which is half the laboratory detection limit) is 0.11 ppb.

Non-Cancer Exposure Evaluation

The maximum concentration detected in this EI was below the non-cancer chronic exposure CV of 20 ppb. Therefore, adverse non-cancer health effects are not expected from inhalation exposures to chloroform at the levels detected in this EI.

Cancer Exposure Evaluation

Based on animal studies, the Department of Health and Human Services (DHHS) has determined that chloroform may reasonably be anticipated to be a carcinogen. The International Agency for Research on Cancer (IARC) has determined that chloroform is possibly carcinogenic to humans (2B). The EPA has determined that chloroform is a probable human carcinogen (ATSDR 1997).

EPA has determined that although chloroform is likely to be carcinogenic to humans by all routes of exposure under high-exposure conditions that lead to cell death and regrowth in susceptible tissues. Specifically, EPA notes that their confidence in the cancer assessment for chloroform is rated as medium. This conclusion is based on a strong database in animals that supports the conclusion that cancer does not occur without antecedent cytotoxicity and regenerative hyperplasia, leading in turn to the conclusion that cancer risk is negligible at doses that do not result in cytotoxicity. Confidence in this conclusion is tempered by absence of direct studies in humans and by the finding that there are some positive results in studies on the mutagenicity of chloroform, even though the weight-of-evidence indicates that chloroform is not a strong mutagen and that a mutagenic mode of action is not likely to account for the cancer responses observed in animals (EPA 2001).

EPA is currently revising its guidelines for cancer risk assessment. Among other issues, EPA is looking closely at how to assess whether a postulated mode of action in adults is applicable to children. When the guidelines are final, EPA will consider their impact on existing health assessments on the EPA Integrated Risk Information System (IRIS).

While the EPA has expressed medium confidence in the chloroform cancer assessment database, they maintain the inhalation unit risk of 0.000023 per microgram per cubic meter on their website also expressed as 2.3E-5 $(\mu g/m^3)^{-1}$ (EPA 2001). To quantify the excess lifetime cancer for residents exposed to ambient chloroform at the levels detected in this EI, the average concentration of chloroform is multiplied by the inhalation unit risk, in this case the average concentration of 0.11 ppb (0.547 $\mu g/m^3$) is multiplied by 2.3E-5 $(\mu g/m^3)^{-1}$. The resulting excess cancer risk value for 78 years of continuous exposure to the maximum chloroform level detected is $1.3x10^{-5}$. Just over one excess cancer per 100,000 exposed individuals falls within EPA's acceptable cancer risk range. The cancer risk from exposure to chloroform at the levels detected in this EI is not of public health concern.

Estimated chloroform excess cancer risk[1]

Chloroform concentration x inhalation unit risk = excess lifetime cancer risk

0.11 ppb x **0.000023 $(\mu g/m^3)^{-1}$ = 0.547 $\mu g/m^3$ x 0.000023 $(\mu g/m^3)^{-1}$ = 0.0000126= $1.3x10^{-5}$**

Note: 0.11 ppb chloroform is equal to 0.547 $\mu g/m^3$chloroform; [1]assumes 78 years of daily exposure for 24 hours per day; $\mu g/m^3$ = micrograms per cubic meter; ppb = parts per billion

Crotonaldehyde

Crotonaldehyde is a clear, colorless to straw colored liquid with a strong odor. It is highly flammable and produces toxic vapors at room temperature. Crotonaldehyde is found naturally in emissions of some vegetation and volcanoes, and many foods contain crotonaldehyde in small amounts (ATSDR 2002).

Crotonaldehyde is mainly used in the manufacture of sorbic acid, which is a yeast and mold inhibitor. Crotonaldehyde has been used as an alcohol denaturant, as stabilizer for tetraethyl-lead, in the preparation of rubber accelerators, and in leather tanning (ATSDR 2002). Crotonaldehyde is also used as a warning agent in fuel gases, for locating breaks and leaks in pipes (Budavari 1989).

When released to air, crotonaldehyde will exist solely as a gas. Crotonaldehyde gas is degraded rapidly in the atmosphere by reacting with substances commonly found in the air. It will only persist in the atmosphere for several hours to a few days before being degraded. Crotonaldehyde does not accumulate in the food chain (ATSDR 2002).

During this EI, crotonaldehyde was detected 72 times at sampling locations surrounding the Brigich compressor (including duplicates). Crotonaldehyde was not assessed at the background location. The maximum crotonaldehyde concentration detected during this EI was 0.632 ppb. While the overall average crotonaldehyde concentration for all positive detections from all sites was 0.256 ppb, two sampling locations, sites 1 (0.309 ppb) and 2 (0.301 ppb) had average crotonaldehyde concentrations slightly above the TCEQ long ESL of 0.3 ppb.

Crotonaldehyde in the air can irritate the eyes, nose, throat, and lungs, possibly causing coughing, chest tightness, and shortness of breath. After an acute, relatively high-concentration exposure, persons may become sensitized to crotonaldehyde (ATSDR 2014a). This EI did not detect relatively high-concentrations such as those that might be experienced in an occupational setting. Crotonaldehyde has a low odor threshold reported at 35-200 ppb (Verschueren 1996), 37 to 1,050 ppb (Ruth 1986), and 38 ppb (Tepikina et al. 1997). Apart from rare cases of sensitization, no adverse effects in humans chronically exposed to relatively low concentrations of crotonaldehyde have been reported (ATSDR 2014a). Chronic exposure may be more serious for children because of their potential for a longer latency period (ATSDR 2014a).

Non Cancer Exposure Evaluation

Limited toxicological information on chronic inhalation exposure to low concentrations of crotonaldehyde is available. One study noted that 15-minute exposures to crotonaldehyde at 4.1 parts per million (4,100 ppb) was highly irritating to the nose and upper respiratory tract and produced *lacrimation*, or watering of the eyes, in human volunteers in 30 seconds (NLM 2012). Another study found that 15 ppm for the same duration of exposure was detected as a strong but tolerable odor, and no irritation was reported for brief exposures. Brief exposures, after a few seconds at 45 ppm, proved very disagreeable with eye irritation prominent (NLM 2012). Clinical cases of sensitization have occurred in humans and vapors may produce pulmonary edema at high concentrations (Sullivan and Geiger 1992). Crotonaldehyde is recognized as a lacrimator (causes tearing). In the Handbook of Toxic and Hazardous Chemicals and Carcinogens, it was noted that crotonaldehyde vapor can cause severe and painful irritation and burn the eye (can cause corneal damage) and skin. The vapor can irritate the respiratory tract causing cough and shortness of breath. The substance may affect the lungs, resulting in impaired function, coughing, and shortness of breath. Although slightly less toxic, crotonaldehyde is similar chemically and toxicologically to acrolein which is rated as extremely toxic. Toxic crotonaldehyde concentrations for human inhalation have been reported at 4,109 ppb (Sittig 2002).

One Health Hazard Evaluation conducted by National Institute for Occupational Safety and Health (NIOSH) in which workers exposed to approximately 0.56 ppm (560 ppb) of crotonaldehyde for less than eight hours reported occasional minor eye irritation (Fannick 1982).

In 2008, the National Academy of Science (NAS) released their report on Acute Exposure Guideline Levels for Selected Airborne Chemicals, including crotonaldehyde (NAS 2008). The NAS report listed the available human crotonaldehyde exposure data from inhalation exposure, including one study (Trofimov 1962), which noted odor detection and irritation at 170 ppb crotonaldehyde exposure concentration following one minute of exposure (NAS 2008). This was the lowest concentration that has been identified as having an adverse human health effect (respiratory irritation). The NAS report also notes that crotonaldehyde, “appear to be primarily a locally acting irritant; systemic effects were seen only after exposure to extremely high doses (i.e., which caused death within 2 hours)” (NAS 2008).

The maximum concentration detected during this study was 0.63 ppb from a 24-hour air sample. This result was the average crotonaldehyde concentration over a 24-hour period and no additional information is available regarding peak concentrations in air during this 24-hour sample collection time. This maximum concentration from the EI sampling is more than 170 times less than the lowest concentration Trofimov (1962) found to produce irritation.

Based on the sampling data collected for and assessed in this EI, exposures to crotonaldehyde at the levels detected are not expected to be harmful to healthy individuals. However, because crotonaldehyde is a known chemical sensitizer and there are insufficient air quality data from this EI to assess short and intermittent peak levels (i.e. less than 24 hours), ATSDR recommends reducing the potential for crotonaldehyde exposure by implementing additional source controls at sites where crotonaldehyde is known to be present. If source control is not possible, additional ambient air sampling and/or modeling may provide more definitive exposure information.

Cancer Exposure Evaluation

Based on no human data and an increased incidence of hepatocellular carcinomas and hepatic neoplastic nodules (combined) in male F344 rats, crotonaldehyde has been classified by the EPA as a possible human carcinogen (EPA 1991a). The International Agency for Research on Cancer (IARC) has not classified crotonaldehyde as to its carcinogenicity because there are no human data and limited animal data to determine carcinogenicity (IARC 1997). At this time, there is insufficient toxicological information to quantify the excess lifetime cancer to humans following specific exposure conditions (e.g. exposure concentration, duration and frequency) to crotonaldehyde.

1,2-Dichloroethane (1,2-DCA)

1,2-DCA, also called ethylene dichloride, is a manufactured chemical that is not found naturally in the environment. It is a clear liquid and has a pleasant smell and sweet taste. The most common use of 1,2-DCA is in the production of vinyl chloride which is used to make a variety of plastic and vinyl products including polyvinyl chloride (PVC) pipes, furniture and automobile upholstery, wall coverings, housewares, and automobile parts. It is also used to as a solvent and is added to leaded gasoline to remove lead.

Humans are exposed to 1,2-DCA mainly by breathing air or drinking water that contains 1,2-DCA. Human exposure usually happens where the chemical has been improperly disposed of, or spilled onto the ground. However, low levels of 1,2-DCA have also been found in the air near industries where it is made or used in manufacturing. Humans can be exposed to low levels of 1,2-DCA through the skin or air by contact with old products made with 1,2-DCA, such as cleaning agents, pesticides, and adhesives used to glue wallpaper and carpets. Such direct skin contact and inhalational exposure to this chemical is probably not enough to cause harmful health effects. These types of exposures (i.e. skin contact with liquids containing 1,2-DCA) are not the focus of this document. 1,2-DCA has been found in the air near urban areas at levels of

0.10–1.50 ppb and near hazardous waste sites at levels of 0.01–0.003 ppb. Small amounts of 1,2-DCA have also been found in foods.

1,2-DCA was detected five times (ranging from approximately 0.2 to 1.2 ppb) at site sampling locations and was not detected at the background location. The average concentration of positive detections (not including non-detections which account for a majority of the sampling days) was 0.62 ppb. 1,2-DCA was detected in five of the 118 samples (4.2%) collected from the three sites surrounding the Brigich compressor. The laboratory detection limit for 1,2-DCA during this EI was 0.1 ppb. The average site sample concentration, including all non-detect results (using 0.05 ppb to represent non-detection, which is half the laboratory detection limit), is 0.074 ppb.

Non Cancer Exposure Evaluation

In laboratory animals, breathing or ingesting large amounts of 1,2-DCA has caused nervous system disorders and liver, kidney, and lung effects. Animal studies also suggest that 1,2-DCA may damage the immune system. Nervous system disorders, liver and kidney diseases, and lung effects have also been reported in humans ingesting or inhaling large amounts of 1,2-DCA, though the actual exposure concentrations in these studies have not been determined. Kidney disease has also been seen in animals ingesting low doses of 1,2-DCA for a long time. Studies in animals indicate that 1,2-DCA does not affect reproduction (ATSDR 2001).

The Cheever *et al.* study (1990) identified 50,000 ppb (50 parts per million) as the no adverse effect level (NOAEL) for inhalation exposures in a chronic inhalation exposure (2 years, 5 days per week, 7 hours per day) study on Sprague-Dawley rats. The Cheever *et al*. study was used by ATSDR to identify the inhalation minimal risk level (MRL) of 600 ppb for chronic exposures. The NOAEL from the study (50,000 ppb) was divided by an uncertainty factor of 90 (3 for interspecies extrapolation from rat to human, 10 for human variability, and 3 as a modifying factor for deficiencies is the toxicological database for the chemical) to determine the 600 ppb MRL (ATSDR 2001). The maximum concentration identified in this EI (1.2 ppb) is less than the chronic MRL (600 ppb). Therefore, adverse non-cancer health effects are not expected from inhalation exposures to 1,2-DCA.

Cancer Exposure Evaluation

So far, exposure to 1,2-dichloroethane has not been associated with cancer in humans. One study showed a relationship between increased cancer and exposure to pollutants in groundwater, including 1,2-dichloroethane, but the people were probably exposed to many other chemicals at the same time. Cancer was found in laboratory animals who were fed large doses of 1,2-dichloroethane. When 1,2-dichloroethane was put on the skin of laboratory animals, they developed lung tumors. We are not sure whether breathing 1,2-dichloroethane causes cancer in animals. Because of the cancer findings in animals, the possibility of cancer in humans cannot be ruled out. The Department of Health and Human Services (DHHS) has determined that 1,2-dichloroethane may reasonably be expected to cause cancer. The International Agency for Research on Cancer (IARC) has determined that 1,2-dichloroethane can possibly cause cancer in humans. EPA has determined that 1,2-dichloroethane is a probable human carcinogen (ATSDR 2001).

Based on the EPA inhalation unit risk of 0.000026 per microgram per cubic meter, the ATSDR CREG is 0.04 µg/m^3 (0.0095 ppb). 1,2-DCA was detected in 5 of 118 samples (4.2%), with each of the positive results exceeding the CREG. Using the average concentration of 0.074 ppb and assuming 78 years of continuous exposure, the excess lifetime cancer risk is 8.1 excess cancers per 1,000,000 exposed individuals, a risk level that is considered low and within the EPA acceptable risk range (see formula below). Based on the concentrations of 1,2-DCA detected and the limited number of positive detections, ATSDR does not expect 1,2-DCA exposures in this community to result in unacceptable cancer risks. The cancer risk from exposure to 1,2-DCA at the levels detected in this EI is not of public health concern.

Estimated 1,2-DCA excess cancer risk[*]

1,2-DCA concentration[**] x inhalation unit risk = excess lifetime cancer risk

$$\mathbf{0.074\ ppb \times 0.000026\ (\mu g/m^3)^{-1} = 0.31\ \mu g/m^3 \times 0.000026\ (\mu g/m^3)^{-1} = 0.0000081 = 8.1\times10^{-6}}$$

Note: [*]assumes 78 years of daily exposure for 24 hours per day; [**]Average concentration of positive detections only; µg/m^3 =micrograms per cubic meter; ppb = parts per billion

Formaldehyde

Formaldehyde is a colorless, flammable gas at room temperature, has a pungent, distinct odor, and may cause a burning sensation to the eyes, nose, and lungs at much high concentrations. Formaldehyde is a gaseous pollutant produced by both human activity and natural sources. Combustion processes account directly or indirectly for most of the formaldehyde entering the environment. Large amounts of formaldehyde are produced in the United States during manufacturing processes and as components of many end-use products (power plants, manufacturing facilities, automobile exhaust). Oxidation of methane is the dominant source of formaldehyde in regions remote from hydrocarbon emissions (Staffelbach *et al*. 1991). Other anthropogenic sources of formaldehyde in the environment include vent gas from formaldehyde production; exhaust from diesel and gasoline-powered motor vehicles; emissions from the use of formaldehyde as a fumigant, soil disinfectant, embalming fluid, and leather tanning agent; emissions from resins in particle board, and plywood; emissions from resin-treated fabrics and paper; waste water from the production and use of formaldehyde in the manufacture of various resins and as a chemical intermediate; and waste water from the use of formaldehyde-containing resins (EPA 1976; Kleindienst et al. 1986; NRC 1981; Verschueren 1983). Small amounts of formaldehyde are produced naturally by plants, animals, and humans. Formaldehyde can mostly be found in the air. Indoor air may contain formaldehyde due to building materials, consumer products and tobacco smoke. Formaldehyde can be found in rain water and surface water after release from the manufacture, use, and disposal of formaldehyde-based products (ATSDR 2008).

Formaldehyde concentration for all site samples collected as part of this EI ranged from 1.16 to 5.83 ppb. Each sample results exceeded the ATSDR CREG of 0.063 ppb. The average formaldehyde concentration was 2.88 ppb. For reference, typical formaldehyde levels in outdoor air range from 0.2 to 6 ppb in rural and suburban areas and 1 to 20 ppb in urban areas (ATSDR 2008).

Non Cancer Exposure Evaluation

The health-based non-cancer CV of 8 ppb for chronic exposures was not exceeded during this EI at any of the sampling locations. Based on the results from this EI, ATSDR does not expect adverse non-cancer health effects from exposure to airborne formaldehyde in this community.

Cancer Exposure Evaluation

Estimated excess lifetime cancer risk from exposures to formaldehyde at the average level documented in this EI is 4.7 excess cancers in 100,000 exposed individuals; a level which falls within the acceptable EPA cancer risk range. The cancer risk from exposure to formaldehyde at the levels detected in this EI is not of public health concern.

Estimated formaldehyde excess cancer risk[*]

Formaldehyde concentration x inhalation unit risk = excess lifetime cancer risk

$$\mathbf{2.88\ ppb \times 0.000013\ (\mu g/m^3)^{-1} = 3.6\ \mu g/m^3 \times 0.000013\ (\mu g/m^3)^{-1} = 0.000047 = 4.7\times10^{-5}}$$

Note: [*]assumes 78 years of daily exposure for 24 hours per day; µg/m^3 =micrograms per cubic meter; ppb = parts per billion

Hydrogen Sulfide (H_2S)

Hydrogen sulfide (H_2S) is a flammable, colorless gas with a sweetish taste and characteristic odor of rotten eggs that can be poisonous at high concentrations. Other names for hydrogen sulfide include hydrosulfuric acid, sewer gas, hydrogen sulphide, and stink damp. People usually can smell hydrogen sulfide at low concentrations in air, ranging from 0.5 to 300 ppb; however, at high concentrations (150,000 to 200,000 ppb), a person might lose their ability to smell it (ATSDR 2014). This can make hydrogen sulfide very dangerous.

Hydrogen sulfide occurs both naturally and from man-made processes. It is in the gases from volcanoes, sulfur springs, undersea vents, swamps, and stagnant bodies of water and in crude petroleum and natural gas (ATSDR 2014). Hydrogen sulfide also is associated with municipal sewers and sewage treatment plants, landfills, swine containment and manure-handling operations, and pulp and paper operations. Industrial sources of hydrogen sulfide include petroleum refineries, natural gas plants, petrochemical plants, coke oven plants, food processing plants, and tanneries. Bacteria found in the mouth and gastrointestinal tract of people produce hydrogen sulfide during the digestion of food containing vegetable or animal proteins. The principal source of hydrogen sulfide is recovery as a by-product in the purification of natural and refinery gases (WHO 2003).

Ambient air concentrations of hydrogen sulfide from natural sources range between 0.11 and 0.33 ppb. Concentrations of hydrogen sulfide in urban areas are generally less than 1 ppb. Much higher levels (often exceeding 90 ppb) have been detected in communities living near natural sources of hydrogen sulfide or near industries releasing hydrogen sulfide (ATSDR 2014). In undeveloped areas of the United States, concentrations have been reported at 0.02 to 0.07 ppb.

The average H_2S concentrations for each of the six locations assessed in this EI over the entire two phases of sampling ranged from 0.53 to 0.85 ppb (see Table 6). Higher instantaneous levels of H_2S (ranging from 7.4 to 92.8 ppb) were detected during the EI (see Appendix B, Tables 1

Table 6
Average Hydrogen Sulfide
Concentration by Air Sampling Site (in ppb)

Site	Phase 1	Phase 2	Average of both phases
1	0.54	1.16	0.85
2	0.75	0.31	0.53
3	0.89	0.56	0.73
4	0.82	0.51	0.67
5	0.63	0.69	0.66
6	0.71	No Data	0.71
		Average:	0.69

Note: ppb = parts per billion

and 2). During this EI, thirty minute average concentrations exceeding 50 ppb were recorded three times: (1) on September 20, 2012 from 9:05 to 9:35 am, Site 1 averaged 50.39 ppb; (2) on July 25, 2012 from 11:25-11:55 am, Site 3 averaged 51.14 ppb; and, (3) on September 13, 2012, from 5:21 to 5:51 am, Site 3 averaged 51.34 ppb. H_2S exceeded 20 ppb for 30 minutes or more on 10 occasions (see Appendix B, Table 3).

Health effects data for H_2S exposure are derived from case reports of acute poisonings, occupational exposures and a limited amount of data on community resident exposures. At concentrations greater than 98,591 ppb, olfactory paralysis (odor desensitization) occurs, making hydrogen sulfide very dangerous, because a few breaths at 492,957 ppb can be fatal (WHO 2003). These extremely high H_2S concentrations are not expected, and were not detected, in the site area. In the 2003 WHO report, Hydrogen Sulfide: Human Health Aspects, it is noted that, “due to the serious toxic effects associated with exposures to high concentrations of hydrogen sulfide for very short durations, all exposure should be avoided” (WHO 2003).

Non Cancer Exposure Evaluation

While lower concentration acute exposures to H_2S have been quantitatively studied with human volunteers, the dose-response relationship for human toxicity due to exposure is not known (CalEPA 2013). The California Office of Environmental Health Hazard Assessment (2013) has noted that, “although numerous case studies of acutely toxic effects of H_2S exist, there is inadequate occupational or epidemiological information for specific chronic effects in humans exposed to H_2S.” The inability to define a dose-response relationship for H_2S exposures creates uncertainty around the average and peak concentrations and their potential for health effects.

Short-term inhalation exposure to high concentrations of hydrogen sulfide is known to cause health effects in many systems of the body; reported health effects in humans following exposure to hydrogen sulfide include respiratory, ocular, neurological, cardiovascular, metabolic, and reproductive effects and death. The concentrations detected during this EI were far below the high concentrations where health effects were observed in toxicological studies.

No health effects have been found in humans exposed to typical environmental concentrations of hydrogen sulfide (0.11 to 0.33 ppb) (ATSDR 2014). The lowest observed-adverse-effect level (LOAEL) from inhalation exposure to H_2S is much higher (than typical background levels), at

1,972 ppb for asthmatic individuals, resulting in respiratory and neurological effects (WHO 2003).

Long-term (chronic) exposures to hydrogen sulfide may result in adverse health effects. These include: neurologic effects (fatigue, loss of appetite, nausea, headache, vomiting, irritability, poor memory, depression, motor skills, and dizziness) and respiratory effects (nosebleeds, breathing abnormalities) (Alborg 1951, Kilburn 1997, Kilburn and Warshaw 1995, ATSDR 2002a, Campagna *et al.* 2004). Several studies have been conducted which show neurologic effects from chronic low-level exposures. These studies have documented deficits in cognitive function, reduced perceptual motor speed, impaired memory, impaired balance, and abnormal mood status. These effects were still evident months and sometimes years after exposures ceased (Kilburn 1997, Kilburn and Warshaw 1995, Kilburn 1999). The magnitude of exposure in these studies ranged in low parts per billion to low parts per million. Kilburn and Warshaw (1995) studied chronic exposures to sulfide gases in oil processing plants and found that people working at the plant or living downwind at the plant experienced nausea, headache, vomiting, breathing abnormalities, nosebleeds, depression, and personality changes at levels between 10 ppb and 100 ppb. One study examining health effects in a community exposed to low levels of hydrogen sulfide noted that after days when hydrogen sulfide levels are above 30 ppb, there is an increase in asthma-related hospital visits among children (Campagna *et al.*2004).

Since the respiratory tract is the major target organ of H_2S toxicity, humans with asthma, the elderly and young children with compromised respiratory function represent sensitive subpopulations. Exposure to low concentrations of hydrogen sulfide may cause irritation to the eyes, nose, or throat. Low concentration exposures may also cause difficulty in breathing for some asthmatics. There were ten occasions during the EI where hydrogen sulfide concentrations remained above 20 ppb for 30 minutes or more. On three of those occasions, H_2S averaged over 50 ppb (see Appendix B, Table 3). Elevations in ambient air H_2S concentrations above background, such as those discussed above, may be of concern for sensitive subpopulations.

Average H_2S concentrations from this EI were slightly below the EPA RfC of 1.4 ppb, indicating chronic low level exposures in the community are not expected to be of concern for the general population. However, peak concentrations detected during this EI may irritate some individuals due to the objectionable odor of H_2S and it may exacerbate pre-existing respiratory conditions. ATSDR concludes that, due to detection of ambient H_2S exceeding 20 ppb for 30 minutes or more on multiple occasions during this EI, H_2S may be of concern for sensitive subpopulations (*e.g.*, asthmatics, elderly).

Cancer Exposure Evaluation

Hydrogen sulfide has not been shown to cause cancer in humans, and its possible ability to cause cancer in animals has not been studied thoroughly (ATSDR 2014).

1-Methoxy-2-propanone (Methoxyacetone)

Methoxyacetone is a clear, yellow, liquid methyl ketone. Very little information is available regarding the use and toxicity of methoxyacetone. One material safety data sheet (MSDS) notes that methoxyacetone (in a 96% solution) causes eye and skin irritation from contact, gastrointestinal irritation and possibly central nervous system depression from ingestion and respiratory tract irritation from inhalation. The MSDS also notes that methoxyacetone inhalation may cause dizziness and suffocation, delayed pulmonary edema and possibly a burning sensation in the chest (Guidechem 2003). It is unclear on the Guidechem MSDS what studies were used to report health effects from inhalation of the chemical.

The Registry of Toxic Effects of Chemical Substances (RTECS) provides limited toxicological study information for methoxyacetone, including skin and eye sensitivity testing on rabbits and ingestion by rodents. Mild skin and eye sensitivity was reported on the RTECS database following 24-hours of exposure to 500 milligrams of methoxyacetone. The limited toxicological information in RTECS provides little relevant information for inhalation to very low concentrations of methoxyacetone such as those detected during this EI (maximum of 10 ppb).

Methoxyacetone was identified as a tentatively identified compound (TIC) three times out of the 118 samples collected during this EI at 4.0, 5.0, and 10.0 ppb. Each of these detections exceed the TCEQ ESL[1] of 3.4 ppb. Methoxyacetone is not a commonly detected chemical, and the EPA laboratory did not have a reference standard during sample analyses. Without a laboratory reference standard, the presence of this chemical in the sample cannot be confirmed. For this health consultation, ATSDR assumed the chemical was properly identified and the concentrations were accurate. The average concentration for only the positive detected concentrations therefore is 6.3 ppb, although the actual ambient air exposure to this chemical in the community could be as low as zero.

Non Cancer Exposure Evaluation

Studies, completed by the Carnegie Mellon Institute for Research (CMIR) in 1977, evaluated the comparative toxicity and pathology of five ketones and methoxyacetone in drinking water of rodents (CMIR 1977). CMIR concluded that methoxyacetone was less toxic than methyl n-butyl ketone. EPA has identified an inhalational reference concentration (RfC) of 3,000 µg/m^3 (718 ppb) for methyl iso-butyl ketone (MIBK), one of the more toxic ketones identified in the CMIR comparative studies. The RfC for MIBK is more than 450 times higher than the average concentration of methoxyacetone tentatively identified in the field samples from this EI. Therefore, exposure to methoxyacetone is not expected to result in any adverse non-cancer health effects and is not of public health concern.

Cancer Exposure Evaluation

There is insufficient animal or human study data to determine if methoxyacetone is a carcinogen.

$PM_{2.5}$

Airborne particulate matter smaller than 2.5 microns ($PM_{2.5}$) in aerodynamic diameter—also known as fine particulate matter—originates from many sources. “Primary” emissions sources, or sources that release $PM_{2.5}$ directly into the air, are responsible for some airborne $PM_{2.5}$. In addition to primary emission sources, “secondary” particles form in the air from chemical reactions involving precursor gaseous emissions, such as sulfur dioxide and nitrogen oxides. Note that these secondary particles can form at locations far from those emissions sources that

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[1] ATSDR has not fully evaluated the toxicological basis for TCEQ effect screening levels (ESL). ESLs are chemical concentrations in the air that TCEQ consider to be safe. Per TCEQ: ESLs protect human health in the general public, including children, the elderly, pregnant women, and people with pre-existing health conditions. ESLs also protect against welfare effects, such as strong odors and harmful effects in plants. ESLs are used in the air permit application process to evaluate the protectiveness of emissions for specific chemicals. Long-term ESLs protect against long-term health effects and plant damage. For air permit applications, long-term ESLs are used to evaluate predicted 1-year average air concentrations. If the predicted maximum air concentrations are below short-term and long-term ESLs, then adverse [human] health effects, nuisance odors, and harmful effects in plants would not be expected (see https://www.tceq.texas.gov/toxicology/esl).

released the precursors (EPA 2008).

The nearest National Ambient Air Quality Standards (NAAQS) monitoring station (Florence) to the site samples air continuously for $PM_{2.5}$, including the same time period as this EI. The maximum daily concentration at the Florence NAAQS monitoring station during the EI sampling time period was 16.11 µg/m^3. The highest fifty daily average concentrations at Florence over the same sampling period ranged from 5.39 to 16.11 µg/m^3, averaging 9.00 µg/m^3.

For this EI, the average $PM_{2.5}$ concentration of 12.4 µg/m^3 was calculated from the 35 days of sampling that began in August 2012 and extended over a 4 month period. The average $PM_{2.5}$ concentration for this EI is higher than the nearest NAAQS monitoring location over the same time period, although there is insufficient data to determine whether annual $PM_{2.5}$ concentrations in this particular area exceeds the EPA annual primary standard of 12 µg/m^3. While the detected concentrations are slightly higher than the nearest NAAQS monitor, harmful health effects from short term exposures are not expected. It is not known whether $PM_{2.5}$ concentrations from the site area would have exceeded the annual primary standard of 12 µg/m^3 in 2012.

Airborne $PM_{2.5}$ concentrations detected in this EI may reflect contributions from the Brigich Compressor Station's primary emissions as well as from the combined effect of other industrial and mobile emissions sources throughout the area and beyond. The data collected for this EI are not sufficient to specifically attribute the detected $PM_{2.5}$ concentrations to the Brigich Compressor Station.

Exposure Evaluation

Mortality and cardiovascular and respiratory morbidity have been associated with both short-and long-term exposure to $PM_{2.5}$ (EPA 2009). As $PM_{2.5}$ health effect thresholds have not been identified, and given a substantial interpersonal variability in exposure and subsequent harmful effects, it is unlikely that any standard or guideline value will lead to complete protection for everyone against all possible adverse health effects (WHO 2006). Population subgroups that may be more sensitive to the effects of PM exposure include infants, older adults (65+ years), individuals with asthma, COPD or cardiovascular disease, diabetics, lower socioeconomic status, and those with certain genetic polymorphisms (EPA 2009).

Several health studies have investigated potential health effects resulting from long-term exposure to PM. Historical mean $PM_{2.5}$ concentrations of 18 µg/m3 (range 11.0 - 29.6 µg/m^3) and 20 µg/m^3 were identified in the Six-Cities Study (range 9.0 – 33.5 µg/m3) and in the American Cancer Society (ACS) study, respectively (Dockery et al., 1993; Pope et al., 1995, 2002; HEI, 2000; Jerrett, 2005). Thresholds (exposure levels where health effects are first seen) are not apparent in these studies. In the ACS study, statistical uncertainty in the risk estimates becomes apparent at concentrations of about 13 µg/m^3, below which the confidence bounds significantly widen because of the variability in the exposure concentrations. According to the results of the Dockery *et al*. (1993) study, the risks are similar in the cities with the lowest long-term $PM_{2.5}$ concentrations (*i.e*., 11 and 12.5 µg/m^3). Increases in risk are apparent in the city with the next lowest long-term $PM_{2.5}$ average concentration (i.e., 14.9 µg/m^3), indicating that when annual mean concentrations are in the range of 11–15 µg/m^3, health effects can be expected (WHO 2006).

The average $PM_{2.5}$ concentration identified in the EI was 12.4 µg/m^3 over a four month period, falling within the range that the WHO has concluded health effects can be expected following one year of exposure to these concentrations. $PM_{2.5}$ sampling at the site was limited to a four month period; it is not clear what the annual average $PM_{2.5}$ concentration was for 2012. Based on the four month average of 12.4 $\mu g/m^3$, ATSDR concludes that, some individuals, and particularly sensitive individuals (*e.g.,* infants, asthmatics), may experience adverse health effects from ambient $PM_{2.5}$ concentrations in the site area.

1,1,2-Trichloroethane (1,1,2-TCA)

1,1,2-TCA is a colorless, sweet-smelling liquid. It does not burn easily, can be dissolved in water, and evaporates easily. It is used as a solvent (a chemical that dissolves other substances) and as an intermediate in the production of the chemical, 1,1-dichloroethane. 1,1,2-Trichloroethane is sometimes present as an impurity in other chemicals, and it may be formed when another chemical breaks down in the environment under conditions where there is no air. Breakdown of 1,1,2-TCA in both the air and groundwater is slow. In the air, half the 1,1,2-TCA is expected to breakdown in 49 days and so it is likely to spread far from where it is released before breaking down. Background levels of 1,1,2-trichloroethane in ambient air usually contain around 0.01 to 0.05 parts per billion (ppb) of 1,1,2-trichloroethane (ATSDR 1989).

1,1,2-TCA was detected in one of 118 samples collected around the Brigich Compressor Station and it was not detected in any samples at the background sampling location. The one sample was reported as an approximate concentration of 0.2 ppb, which exceeds the ATSDR CREG of 0.01 ppb.

The laboratory detection limit for 1,1,2-TCA during this EI was 0.1 ppb. The average site sample concentration, including all non-detect results (using 0.05 ppb to represent non-detection, which is half the laboratory detection limit), is 0.051 ppb.

Non Cancer Exposure Evaluation

ATSDR has not developed a chronic inhalation comparison value for non-cancer health effects. The TCEQ ESL for chronic exposures is 10 ppb. The California Environmental Protection Agency (CalEPA) has established a chronic reference exposure level of 0.4 milligrams per cubic meter (72 ppb) based on liver effects in rats. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. The maximum concentration detected in this EI was below both the TCEQ ESL and the CalEPA chronic reference level, under which health effects are not expected. Given the low and intermittent potential exposures (one positive detection in 118 samples), ATSDR does expect adverse non-cancer health effects from exposures to 1,1,2-TCA at the concentration detected in this EI.

Cancer Exposure Evaluation

The ATSDR CREG for 1,1,2-TCA is 0.01 ppb, based on the EPA inhalation unit risk value of 0.0000029 (µg/m3)-1. Based on the average 1,1,2-TCA concentration of 0.051 ppb (0.28 µg/m3), the estimated excess lifetime cancer risk from 78 years of continuous exposure to 1,1,2-TCA is 8.1×10^{-7}. The cancer risk from exposure to formaldehyde at the levels detected in this EI is not of public health concern. This excess lifetime cancer risk is very low and less than the EPA target risk range. ATSDR does not expect adverse health effects (cancer or non-cancer) from exposures to 1,1,2-TCA at the levels detected in this community.

Estimated 1,1,2-trichloroethane excess cancer risk[*]

1,1,2-TCA concentration x inhalation unit risk = excess lifetime cancer risk

$$\mathbf{0.051\ ppb \times 0.0000029\ (\mu g/m^3)^{-1} = 0.28\ \mu g/m^3 \times 0.0000029\ (\mu g/m^3)^{-1} = 0.00000081 = 8.1\times10^{-7}}$$

Note: [*]assumes 78 years of daily exposure for 24 hours per day; µg/m^3 =micrograms per cubic meter; ppb = parts per billion

Conclusions

Exposure to the detected levels of chemicals in the ambient air from residences surrounding Brigich compressor is not expected to harm the health of the general population. However, some sensitive subpopulations, including individuals with underlying medical conditions (e.g. asthmatics) or chemical sensitivities, may experience harmful effects from exposures to hydrogen sulfide, $PM_{2.5}$, and/or carbonyls (e.g. crotonaldehyde and glutaraldehyde).

- Short-term, peak concentrations of hydrogen sulfide may be of concern for sensitive subpopulations (*e.g*., asthmatics, elderly). On ten occasions (four times at Site 1 and six times at Site 3), H_2S levels remained above 20 ppb for 30 minutes or more at this site. Several studies have been conducted which show adverse health effects from low-level hydrogen sulfide exposures (Alborg 1951, CalEPA 2013).

- The four-month average $PM_{2.5}$ concentration at this site was 12.4 µg/m^3. The World Health Organization notes that when annual mean concentrations are in the range of 11–15 µg/m^3, health effects can be expected (WHO 2006). Although the 4 month average determined during this EI was 12.4 µg/m^3, there is insufficient data to determine whether the annual $PM_{2.5}$ concentration at this site would exceed the EPA annual primary standard of 12 µg/m^3; exposures may result in cardiovascular and respiratory morbidity for sensitive individuals.

- While the crotonaldehyde and glutaraldehyde results from 24-hour sampling at residential locations were below levels known to cause adverse health effects from chronic exposures, there is insufficient short term data from this EI (*i.e.,* less than 24 hour sampling periods) to determine whether peak exposures were high enough to be harmful to some individuals. Crotonaldehyde and glutaraldehyde have caused sensitization in some individuals following exposure and both chemicals are known to produce acute respiratory symptoms from short and intermittent exposures (ATSDR 2002, NJDOH 2000, NLM 2012).

There are significant limitations and site-specific variables associated with this Exposure Investigation (EI) and Health Consultation (HC). The data collected and analyzed in this Health Consultation should not be generalized to all natural gas compressor stations. Although this study collected 24-hour samples on many dates over a number of months, there remains a lack of continuous ambient air data in the community through each season of the year, making it difficult to determine accurate annual average exposure concentrations. Further, the sampling equipment used in this investigation for reduced sulfur compounds did not perform as expected, and therefore these data were not evaluated in this report. Representative ambient air reduced sulfur compound data remains an important data gap.

A number of nearby industrial sources, and particularly other natural gas-related facilities (impoundments, drill pads, compressors, gas processing plant), are present in the immediate area of the Brigich Compressor Station. This co-mingling of sources makes it infeasible to determine individual sources of the chemicals detected in the air during this investigation. Additionally, many analytes (e.g., VOCs, $PM_{2.5}$) are commonly detected in regional air sampling programs and come from common sources such as automobiles and agricultural equipment.

The sampling conducted for this study attempted to capture the variety of conditions encountered in the community, but it may not have adequately captured uncommon but significant incidents when peak emissions (*e.g.* unscheduled facility incidents, blowdowns or flaring events) coincide with unfavorable meteorological conditions (e.g. air inversion) and the placement of active monitoring equipment. Most of the data evaluated in this EI were from samples collected for 24-hour sampling periods on non-consecutive days.

Science is limited in its ability to assess the health impact from exposures to complex mixtures of airborne toxic chemicals, particularly synergistic or antagonistic interactions of chemicals at low exposure concentrations.

Recommendations

The information from this health consultation will be shared with the community near Brigich Compressor Station and relevant state health and environmental agencies.

ATSDR recommends reducing exposures to $PM_{2.5}$, crotonaldehyde, glutaraldehyde and hydrogen sulfide in ambient air by taking steps to control releases from the emission sources of these chemicals to protect the health of sensitive populations living near the site.

ATSDR recommends collecting emission source or fence-line samples for a wide range of chemicals (VOCs, carbonyls, $PM_{2.5}$, reduced sulfur compounds, crotonaldehyde and glutaraldehyde) by the appropriate environmental agency (PADEP, EPA) for long term and peak exposures. This information could be compared to the residential sampling summarized in this report, and it could be used in air modeling to further understand community exposures.

ATSDR recommends air modeling, based on sufficient representative data of fugitive and combustion emissions at compressor stations, including but not limited to, carbonyls, volatiles, and hydrogen sulfide, as it may provide a more generalized understanding of ambient air quality near these types of facilities. When modeling is conducted, topographic and meteorological conditions should also be considered as important variables.

Public Health Action Plan

The information from this health consultation will be shared with the community near Brigich Compressor Station, including government environmental and health agencies.

If requested, ATSDR will provide technical assistance, such as data evaluation or the development of environmental assessment strategies that target public health concerns, to the local community and local, state and federal agency stakeholders

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Appendix A -

Exposure Investigation Overview -

(14 pages)

This appendix provides details about the Natural Gas Ambient Air Monitoring Initiative (NGAAMI), including the objective, investigators and collaborators, the method for selecting the site, the compressor station chemical parameter selection, the field sampling and laboratory analytical methods, and the schedule for sampling completed during this EI.

The objective of this assessment was to evaluate possible community exposures to and potential health impacts from airborne contaminants near the Brigich natural gas compressor station. As part of this public health evaluation, the information collected was used to evaluate the need to mitigate exposures, conduct additional air assessments, and identify whether air modeling is needed evaluate public health impacts in the investigation area. This investigation was not designed to determine adherence to regulatory standards (*e.g*. National Ambient Air Quality Standards) but to specifically identify ambient airborne concentrations of specific contaminants in the residential community that are expected from natural gas compressor stations.

The data collected through this EI and the concurrent but separate EPA investigation allows ATSDR to determine, with limitations, whether people living near the Brigich compressor are being exposed to carbonyl/aldehydes, hydrogen sulfide, reduced sulfur compounds, particulate matter (PM 2.5), and volatile organic compounds at concentrations that could pose a public health hazard.

Investigators and Collaborators

The ATSDR Division of Community Health Investigations (DCHI) was the lead for this exposure investigation. ATSDR collaborated with the Region 3 U.S. Environmental Protection Agency (EPA) Air Protection Division (APD), the EPA Environmental Response Team (ERT), and Eastern Research Group (ERG) on field activities and laboratory analyses.

ATSDR Division of Community Health Investigations (DCHI):

- Developed Exposure Investigation protocol;
- Secured informed consent for environmental testing from residential property owners in Chartiers Township;
- Conducted air sampling for carbonyls/aldehydes, hydrogen sulfide, and reduced sulfur compounds with the assistance of ERT and ERG;
- Provided air sampling equipment and supplies and arranged for sample handling, shipping and analyses;
- Evaluated the analytical test results;
- Communicated the test results with residential property owners that participated and interpreted what the results mean for community health; and,
- Wrote the report which summarized and evaluated the EI findings.

EPA Air Protection Division (APD):

- Developed and implemented quality assurance project plan (QAPP);
- Conducted air sampling for particulate matter and volatile organic compounds;
- Coordinated with EPA Fort Meade laboratory for analysis of air samples; and,

- Coordinated with Pennsylvania Department of Environmental Protection (PADEP) for the sharing of site-specific meteorological data from PADEP weather station located on site. Developed daily wind roses for all sampling periods of the EI and shared with ATSDR.

EPA Environmental Response Team (ERT):

- Developed QAPP for sampling and analyses performed by ERT;
- Provided equipment, supplies and staff and conducted 2nd phase of air sampling for carbonyls/aldehydes, hydrogen sulfide and reduced sulfur compounds;
- Analyzed air samples collected during the 2nd phase of this EI; and,
- Wrote report summarizing ERT field activities and the analytical sampling results produced during the 2nd phase of the EI.

Eastern Research Group (ERG):

- Assisted ATSDR with air sampling for carbonyls/aldehydes, hydrogen sulfide, and reduced sulfur compounds with the assistance of ERT and ERG;
- Provided air sampling equipment and supplies and arranged for sample handling, shipping and analyses; and,
- Conducted sample analyses following approved methods.

Residential Property Owners:

- Signed access agreements with ATSDR to allow staging and operation of air monitoring and sampling devices on their property during field sampling activities; and,
- Provided electricity for instruments requiring a power source, when necessary.

Methods

Site Selection

ATSDR, in collaboration with EPA APD, chose the community surrounding the Brigich compressor station in southwest PA for air sampling for a number of reasons. After weighing the pros and cons for multiple compressor stations in southwest PA, the Brigich station was chosen as the best option from the list. Other compressor stations considered for this EI included the Dwyer, Stewart, Fulton, Cowden Junction, and the Godwin compressor stations. The Brigich compressor station was selected because it was considered most suited for an extended air monitoring initiative of the surrounding residential area for the following reasons:

1. Surrounded by residences - The residential community is located on grade and in the dominant downwind direction, making the residences around Brigich ideal for an extended air sampling program. Additional sampling locations within one half mile of the compressor were also identified to the north and south, with residences to the south located downgradient from the compressor and in a valley, a topographic layout which may increase the potential for resident exposures to compressor station air releases. Additionally, ATSDR has been informed in the past that residents living in valleys near natural gas industry activities have complained of poor air quality and adverse health symptoms.

2. Brigich compressor station is a large (5 compressors), complex natural gas compressor station containing all of the components and processes which may be of concern. The station includes multiple compressors, a dehydrator, condensate tank, flare, diesel-powered generator and a reboiler.
3. Brigich is not blocked significantly in any particular direction by natural features (e.g. steep slopes, forest). This makes the station ideal for assessing air quality in the surrounding communities.

ATSDR and the EPA APD jointly shared the responsibility of selecting the EI monitoring locations around the Brigich compressor station. After recruiting efforts were completed, ATSDR and EPA selected locations to host monitoring sites. Six locations were chosen for ATSDR sampling and were documented by latitude and longitude using hand held global positioning system (GPS) instrumentation. All six monitoring sites were less than 0.65 miles from the facility. For the location of each monitoring site, refer to Figure 1. Further detail of each of the six sampling locations is provided in the EI Field Investigation Reports, attached to this document.

Compressor Station Chemical Parameter Selection

Natural gas from individual well sites is usually routed to compressor stations, where the gas is treated to remove water vapor and other impurities and then compressed to facilitate further distribution via larger transmission lines. Compressor stations typically serve multiple well sites, and the energy needed to compress the gas is usually generated by gas-fired engines. Although many emission sources may be found at these sites, the two primary categories include combustion by-products from engines that power compressors and fugitive emissions (primarily hydrocarbons) from various unit operations.

Combustion by-products

According to EPA emission factors, combustion of natural gas can generate a wide range of by-products. These include criteria pollutants and various hydrocarbons and carbonyls/aldehydes. Two modeling studies were identified that estimated air quality impacts from combustion by-products and are summarized here:

- The Fort Worth Natural Gas Air Quality Study, conducted by ERG, assessed air quality impacts of combustion by-products by estimating emissions and modeling transport to downwind locations (ERG, 2011). This modeling considered more than 50 different combustion by-products. Only two combustion by-products—acrolein and formaldehyde—were found to have estimated air quality impacts greater than health-based screening values. It should be noted that the emission factors used to evaluate these pollutants were based on "uncontrolled emissions." Engines that operate with air pollution controls would be expected to have lower emissions and lower air quality impacts.

- The Environmental Impact Statement prepared by the New York State Department of Environmental Control (NYSDEC) includes modeling results for compressor stations (NYSDEC, 2009). Multiple pollutants were considered as combustion by-products, but only formaldehyde was found to have estimated offsite concentrations greater than health-based screening values. Notably, NYSDEC reports that "these exceedances occur even…with 90% reduction in formaldehyde emissions accounted for by the installation of an oxidation catalyst."

Ambient air monitoring in the vicinity of compressor stations has been conducted by multiple parties, including the Texas Commission on Environmental Quality (TCEQ), PADEP, contractors to the Texas cities of Fort Worth and DISH, and contractors to industry groups (Titan Engineering 2010). TCEQ conducted a short-term air sampling project near compressor stations in Fort Worth and DISH, but found no measurements exceeding short-term screening levels (TCEQ 2011). PADEP conducted three short-term air quality studies in the Marcellus Shale region (PADEP 2010a, b; 2011a, b). All three studies "did not identify concentrations of any compound that would likely trigger air-related health issues." However, one study indicated that pollutants were detected more frequently near compressor stations. These studies were of limited duration and, for some pollutants, used methods that had relatively high detection limits. Additionally, air quality studies conducted for the cities of Fort Worth (ERG 2011) and DISH (Wolf Eagle Environmental 2009) collected air samples in the vicinity of compressor stations. The samples collected in Fort Worth were all lower than health-based screening levels, but the study for DISH reported numerous pollutants having air quality impacts at levels of health concern. However, limited documentation is available on the DISH study.

Overall, a common theme from the modeling studies is that carbonyls are the primary combustion by-products of concern for compressor stations. The available monitoring studies have not validated this concern, but those studies were generally of short duration and may not have captured the greatest air quality impacts. Various other pollutants may also be found in the exhaust from these engines (e.g., particulate matter), but the lack of information for these other pollutants may not be a critical data gap.

Fugitive emissions

All compressor stations will have fugitive emissions, as chemicals in the compressed gas and associated unit operations do leak through connectors, vents, flanges, and other equipment. The nature and extent of emissions will depend on the type of operations that occur at the compressor stations. For instance, the emissions of greatest interest could depend on what chemicals are emitted from holding tanks, glycol dehydrators, and other equipment. NYSDEC's modeling study noted that fugitive air emissions of hydrogen sulfide and benzene could be of concern in fugitive emissions. In the case of hydrogen sulfide, NYSDEC reports: "If any 'wet' gas is encountered in the Marcellus Shale, there will be potential for exceedance of the H_2S standard."

In terms of hydrocarbons, data from multiple studies confirm their presence in fugitive emissions from compressor stations. Simple, short-chain chemicals (e.g., methane, ethane, propane, butane) appear to account for the greatest portion of these emissions. Methods are readily available for measuring air concentrations of these pollutants, but past projects found air quality impacts to be orders of magnitude below health-based screening levels largely due to the fact that these chemicals have relatively low toxicity.

The sampling conducted during this EI followed a standard approach for assessing common volatile organics (i.e., TO-15 analytical procedures), which includes some of the compounds that are of particular interest for this site from a health perspective (e.g., benzene, toluene). The approach used in this EI was also able to address concerns regarding emissions of BTEX compounds (benzene, toluene, ethylbenzene, and xylenes) from glycol dehydrators—a concern previously noted for fugitive emissions from these unit operations (EPA, 1995).

This initiative is a collaborative effort between ATSDR and EPA Region 3 Air Protection Division (APD). APD conducted air sampling for volatile organic compounds following TO-15 method and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) following the gravimetric method discussed further below. And, based on a review of recent studies of natural gas compressors stations, ATSDR assessed two specific chemical classes that have not been adequately assessed in natural gas compressor "host" communities:

- Carbonyls: 14 specific chemicals including 2,5-dimethylbenzaldehyde, 2-butanone, acetaldehyde, acetone, benzaldehyde, butyr/isobutyraldehyde, crotonaldehyde, formaldehyde, glutaraldehyde, hexaldehyde, isovaleraldehyde, propionaldehyde, tolualdehydes, and valeraldehyde
- Reduced sulfur compounds and hydrogen sulfide: carbonyl sulfide, methyl mercaptan, ethyl mercaptan, dimethyl sulfide, carbon disulfide, isopropyl mercaptan, ethyl methyl sulfide, n-propyl mercaptan, t-butyl mercaptan, methyl propanethiol, thiophene/2-methyl propanethiol, methyl isopropyl sulfide, and n-butyl mercaptan.

Sampling and Analyses

ATSDR (with assistance from ERG and EPA ERT)

ATSDR completed sampling in two phases. The initial 4-week EI, which was completed by ATSDR field staff with ERG contractor support used a network of six sampling locations surrounding the gas compressor station. The 9-week continuation of the EI, which was completed by EPA ERT field staff, used five of the six original sampling locations. Slightly different field methods and analytical methods were employed during the two phases of this investigation, which is further detailed below and in the attached EI Field Investigation Reports.

Carbonyls

Phase 1 (Sites 1-5; "every-other-day" schedule)

Manually operated samplers were used during Phase 1 to collect carbonyl compounds at five monitoring sites (Sites 1 through 5), with all procedures performed according to guidance in EPA's Compendium of Methods TO-11A (EPA 1999). This method outlines sampling and analytical procedures for measuring formaldehyde and other carbonyl compounds (aldehydes and ketones) in ambient air. Specifically, Method TO-11A uses cartridges impregnated with 2,4-dinitrophenylhydrazine (DNPH) to selectively derivatize aldehydes and ketones from the air. The derivatized samples are then extracted with acetonitrile. The resulting organic extract is then analyzed by the ERG laboratory using high performance liquid chromatography (HPLC) analysis with ultraviolet (UV) detection.

The 24-hour integration time was used during the EI program to assess the potential for exposure over a 1-day period. The EI field staff calibrated all of the devices used to control the carbonyl compound sample collection flow rates. Additionally, weatherproof and temperature controlled shelters were set up for the carbonyl compound samplers. These shelters supplied 15 amp/110V AC electricity to power the sampling equipment, and were properly secured to reduce risks of equipment theft or tampering. Table 1 presents the target carbonyl compounds and their corresponding method detection limits (MDL) for both phases of this EI. Table 2 provides the sample schedule dates for both phases of the EI.

Phase 2 (Sites 1-5; twice-every-five-day schedule)

Except for schedule, the same sampling and analysis method was applied in Phase 2 carbonyl sampling as in Phase 1. The 24-hour integration time was used during the EI program to assess the potential for exposure over a 1-day period. The EI field staff calibrated all of the devices used to control the carbonyl compound sample collection flow rates. Table 1 presents the target carbonyl compounds and their corresponding method detection limits (MDL) for both phases of this EI. Table 2 provides the sample schedule dates for both phases of the EI.

Unfortunately, after much discussion and effort by the EPA ERT contract laboratory, it was determined that the sampling media used during Phase 2 was not adequate for a 24-hour sampling event due to the large amount of water vapor present in the ambient air samples collected. It is important to note that the media utilized met the criteria specified in TO-11A. The laboratory decided to cease analysis of the samples and all initial results were rejected. Large amounts of water vapor reacted with both the KI-scrubber and the DNPH-treated sorbent causing multiple problems with sample analysis, as well as uncertainty in the results that were generated. No valid carbonyl data was produced from Phase 2 sampling and analyses.

Table 1
TO-11A Method Detection Limits (MDLs)

Compound	MDL in Phase 1	MDL in Phase 2	Lowest health-based comparison value
Units:	Parts per billion (ppb)	ppb	ppb
Acetaldehyde	0.006	0.022	5
Acetone	0.008	0.038	10,000
Benzaldehyde	0.003	0.009	2
2-Butanone (methyl ethyl ketone)	0.004	NA	440
Butyr/Isobutyraldehyde	0.003	0.014	5
Crotonaldehyde	0.003	0.031	0.3
2,5-Dimethylbenzaldehyde	0.003	0.016	2
Formaldehyde	0.009	0.033	0.06
Glutaraldehyde	0.001	0.073	0.05
Hexaldehyde	0.002	0.022	20
Isovaleraldehyde	0.002	0.011	50
Propionaldehyde	0.003	0.017	3.4
Tolualdehyde	0.005	0.008	2
Valeraldehyde	0.003	0.011	30

Note: NA = not included in phase 2; Minimum detection limits are based on a sample volume of 1,000 liters.

Table 2
Schedule for 24-hour Carbonyl Compound Sample Collection

Sampling Event Day	Site ID				
	Site 1	Site 2	Site 3	Site 4	Site 5
Phase 1 (ERG sampling with ATSDR oversight)					
7/9/12	Duplicate	—*	Primary	Primary	Primary
7/11/12	Primary, FB	—	Primary, FB	Primary, FB	Primary, FB
7/13/12	Primary	Duplicate	Primary	Primary	Primary
7/15/12	Primary	Primary	Duplicate	Primary	Primary
7/17/12	Primary	Primary	Primary	Duplicate	Primary
7/19/12	Primary	Primary	Primary	Primary	Duplicate
7/21/12	Primary	Primary	—	Primary	Primary
7/23/12	Duplicate	Primary	Primary	Primary	Primary

Sampling Event Day	Site ID				
	Site 1	Site 2	Site 3	Site 4	Site 5
7/25/12	Primary, FB	Primary, FB	Primary, FB	Primary, FB	Primary, FB
7/27/12	Primary	Duplicate	Primary	Primary	Primary
7/29/12	Primary	Primary	Duplicate	Primary	Primary
7/31/12	Primary	Primary	Primary	Duplicate	Primary
8/2/12	Primary	Primary	Primary	Primary	Duplicate
8/4/12	Primary	Primary	Primary	Primary	Primary
8/6/12	Primary	Primary	Primary	Primary	Primary
Phase 2 begins (ERT sampling)**					
8/11/2012	Duplicate	Primary	Primary, FB	Primary	Primary
8/12/2012	Primary	Primary	Primary	Primary, FB	Primary
8/16/2012	Primary	Duplicate	Primary	Primary	Primary, FB
8/17/2012	Primary, FB	Primary	Primary	Primary	Primary
8/21/2012	Primary	Primary, FB	Duplicate	Primary	Primary
8/22/2012	Primary	Primary	Primary. FB	Primary	Primary
8/26/2012	Primary	Primary	Primary	Primary, FB	Primary
8/27/2012	Primary	Primary	Primary	Duplicate	Primary, FB
8/31/2012	Primary, FB	Primary	Primary	Primary	Primary
9/1/2012	Primary	Primary, FB	Primary	Primary	Duplicate
9/5/2012	Duplicate	Primary	Primary, FB	Primary	Primary
9/6/2012	Primary	Primary	Primary	Primary, FB	Primary
9/10/2012	Primary	Primary	Primary	Primary	Primary, FB
9/11/2012	Primary, FB	Duplicate	Primary	Primary	Primary
9/15/2012	Primary	Primary, FB	Primary	Primary	Duplicate
9/16/2012	Primary	Primary	Primary. FB	Primary	Primary
9/20/2012	Primary	Primary	Duplicate	Primary, FB	Primary
9/21/2012	Primary	Primary	Primary	Primary	Primary, FB
9/25/2012	Primary, FB	Primary	Primary	Primary	Primary
9/26/2012	Primary	Primary, FB	Primary	Duplicate	Primary
9/30/2012	Primary	Primary	Primary, FB	Primary	Primary
10/1/2012	Primary	Primary	Primary	Primary, FB	Duplicate
10/5/2012	Duplicate, FB	Primary	Primary	Primary	Primary
10/6/2012	Primary	Primary, FB	Primary	Primary	Primary
Total:	**39**	**37**	**38**	**39**	**39**

Notes: * The first carbonyl compound sample was collected at Site 2 on July 13. No carbonyl compound sample was collected at Site 3 on 7/21; ** During phase 2, one trip blank was sent with each 2-day/event sample shipment; FB = field blank sample was collected; Duplicate = a duplicate and primary sample pair were collected

Carbonyl Sampling Completeness

During phase 1, there were 111 carbonyl compound samples analyzed, including primary samples, duplicates, replicates, and field blanks. Specifically, the 111 carbonyl compound samples analyzed include the following:[1]

- 62 field samples
- 10 primary and duplicate sample pairs

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[1] Field samples represent measurements collected directly from the instrument at each monitoring location. Primary and duplicate sample pairs are samples that are run together from the sampling equipment at the monitoring locations to check the sampling and analysis precision of the field sampling equipment. In other words, two samples are collected from the same instrument at the same time. Field blanks are collected to ensure there was no background interference on the sampling equipment. Replicate samples are analyzed in the laboratory to evaluate lab-specific precision in the data analysis.

- 9 field blanks
- 20 laboratory replicates

All 111 sample analyses were considered valid, yielding 100% measurement completeness for carbonyls in phase 1 of sampling.

For phase 2, there were 148 carbonyl samples collected including primary samples, primary/ collocated pairs, field blanks, and trip blanks. The 148 carbonyl compound samples included:

- 94 field samples
- 10 primary and collocated sample pairs (20 samples)
- 21 field blanks
- 13 trip blanks

A number of issues at the laboratory were encountered during phase 2. Specifically the large and varied amount of water in the samples, due to relative humidity levels and/or rain during the sampling events, reacted with laboratory chemicals creating irregular retention-time shifts and other problems with the analysis. These difficulties were not resolved and all carbonyl analytical results from phase 2 were rejected or cancelled, yielding 0% completeness for phase 2.

Hydrogen Sulfide

Honeywell single point monitors (SPMs) were used to measure H_2S at all six monitoring locations during both phases of the EI. The manufacturer performed primary calibration certification of the SPMs. Supplemental calibration checks on these instruments were prior to field deployment, and again after the EI was completed. Two-point internal optical performance checks were conducted during deployment and at the end of each week of monitoring. Results from the calibration and optical checks are included in the attached Phase 1 Field Investigation Report.

One SPM instrument configuration was used during the EI. ChemKeys (i.e., programmable read-only memory chips) were used to set the measurements range on each instrument to allow an overall measurement range of 3–90 ppb H_2S (note: the lower detection limit of 3 ppb was identified for both phases of the EI; any H_2S detections below this limit are considered estimated results). The SPMs detected the presence of the target analyte (H_2S) and calculated corresponding concentrations using a colorimetric detection method. This method utilizes an optical scanning system that quantifies ambient air concentrations by measuring color change on a chemically impregnated paper tape specific to the target analyte. In this program, ATSDR used a measurement tape impregnated with a specially formulated chemical reagent specific for H_2S.

Hydrogen Sulfide Monitoring Completeness

During phase 1, measurement completeness for H_2S ranged from 92.5% at Site 3-collocated to 99. 8% at Site 2, with an overall program completeness of 97.5%. The program data quality objective (DQO) of 80% data capture was exceeded for all monitoring locations during phase 1.

During phase 2, measurement completeness for H_2S ranged from 79.0% at Site 2 to 99.8% at Site 1, with an overall program completeness of 92.8%. Except for Site 2, the program DQO of 80% data capture was exceeded for all monitoring locations throughout phase 2. Of the 412,687 possible H2S measurements, 396,148 measurements were considered valid for a 96% overall measurement completeness.

Sulfur Compounds

Sulfur compound sampling was only conducted during Phase 2 of the EI. ATSDR requested collaborative technical assistance from EPA/ERT in developing and implementing air sampling and analysis of reactive sulfur compounds collected during 24-hour sampling periods. Samples were analyzed by the ERT/SERAS Laboratory following modified ASTM Method D5504, *Standard Test Method for Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence*.

Time-weighted 24-hour samples for reduced sulfur compounds were collected from Sites 1 through 5 over the nine-week continuation of the EI. Samples were collected using Silonite-fused canisters with Silonite-coated flow controllers. The flow controllers were set to collect approximately 4 to 5 liters of sample over a 24-hour period. The 24-hour integration time was used during the EI program to assess the potential for exposure over a 1-day period. As noted in Table 3, 12 of the 14 lowest health-based comparison values were above the laboratory reporting limit for each compound.

Table 3
Reduced Sulfur Compounds Reporting Limits (RLs)

Compound	RL (ppb)	Lowest health-based comparison value (ppb)
Hydrogen sulfide	5.15	1
Carbonyl sulfide	5.05	1.1
Methyl mercaptan	5.05	0.7
Ethyl mercaptan	5.30	0.5
Dimethyl sulfide	5.30	2.1
Carbon disulfide	5.05	200
Isopropyl mercaptan	5.30	0.025
Ethyl methyl sulfide	5.25	1.58
n-Propyl mercaptan	5.30	0.5
t-Butyl mercaptan	5.20	0.37
Methyl propanethiol	5.30	0.37
Thiophene/2-methyl propanethiol	10.6	2
Methyl isopropyl sulfide	5.25	None available
n-Butyl mercaptan	5.20	0.5

EPA APD

The EPA APD primary objective for this project was to collect sufficient representative empirical data on target compounds in ambient air from select natural gas activity host areas of Pennsylvania and/or West Virginia to allow regulators and health assessors to make informed decisions, conclusions and recommendations. EPA conducted sampling for volatile organic compounds (VOC) and particulate matter less than two microns in diameter ($PM_{2.5}$) from 3 locations surrounding the Brigich compressor. The three EPA sampling locations are as follows:

- “EPA 1” is same location as ATSDR “Site 5”;
- “EPA 2” is same location as ATSDR “Site 3”; and,
- “EPA 3” is same location as ATSDR “Site 1”.

All field activities were completed by EPA APD staff from August 4, 2012 to November 28, 2012. VOC and $PM_{2.5}$ sampling was conducted in accordance in accordance with EPA Region 3 Quality Assurance Project Plan (QAPP) for the Natural Gas Activities Air Monitoring Initiative.

Volatile Organic Compound (VOC) Sampling

EPA personnel deployed and collected 24-hour ambient air samples from pre-designated monitoring site locations using 6 liter canisters. Each canister was equipped with a restrictive orifice set at a flow range between 2-4 milliliters per minute and sampled for a duration of 24 hours. An in-line timer was used to ensure samples started and stopped at the same time. All samples were submitted to the EPA Region 3 Office of Analytical Services and Quality Assurance (OASQA) laboratory in Fort Meade, MD for VOC analysis. The OAQSA laboratory list of determined Minimum Detection Limits (MDL) for compounds analyzed by EPA Compendium Method TO-15 is provided in Table 4. The OAQSA laboratory also set the reporting limit at 0.5 parts per billion by volume (ppbv). All canisters and flow rate orifices were certified clean by the OAQSA lab prior to being shipped back out to the field.

EPA notes in their site-specific QAPP that all analytical method SOPs concerning VOC analysis are on file at the EPA Regional Laboratory in Ft. Meade, MD. Analytical methods for air canisters are performed following the EPA Region 3 Standard Operating Procedure R3QA230-041912, also listed on file and referenced in the site-specific QAPP. Summa canisters used for sample collection were cleaned following Region 3 SOP R3QA231, and certified by GC/MS analysis to ensure cleanliness for its intended use.

VOC sampling was completed by EPA APD on residential properties at three locations surrounding the Brigich compressor and at one background location. One collocated sampler was also staged at one site during sampling. Valid samples were collected by EPA on a once-every three day schedule, starting August 4 and completed on November 28, 2012. Table 5 provides a summary of the sampling schedule completed.

Table 4
EPA APD TO-15 Sampling Compounds and Limits

Target Compound	Chemical Abstract Number (CAS)	Lab MDL Full Scan (ppb)	Lab Reporting Limit (RL) (ppb)	Lowest health-based comparison value (ppb)
1,1-Dichloroethane	75-34-3	0.034	0.5	100
1,1-Dichloroethene	75-35-4	0.035	0.5	20
1,1,1-Trichloroethane	71-55-6	0.017	0.5	700
1,1,2-Trichloroethane	79-00-5	0.022	0.5	0.01
1,1,2,2-Tetrachloroethane	79-34-5	0.022	0.5	0.003
1,2-Dibromoethane	106-93-4	0.025	0.5	0.0002
1,2-Dichlorobenzene	95-50-1	0.04	0.5	5.4
1,2-Dichloroethane	107-06-2	0.022	0.5	0.01
1,2-Dichloropropane	78-87-5	0.024	0.5	0.9
1,2,4-Trichlorobenzene	120-82-1	0.099	0.5	0.67
1,2,4-Trimethylbenzene	95-63-6	0.047	0.5	25
1,3-Butadiene	106-99-0	0.051	0.5	0.02
1,3-Dichlorobenzene	541-73-1	0.054	0.5	5.4
1,3,5-Trimethylbenzene	108-67-8	0.036	0.5	250
1,4-Dichlorobenzene	106-46-7	0.025	0.5	10

Target Compound	Chemical Abstract Number (CAS)	Lab MDL Full Scan (ppb)	Lab Reporting Limit (RL) (ppb)	Lowest health-based comparison value (ppb)
2-Butanone	78-73-3	0.036	0.5	440
4-Methyl-2-pentanone	108-10-1	0.022	0.5	None
Benzene	71-43-2	0.017	0.5	0.04
Benzyl chloride	100-44-7	0.034	0.5	1
Bromodichloromethane	75-27-4	0.018	0.5	10
Bromoform	75-25-2	0.012	0.5	0.09
Bromomethane	74-83-9	0.042	0.5	1
Carbon disulfide	75-15-0	0.018	0.5	10
Carbon tetrachloride	56-23-5	0.015	0.5	0.03
Chlorobenzene	108-90-7	0.012	0.5	10
Chloroethane	75-00-3	0.022	0.5	4000
Chloroform	67-66-3	0.024	0.5	0.009
Chloromethane	74-87-3	0.036	0.5	40
cis-1,3-Dichloropropene	10061-01-5	0.031	0.5	0.06
cis-1,2-Dichloroethene	156-59-2	0.034	0.5	200
Dibromochloromethane	124-48-1	0.024	0.5	0.23
Dichlorodifluoromethane	75-71-8	0.043	0.5	1000
Dichlorotetrafluoroethane	76-14-2	0.035	0.5	1000
Ethanol	64-17-5	0.094	0.5	1000
Ethylbenzene	100-41-4	0.031	0.5	60
Hexachlorobutadiene	87-68-3	0.067	0.5	0.02
m,p-Xylene	108-38-3/106-42-3	0.107	1.0	20
Methyl tert-butyl ether	1634-04-4	0.015	0.5	700
Methylene chloride	75-09-2	0.018	0.5	0.6
Naphthalene	91-20-3	0.089	0.5	0.6
o-Xylene	95-47-6	0.017	0.5	20
Propylene	115-07-1	0.071	0.5	1,000,000
Styrene	100-42-5	0.035	0.5	200
Tetrachloroethene	127-18-4	0.015	0.5	40
Toluene	108-88-3	0.024	0.5	80
trans-1,2-Dichloroethene	156-60-5	0.022	0.5	200
trans-1,3-Dichloropropene	10061-02-6	0.017	0.5	0.06
Trichloroethene	79-01-6	0.018	0.5	10
Trichlorofluoromethane	75-69-4	0.035	0.5	500
Trichlorotrifluoroethane (Freon 113)	76-13-1	0.030	0.5	500
Vinyl chloride	75-01-4	0.061	0.5	0.04

Notes: MDL = Method detection limit, ppb = parts per billion

Table 5
EPA APD Valid Volatile Organic Compound Sampling Dates

Sampling Event Day	EPA 1	EPA 2	EPA 2 (Collocated)	EPA 3	Florence (background)
8/4/12	X	X	X	X	X
8/7/12	X	X	X		
8/10/2012	X	X	X	X	X
8/13/2012	X	X	X	X	X
8/16/2012	X	X	X	X	

Sampling Event Day	EPA 1	EPA 2	EPA 2 (Collocated)	EPA 3	Florence (background)
8/25/2012		X		X	
8/28/2012	X	X	X	X	X
8/31/2013	X		X	X	X
9/3/2012	X	X	X		
9/6/2012	X	X	X	X	X
9/9/2012	X	X	X		X
9/12/2012		X	X	X	X
9/15/2012		X	X	X	X
9/19/2012	X	X	X	X	
9/22/2012	X	X	X	X	
9/24/2012	X	X	X	X	X
9/27/2012	X	X	X	X	X
9/30/2012	X		X	X	X
10/3/2012	X		X	X	X
10/6/2012	X	X			X
10/9/2012	X			X	
10/12/2012	X	X	X		X
10/15/2012	X	X	X	X	X
10/17/2012	X	X	X	X	X
10/19/2012	X	X	X	X	X
10/22/2012	X			X	X
10/25/2012	X	X	X	X	X
10/28/2012	X	X			
10/31/2012		X		X	X
11/3/2012	X	X	X	X	X
11/6/2012		X	X	X	X
11/9/2012		X			X
11/12/2012	X	X	X	X	X
11/15/2012		X		X	X
11/17/2012		X	X	X	X
11/19/2012	X	X		X	X
11/25/2012					X
11/27/2012	X			X	X
11/28/2012	X				
Total:	30	31	27	30	30

$PM_{2.5}$

EPA personnel collected 24-hour $PM_{2.5}$ samples from one predetermined location, EPA 1/Site 2, located near the compressor station on a one-in-every-three day schedule. Collocated sampling was also conducted at this location as part of the quality assurance program defined in the site-specific QAPP. $PM_{2.5}$ samples were collected using Airmetrics MiniVol™ TAS. Ambient air was sampled at 5 liters/per minute and $PM_{2.5}$ was collected on a $PM_{2.5}$, polytetrafluoroethylene

(PTFE) teflon, 46.2 millimeter filter membrane.

All sample filters were submitted to the Allegheny County Health Department (ACHD) in Pittsburgh, PA, for filter mass measurement by gravimetric method. The net mass of the filter was obtained by taking the difference between the tare and gross weights of that filter. Tare weight is the weight of the specific filter after it has been conditioned and before it is sampled. The gross weight is the weight of the specific filter after it has been sampled and after it has again been conditioned. Both procedures were done in the ACHD laboratory.

Appendix B -

Carbonyl and Hydrogen Sulfide Data - Analyses, Tables and Graphs -

(15 pages)

Introduction

Carbonyl and hydrogen sulfide results were compared to health-based comparison values (CV) to determine which chemicals are of potential public health concern. Crotonaldehyde, formaldehyde, and hydrogen sulfide exceeded respective health-based CVs. Additional evaluation of the data by sampling/monitoring location and specific chemical is provided in this Appendix. First, the carbonyl detections are presented by site location (sites 1 through 5). Second, carbonyl detections are presented by specific chemical. And, finally, the hydrogen sulfide data is presented in two tables and two graphs, separated by the period in which monitoring was conducted (Phase 1 hydrogen sulfide monitoring completed by ERG, and Phase 2 monitoring completed by EPA ERT).

Carbonyls by Site

Carbonyl were regularly detected in the 24-hour samples, with formaldehyde and crotonaldehyde detected on all days of sampling. To calculate average concentrations, the reported value, including the estimated values that were provided by the laboratory for detections below the reporting limit, were used.

Site 1

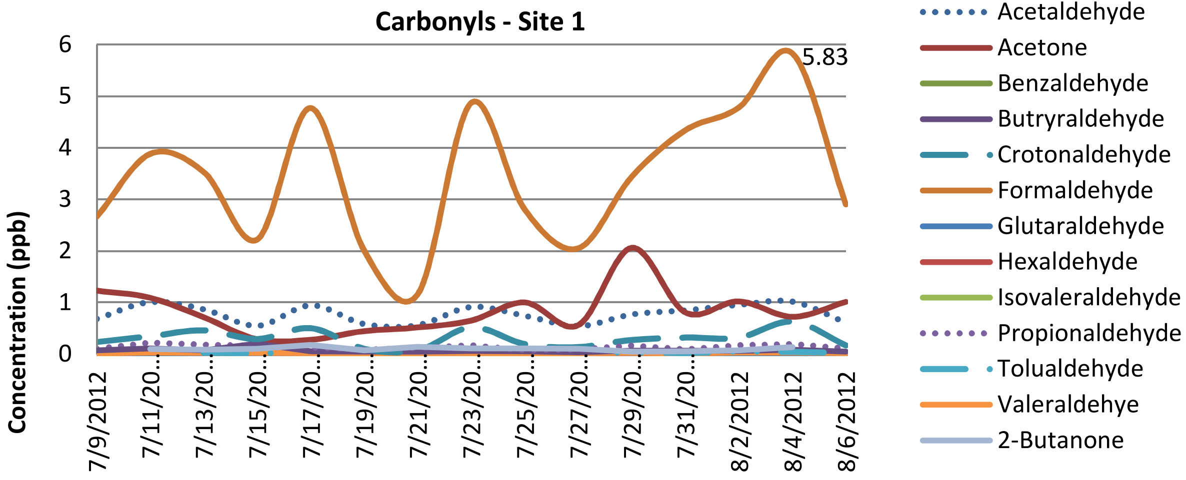
- The maximum 24-hour concentrations of formaldehyde (5.83 ppb), glutaraldehyde (0.011 ppb), and isovaleraldehyde (0.012 ppb) were detected at Site 1. The maximum detection of formaldehyde and glutaraldehyde were on days when Site 1 was downwind of the Brigich Compressor Station. Crotonaldehyde and formaldehyde were the only carbonyls which exceeded their respective CVs at site 1.

- Crotonaldehyde was detected on 7 of 15 sampling days above the TCEQ long-term ESL of 0.3 ppb. The average crotonaldehyde concentration (0.31 +/- 0.16 ppb) for all 15 days of sampling slightly exceeded the TCEQ long-term ESL of 0.3 ppb.

- Formaldehyde was detected on each day of sampling at site 1, with an average concentration of 3.4 +/ 1.3 ppb. Formaldehyde exceeded the cancer risk evaluation guideline (CREG) of 0.06 ppb but did not exceed the non-cancer minimal risk level (MRL) of 8 ppb.

Figure 1 provides the carbonyls detected at Site 1 along with concentrations over the entire sampling period for which valid field results were obtained (July 9 through August 6, 2012).

Figure 1
Carbonyls - Site 1



Site 2

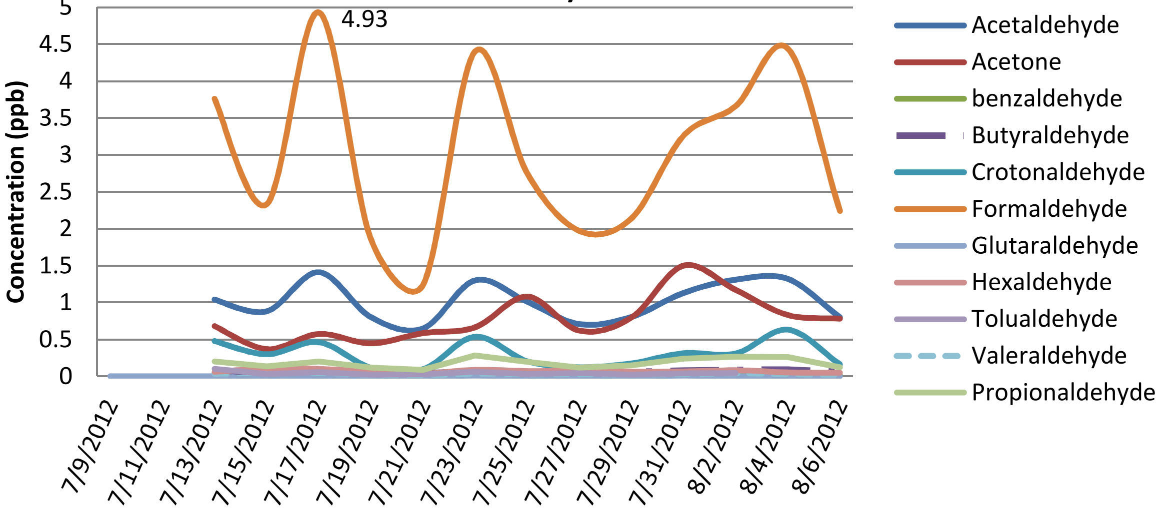
- The maximum 24-hour concentrations of crotonaldehyde (0.632 ppb), propionaldehyde (0.282 ppb), acetaldehyde (1.41 ppb), hexaldehyde (0.104 ppb), and tolualdehyde (0.103 ppb) were detected at Site 2. The maximum detections of crotonaldehyde and tolualdehyde were on days that Site 2 was downwind of the Brigich Compressor Station. Crotonaldeyhde and formaldehyde were the only carbonyls which exceeded their respective CVs at site 2.

- Crotonaldehyde was detected on 6 of 13 sampling days above the TCEQ long-term ESL of 0.3 ppb. The average crotonaldehyde concentration (0.3 +/- 0.17 ppb) for all 13 days of sampling was equal to the TCEQ long-term ESL of 0.3 ppb.

- Formaldehyde was detected on each day of sampling at site 1, with an average concentration of 3.0 +/ 1.2 ppb. Formaldehyde exceeded the CREG of 0.06 ppb but did not exceed the non-cancer MRL of 8 ppb.

Figure 2 provides the carbonyls detected at Site 2 along with concentrations over the entire sampling period for which valid field results were obtained (July 13 through August 6, 2012).

Figure 2
Carbonyls - Site 2



Site 3

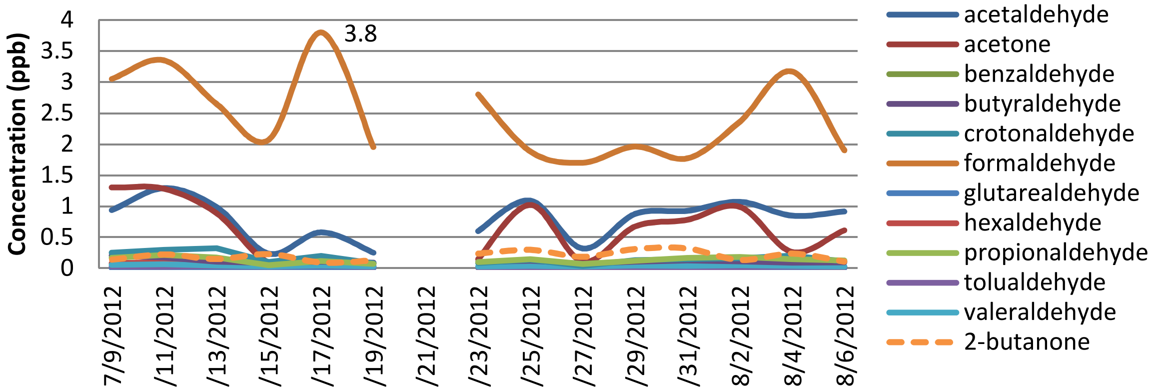
- The maximum 24-hour concentrations of 2-butanone (0.322 ppb), 2,5-dimethylbenzaldehyde (0.032 ppb), benzaldehyde (0.065 ppb), valeraldehyde (0.064 ppb), and butyraldehyde (0.203 ppb) were detected at Site 3. The maximum detection of both benzaldehyde and butyraldehyde was on a day (July 11, 2013) that Site 3 was downwind of the Brigich Compressor Station. Crotonaldehyde and formaldehyde were the only carbonyls which exceeded their respective CVs at Site 3.

- Crotonaldehyde was detected only once (July 13, 2012) out of the 14 days of carbonyl sampling at Site 3 at a level exceeding the TCEQ long-term ESL of 0.3 ppb. The average crotonaldehyde concentration (0.16 +/- 0.08 ppb) for all 14 days of sampling was below the TCEQ long-term ESL of 0.3 ppb.

- Formaldehyde was detected on each day of sampling at site 3, with an average concentration of 2.5 +/- 0.67 ppb. Formaldehyde exceeded the CREG of 0.06 ppb but did not exceed the non-cancer MRL of 8 ppb.

Figure 3 provides the carbonyls detected and results for Site 3 over the entire sampling period for which valid field results were obtained (July 9 through August 6, 2012).

Figure 3
Carbonyls - Site 3



Site 4

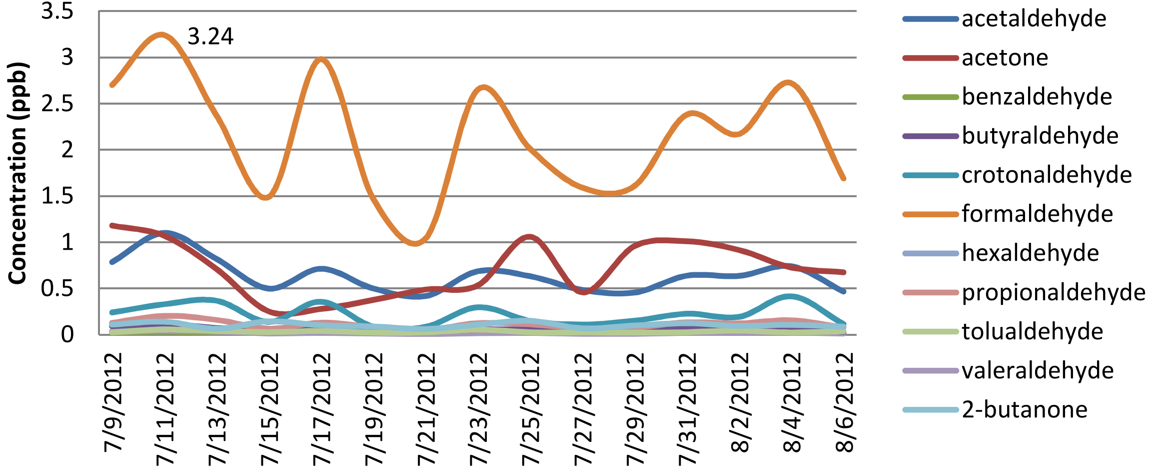
- Crotonaldehyde and formaldehyde were the only carbonyls which exceeded their respective CVs at Site 4.

- Crotonaldehyde was detected on four of 15 sampling days at Site 4 at concentrations exceeding the TCEQ long-term ESL of 0.3 ppb. The average crotonaldehyde concentration (0.22+/- 0.11 ppb) for all 15 days of sampling was below the TCEQ long-term ESL of 0.3 ppb.

- Formaldehyde was detected on each day of sampling at site 4, with an average concentration of 2.1 +/- 0.65 ppb. Formaldehyde exceeded the CREG of 0.06 ppb but did not exceed the non-cancer MRL of 8 ppb.

Figure 4 provides the carbonyls detected and results for Site 4 over the entire sampling period for which valid field results were obtained (July 9 through August 6, 2012).

Figure 4
Carbonyls - Site 4



Site 5

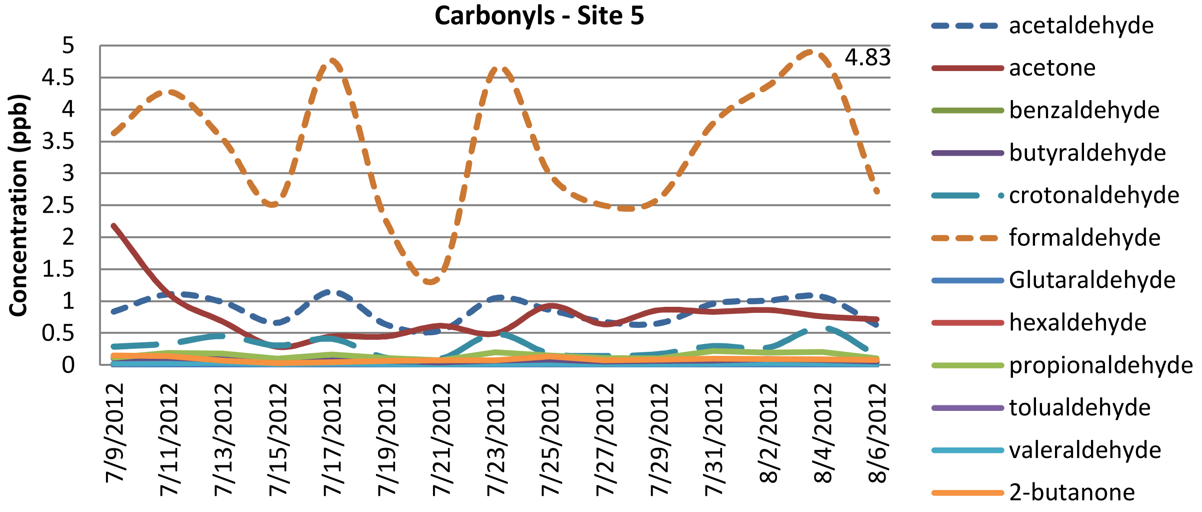
- The maximum 24-hour concentration of acetone (2.18 ppb) was detected at Site 5. Crotonaldehyde and formaldehyde were the only carbonyls which exceeded their respective CVs at Site 4.

- Crotonaldehyde was detected on six of 15 days of carbonyl sampling at Site 5 at concentrations exceeding the TCEQ long-term ESL of 0.3 ppb. The average crotonaldehyde concentration (0.29+/- 0.15 ppb) for all 15 days of sampling was just below the TCEQ long-term ESL of 0.3 ppb.

- Formaldehyde was detected on each day of sampling at site 5, with an average concentration of 3.4 +/- 1.1 ppb. Formaldehyde exceeded the CREG of 0.06 ppb but did not exceed the non-cancer MRL of 8 ppb.

Figure 5 provides the carbonyls detected and results for Site 5 over the entire sampling period for which valid field results were obtained (July 9 through August 6, 2012).

Figure 5
Carbonyls - Site 5



Carbonyls by Chemical

The following graphs provide analyte-specific concentrations over the entire sampling time period and health-based comparison value used by ATSDR for determining chemicals of potential concern. Acronyms used in the following graphs are defined at the end of this appendix.

Figure 6
Acetaldehyde

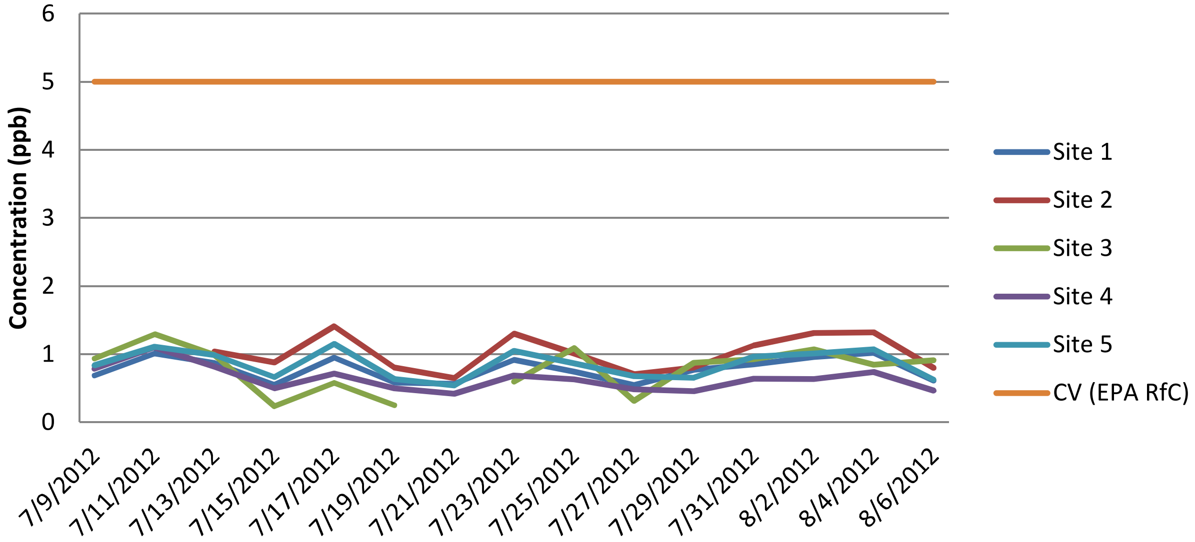
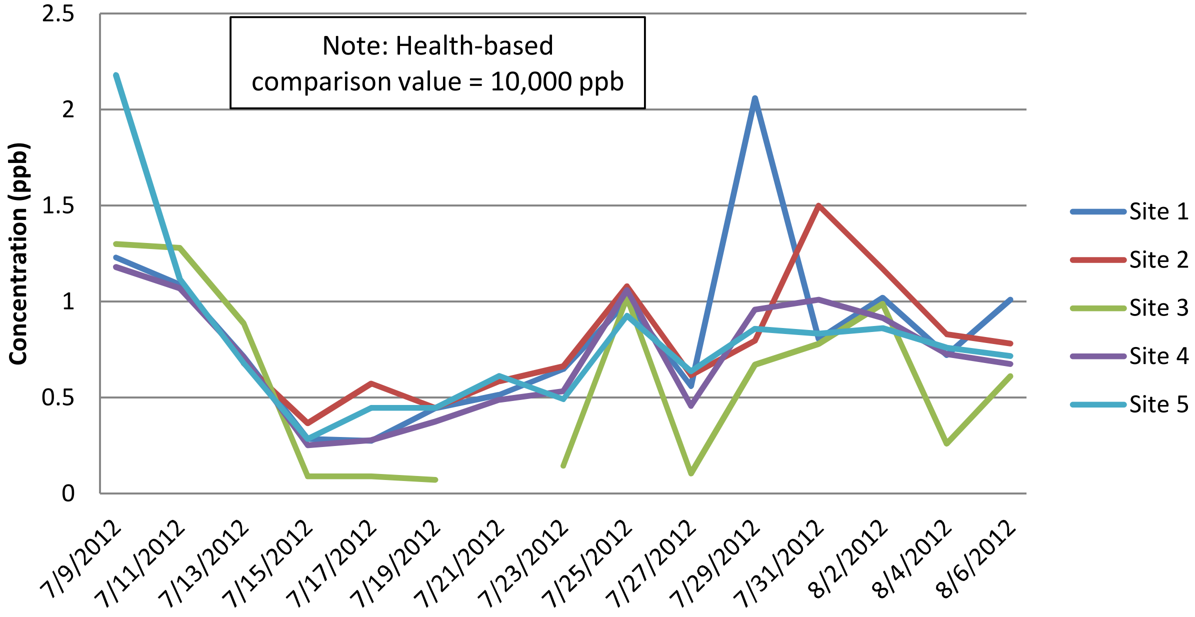


Figure 7
Acetone



Note: Health-based comparison value = 10,000 ppb

Figure 8
Benzaldehyde

Note: Health-based comparison value = 2 ppb

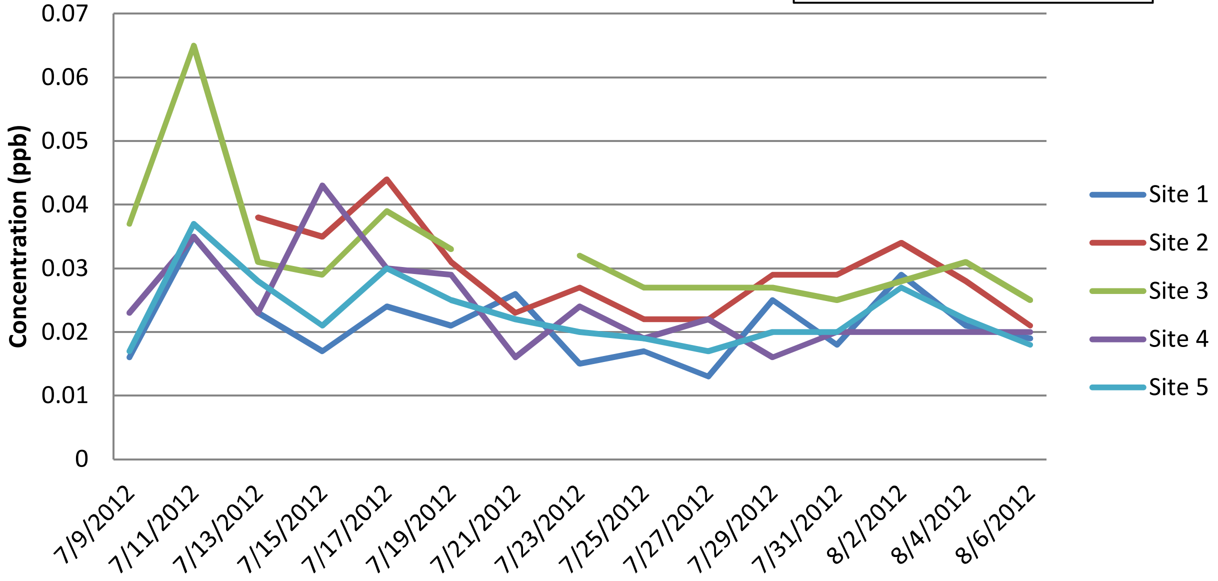


Figure 9
Butyraldehyde

Note: Health-based comparison value = 25 ppb

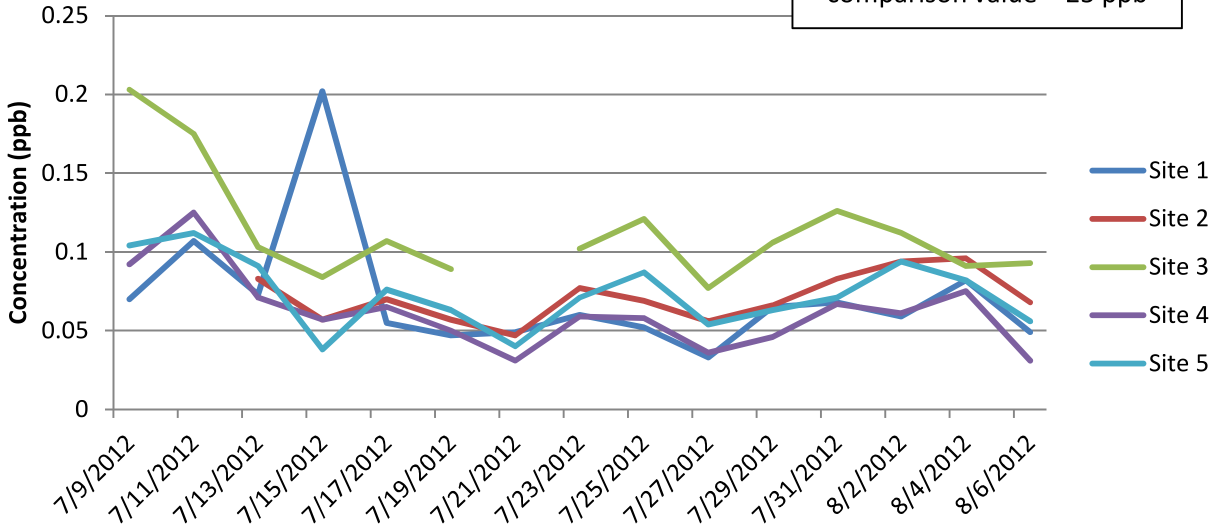


Figure 10
Crotonaldehyde

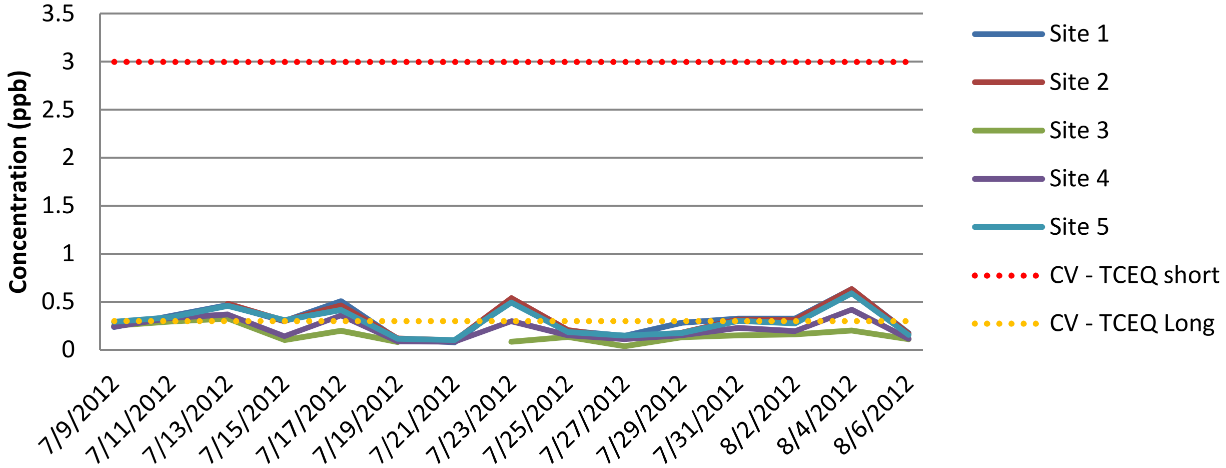


Figure 11
Crotonaldehyde CV Exceedances

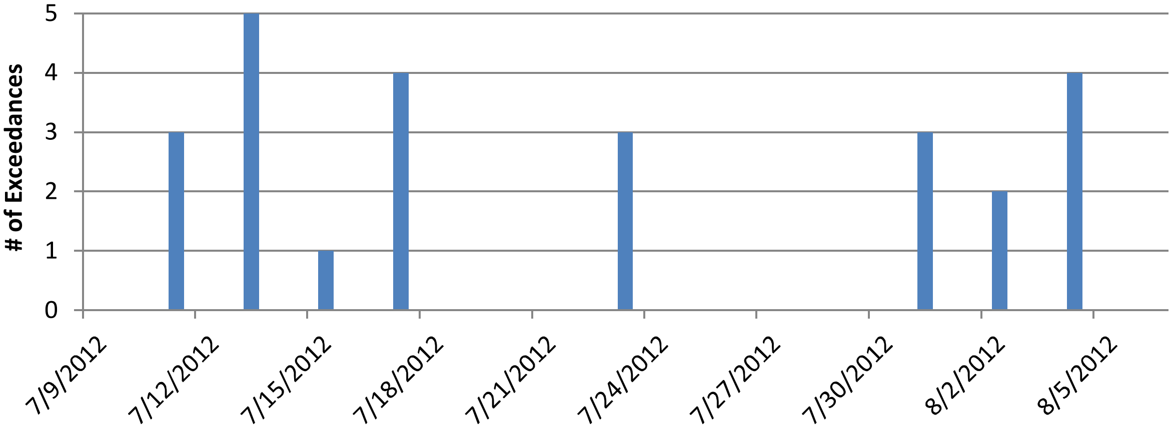


Figure 12
Formaldehyde

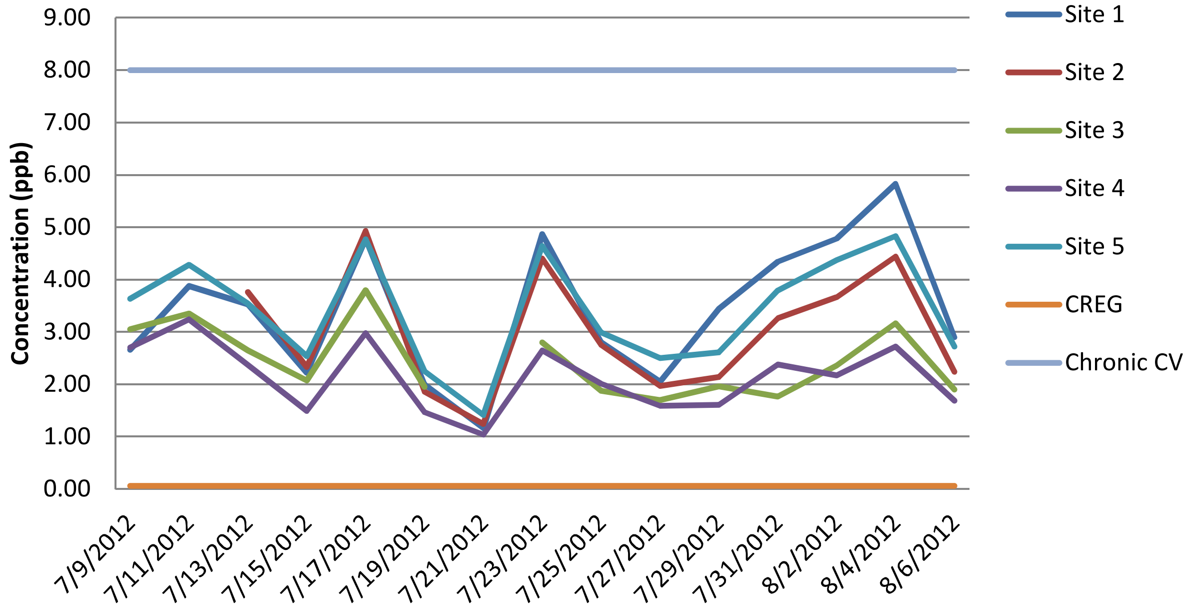


Figure 13
Glutaraldehyde

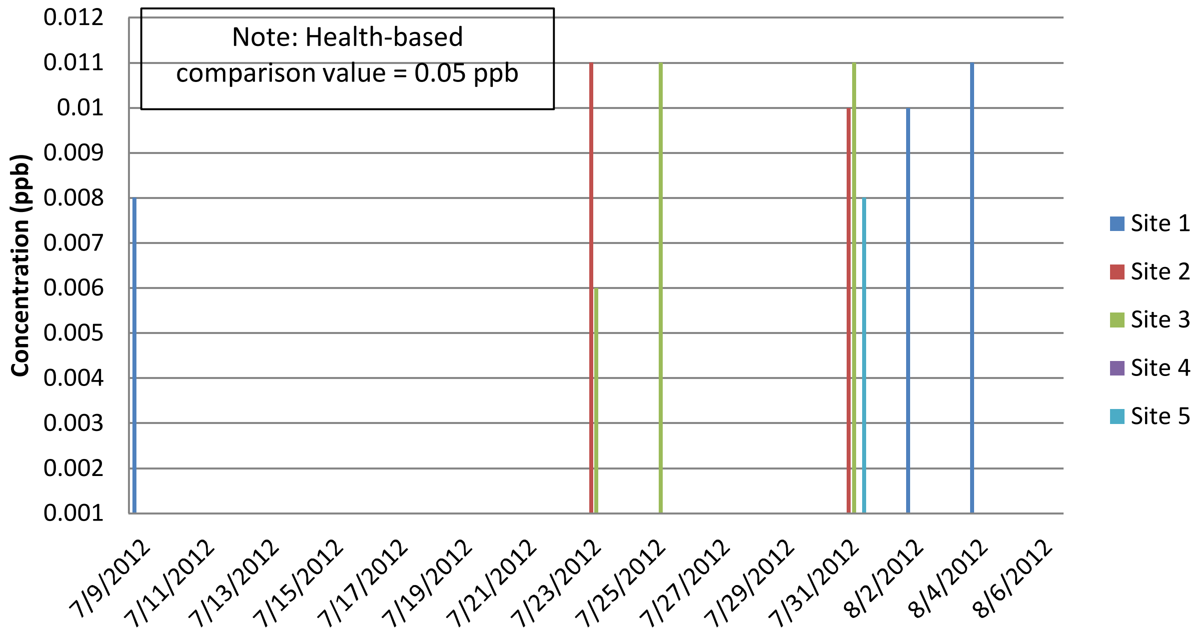
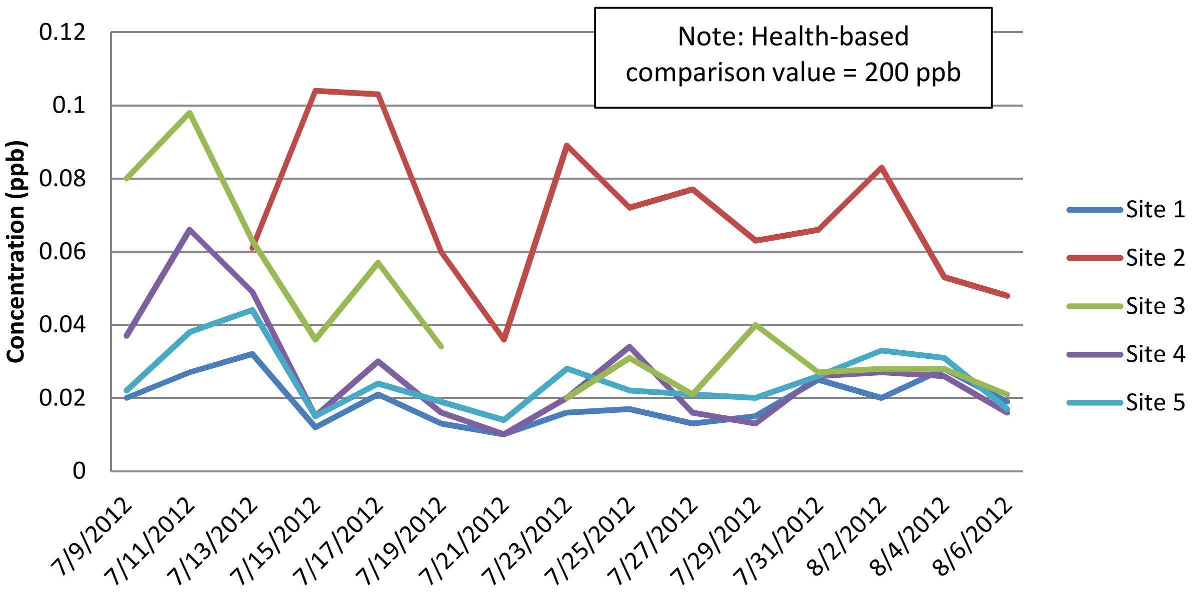


Figure 14
Hexaldehyde



Isovaleraldehyde
Isovaleraldehyde (not graphed) was detected once, on July 21, 2012 at Site 1 at a concentration of 0.012 parts per billion.

Figure 15
Propionaldehyde

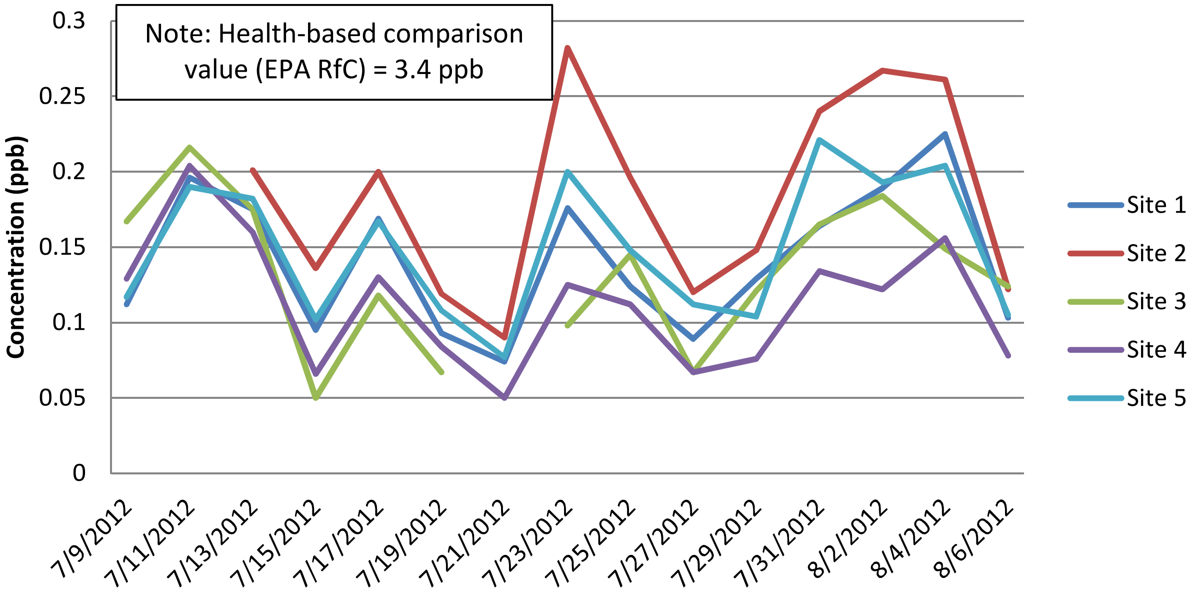


Figure 16
Tolualdehyde

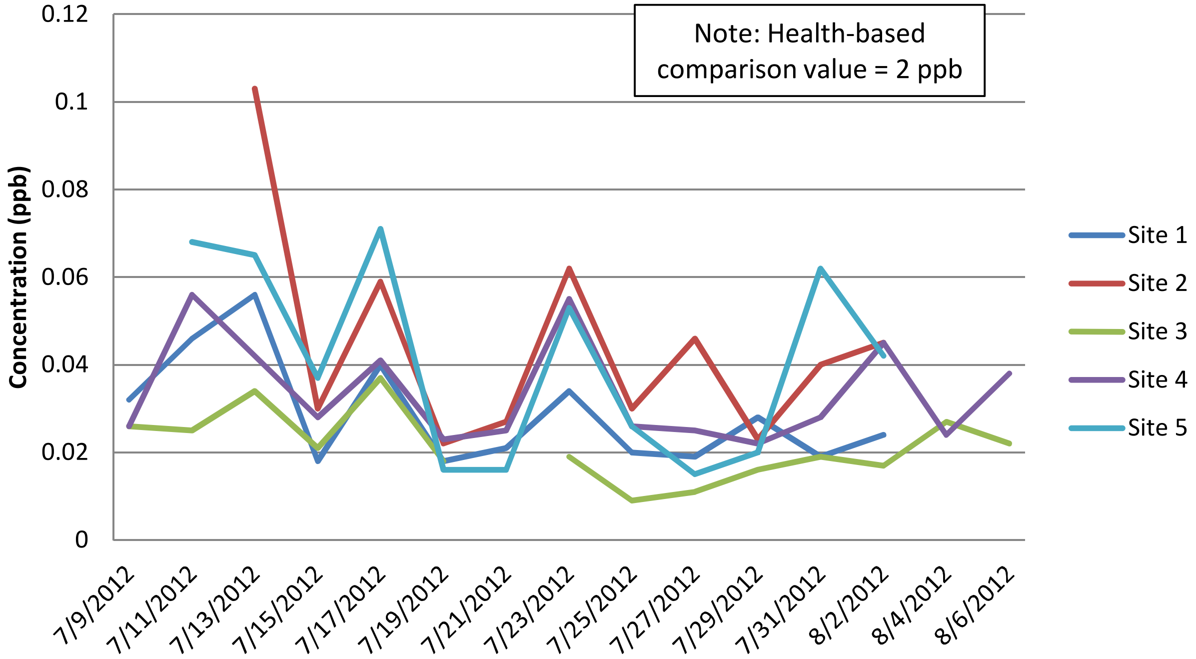


Figure 17
Valeraldehyde

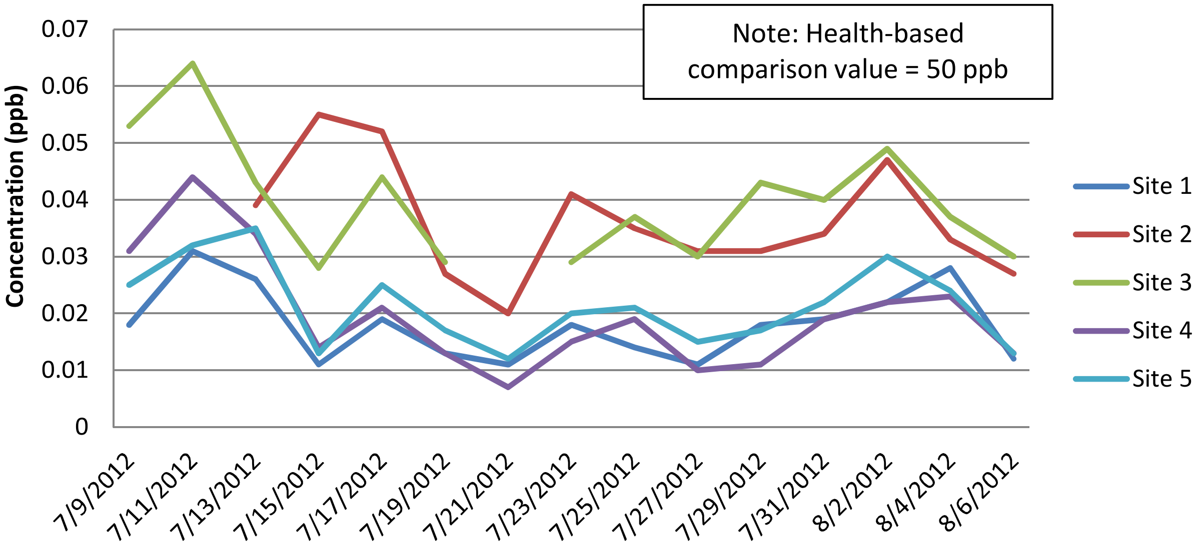
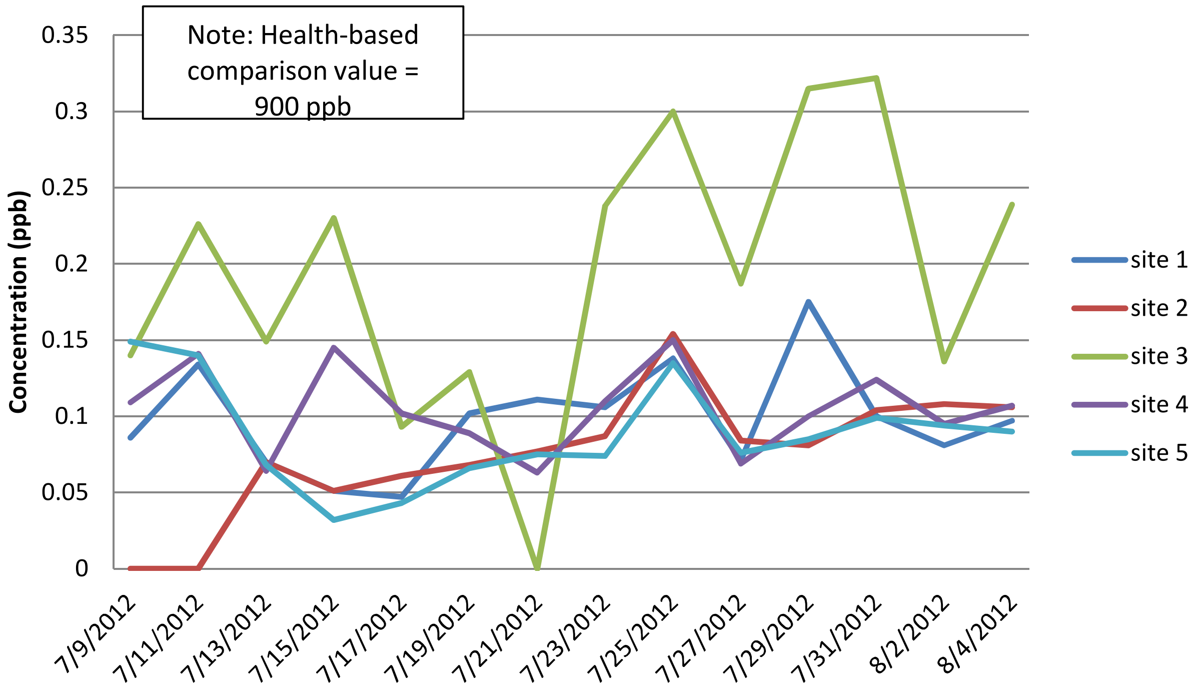


Figure 18
2-Butanone (MEK)



Note: Health-based comparison value = 900 ppb

2,5-Dimethylbenzaldehyde

2,5-Dimethylbenzaldehyde was detected once, on July 17, 2012 at Site 3 at a concentration of 0.032 parts per billion.

Hydrogen Sulfide

Hydrogen sulfide was continuously monitored during both phases of the EI. The following graphs and tables summarize the monitoring results from the EI.

Table 1
Phase 1 Hydrogen Sulfide Results Summary

Monitoring Location	Units	Health-based comparison value (Source)	Maximum 24-hour Average Concentration (Date)		Maximum 5-Minute Concentration (Date)		Average Concentration (Dates)	
Site 1	ppb	1.4 (RfC)	1.47	(7/10/12)	49.0	(7/10/12)	0.54*	(7/7 to 8/7/12)
Site 2	ppb		1.55	(8/7/12)	13.1	(7/25/12)	0.75	(7/10 to 8/7/12)
Site 3	ppb		**2.77**	(8/7/12)	**55.8**	(7/25/12)	**0.89***	(7/7 to 8/7/12)
Site 4	ppb		1.43	(8/7/12)	7.4	(7/30/12)	0.82	(7/7 to 8/7/12)
Site 5	ppb		1.02	(8/7/12)	16.3	(7/25/12)	0.63	(7/7 to 8/7/12)
Site 6	ppb		1.57	(8/7/12)	40.5	(7/23/12)	0.71	(7/13 to 8/7/12)

Note: *Includes primary and collocated monitoring results; **bold** indicates maximum concentration; ppb = parts per billion; RfC = EPA reference concentration

Figure 19
Phase 1 Hydrogen Sulfide Daily Average (in ppb)

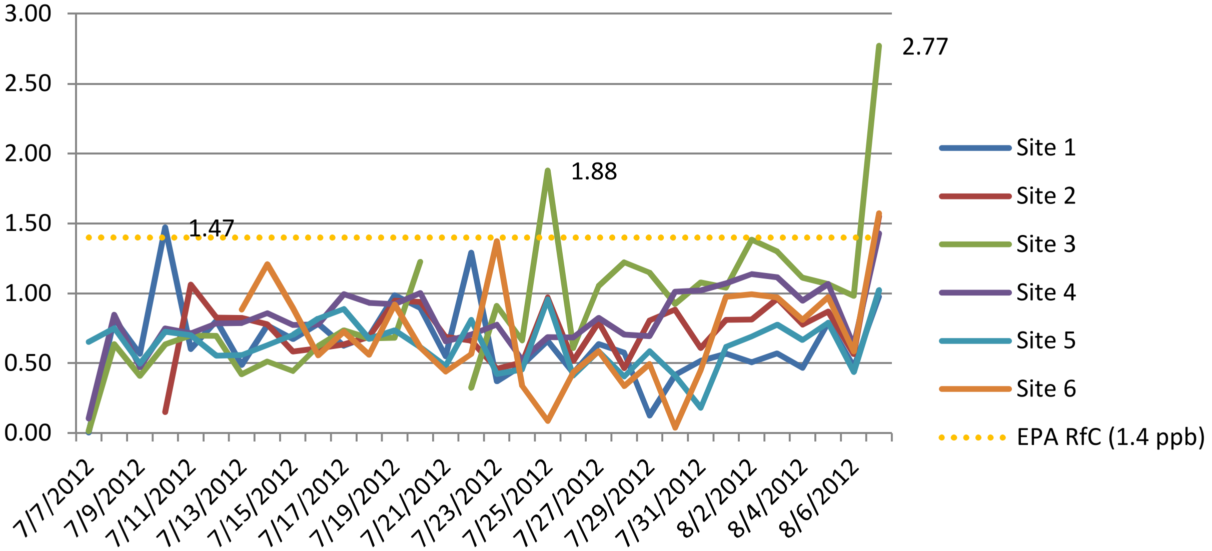


Table 2
Phase 2 Hydrogen Sulfide Results Summary

Monitoring Location	Units	Health-based comparison value (Source)	Maximum 24-hour Average Concentration (Date)	Maximum Instantaneous Concentration (Date)	Average Concentration (Dates)
Site 1	ppb	1.4 (RfC)	13.8 (9/5/12)	92.2 (9/20/12)	1.16 (8/12 to 10/6/12)
Site 2	ppb		1.15 (8/30/12)	22.8 (8/30/12)	0.31 (8/11 to 10/6/12)
Site 3	ppb		3.41 (8/21/12)	92.8 (9/13/12)	0.56 (8/17 to 10/6/12)
Site 4	ppb		3.91 (8/31/12)	9.0 (8/16/12)	0.51 (8/11 to 10/6/12)
Site 5	ppb		1.61 (8/18/12)	9.6 (8/11/12)	0.69 (8/11 to 10/6/12)

Note: **bold** indicates maximum concentration; ppb = parts per billion; RfC = EPA reference concentration

Figure 20
Phase 2 Hydrogen Sulfide Daily Average (in ppb)

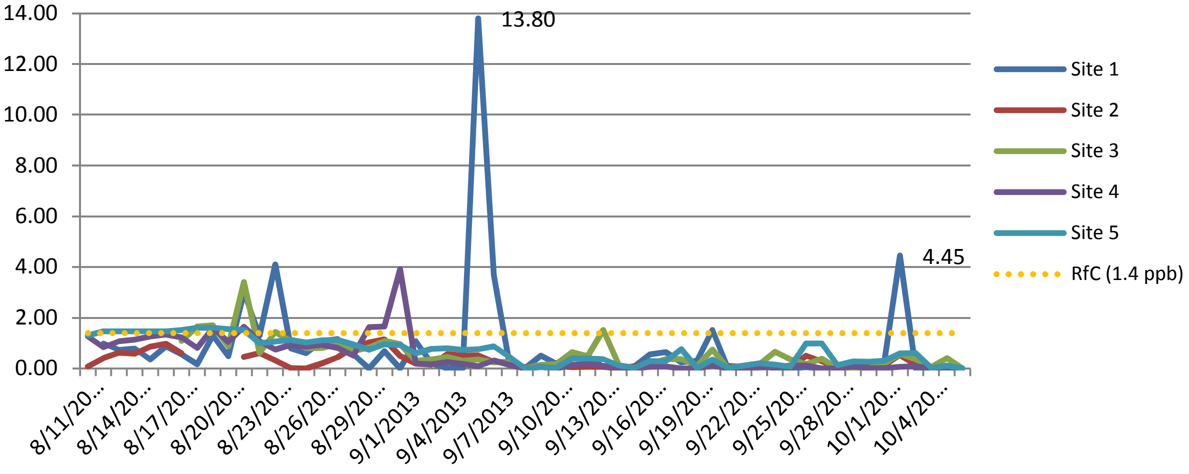


Table 3

Hydrogen Sulfide 30-Minute Averages
Exceeding 20 Parts per Billion (ppb)

Location	Date	Time (am)	H_2S Concentration (in ppb)
Site 1	7/10/2014	8-8:30	46.33
Site 1	7/22/2014	8:49-9:19	20.41
Site 1	8/22/2014	8:51-9:21	29.63
Site 1	9/20/2014	9:05-9:35	50.39
Site 3	7/25/2014	11:25-11:55	51.14
Site 3	8/2/2014	11:06-11:36	27.17
Site 3	8/7/2014	11:26-11:56	26.83
Site 3	7/29/2014	11:33-12:03	27
Site 3	8/18/2014	10:47-11:12	24.29
Site 3	9/13/2014	5:21-5:51	**51.34**

Notes:

CREG = ATSDR cancer risk evaluation guideline
CV = Comparison Value
ppb = parts per billion
MEK = Methyl ethyl ketone
RfC = EPA reference concentration
TCEQ short = Texas Commission on Environmental Quality acute exposure duration effect screening level
TCEQ long = Texas Commission on Environmental Quality chronic exposure effect screening level

Appendix C

Volatile Organic Compounds Detected

(15 pages)

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
FLO-VOC-093012	1,3-Butadiene	0.2	ppbv	J	
BRIG-VOC-083112-3	4-Methyl-2-pentanone	1.8	ppbv		
FLO-VOC-093012	4-Methyl-2-pentanone	1.6	ppbv		
BRIG-VOC-083112-1	4-Methyl-2-pentanone	1.2	ppbv		
BRIG-VOC-090312-2CO	4-Methyl-2-pentanone	0.3	ppbv	J	
BRIG-VOC-080412-3	4-Methyl-2-pentanone	0.2	ppbv	J	
BRIG-VOC-081612-1	4-Methyl-2-pentanone	0.2	ppbv	J	
BRIG-VOC-100612-2	4-Methyl-2-pentanone	0.2	ppbv	J	
BRIG-VOC-080412-3	Benzene	0.8	ppbv		
BRIG-VOC-080412-1	Benzene	0.7	ppbv		
BRIG-VOC-080712-1	Benzene	0.7	ppbv		
BRIG-VOC-082812-1	Benzene	0.7	ppbv		
BRIG-VOC-080412-2CO	Benzene	0.6	ppbv		
BRIG-VOC-080712-2	Benzene	0.6	ppbv		
BRIG-VOC-083112-1	Benzene	0.6	ppbv		
BRIG-VOC-083112-3	Benzene	0.6	ppbv		
BRIG-VOC-090312-2CO	Benzene	0.6	ppbv		
BRIG-VOC-111912-1	Benzene	0.6	ppbv		
BRIG-VOC-111912-2	Benzene	0.6	ppbv		
FLO-VOC-090612	Benzene	0.6	ppbv		
FLO-VOC-093012	Benzene	0.6	ppbv		
FLO-VOC-111912	Benzene	0.6	ppbv		
BRIG-VOC-080712-2CO	Benzene	0.5	ppbv		
BRIG-VOC-081612-1	Benzene	0.5	ppbv		
BRIG-VOC-082512-2	Benzene	0.5	ppbv		
BRIG-VOC-082512-3	Benzene	0.5	ppbv		
BRIG-VOC-082812-2	Benzene	0.5	ppbv		
BRIG-VOC-090312-1	Benzene	0.5	ppbv		
BRIG-VOC-090312-2	Benzene	0.5	ppbv		
BRIG-VOC-110912-2	Benzene	0.5	ppbv		
BRIG-VOC-111512-3	Benzene	0.5	ppbv		
FLO-VOC-083112	Benzene	0.5	ppbv		
BRIG-VOC-081012-2	Benzene	0.4	ppbv	J	
BRIG-VOC-081012-2CO	Benzene	0.4	ppbv	J	
BRIG-VOC-081312-1	Benzene	0.4	ppbv	J	
BRIG-VOC-081312-2	Benzene	0.4	ppbv	J	
BRIG-VOC-081312-2CO	Benzene	0.4	ppbv	J	
BRIG-VOC-081612-2	Benzene	0.4	ppbv	J	
BRIG-VOC-083112-2CO	Benzene	0.4	ppbv	J	
BRIG-VOC-090612-1	Benzene	0.4	ppbv	J	
BRIG-VOC-090612-2	Benzene	0.4	ppbv	J	
BRIG-VOC-090612-2CO	Benzene	0.4	ppbv	J	
BRIG-VOC-102512-1	Benzene	0.4	ppbv	J	
BRIG-VOC-102512-2CO	Benzene	0.4	ppbv	J	
BRIG-VOC-102512-3	Benzene	0.4	ppbv	J	
BRIG-VOC-111512-2	Benzene	0.4	ppbv	J	
BRIG-VOC-111712-2	Benzene	0.4	ppbv	J	
BRIG-VOC-111712-3	Benzene	0.4	ppbv	J	
BRIG-VOC-111912-3	Benzene	0.4	ppbv	J	
FLO-VOC-082812	Benzene	0.4	ppbv	J	
FLO-VOC-110912	Benzene	0.4	ppbv	J	
FLO-VOC-111512	Benzene	0.4	ppbv	J	
FLO-VOC-112512	Benzene	0.4	ppbv	J	
BRIG-VOC-080412-2	Benzene	0.3	ppbv	J	
BRIG-VOC-081312-3	Benzene	0.3	ppbv	J	
BRIG-VOC-081612-2CO	Benzene	0.3	ppbv	J	
BRIG-VOC-081612-3	Benzene	0.3	ppbv	J	
BRIG-VOC-090612-3	Benzene	0.3	ppbv	J	
BRIG-VOC-090912-2	Benzene	0.3	ppbv	J	
BRIG-VOC-090912-2CO	Benzene	0.3	ppbv	J	
BRIG-VOC-091212-2	Benzene	0.3	ppbv	J	
BRIG-VOC-091212-3	Benzene	0.3	ppbv	J	
BRIG-VOC-091512-2	Benzene	0.3	ppbv	J	
BRIG-VOC-091512-2CO	Benzene	0.3	ppbv	J	
BRIG-VOC-091512-3	Benzene	0.3	ppbv	J	
BRIG-VOC-100912-3	Benzene	0.3	ppbv	J	
BRIG-VOC-101212-2CO	Benzene	0.3	ppbv	J	
BRIG-VOC-102212-3	Benzene	0.3	ppbv	J	
BRIG-VOC-102512-2	Benzene	0.3	ppbv	J	
BRIG-VOC-110612-2CO	Benzene	0.3	ppbv	J	
BRIG-VOC-110912-3	Benzene	0.3	ppbv	J	
BRIG-VOC-111212-3	Benzene	0.3	ppbv	J	
BRIG-VOC-111712-2co	Benzene	0.3	ppbv	J	
BRIG-VOC-112712-1	Benzene	0.3	ppbv	J	
BRIG-VOC-112712-3	Benzene	0.3	ppbv	J	
FLO-VOC-081312	Benzene	0.3	ppbv	J	
FLO-VOC-100312	Benzene	0.3	ppbv	J	
FLO-VOC-102212	Benzene	0.3	ppbv	J	
FLO-VOC-111712	Benzene	0.3	ppbv	J	
BRIG-VOC-081012-1	Benzene	0.2	ppbv	J	
BRIG-VOC-081012-3	Benzene	0.2	ppbv	J	
BRIG-VOC-082812-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-082812-3	Benzene	0.2	ppbv	J	
BRIG-VOC-090912-1	Benzene	0.2	ppbv	J	
BRIG-VOC-091212-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-091912-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-092212-1	Benzene	0.2	ppbv	J	
BRIG-VOC-092212-2	Benzene	0.2	ppbv	J	
BRIG-VOC-092212-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-092212-3	Benzene	0.2	ppbv	J	
BRIG-VOC-092412-1	Benzene	0.2	ppbv	J	
BRIG-VOC-092412-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-092412-3	Benzene	0.2	ppbv	J	
BRIG-VOC-092712-1	Benzene	0.2	ppbv	J	
BRIG-VOC-092712-2	Benzene	0.2	ppbv	J	
BRIG-VOC-092712-2CO	Benzene	0.2	ppbv	J	

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-092712-3	Benzene	0.2	ppbv	J	
BRIG-VOC-093012-1	Benzene	0.2	ppbv	J	
BRIG-VOC-093012-3	Benzene	0.2	ppbv	J	
BRIG-VOC-100312-1	Benzene	0.2	ppbv	J	
BRIG-VOC-100312-2	Benzene	0.2	ppbv	J	
BRIG-VOC-100312-3	Benzene	0.2	ppbv	J	
BRIG-VOC-100612-2	Benzene	0.2	ppbv	J	
BRIG-VOC-100912-1	Benzene	0.2	ppbv	J	
BRIG-VOC-101512-1	Benzene	0.2	ppbv	J	
BRIG-VOC-101512-2	Benzene	0.2	ppbv	J	
BRIG-VOC-101512-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-101712-1	Benzene	0.2	ppbv	J	
BRIG-VOC-101712-2	Benzene	0.2	ppbv	J	
BRIG-VOC-101712-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-101712-3	Benzene	0.2	ppbv	J	
BRIG-VOC-101912-1	Benzene	0.2	ppbv	J	
BRIG-VOC-101912-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-102212-1	Benzene	0.2	ppbv	J	
BRIG-VOC-110312-1	Benzene	0.2	ppbv	J	
BRIG-VOC-110312-2	Benzene	0.2	ppbv	J	
BRIG-VOC-110312-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-110312-3	Benzene	0.2	ppbv	J	
BRIG-VOC-110612-2	Benzene	0.2	ppbv	J	
BRIG-VOC-110612-3	Benzene	0.2	ppbv	J	
BRIG-VOC-111212-1	Benzene	0.2	ppbv	J	
BRIG-VOC-111212-2	Benzene	0.2	ppbv	J	
BRIG-VOC-111212-2CO	Benzene	0.2	ppbv	J	
BRIG-VOC-112812-1	Benzene	0.2	ppbv	J	
FLO-VOC-090912	Benzene	0.2	ppbv	J	
FLO-VOC-091212	Benzene	0.2	ppbv	J	
FLO-VOC-091512	Benzene	0.2	ppbv	J	
FLO-VOC-092712	Benzene	0.2	ppbv	J	
FLO-VOC-101212	Benzene	0.2	ppbv	J	
FLO-VOC-101512	Benzene	0.2	ppbv	J	
FLO-VOC-101712	Benzene	0.2	ppbv	J	
FLO-VOC-101912	Benzene	0.2	ppbv	J	
FLO-VOC-102512	Benzene	0.2	ppbv	J	
FLO-VOC-110612	Benzene	0.2	ppbv	J	
FLO-VOC-111212	Benzene	0.2	ppbv	J	
FLO-VOC-112712	Benzene	0.2	ppbv	J	
BRIG-VOC-090312-2	Carbon disulfide	1.4	ppbv		
BRIG-VOC-083112-3	Carbon disulfide	0.5	ppbv		
BRIG-VOC-091212-2CO	Carbon disulfide	0.4	ppbv	J	
BRIG-VOC-083112-1	Carbon disulfide	0.3	ppbv	J	
BRIG-VOC-090312-2CO	Carbon disulfide	0.3	ppbv	J	
BRIG-VOC-110912-3	Carbon disulfide	0.3	ppbv	J	
BRIG-VOC-080412-1	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-080412-3	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-081612-1	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-092212-2	Carbon disulfide	0.2	ppbv	JL	
BRIG-VOC-092212-3	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-101512-3	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-103112-2	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-103112-3	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-110612-3	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-112712-3	Carbon disulfide	0.2	ppbv	J	
FLO-VOC-093012	Carbon disulfide	0.2	ppbv	JL	
FLO-VOC-103112	Carbon disulfide	0.2	ppbv	J	
FLO-VOC-110312	Carbon disulfide	0.2	ppbv	J	
BRIG-VOC-081612-1	Carbon Tetrachloride	0.2	ppbv	J	
BRIG-VOC-082512-2	Carbon Tetrachloride	0.2	ppbv	J	
BRIG-VOC-100912-3	Carbon Tetrachloride	0.2	ppbv	J	
BRIG-VOC-101212-2	Carbon Tetrachloride	0.2	ppbv	J	
BRIG-VOC-101212-2CO	Carbon Tetrachloride	0.2	ppbv	J	
BRIG-VOC-101512-1	Carbon Tetrachloride	0.2	ppbv	J	
BRIG-VOC-101512-2CO	Carbon Tetrachloride	0.2	ppbv	J	
FLO-VOC-101712	Carbon Tetrachloride	0.2	ppbv	J	
BRIG-VOC-091512-2	Chloroform	0.6	ppbv		
BRIG-VOC-091212-2CO	Chloroform	0.4	ppbv	J	
BRIG-VOC-091512-3	Chloroform	0.3	ppbv	J	
BRIG-VOC-081612-1	Chloroform	0.2	ppbv	J	
FLO-VOC-091512	Chloroform	0.2	ppbv	J	
BRIG-VOC-080412-3	Dichlorobenzene-1,4	1.8	ppbv		
BRIG-VOC-081012-3	Dichlorodifluoromethane	0.9	ppbv		
BRIG-VOC-101212-2CO	Dichlorodifluoromethane	0.9	ppbv		
BRIG-VOC-080412-1	Dichlorodifluoromethane	0.8	ppbv		
BRIG-VOC-080412-2CO	Dichlorodifluoromethane	0.8	ppbv		
BRIG-VOC-080712-1	Dichlorodifluoromethane	0.8	ppbv		
BRIG-VOC-080712-2	Dichlorodifluoromethane	0.8	ppbv		
BRIG-VOC-081012-2	Dichlorodifluoromethane	0.8	ppbv		
BRIG-VOC-081012-2CO	Dichlorodifluoromethane	0.8	ppbv		
BRIG-VOC-081612-1	Dichlorodifluoromethane	0.8	ppbv		
BRIG-VOC-101212-2	Dichlorodifluoromethane	0.8	ppbv		
FLO-VOC-081312	Dichlorodifluoromethane	0.8	ppbv		
FLO-VOC-101712	Dichlorodifluoromethane	0.8	ppbv		
BRIG-VOC-080712-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-081312-1	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-081312-2	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-081312-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-081312-3	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-081612-2	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-081612-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-081612-3	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-090912-2	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-090912-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-091212-2	Dichlorodifluoromethane	0.7	ppbv		

Appendix C
Volatile Organic Compound Results by TO-15
Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-091212-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-091212-3	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-092712-2	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-092712-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-092712-3	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-093012-1	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-093012-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-093012-3	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-100312-1	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-100912-1	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-100912-3	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-101212-1	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-101512-1	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-101512-2	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-101512-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-101712-1	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-101712-2	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-101712-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-101712-3	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-110612-2CO	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-111512-3	Dichlorodifluoromethane	0.7	ppbv		
FLO-VOC-090912	Dichlorodifluoromethane	0.7	ppbv		
FLO-VOC-091212	Dichlorodifluoromethane	0.7	ppbv		
FLO-VOC-092712	Dichlorodifluoromethane	0.7	ppbv		
FLO-VOC-101212	Dichlorodifluoromethane	0.7	ppbv		
FLO-VOC-101512	Dichlorodifluoromethane	0.7	ppbv		
BRIG-VOC-080412-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-081012-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-082512-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-082512-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-082812-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-082812-2CO	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-083112-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-083112-2CO	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-083112-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-090312-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-090312-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-090312-2CO	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-090612-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-090612-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-090612-2CO	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-090612-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-090912-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-092212-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-092212-2CO	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-092212-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-092412-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-092412-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-092712-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-100312-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-100312-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-100612-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-100612-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-101512-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-101912-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-101912-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-102512-2CO	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-103112-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-103112-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-110312-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-110312-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-110312-2CO	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-110312-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-110612-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-110612-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-110912-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-110912-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111212-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111212-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111212-2CO	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111212-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111512-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111712-2	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111712-2co	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111712-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-111912-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-112712-1	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-112712-3	Dichlorodifluoromethane	0.6	ppbv		
BRIG-VOC-112812-1	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-083112	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-090612	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-092412	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-093012	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-100312	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-100612	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-102212	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-103112	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-110312	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-110612	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-110912	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-111212	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-111512	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-111712	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-111912	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-112512	Dichlorodifluoromethane	0.6	ppbv		
FLO-VOC-112712	Dichlorodifluoromethane	0.6	ppbv		

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-080412-2	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-082812-2	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-082812-3	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-091512-2	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-091512-2CO	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-091512-3	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-091912-1	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-091912-2	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-091912-2CO	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-091912-3	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-092212-1	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-092412-1	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-092412-2CO	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-101912-2CO	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-101912-3	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-102212-1	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-102212-3	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-102512-1	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-102512-2	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-102512-3	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-102812-1	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-102812-2	Dichlorodifluoromethane	0.5	ppbv		
FLO-VOC-082812	Dichlorodifluoromethane	0.5	ppbv		
FLO-VOC-091512	Dichlorodifluoromethane	0.5	ppbv		
FLO-VOC-101912	Dichlorodifluoromethane	0.5	ppbv		
FLO-VOC-102512	Dichlorodifluoromethane	0.5	ppbv		
BRIG-VOC-111912-2	Dichlorodifluoromethane	0.4	ppbv	J	
BRIG-VOC-081612-1	Dichloroethane-1,1	0.2	ppbv	J	
BRIG-VOC-083112-3	Dichloroethane-1,2	1.2	ppbv		
BRIG-VOC-083112-1	Dichloroethane-1,2	0.8	ppbv		
BRIG-VOC-080412-3	Dichloroethane-1,2	0.6	ppbv		
BRIG-VOC-090312-2CO	Dichloroethane-1,2	0.3	ppbv	J	
BRIG-VOC-081612-1	Dichloroethane-1,2	0.2	ppbv	J	
FLO-VOC-093012	Dichloropropane, 1,2-	1.2	ppbv		
BRIG-VOC-111712-2co	Ethanol	64.3	ppbv	D	
BRIG-VOC-110612-2CO	Ethanol	56.3	ppbv	D	
FLO-VOC-093012	Ethanol	39	ppbv	DL	
BRIG-VOC-080412-3	Ethanol	34.6	ppbv	D	
BRIG-VOC-090312-2CO	Ethanol	26	ppbv	D	
BRIG-VOC-083112-3	Ethanol	25.5	ppbv	D	
BRIG-VOC-083112-1	Ethanol	23.2	ppbv	D	
FLO-VOC-092712	Ethanol	22.3	ppbv	DL	
BRIG-VOC-082812-2	Ethanol	17.4	ppbv		
BRIG-VOC-100612-2	Ethanol	17	ppbv	L	
BRIG-VOC-080712-2CO	Ethanol	16.3	ppbv	J	
BRIG-VOC-080412-1	Ethanol	16.1	ppbv		
BRIG-VOC-090312-2	Ethanol	14.2	ppbv		
BRIG-VOC-082812-1	Ethanol	14	ppbv		
BRIG-VOC-090312-1	Ethanol	14	ppbv		
BRIG-VOC-080712-1	Ethanol	13.6	ppbv		
BRIG-VOC-081312-2CO	Ethanol	13.4	ppbv		
FLO-VOC-090612	Ethanol	11.7	ppbv		
FLO-VOC-083112	Ethanol	11.6	ppbv		
BRIG-VOC-080412-2	Ethanol	11.3	ppbv		
BRIG-VOC-110912-2	Ethanol	11.2	ppbv		
BRIG-VOC-091512-2CO	Ethanol	11.1	ppbv	H	
BRIG-VOC-081012-2CO	Ethanol	11	ppbv		
BRIG-VOC-080412-2CO	Ethanol	10.9	ppbv		
BRIG-VOC-090612-1	Ethanol	10.9	ppbv		
BRIG-VOC-083112-2CO	Ethanol	10.7	ppbv		
BRIG-VOC-082512-3	Ethanol	10.5	ppbv		
FLO-VOC-082812	Ethanol	10.5	ppbv		
BRIG-VOC-081612-1	Ethanol	10.3	ppbv		
BRIG-VOC-080712-2	Ethanol	10.2	ppbv		
BRIG-VOC-102512-2CO	Ethanol	10.1	ppbv	L	
BRIG-VOC-081612-2	Ethanol	9.7	ppbv		
BRIG-VOC-081312-1	Ethanol	9.6	ppbv		
FLO-VOC-081312	Ethanol	9.4	ppbv		
BRIG-VOC-091512-3	Ethanol	8.9	ppbv	H	
BRIG-VOC-102512-2	Ethanol	8.9	ppbv	L	
BRIG-VOC-092212-2CO	Ethanol	8.8	ppbv	H	
BRIG-VOC-081012-2	Ethanol	8.6	ppbv		
BRIG-VOC-082512-2	Ethanol	8.6	ppbv		
BRIG-VOC-101712-2	Ethanol	8.6	ppbv		
FLO-VOC-110912	Ethanol	8.6	ppbv		
BRIG-VOC-090912-2CO	Ethanol	8.3	ppbv		
BRIG-VOC-091512-2	Ethanol	8.3	ppbv	H	
FLO-VOC-091512	Ethanol	8	ppbv	H	
BRIG-VOC-090612-3	Ethanol	7.9	ppbv		
BRIG-VOC-090612-2	Ethanol	7.8	ppbv		
BRIG-VOC-090612-2CO	Ethanol	7.8	ppbv		
BRIG-VOC-102512-3	Ethanol	7.5	ppbv	L	
BRIG-VOC-081312-2	Ethanol	7.4	ppbv		
BRIG-VOC-102512-1	Ethanol	7.3	ppbv	L	
BRIG-VOC-090912-2	Ethanol	7.1	ppbv		
BRIG-VOC-092212-1	Ethanol	6.8	ppbv	H	
BRIG-VOC-081012-1	Ethanol	6.7	ppbv		
BRIG-VOC-100312-2	Ethanol	6.1	ppbv	L	
FLO-VOC-102512	Ethanol	5.9	ppbv	L	
BRIG-VOC-111212-2CO	Ethanol	5.7	ppbv		
BRIG-VOC-101512-1	Ethanol	5.6	ppbv		
BRIG-VOC-081312-3	Ethanol	5.3	ppbv		
BRIG-VOC-082812-2CO	Ethanol	5.3	ppbv		
BRIG-VOC-091212-2CO	Ethanol	5.3	ppbv		
BRIG-VOC-091912-2	Ethanol	5.3	ppbv	H	
FLO-VOC-091212	Ethanol	5.3	ppbv		

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-091212-2	Ethanol	5.2	ppbv		
BRIG-VOC-092212-3	Ethanol	5	ppbv		
BRIG-VOC-101712-1	Ethanol	5	ppbv		
BRIG-VOC-101712-2CO	Ethanol	5	ppbv		
BRIG-VOC-111212-2	Ethanol	4.9	ppbv		
BRIG-VOC-102212-1	Ethanol	4.8	ppbv	L	
BRIG-VOC-082812-3	Ethanol	4.7	ppbv		
BRIG-VOC-100312-1	Ethanol	4.7	ppbv	L	
FLO-VOC-111912	Ethanol	4.7	ppbv		
BRIG-VOC-111912-1	Ethanol	4.5	ppbv		
FLO-VOC-090912	Ethanol	4.5	ppbv		
BRIG-VOC-081012-3	Ethanol	4.4	ppbv		
BRIG-VOC-110912-3	Ethanol	4.4	ppbv		
BRIG-VOC-111712-2	Ethanol	4.4	ppbv		
FLO-VOC-102212	Ethanol	4.4	ppbv	L	
BRIG-VOC-081612-3	Ethanol	4.2	ppbv		
BRIG-VOC-090912-1	Ethanol	4.2	ppbv		
BRIG-VOC-092712-2	Ethanol	4.2	ppbv	L	
BRIG-VOC-101512-2CO	Ethanol	4.2	ppbv		
BRIG-VOC-111212-3	Ethanol	4.1	ppbv		
BRIG-VOC-111912-2	Ethanol	4.1	ppbv		
BRIG-VOC-091912-3	Ethanol	4	ppbv	H	
FLO-VOC-101712	Ethanol	4	ppbv		
BRIG-VOC-091912-2CO	Ethanol	3.9	ppbv	H	
FLO-VOC-101512	Ethanol	3.9	ppbv		
BRIG-VOC-101912-1	Ethanol	3.8	ppbv	L	
BRIG-VOC-111712-3	Ethanol	3.8	ppbv		
FLO-VOC-111212	Ethanol	3.8	ppbv		
BRIG-VOC-101512-3	Ethanol	3.7	ppbv		
BRIG-VOC-092212-2	Ethanol	3.6	ppbv	H	
BRIG-VOC-100312-3	Ethanol	3.6	ppbv	L	
BRIG-VOC-101712-3	Ethanol	3.6	ppbv		
BRIG-VOC-092712-1	Ethanol	3.5	ppbv	L	
FLO-VOC-100312	Ethanol	3.5	ppbv	L	
BRIG-VOC-092712-2CO	Ethanol	3.4	ppbv	L	
BRIG-VOC-101912-2	Ethanol	3.4	ppbv	L	
BRIG-VOC-102212-3	Ethanol	3.4	ppbv	L	
BRIG-VOC-091912-1	Ethanol	3.3	ppbv	H	
BRIG-VOC-092712-3	Ethanol	3.2	ppbv	L	
BRIG-VOC-101912-2CO	Ethanol	3.2	ppbv	L	
BRIG-VOC-111512-2	Ethanol	3	ppbv		
FLO-VOC-101212	Ethanol	2.9	ppbv		
BRIG-VOC-101212-1	Ethanol	2.8	ppbv		
BRIG-VOC-111212-1	Ethanol	2.8	ppbv	L	
BRIG-VOC-112812-1	Ethanol	2.8	ppbv		
FLO-VOC-103112	Ethanol	2.8	ppbv		
BRIG-VOC-101512-2	Ethanol	2.7	ppbv		
BRIG-VOC-110612-3	Ethanol	2.6	ppbv		
BRIG-VOC-100912-1	Ethanol	2.5	ppbv		
BRIG-VOC-110612-2	Ethanol	2.5	ppbv		
FLO-VOC-101912	Ethanol	2.5	ppbv	L	
BRIG-VOC-092412-2CO	Ethanol	2.3	ppbv		
BRIG-VOC-101212-2CO	Ethanol	2.3	ppbv		
BRIG-VOC-101912-3	Ethanol	2.3	ppbv	L	
BRIG-VOC-101212-2	Ethanol	2.2	ppbv		
FLO-VOC-110612	Ethanol	2.1	ppbv		
BRIG-VOC-092412-1	Ethanol	2	ppbv		
BRIG-VOC-100912-3	Ethanol	2	ppbv		
FLO-VOC-110312	Ethanol	2	ppbv		
BRIG-VOC-092412-2	Ethanol	1.9	ppbv		
BRIG-VOC-092412-3	Ethanol	1.9	ppbv		
FLO-VOC-111712	Ethanol	1.9	ppbv		
FLO-VOC-112512	Ethanol	1.9	ppbv		
BRIG-VOC-100612-1	Ethanol	1.8	ppbv	L	
BRIG-VOC-103112-3	Ethanol	1.8	ppbv		
FLO-VOC-111512	Ethanol	1.8	ppbv		
BRIG-VOC-112712-1	Ethanol	1.7	ppbv	L	
BRIG-VOC-093012-1	Ethanol	1.6	ppbv	L	
BRIG-VOC-110312-1	Ethanol	1.6	ppbv		
FLO-VOC-100612	Ethanol	1.6	ppbv	L	
BRIG-VOC-102812-1	Ethanol	1.5	ppbv	L	
BRIG-VOC-111912-3	Ethanol	1.5	ppbv		
FLO-VOC-092412	Ethanol	1.5	ppbv		
BRIG-VOC-110312-2	Ethanol	1.4	ppbv		
BRIG-VOC-112712-3	Ethanol	1.4	ppbv		
BRIG-VOC-103112-2	Ethanol	1.3	ppbv		
BRIG-VOC-093012-3	Ethanol	1.2	ppbv	L	
BRIG-VOC-110312-2CO	Ethanol	1.2	ppbv		
BRIG-VOC-110312-3	Ethanol	1	ppbv		
BRIG-VOC-102812-2	Ethanol	0.8	ppbv	L	
BRIG-VOC-080412-3	Ethylbenzene	1.4	ppbv		
BRIG-VOC-083112-3	Ethylbenzene	0.7	ppbv		
FLO-VOC-093012	Ethylbenzene	0.6	ppbv		
BRIG-VOC-083112-1	Ethylbenzene	0.5	ppbv		
BRIG-VOC-080412-2CO	Ethylbenzene	0.3	ppbv	J	
BRIG-VOC-110912-2	Ethylbenzene	0.3	ppbv	J	
BRIG-VOC-080412-2	Ethylbenzene	0.2	ppbv	J	
BRIG-VOC-082512-2	Ethylbenzene	0.2	ppbv	J	
BRIG-VOC-090312-2CO	Ethylbenzene	0.2	ppbv	J	
BRIG-VOC-100612-2	Ethylbenzene	0.2	ppbv	J	
FLO-VOC-110912	Ethylbenzene	0.2	ppbv	J	
BRIG-VOC-081612-1	Freon 113	0.2	ppbv	J	
BRIG-VOC-082512-2	Freon 113	0.2	ppbv	J	
BRIG-VOC-101212-2CO	Freon 113	0.2	ppbv	J	
FLO-VOC-101712	Freon 113	0.2	ppbv	J	
BRIG-VOC-081612-1	Freon 114	0.2	ppbv	J	

Appendix C
Volatile Organic Compound Results by TO-15
Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-080412-3	M,P-XYLENE (SUM OF ISOMERS)	2.5	ppbv		
BRIG-VOC-083112-3	M,P-XYLENE (SUM OF ISOMERS)	2.4	ppbv		
FLO-VOC-093012	M,P-XYLENE (SUM OF ISOMERS)	1.8	ppbv		
BRIG-VOC-083112-1	M,P-XYLENE (SUM OF ISOMERS)	1.7	ppbv		
BRIG-VOC-080412-2CO	M,P-XYLENE (SUM OF ISOMERS)	1	ppbv		
BRIG-VOC-080412-2	M,P-XYLENE (SUM OF ISOMERS)	0.9	ppbv	J	
BRIG-VOC-110912-2	M,P-XYLENE (SUM OF ISOMERS)	0.8	ppbv	J	
BRIG-VOC-090312-2CO	M,P-XYLENE (SUM OF ISOMERS)	0.7	ppbv	J	
BRIG-VOC-092412-2CO	M,P-XYLENE (SUM OF ISOMERS)	0.6	ppbv	J	
BRIG-VOC-080412-1	M,P-XYLENE (SUM OF ISOMERS)	0.5	ppbv	J	
BRIG-VOC-080712-2CO	M,P-XYLENE (SUM OF ISOMERS)	0.5	ppbv	J	
BRIG-VOC-082512-2	M,P-XYLENE (SUM OF ISOMERS)	0.5	ppbv	J	
BRIG-VOC-100612-2	M,P-XYLENE (SUM OF ISOMERS)	0.5	ppbv	J	
BRIG-VOC-080712-1	M,P-XYLENE (SUM OF ISOMERS)	0.4	ppbv	J	
BRIG-VOC-080712-2	M,P-XYLENE (SUM OF ISOMERS)	0.4	ppbv	J	
BRIG-VOC-081612-1	M,P-XYLENE (SUM OF ISOMERS)	0.4	ppbv	J	
BRIG-VOC-082812-2	M,P-XYLENE (SUM OF ISOMERS)	0.4	ppbv	J	
BRIG-VOC-092412-2	M,P-XYLENE (SUM OF ISOMERS)	0.4	ppbv	J	
FLO-VOC-110912	M,P-XYLENE (SUM OF ISOMERS)	0.4	ppbv	J	
BRIG-VOC-081312-2CO	M,P-XYLENE (SUM OF ISOMERS)	0.3	ppbv	J	
BRIG-VOC-111912-1	M,P-XYLENE (SUM OF ISOMERS)	0.3	ppbv	J	
BRIG-VOC-111912-2	M,P-XYLENE (SUM OF ISOMERS)	0.3	ppbv	J	
FLO-VOC-111912	M,P-XYLENE (SUM OF ISOMERS)	0.3	ppbv	J	
BRIG-VOC-081612-1	Methyl bromide	0.2	ppbv	J	
BRIG-VOC-081612-1	Methyl chloride	1.1	ppbv		
BRIG-VOC-080412-1	Methyl chloride	1	ppbv		
BRIG-VOC-080412-2CO	Methyl chloride	1	ppbv		
BRIG-VOC-080712-1	Methyl chloride	1	ppbv		
BRIG-VOC-081012-2	Methyl chloride	1	ppbv		
BRIG-VOC-081012-3	Methyl chloride	1	ppbv		
BRIG-VOC-080712-2	Methyl chloride	0.9	ppbv		
BRIG-VOC-081012-2CO	Methyl chloride	0.9	ppbv		
BRIG-VOC-081312-2	Methyl chloride	0.9	ppbv		
BRIG-VOC-090612-2	Methyl chloride	0.9	ppbv		
BRIG-VOC-090612-2CO	Methyl chloride	0.9	ppbv		
BRIG-VOC-100912-3	Methyl chloride	0.9	ppbv		
BRIG-VOC-101712-2	Methyl chloride	0.9	ppbv		
BRIG-VOC-080412-3	Methyl chloride	0.8	ppbv		
BRIG-VOC-080712-2CO	Methyl chloride	0.8	ppbv		
BRIG-VOC-081012-1	Methyl chloride	0.8	ppbv		
BRIG-VOC-081312-1	Methyl chloride	0.8	ppbv		
BRIG-VOC-081312-2CO	Methyl chloride	0.8	ppbv		
BRIG-VOC-081312-3	Methyl chloride	0.8	ppbv		
BRIG-VOC-081612-3	Methyl chloride	0.8	ppbv		
BRIG-VOC-083112-1	Methyl chloride	0.8	ppbv		
BRIG-VOC-083112-3	Methyl chloride	0.8	ppbv		
BRIG-VOC-090312-1	Methyl chloride	0.8	ppbv		
BRIG-VOC-090312-2CO	Methyl chloride	0.8	ppbv		
BRIG-VOC-090612-1	Methyl chloride	0.8	ppbv		
BRIG-VOC-090612-3	Methyl chloride	0.8	ppbv		
BRIG-VOC-091212-3	Methyl chloride	0.8	ppbv		
BRIG-VOC-091512-3	Methyl chloride	0.8	ppbv		
BRIG-VOC-092212-1	Methyl chloride	0.8	ppbv		
BRIG-VOC-092212-2	Methyl chloride	0.8	ppbv		
BRIG-VOC-092212-2CO	Methyl chloride	0.8	ppbv		
BRIG-VOC-101212-2	Methyl chloride	0.8	ppbv		
BRIG-VOC-101212-2CO	Methyl chloride	0.8	ppbv		
BRIG-VOC-101512-1	Methyl chloride	0.8	ppbv		
BRIG-VOC-101712-1	Methyl chloride	0.8	ppbv		
BRIG-VOC-102512-2CO	Methyl chloride	0.8	ppbv		
BRIG-VOC-110912-3	Methyl chloride	0.8	ppbv		
FLO-VOC-081312	Methyl chloride	0.8	ppbv		
FLO-VOC-090612	Methyl chloride	0.8	ppbv		
FLO-VOC-093012	Methyl chloride	0.8	ppbv		
FLO-VOC-101512	Methyl chloride	0.8	ppbv		
FLO-VOC-101712	Methyl chloride	0.8	ppbv		
BRIG-VOC-081612-2	Methyl chloride	0.7	ppbv		
BRIG-VOC-081612-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-082812-1	Methyl chloride	0.7	ppbv		
BRIG-VOC-083112-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-090312-2	Methyl chloride	0.7	ppbv		
BRIG-VOC-090912-2	Methyl chloride	0.7	ppbv		
BRIG-VOC-090912-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-091212-2	Methyl chloride	0.7	ppbv		
BRIG-VOC-091212-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-091512-2	Methyl chloride	0.7	ppbv		
BRIG-VOC-091512-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-091912-1	Methyl chloride	0.7	ppbv		
BRIG-VOC-091912-2	Methyl chloride	0.7	ppbv		
BRIG-VOC-091912-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-091912-3	Methyl chloride	0.7	ppbv		
BRIG-VOC-100912-1	Methyl chloride	0.7	ppbv		
BRIG-VOC-101512-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-101712-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-102212-3	Methyl chloride	0.7	ppbv		
BRIG-VOC-110612-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-110912-2	Methyl chloride	0.7	ppbv		
BRIG-VOC-111212-1	Methyl chloride	0.7	ppbv		
BRIG-VOC-111212-2CO	Methyl chloride	0.7	ppbv		
BRIG-VOC-111212-3	Methyl chloride	0.7	ppbv		
BRIG-VOC-111512-3	Methyl chloride	0.7	ppbv		
BRIG-VOC-112812-1	Methyl chloride	0.7	ppbv		
FLO-VOC-083112	Methyl chloride	0.7	ppbv		
FLO-VOC-091212	Methyl chloride	0.7	ppbv		
FLO-VOC-091512	Methyl chloride	0.7	ppbv		
FLO-VOC-110912	Methyl chloride	0.7	ppbv		

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
FLO-VOC-111212	Methyl chloride	0.7	ppbv		
FLO-VOC-111912	Methyl chloride	0.7	ppbv		
BRIG-VOC-080412-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-082512-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-082512-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-082812-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-082812-2CO	Methyl chloride	0.6	ppbv		
BRIG-VOC-082812-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-090912-1	Methyl chloride	0.6	ppbv		
BRIG-VOC-092212-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-092412-1	Methyl chloride	0.6	ppbv		
BRIG-VOC-092412-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-092412-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-092712-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-092712-2CO	Methyl chloride	0.6	ppbv		
BRIG-VOC-092712-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-100312-1	Methyl chloride	0.6	ppbv		
BRIG-VOC-100612-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-101212-1	Methyl chloride	0.6	ppbv		
BRIG-VOC-101512-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-101512-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-101712-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-101912-1	Methyl chloride	0.6	ppbv		
BRIG-VOC-101912-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-102212-1	Methyl chloride	0.6	ppbv		
BRIG-VOC-102512-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-102512-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-103112-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-103112-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-110312-1	Methyl chloride	0.6	ppbv		
BRIG-VOC-110312-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-110312-2CO	Methyl chloride	0.6	ppbv		
BRIG-VOC-110312-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-110612-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-110612-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-111212-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-111512-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-111712-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-111712-2co	Methyl chloride	0.6	ppbv		
BRIG-VOC-111712-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-111912-2	Methyl chloride	0.6	ppbv		
BRIG-VOC-111912-3	Methyl chloride	0.6	ppbv		
BRIG-VOC-112712-1	Methyl chloride	0.6	ppbv		
BRIG-VOC-112712-3	Methyl chloride	0.6	ppbv		
FLO-VOC-090912	Methyl chloride	0.6	ppbv		
FLO-VOC-092412	Methyl chloride	0.6	ppbv		
FLO-VOC-101212	Methyl chloride	0.6	ppbv		
FLO-VOC-103112	Methyl chloride	0.6	ppbv		
FLO-VOC-110312	Methyl chloride	0.6	ppbv		
FLO-VOC-110612	Methyl chloride	0.6	ppbv		
FLO-VOC-111512	Methyl chloride	0.6	ppbv		
FLO-VOC-111712	Methyl chloride	0.6	ppbv		
FLO-VOC-112512	Methyl chloride	0.6	ppbv		
FLO-VOC-112712	Methyl chloride	0.6	ppbv		
BRIG-VOC-092412-2CO	Methyl chloride	0.5	ppbv		
BRIG-VOC-092712-1	Methyl chloride	0.5	ppbv		
BRIG-VOC-093012-1	Methyl chloride	0.5	ppbv		
BRIG-VOC-093012-2CO	Methyl chloride	0.5	ppbv		
BRIG-VOC-093012-3	Methyl chloride	0.5	ppbv		
BRIG-VOC-100312-2	Methyl chloride	0.5	ppbv		
BRIG-VOC-100312-3	Methyl chloride	0.5	ppbv		
BRIG-VOC-101912-2CO	Methyl chloride	0.5	ppbv		
BRIG-VOC-101912-3	Methyl chloride	0.5	ppbv		
BRIG-VOC-102512-1	Methyl chloride	0.5	ppbv		
FLO-VOC-082812	Methyl chloride	0.5	ppbv		
FLO-VOC-092712	Methyl chloride	0.5	ppbv		
FLO-VOC-100312	Methyl chloride	0.5	ppbv		
FLO-VOC-101912	Methyl chloride	0.5	ppbv		
FLO-VOC-102212	Methyl chloride	0.5	ppbv		
FLO-VOC-102512	Methyl chloride	0.5	ppbv		
BRIG-VOC-100612-1	Methyl chloride	0.4	ppbv	J	
BRIG-VOC-102812-1	Methyl chloride	0.4	ppbv	J	
BRIG-VOC-102812-2	Methyl chloride	0.4	ppbv	J	
FLO-VOC-100612	Methyl chloride	0.4	ppbv	J	
FLO-VOC-093012	Methyl ethyl ketone	4.8	ppbv		
BRIG-VOC-083112-3	Methyl ethyl ketone	2.4	ppbv		
BRIG-VOC-080412-3	Methyl ethyl ketone	2.2	ppbv		
BRIG-VOC-083112-1	Methyl ethyl ketone	1.7	ppbv		
BRIG-VOC-110912-2	Methyl ethyl ketone	0.9	ppbv		
BRIG-VOC-080412-1	Methyl ethyl ketone	0.8	ppbv		
BRIG-VOC-090312-2CO	Methyl ethyl ketone	0.7	ppbv		
BRIG-VOC-100612-2	Methyl ethyl ketone	0.7	ppbv		
BRIG-VOC-102512-1	Methyl ethyl ketone	0.7	ppbv		
BRIG-VOC-102512-3	Methyl ethyl ketone	0.7	ppbv		
BRIG-VOC-080412-2CO	Methyl ethyl ketone	0.6	ppbv		
BRIG-VOC-080712-1	Methyl ethyl ketone	0.6	ppbv		
BRIG-VOC-081612-1	Methyl ethyl ketone	0.6	ppbv		
BRIG-VOC-082812-2CO	Methyl ethyl ketone	0.6	ppbv		
BRIG-VOC-090612-2	Methyl ethyl ketone	0.6	ppbv		
BRIG-VOC-090612-2CO	Methyl ethyl ketone	0.6	ppbv		
BRIG-VOC-102212-3	Methyl ethyl ketone	0.6	ppbv		
BRIG-VOC-102512-2CO	Methyl ethyl ketone	0.6	ppbv		
FLO-VOC-110912	Methyl ethyl ketone	0.6	ppbv		
BRIG-VOC-082512-2	Methyl ethyl ketone	0.5	ppbv		
BRIG-VOC-082512-3	Methyl ethyl ketone	0.5	ppbv		
BRIG-VOC-083112-2CO	Methyl ethyl ketone	0.5	ppbv		

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-090612-1	Methyl ethyl ketone	0.5	ppbv		
BRIG-VOC-101712-2	Methyl ethyl ketone	0.5	ppbv		
BRIG-VOC-102512-2	Methyl ethyl ketone	0.5	ppbv		
FLO-VOC-090612	Methyl ethyl ketone	0.5	ppbv		
BRIG-VOC-080412-2	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-080712-2	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-080712-2CO	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-082812-1	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-082812-2	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-090612-3	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-091212-3	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-101712-1	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-102212-1	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-102812-1	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-110912-3	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-111212-2	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-111712-3	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-111912-1	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-111912-2	Methyl ethyl ketone	0.4	ppbv	J	
FLO-VOC-102212	Methyl ethyl ketone	0.4	ppbv	J	
FLO-VOC-102512	Methyl ethyl ketone	0.4	ppbv	J	
FLO-VOC-111912	Methyl ethyl ketone	0.4	ppbv	J	
BRIG-VOC-081012-1	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081012-2	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081012-2CO	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081012-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081312-1	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081312-2	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081312-2CO	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081312-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081612-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-082812-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-090312-1	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-090312-2	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-091212-2	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-091212-2CO	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-091512-2	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-091512-2CO	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-091512-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-091912-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-092212-1	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-092212-2	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-092212-2CO	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-092212-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-092712-2	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-100312-2	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-110612-2CO	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-111212-1	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-111212-2CO	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-111212-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-111512-3	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-111712-2co	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-111912-3	Methyl ethyl ketone	0.3	ppbv	J	
FLO-VOC-081312	Methyl ethyl ketone	0.3	ppbv	J	
FLO-VOC-082812	Methyl ethyl ketone	0.3	ppbv	J	
FLO-VOC-083112	Methyl ethyl ketone	0.3	ppbv	J	
FLO-VOC-091512	Methyl ethyl ketone	0.3	ppbv	J	
FLO-VOC-100312	Methyl ethyl ketone	0.3	ppbv	J	
FLO-VOC-101712	Methyl ethyl ketone	0.3	ppbv	J	
FLO-VOC-111212	Methyl ethyl ketone	0.3	ppbv	J	
FLO-VOC-111712	Methyl ethyl ketone	0.3	ppbv	J	
BRIG-VOC-081612-2	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-081612-2CO	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-090912-2	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-090912-2CO	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-091912-2	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-092412-2	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-092712-1	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-092712-2CO	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-092712-3	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-100312-1	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-100312-3	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-100912-1	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-100912-3	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101212-1	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101512-1	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101512-2	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101512-2CO	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101512-3	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101712-2CO	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101712-3	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101912-1	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101912-2	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101912-2CO	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-101912-3	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-110612-3	Methyl ethyl ketone	0.2	ppbv	J	
BRIG-VOC-111712-2	Methyl ethyl ketone	0.2	ppbv	J	
FLO-VOC-091212	Methyl ethyl ketone	0.2	ppbv	J	
FLO-VOC-092712	Methyl ethyl ketone	0.2	ppbv	J	
FLO-VOC-101512	Methyl ethyl ketone	0.2	ppbv	J	
FLO-VOC-101912	Methyl ethyl ketone	0.2	ppbv	J	
FLO-VOC-110612	Methyl ethyl ketone	0.2	ppbv	J	
FLO-VOC-093012	Methylene chloride	1.6	ppbv		
BRIG-VOC-110912-2	Methylene chloride	1.5	ppbv		
BRIG-VOC-100612-2	Methylene chloride	1.2	ppbv		
BRIG-VOC-081612-3	Methylene chloride	1.1	ppbv		

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-080412-3	Methylene chloride	0.8	ppbv		
BRIG-VOC-083112-3	Methylene chloride	0.6	ppbv		
BRIG-VOC-101712-2	Methylene chloride	0.6	ppbv		
FLO-VOC-081312	Methylene chloride	0.6	ppbv		
FLO-VOC-110912	Methylene chloride	0.5	ppbv		
BRIG-VOC-081012-2	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-081312-1	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-081312-2	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-081312-3	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-081612-1	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-083112-1	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-090612-2	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-090612-2CO	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-100312-2	Methylene chloride	0.4	ppbv	J	
BRIG-VOC-081012-1	Methylene chloride	0.3	ppbv	J	
BRIG-VOC-081012-2CO	Methylene chloride	0.3	ppbv	J	
BRIG-VOC-081012-3	Methylene chloride	0.3	ppbv	J	
BRIG-VOC-081312-2CO	Methylene chloride	0.3	ppbv	J	
BRIG-VOC-093012-1	Methylene chloride	0.3	ppbv	J	
FLO-VOC-090612	Methylene chloride	0.3	ppbv	J	
BRIG-VOC-080412-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-080412-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-080412-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-080712-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-080712-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-080712-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-081612-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-081612-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-082512-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-082512-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-082812-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-082812-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-082812-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-082812-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-083112-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-090312-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-090312-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-090312-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-090612-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-090612-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-090912-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-090912-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-090912-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-091212-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-091212-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-091212-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-092212-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-092412-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-093012-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-093012-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-100312-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-100312-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-100912-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-100912-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101212-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101212-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101212-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101512-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101512-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101512-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101712-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101712-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101712-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101912-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-101912-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-102212-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-102212-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-102512-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-102512-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-102512-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-102512-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-102812-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-102812-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-103112-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-103112-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-110312-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-110312-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-110312-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-110312-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-110612-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-110612-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-110612-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-110912-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111212-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111212-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111212-2CO	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111212-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111512-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111512-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111712-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111712-2co	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111712-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111912-1	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111912-2	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-111912-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-112712-1	Methylene chloride	0.2	ppbv	J	

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-112712-3	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-112812-1	Methylene chloride	0.2	ppbv	J	
FLO-VOC-082812	Methylene chloride	0.2	ppbv	J	
FLO-VOC-083112	Methylene chloride	0.2	ppbv	J	
FLO-VOC-090912	Methylene chloride	0.2	ppbv	J	
FLO-VOC-091212	Methylene chloride	0.2	ppbv	J	
FLO-VOC-101212	Methylene chloride	0.2	ppbv	J	
FLO-VOC-101712	Methylene chloride	0.2	ppbv	J	
FLO-VOC-101912	Methylene chloride	0.2	ppbv	J	
FLO-VOC-102212	Methylene chloride	0.2	ppbv	J	
FLO-VOC-102512	Methylene chloride	0.2	ppbv	J	
FLO-VOC-103112	Methylene chloride	0.2	ppbv	J	
FLO-VOC-110312	Methylene chloride	0.2	ppbv	J	
FLO-VOC-110612	Methylene chloride	0.2	ppbv	J	
FLO-VOC-111212	Methylene chloride	0.2	ppbv	J	
FLO-VOC-111512	Methylene chloride	0.2	ppbv	J	
FLO-VOC-111712	Methylene chloride	0.2	ppbv	J	
FLO-VOC-111912	Methylene chloride	0.2	ppbv	J	
FLO-VOC-112512	Methylene chloride	0.2	ppbv	J	
FLO-VOC-112712	Methylene chloride	0.2	ppbv	J	
BRIG-VOC-091212-2	Naphthalene	0.4	ppbv	J	
FLO-VOC-093012	Naphthalene	0.3	ppbv	J	
BRIG-VOC-080412-3	Naphthalene	0.2	ppbv	J	
BRIG-VOC-081612-1	Naphthalene	0.2	ppbv	J	
BRIG-VOC-083112-2CO	Naphthalene	0.2	ppbv	J	
BRIG-VOC-103112-2	Naphthalene	0.2	ppbv	J	
BRIG-VOC-110612-2CO	Naphthalene	0.2	ppbv	J	
BRIG-VOC-110612-3	Naphthalene	0.2	ppbv	J	
BRIG-VOC-110912-2	Naphthalene	0.2	ppbv	J	
BRIG-VOC-110912-3	Naphthalene	0.2	ppbv	J	
BRIG-VOC-111212-2	Naphthalene	0.2	ppbv	J	
BRIG-VOC-111212-2CO	Naphthalene	0.2	ppbv	J	
BRIG-VOC-111212-3	Naphthalene	0.2	ppbv	J	
BRIG-VOC-111512-2	Naphthalene	0.2	ppbv	J	
BRIG-VOC-111512-3	Naphthalene	0.2	ppbv	J	
BRIG-VOC-111912-1	Naphthalene	0.2	ppbv	J	
BRIG-VOC-111912-2	Naphthalene	0.2	ppbv	J	
BRIG-VOC-111912-3	Naphthalene	0.2	ppbv	J	
FLO-VOC-090612	Naphthalene	0.2	ppbv	J	
FLO-VOC-111212	Naphthalene	0.2	ppbv	J	
FLO-VOC-111912	Naphthalene	0.2	ppbv	J	
FLO-VOC-112512	Naphthalene	0.2	ppbv	J	
BRIG-VOC-080412-3	Styrene	9.8	ppbv		
BRIG-VOC-083112-3	Styrene	0.6	ppbv		
BRIG-VOC-083112-1	Styrene	0.5	ppbv		
FLO-VOC-093012	Styrene	0.5	ppbv	H	
BRIG-VOC-100612-2	Styrene	0.3	ppbv	J	
BRIG-VOC-080412-2CO	Styrene	0.2	ppbv	J	
BRIG-VOC-082512-2	Styrene	0.2	ppbv	J	
BRIG-VOC-082812-1	Styrene	0.2	ppbv	J	
BRIG-VOC-090312-2CO	Styrene	0.2	ppbv	J	
BRIG-VOC-090612-2	Styrene	0.2	ppbv	J	
BRIG-VOC-090612-2CO	Styrene	0.2	ppbv	J	
BRIG-VOC-081612-1	Tetrachloroethane, 1,1,2,2-	0.2	ppbv	J	
BRIG-VOC-100612-2	Tetrachloroethylene	0.3	ppbv	J	
FLO-VOC-093012	Toluene	27	ppbv	D	
BRIG-VOC-082812-1	Toluene	18.7	ppbv		
BRIG-VOC-080412-3	Toluene	17.4	ppbv		
BRIG-VOC-083112-1	Toluene	15.9	ppbv		
BRIG-VOC-083112-3	Toluene	15.4	ppbv		
BRIG-VOC-080712-2	Toluene	12.1	ppbv		
BRIG-VOC-080412-2CO	Toluene	11.8	ppbv		
BRIG-VOC-090312-1	Toluene	11.5	ppbv		
BRIG-VOC-082512-2	Toluene	9.9	ppbv		
BRIG-VOC-083112-2CO	Toluene	8.9	ppbv		
BRIG-VOC-110912-2	Toluene	8.5	ppbv		
BRIG-VOC-090612-2CO	Toluene	8.1	ppbv		
BRIG-VOC-090612-2	Toluene	8	ppbv		
BRIG-VOC-082512-3	Toluene	7.6	ppbv		
FLO-VOC-110912	Toluene	7.2	ppbv		
BRIG-VOC-090612-1	Toluene	6.8	ppbv		
BRIG-VOC-081012-2	Toluene	6.5	ppbv		
BRIG-VOC-081312-2	Toluene	6.5	ppbv		
BRIG-VOC-090312-2CO	Toluene	5.9	ppbv		
BRIG-VOC-081612-2CO	Toluene	5.2	ppbv		
BRIG-VOC-090912-2	Toluene	5.1	ppbv		
BRIG-VOC-082812-2CO	Toluene	5	ppbv		
BRIG-VOC-102512-3	Toluene	5	ppbv		
BRIG-VOC-081312-3	Toluene	4.8	ppbv		
BRIG-VOC-090612-3	Toluene	4.4	ppbv		
BRIG-VOC-081612-3	Toluene	4.3	ppbv		
BRIG-VOC-091212-2CO	Toluene	4.2	ppbv		
BRIG-VOC-091512-2	Toluene	4.2	ppbv	H	
BRIG-VOC-102512-2CO	Toluene	4.2	ppbv		
BRIG-VOC-082812-2	Toluene	3.9	ppbv		
BRIG-VOC-091212-3	Toluene	3.9	ppbv		
BRIG-VOC-080412-1	Toluene	3.8	ppbv		
BRIG-VOC-102512-1	Toluene	3.7	ppbv		
BRIG-VOC-080712-1	Toluene	3.5	ppbv		
BRIG-VOC-100612-2	Toluene	3.5	ppbv		
BRIG-VOC-081012-3	Toluene	3.4	ppbv		
BRIG-VOC-090312-2	Toluene	3.4	ppbv		
BRIG-VOC-091512-3	Toluene	3.4	ppbv		
BRIG-VOC-080712-2CO	Toluene	3.2	ppbv		
BRIG-VOC-082812-3	Toluene	3.2	ppbv		
BRIG-VOC-101712-2	Toluene	3	ppbv	H	

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-081312-2CO	Toluene	2.9	ppbv		
BRIG-VOC-092212-2	Toluene	2.8	ppbv		
BRIG-VOC-100312-2	Toluene	2.6	ppbv		
FLO-VOC-100312	Toluene	2.5	ppbv		
FLO-VOC-082812	Toluene	2.4	ppbv		
BRIG-VOC-081012-2CO	Toluene	2.3	ppbv		
BRIG-VOC-090912-1	Toluene	2.3	ppbv		
BRIG-VOC-092212-3	Toluene	2.3	ppbv		
BRIG-VOC-092712-2	Toluene	2.3	ppbv		
BRIG-VOC-080412-2	Toluene	2.2	ppbv		
BRIG-VOC-092212-1	Toluene	2.2	ppbv		
FLO-VOC-083112	Toluene	2.2	ppbv		
BRIG-VOC-100312-1	Toluene	2.1	ppbv		
FLO-VOC-090612	Toluene	2	ppbv		
BRIG-VOC-081612-2	Toluene	1.7	ppbv		
BRIG-VOC-111212-2	Toluene	1.7	ppbv		
BRIG-VOC-081312-1	Toluene	1.6	ppbv		
BRIG-VOC-081612-1	Toluene	1.6	ppbv		
BRIG-VOC-090912-2CO	Toluene	1.6	ppbv		
BRIG-VOC-091212-2	Toluene	1.6	ppbv		
BRIG-VOC-100312-3	Toluene	1.6	ppbv		
BRIG-VOC-101512-2CO	Toluene	1.6	ppbv		
BRIG-VOC-111212-3	Toluene	1.6	ppbv		
FLO-VOC-092712	Toluene	1.5	ppbv		
BRIG-VOC-092712-1	Toluene	1.4	ppbv		
BRIG-VOC-101512-1	Toluene	1.4	ppbv		
BRIG-VOC-091512-2CO	Toluene	1.3	ppbv		
BRIG-VOC-101512-3	Toluene	1.3	ppbv		
BRIG-VOC-102212-3	Toluene	1.3	ppbv		
BRIG-VOC-102512-2	Toluene	1.3	ppbv		
BRIG-VOC-110912-3	Toluene	1.3	ppbv		
BRIG-VOC-111212-1	Toluene	1.3	ppbv		
FLO-VOC-081312	Toluene	1.3	ppbv		
BRIG-VOC-091912-1	Toluene	1.2	ppbv		
BRIG-VOC-102212-1	Toluene	1.2	ppbv		
FLO-VOC-102512	Toluene	1.2	ppbv		
BRIG-VOC-081012-1	Toluene	1.1	ppbv		
BRIG-VOC-091912-2	Toluene	1.1	ppbv		
BRIG-VOC-092712-3	Toluene	1.1	ppbv		
BRIG-VOC-101712-1	Toluene	1.1	ppbv		
BRIG-VOC-091912-3	Toluene	0.8	ppbv		
BRIG-VOC-092212-2CO	Toluene	0.8	ppbv		
BRIG-VOC-101712-3	Toluene	0.7	ppbv		
BRIG-VOC-111712-3	Toluene	0.7	ppbv		
BRIG-VOC-111912-1	Toluene	0.7	ppbv		
FLO-VOC-090912	Toluene	0.7	ppbv		
FLO-VOC-091212	Toluene	0.7	ppbv		
FLO-VOC-091512	Toluene	0.7	ppbv		
FLO-VOC-092412	Toluene	0.7	ppbv		
FLO-VOC-111212	Toluene	0.7	ppbv		
FLO-VOC-111912	Toluene	0.7	ppbv		
BRIG-VOC-092412-2	Toluene	0.6	ppbv		
BRIG-VOC-093012-1	Toluene	0.6	ppbv		
BRIG-VOC-101212-1	Toluene	0.6	ppbv		
BRIG-VOC-101212-2	Toluene	0.6	ppbv		
BRIG-VOC-101912-1	Toluene	0.6	ppbv		
BRIG-VOC-101912-2CO	Toluene	0.6	ppbv		
BRIG-VOC-111512-2	Toluene	0.6	ppbv		
BRIG-VOC-111512-3	Toluene	0.6	ppbv		
BRIG-VOC-111712-2	Toluene	0.6	ppbv		
BRIG-VOC-111912-2	Toluene	0.6	ppbv		
FLO-VOC-100612	Toluene	0.6	ppbv		
FLO-VOC-102212	Toluene	0.6	ppbv		
BRIG-VOC-091912-2CO	Toluene	0.5	ppbv		
BRIG-VOC-092412-1	Toluene	0.5	ppbv		
BRIG-VOC-100912-3	Toluene	0.5	ppbv		
BRIG-VOC-101512-2	Toluene	0.5	ppbv		
BRIG-VOC-101912-3	Toluene	0.5	ppbv		
BRIG-VOC-102812-2	Toluene	0.5	ppbv		
BRIG-VOC-103112-3	Toluene	0.5	ppbv		
BRIG-VOC-110612-2	Toluene	0.5	ppbv		
BRIG-VOC-110612-3	Toluene	0.5	ppbv		
BRIG-VOC-111212-2CO	Toluene	0.5	ppbv		
FLO-VOC-101512	Toluene	0.5	ppbv		
BRIG-VOC-092412-2CO	Toluene	0.4	ppbv	J	
BRIG-VOC-092412-3	Toluene	0.4	ppbv	J	
BRIG-VOC-092712-2CO	Toluene	0.4	ppbv	J	
BRIG-VOC-093012-2CO	Toluene	0.4	ppbv	J	
BRIG-VOC-093012-3	Toluene	0.4	ppbv	J	
BRIG-VOC-100612-1	Toluene	0.4	ppbv	J	
BRIG-VOC-100912-1	Toluene	0.4	ppbv	J	
BRIG-VOC-101212-2CO	Toluene	0.4	ppbv	J	
BRIG-VOC-102812-1	Toluene	0.4	ppbv	J	
BRIG-VOC-103112-2	Toluene	0.4	ppbv	J	
BRIG-VOC-110312-2	Toluene	0.4	ppbv	J	
BRIG-VOC-110612-2CO	Toluene	0.4	ppbv	J	
BRIG-VOC-111712-2co	Toluene	0.4	ppbv	J	
BRIG-VOC-111912-3	Toluene	0.4	ppbv	J	
BRIG-VOC-112712-3	Toluene	0.4	ppbv	J	
FLO-VOC-101912	Toluene	0.4	ppbv	J	
FLO-VOC-111512	Toluene	0.4	ppbv	J	
FLO-VOC-111712	Toluene	0.4	ppbv	J	
FLO-VOC-112512	Toluene	0.4	ppbv	J	
BRIG-VOC-101712-2CO	Toluene	0.3	ppbv	J	
BRIG-VOC-110312-1	Toluene	0.3	ppbv	J	
BRIG-VOC-110312-3	Toluene	0.3	ppbv	J	

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-112712-1	Toluene	0.3	ppbv	J	
FLO-VOC-101212	Toluene	0.3	ppbv	J	
FLO-VOC-101712	Toluene	0.3	ppbv	J	
FLO-VOC-103112	Toluene	0.3	ppbv	J	
FLO-VOC-110612	Toluene	0.3	ppbv	J	
FLO-VOC-112712	Toluene	0.3	ppbv	J	
BRIG-VOC-101912-2	Toluene	0.2	ppbv	J	
BRIG-VOC-110312-2CO	Toluene	0.2	ppbv	J	
BRIG-VOC-112812-1	Toluene	0.2	ppbv	J	
FLO-VOC-110312	Toluene	0.2	ppbv	J	
BRIG-VOC-091212-2	Trichlorobenzene-1,2,4	0.2	ppbv	J	
BRIG-VOC-103112-2	Trichlorobenzene-1,2,4	0.2	ppbv	J	
BRIG-VOC-110612-2CO	Trichlorobenzene-1,2,4	0.2	ppbv	J	
BRIG-VOC-081612-1	Trichloroethane-1,1,1	0.2	ppbv	J	
BRIG-VOC-081612-1	Trichloroethane-1,1,2	0.2	ppbv	J	
BRIG-VOC-110912-2	Trichloroethylene	1.2	ppbv		
FLO-VOC-110912	Trichloroethylene	0.2	ppbv	J	
BRIG-VOC-081612-1	Trichlorofluoromethane	0.5	ppbv		
BRIG-VOC-080412-1	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-080412-2CO	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-080712-1	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-080712-2	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-081012-2	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-081012-2CO	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-081012-3	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-100912-1	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-100912-3	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-101212-2	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-101212-2CO	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-101512-1	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-101512-2	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-101512-2CO	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-101712-1	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-101712-2	Trichlorofluoromethane	0.4	ppbv	J	
FLO-VOC-081312	Trichlorofluoromethane	0.4	ppbv	J	
FLO-VOC-101512	Trichlorofluoromethane	0.4	ppbv	J	
FLO-VOC-101712	Trichlorofluoromethane	0.4	ppbv	J	
BRIG-VOC-080412-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-080712-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-081012-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-081312-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-081312-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-081312-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-081312-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-081612-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-081612-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-081612-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-082512-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-082512-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-082812-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-082812-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-083112-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-083112-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-083112-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090312-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090312-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090312-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090612-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090612-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090612-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090612-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090912-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090912-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-090912-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-091212-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-091212-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-091212-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092212-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092412-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092412-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092412-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092412-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092712-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092712-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092712-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-092712-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-093012-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-093012-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-093012-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-100312-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-100312-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-100312-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-100612-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-100612-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-101212-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-101512-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-101712-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-101712-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-101912-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-103112-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-103112-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-110312-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-110312-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-110312-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-110312-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-110612-2CO	Trichlorofluoromethane	0.3	ppbv	J	

Appendix C

Volatile Organic Compound Results by TO-15

Natural Gas Ambient Air Monitoring Intiative

Sample ID	Chemical	Concentration	Units	Lab Qualifier	Comments
BRIG-VOC-110612-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-110912-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-110912-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111212-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111212-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111212-2CO	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111212-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111512-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111512-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111712-2	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111712-2co	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111712-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111912-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-111912-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-112712-1	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-112712-3	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-112812-1	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-083112	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-090612	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-090912	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-091212	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-092412	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-092712	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-093012	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-100312	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-100612	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-101212	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-103112	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-110312	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-110612	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-110912	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-111212	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-111512	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-111712	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-111912	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-112512	Trichlorofluoromethane	0.3	ppbv	J	
FLO-VOC-112712	Trichlorofluoromethane	0.3	ppbv	J	
BRIG-VOC-080412-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-082812-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-082812-3	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-091512-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-091512-2CO	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-091512-3	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-091912-1	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-091912-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-091912-2CO	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-091912-3	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-092212-1	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-092212-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-092212-2CO	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-101912-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-101912-2CO	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-101912-3	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-102212-1	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-102212-3	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-102512-1	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-102512-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-102512-2CO	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-102512-3	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-102812-1	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-102812-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-110612-2	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-111912-2	Trichlorofluoromethane	0.2	ppbv	J	
FLO-VOC-082812	Trichlorofluoromethane	0.2	ppbv	J	
FLO-VOC-091512	Trichlorofluoromethane	0.2	ppbv	J	
FLO-VOC-101912	Trichlorofluoromethane	0.2	ppbv	J	
FLO-VOC-102212	Trichlorofluoromethane	0.2	ppbv	J	
FLO-VOC-102512	Trichlorofluoromethane	0.2	ppbv	J	
BRIG-VOC-080412-3	Trimethylbenzene-1,2,4	0.6	ppbv		
FLO-VOC-093012	Trimethylbenzene-1,2,4	0.4	ppbv	JH	
BRIG-VOC-083112-3	Trimethylbenzene-1,2,4	0.2	ppbv	J	
BRIG-VOC-110912-2	Trimethylbenzene-1,2,4	0.2	ppbv	J	
BRIG-VOC-080412-3	Xylene-o	1	ppbv		
BRIG-VOC-083112-3	Xylene-o	0.7	ppbv		
BRIG-VOC-083112-1	Xylene-o	0.5	ppbv		
BRIG-VOC-080412-2CO	Xylene-o	0.4	ppbv	J	
FLO-VOC-093012	Xylene-o	0.4	ppbv	J	
BRIG-VOC-080412-2	Xylene-o	0.3	ppbv	J	
BRIG-VOC-110912-2	Xylene-o	0.3	ppbv	J	
BRIG-VOC-080412-1	Xylene-o	0.2	ppbv	J	
BRIG-VOC-080712-2CO	Xylene-o	0.2	ppbv	J	
BRIG-VOC-081612-1	Xylene-o	0.2	ppbv	J	
BRIG-VOC-082512-2	Xylene-o	0.2	ppbv	J	
BRIG-VOC-090312-2CO	Xylene-o	0.2	ppbv	J	
BRIG-VOC-092412-2CO	Xylene-o	0.2	ppbv	J	
BRIG-VOC-100612-2	Xylene-o	0.2	ppbv	J	

Greetings,

You are receiving a document from the Agency for Toxic Substances and Disease Registry (ATSDR). We are very interested in your opinions about the document you received. We ask that you please take a moment now to complete the following ten question survey. You can access the survey by clicking on the link below.

Completing the survey should take less than 5 minutes of your time. If possible, please provide your responses within the next two weeks. All information that you provide will remain confidential.

The responses to the survey will help ATSDR determine if we are providing useful and meaningful information to you. ATSDR greatly appreciates your assistance as it is vital to our ability to provide optimal public health information.

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