Health Consultation

SUNOCO REFINERY

CITY OF OREGON, LUCAS COUNTY, OHIO

EPA FACILITY ID: OHD005046511

AUGUST 1, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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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HEALTH CONSULTATION

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Prepared by:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Exposure Investigation and Consultation Branch

Background and Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) was petitioned by a resident of Oregon, Ohio to assess the potential health impact on area residents from exposure to air emissions from the Sunoco Refinery (Sun) [1]. The Sunoco Refinery is located in the cities of Toledo and Oregon in Lucas County, Ohio. The area surrounding the site is mixed industrial and residential, including heavy industry, light industry, residences, schools, commercial areas, railroad tracks, and major highways. The facility is composed of two main sections; one contains operating equipment and machinery used to refine crude oil to produce gasoline and to store petroleum products. The other section, southeast of the first section, is a tank farm that is used to store large quantities of gasoline and other petroleum products. (See Map 1, Appendix A).

In May 2002, ATSDR staff conducted a scoping visit of the site, which included a tour of the facility and attending a small meeting with the petitioner and other concerned citizens to gather the community's health concerns regarding the Sunoco Refinery site. Concerns focused on air emissions from Sun and how those emissions affect area residents, including children attending the Coy Elementary school in Oregon. The school is located on the fence line of the tank farm. Some community members are concerned about ongoing air releases, unplanned releases/accidents, rotten-egg odors (typical of hydrogen sulfide), petroleum odors, lack of responsiveness to complaints, and the lack of evacuation procedures for use during possible accidental releases. Health concerns expressed by community members were asthma/respiratory conditions, headaches/central nervous system conditions, gastrointestinal disturbances, multiple sclerosis, multiple chemical sensitivity, leukemia, reproductive problems, cancer (non-specific), and blood clots.

The U.S. Environmental Protection Agency (US EPA) has charged Sun with violations of the Clean Air Act for benzene releases at the company's Toledo refinery [2]. In addition, the Ohio Environmental Protection Agency (Ohio EPA) has charged the Toledo facility with violations of state regulations for sulfur-dioxide emissions. Past chemical releases from the facility have prompted temporary evacuations of Coy Elementary school and the surrounding area. Residents who live near the facility have reported smelling the rotten-egg odor typical of hydrogen sulfide. Chemicals that potentially could be released from the refinery, based on refinery processes and emissions information, are

- Volatile organic compounds (VOCs) — VOCs are chemicals that evaporate readily into air. VOCs might be released from normal, permitted refining processes; leaks in storage tanks; or accidental releases. Examples of VOCs are benzene, toluene, ethylbenzene, and xylene.
- Sulfur dioxide (SO_2) — sulfur dioxide is released from oil refineries during the processing of sulfur-containing crude oil.
- Hydrogen sulfide (H_2S) — hydrogen sulfide occurs naturally in crude oil.

During the scoping visit, ATSDR staff attempted to collect all available data to assess the impact of air emissions on nearby residents. No data were available to characterize off-site ambient-air concentrations of VOCs or sulfur compounds.

Because no data were available to address the concerns of the petitioner and the community, ATSDR conducted an Exposure Investigation (EI) from October 29, 2003, through January 20, 2004. The purpose of the EI was to measure the concentrations of contaminants in ambient air in off-site areas near the facility. These data were used to determine whether contaminants were present in the air at concentrations that might pose a public health hazard. This health consultation is limited to evaluating the data gathered by ATSDR during the EI sampling. ATSDR staff will evaluate additional data, if data become available for the site that characterize community exposure to air emissions from Sun or that address community concerns.

ATSDR also created odor logs for community members to keep track of odor events during the exposure investigation. Although hard copies of the odor logs were passed out to residents during community meetings, and during the exposure investigation, no completed odor logs have been returned, for unknown reasons.

Demographics

The Sunoco Refinery is located in a very densely populated area. About 28,000 people live within a 1-mile radius of the site. Within this 1-mile radius, the community is approximately 90% white, and approximately 3,400 children aged 6 years or less live within the 1-mile radius. The facility is surrounded by residences, commercial areas, light industry, heavy industry, highways, and railroad tracks. Several schools and hospitals are within 1 mile of the site, including an elementary school (adjacent to the tank farm). See Map 1 and 2 in Appendix A for more information on demographic information and for an aerial map of the facility and surrounding area.

Discussion

Exposure Investigation Methodology

ATSDR was the lead agency in this investigation, but ATSDR staff worked closely in collaboration with the Ohio EPA, the Toledo Environmental Services (TES), and the EPA Environmental Response Team (ERT). TES is the local government environmental agency to which Ohio EPA has delegated regulating authority and issuance of permits for facility releases into the air.

ATSDR staff consulted with TES and Ohio EPA to select two locations near the facility to use as monitoring stations. Considerations in selecting the locations were 1) proximity to the facility, 2)

availability of sheltered electrical outlets, 3) security, 4) proximity to street traffic, and 5) willingness of property owner to allow the equipment to remain in the areas for 2–3 months. One monitoring station was located east of the refinery (station E), and the other was located to the west (station W). Both stations were located ¼-mile or less from the property boundary of the facility.

Volatile Organic Compounds

Ohio EPA provided a portable sampling station and Summa canisters to collect ambient air samples for VOC analyses. TES staff collected one 24-hour air sample weekly at each monitoring station. Nine samples were collected at station E; and 12 samples were collected at station W. The samples were collected during the same time period that the Zellweger tape meters were in service. TES shipped the samples by overnight mail to the Ohio EPA laboratory for VOC analyses by EPA method TO-14A. The laboratory analyzed for 71 VOCs, including benzene and other constituents of petroleum products. The lowest level of detection possible for individual chemicals ranged from 0.1–0.5 ppb (parts contaminant per billion parts of air by volume).

ATSDR recruited area residents to collect grab air samples to test ambient air quality. Grab samples are collected in less than 1 minute. These samples are used to provide a quick snapshot of contaminants in the air. Grab samples were used at this site in order to characterize air quality at a time of the residents' choosing, such as during an odor event. Ohio EPA provided evacuated (empty) Summa canisters to occupants of three private residences located within ½-mile of the facility's perimeter. ATSDR instructed the participants in selecting an appropriate location to place the canisters to avoid auto exhaust, stored gasoline, furnaces, and other potential sources of substances that might interfere with air-quality testing. Residents were instructed to collect an air sample when they were experiencing an odor event or a respiratory irritation that they attributed to air contamination. After collecting the samples, the residents telephoned TES to schedule a pickup. A representative of TES collected the canisters and shipped them by overnight mail to Ohio EPA for VOC analysis, using EPA Method TO-14A. A total of four grab samples were collected and tested for VOCs.

Hydrogen Sulfide and Sulfur Dioxide

Zellweger Single Point Monitors, equipped with the ChemKey and Chemcassette detection system (i.e., tape meter), were used to monitor ambient air concentrations of sulfur dioxide and hydrogen sulfide. The detection range for sulfur dioxide was 0-200 ppb, and for hydrogen sulfide, 2-90 ppb. ERT representatives placed the monitors in a sheltered area at both locations. Air was drawn into the instruments through a collection tube that opened to the outdoor air. After installation, TES representatives maintained the monitors and downloaded the data. ERT also installed a WeatherPak 2000 weather station at station E to collect wind speed, wind direction, temperature, and rainfall data. Ambient-air monitoring for sulfur dioxide and hydrogen sulfide was conducted from October 29, 2003 through January 20, 2004.

Environmental Data and Public Health Implications

Volatile Organic Compounds

Tables 1-3 (Appendix B) list the 71 VOCs that were analyzed and the maximum concentrations at which they were detected at monitoring stations E and W, and for residential samples. The maximum concentrations of air VOCs were compared to ATSDR's chemical specific comparison values. A comparison value is a level (concentration) of a chemical in air, soil, or water that is considered safe for human contact. Comparison values are screening values that are used to identify chemicals that need to be further evaluated. Comparison values were not available for all chemicals. None of the maximum concentrations of air VOCs exceeded available comparison values. Therefore, none of the air contaminants that were evaluated against ATSDR's comparison values had concentrations that posed a public health hazard.

Although none of the VOCs detected pose a health hazard, one VOC, trichlorofluoromethane (TCFM), was detected at station E at a level significantly higher than background levels (TCFM background levels in outdoor ambient air are typically less than 1 ppb) [3]. (See table 2, Appendix B). Elevated concentrations of TCFM were detected in all nine samples at concentrations that ranged from 7.2 to 47 ppb. At monitoring station W, the maximum concentration of TCFM was 0.30 ppb. Thus, these data indicate a localized source of TCFM near station E; however, the source is not known. TCFM is a chemically inert gas that has a low toxicity, and the TCFM concentrations found do not pose a health hazard. TCFM, also know as Freon 11, has been widely used as a refrigerant, a blowing agent, and as a propellant in spray cans and medicinal inhalers. The use of TCFM in air conditioners and refrigerating devices is being phased out in the United States and other industrialized countries. The phase out is not because of TCFM toxicity; rather it is because TCFM contributes to depletion of ozone in the stratosphere. However, large amounts of TCFM are still present in older air conditioners and refrigerating devices.

Sulfur Dioxide

Zellweger tape meters were used to monitor sulfur dioxide levels. During the monitoring period, there were some periods of data loss due to power outages, equipment problems, and human error. At station E, sulfur dioxide data were obtained for 68 of the 84 days, and at station W, data were obtained for 84 of 84 days [4].

Summary of Sulfur Dioxide Concentrations		
	ppb*	**ppb**
	Station W	**Station E**
Sampling period average	1.6	3.9
Max 24-hour average	21	62
Max 60-minute average	67	100
Max 15-minute average	107	140
Max 5-minute average	127	154
**ppb = parts per billion*		

The sulfur dioxide data gathered during this investigation are presented in Figures 1–6 (Appendix C). The overall sampling average for the entire monitoring period was 1.6 ppb for Station W and 3.9 ppb for Station E. The maximum concentration of sulfur dioxide detected during a 5-minute monitoring period at station E was 154 ppb, and the maximum concentration of sulfur dioxide detected during a 5-minute monitoring period at station W was 127 ppb. The maximum concentration of sulfur dioxide detected at station E, averaged over any 24-hour monitoring period, was 62 ppb, and the maximum concentration of sulfur dioxide detected at station W, averaged over any 24-hour monitoring period, was 21 ppb.

The US EPA has set Primary Ambient Air Quality Standards for six criteria pollutants (including sulfur dioxide) in ambient air to protect human health and welfare, including sensitive populations such as asthmatics, children, and the elderly. The primary standards for sulfur dioxide are 30 ppb for an annual average and 140 ppb for a 24-hour maximum level [5]. None of the levels of sulfur dioxide measured during this EI exceeded the US EPA air quality standards.

People with asthma are particularly susceptible to adverse health effects from inhalation exposures to sulfur dioxide. The populations most likely to be affected by sulfur dioxide in ambient air pollution are asthmatics, children and adolescents, and adults who are physically active outdoors. The ATSDR Minimal Risk Level (MRL) for sulfur dioxide is 10 ppb for acute (less than 14 days) inhalation exposure. ATSDR develops inhalation Minimal Risk Levels (MRLs) for the following three exposure periods: acute (less than 14 days), intermediate (14 to 365 days), and chronic (greater than 1 year). Inhalation MRLs are contaminant concentrations in air below which noncancerous harmful effects are unlikely. ATSDR MRLs are health guidelines, and are not regulatory standards like EPA's NAAQS.

The 24-hour averages of sulfur dioxide during the EI exceeded the acute MRL of 10 ppb for 13 of 68 days for Station E and 8 of 84 days for Station W. However, contaminant concentrations that exceed an MRL do not mean that harmful effects will occur; rather it means that a more thorough toxicological evaluation is necessary to determine whether adverse health effects are possible. This toxicological review is presented below.

In one study, asthmatics were exposed to sulfur dioxide while exercising [6]. Inhalation of 250 ppb sulfur dioxide caused a significant increase in airway resistance as measured by spirometry in three of seven subjects, and exposure to 100 ppb sulfur dioxide caused a slight increase in airway resistance in two of seven subjects. Although a slight increase in airway resistance was observed in some of these subjects, none of the test subjects in either group experienced any

clinical symptoms (e.g., wheezing or shortness of breath). Studies of healthy, nonasthmatic individuals indicate a minimum level of 1000 ppb to 2000 ppb is required for changes in lung function to occur [7].

Although the 24-hour averages did not exceed 100 ppb, sulfur dioxide levels did exceed 100 ppb several times (up to a maximum of 154 ppb) throughout the monitoring period for short durations of approximately 5–60 minutes in length. Currently no ambient air standard exists for short-term exposure to sulfur dioxide. However, these concentrations are near the threshold for minor health effects in exercising asthmatics.

It was beyond the scope of this investigation to identify the source of contaminants detected in the ambient air. However, ATSDR examined meteorological data for time periods when sulfur dioxide was high (above 100 ppb). Wind-roses (figures that show wind direction) were generated for the time periods that sulfur dioxide was elevated. When high concentrations of sulfur dioxide were detected at monitoring stations W or E, the predominant wind direction was from the refinery toward the monitoring stations. This suggests, but does not conclusively prove, that the refinery was the source of the air contamination.

Hydrogen Sulfide

Zellweger tape meters were used to monitor for hydrogen sulfide. During the monitoring period, there were some periods of data loss due to power outages, equipment problems, and human error. At monitoring station E, hydrogen sulfide data were obtained for 76 of the 84 days, and at monitoring station W, data were obtained for 63 of 84 days.

No events were recorded for hydrogen sulfide. An “event” was defined as 5 minutes of logged data that exceeded a hydrogen sulfide concentration of 10 ppb. The absence of recordable concentrations of hydrogen sulfide indicated that ambient air contamination with hydrogen sulfide did not pose a public health hazard.

Limitations

There are several limitations to the data collected during the EI. The most significant ones are described below.

- During this investigation, grab air samples were collected in residential areas to assess potential episodic exposures to ambient air contamination. These samples were biased samples in that they were collected at times when exposures were perceived to be highest. Therefore, the air contaminant concentrations in these samples were not likely to be representative of chronic exposures. Nevertheless, the concentrations of air contaminants detected in these samples were not at levels of health concern.

- The VOC sampling might have missed significant elevations of VOCs since samples were collected once every 6 days instead of continuously. A total of 9 days for Station E and 12 days for Station W were sampled over the 84-day time period.

- This investigation was conducted during a period of approximately 3 months. During this time interval, the Sunoco facility was in operation. Increases in production capacity, changes in operational procedures, and changes in meteorological conditions during the warmer summer months could cause variations in the ambient air contaminant levels. It was beyond the scope of this investigation to explore this variability.

Health Outcome Data

The Toledo-Lucas County Health Department is presently conducting a Community Cancer Assessment for Lucas County in conjunction with the Ohio Department of Health. The purpose of the study is to characterize the cancer incidence (i.e., new cancer cases) in Lucas County at the community level and compare those rates to Ohio and national background incidence rates. To determine community-level rates, Lucas County will be divided into four sections: Maumee, Oregon, Toledo, and the western portion of Lucas County. Cancer data will be reviewed for the years 1996 (the earliest year cancer data was collected) to the most current data available for all types of cancer, including leukemia (identified as a concern by some in the community). The Community Cancer Assessment also will identify high risk populations for the various types of cancer in order to design and implement cancer prevention and control strategies. Cancer incidence data for the study is being obtained from the Ohio Cancer Incidence Surveillance System (OCISS) through the Ohio Department of Health (Email correspondence dated July 1, 2004, from Jeanine Bailey, Toledo-Lucas County Health Department, to Jennifer Freed, ATSDR, concerning the Lucas County cancer study).

Child Health Considerations

Children and adults with asthma are more sensitive to sulfur dioxide and may experience symptoms after being exposed to sulfur dioxide at concentrations that have no effect on normal individuals. Experimental studies have shown that some asthmatics who are briefly exposed (2 to 10 minutes) to sulfur dioxide at concentrations of 500 to 1000 ppb while exercising may experience bronchoconstriction, wheezing, chest tightness, and shortness of breath [7]. These symptoms are generally transient, and lung function returns to normal within an hour after ceasing exposure or after administration of common asthma medications [8].

Conclusions

1. Ambient air monitoring during the exposure investigation near the Sunoco Refinery did not detect volatile organic compounds, hydrogen sulfide, or sulfur dioxide at concentrations that

would be expected to cause adverse health effects. ATSDR categorizes this as *no apparent public health hazard.*

2. The conclusions in this document are limited to the time period during which ATSDR air sampling took place. These conclusions may not apply for accidental or unplanned releases of airborne chemicals from the facility that have occurred in the past or that may occur in the future.

Recommendations

1. Toledo Environmental Services should continue to respond to community complaints about air quality from the Sunoco Refinery and to conduct air monitoring during complaints as appropriate to assess the public health impact of ambient air contamination in the community.

2. ATSDR should evaluate additional environmental data as it becomes available.

3. Because of uncertainty about how representative the sulfur dioxide and VOC data are, and because the levels of the sulfur dioxide data are occasionally near the threshold for potential adverse health effects in sensitive populations such as exercising asthmatics, additional air monitoring is recommended for these contaminants.

Public Health Action Plan

Completed Activities

In May 2002, ATSDR conducted a scoping visit for the facility. During the scoping visit, ATSDR met with a small group of community members to hear community concerns about the site and to tour the Sunoco facility.

In September 2003, ATSDR held a public meeting in Oregon, Ohio, to discuss plans for air sampling at the facility and to gather any additional community concerns.

From October 29, 2003, through January 20, 2004, ATSDR, in collaboration with TES, Ohio EPA, and the EPA ERT, conducted ambient air monitoring for hydrogen sulfide, sulfur dioxide, and VOCs.

In July 2004, ATSDR held a public meeting in Oregon, Ohio, to discuss the results of the air sampling and the ATSDR health consultation for the Sunoco facility.

In May 2005, ATSDR addressed all public comments received, and released this final health consultation.

Current Activities

The Toledo-Lucas County Health Department is conducting a Community Cancer Assessment for Lucas County, in conjunction with the Ohio Department of Health, which is compiling the data. The Ohio Department of Health is expected to provide the data to the Toledo-Lucas County Health Department in the near future.

Future Activities

The Toledo-Lucas County Health Department will analyze cancer incidence data gathered by the Ohio Department of Health and release a report that will be available to public health partners, health care providers, and the general public.

ATSDR will evaluate other available data and information that becomes available for the site and assess their potential impact on public health. These determinations may be released as additional health consultations.

Authors

Jennifer A. Freed, MPH
Environmental Health Scientist
ATSDR/DHAC/EICB

Kenneth G. Orloff, PhD, DABT
Research Toxicologist
ATSDR/DHAC/EICB

Regional Representative

Michelle Colledge, MPH
Region 5
ATSDR/DRO

Reviewers

Susan Metcalf, MD, MPH
Team Lead
ATSDR/DHAC/EICB

Susan Moore, MS
Branch Chief
ATSDR/DHAC/EICB

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2. U.S. Environmental Protection Agency. EPA Cites Eight Companies for Clean-Air Violations. Available at http://www.epa.gov/region5/news/news02/02opa033.htm. Accessed February 28, 2002.

3. Shah JJ and Singh HW. Distribution of volatile organic chemicals in outdoor and indoor air. Environ Sci Technol. 1988: 22(12)1381-88.

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5. U.S. Environmental Protection Agency. Clean Air Act; National Ambient Air Quality Standards. Washington: U.S. Environmental Protection Agency; 1990.

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7. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Sulfur Dioxide. Atlanta: U.S. Department of Health and Human Services; 1998.

8. US PEA National Ambient Air Quality Standards for Sulfur Oxides (Sulfur Dioxide), Final Decision. Federal Register 1996 May 22; 61:25566-80.

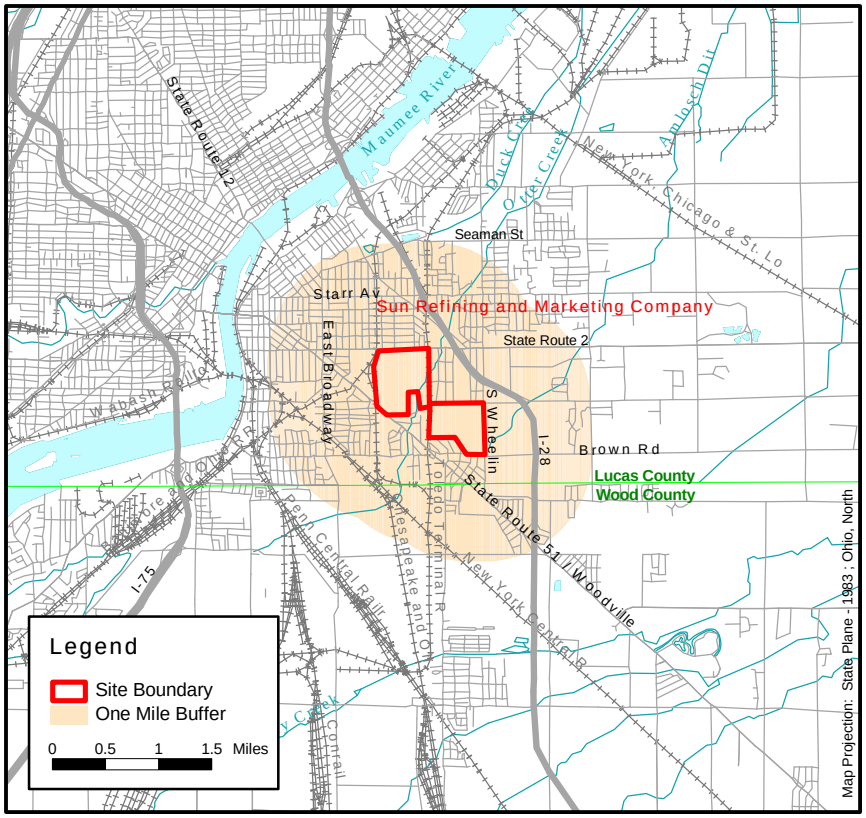
Appendix A
Maps

Sun Refining Company

INTRO MAP

Oregon, Ohio

EPA Facility ID OHD005046511



Base Map Source: 1995 TIGER/Line Files

Site Location

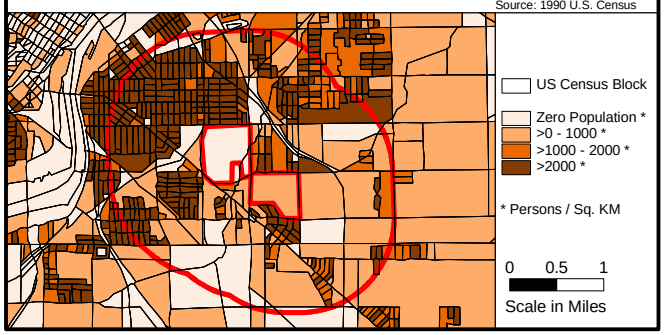
Lucas County, Ohio

Demographic Statistics
Within One Mile of Site*

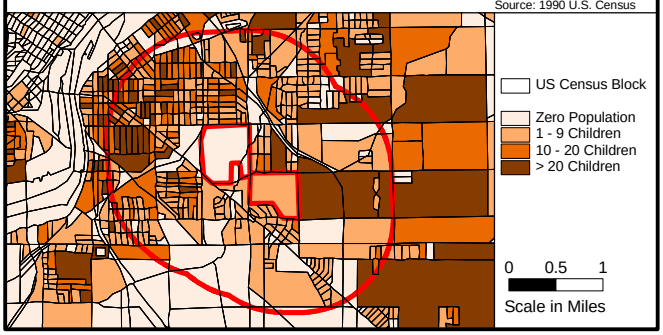
Total Population	28180
White	25728
Black	1176
American Indian, Eskimo, Aleut	96
Asian or Pacific Islander	144
Other Race	1041
Hispanic Origin	1953
Children Aged 6 and Younger	3420
Adults Aged 65 and Older	3455
Females Aged 15 - 44	6678
Total Housing Units	11654

Demographics Statistics Source: 1990 US Census
*Calculated using an area-proportion spatial analysis technique

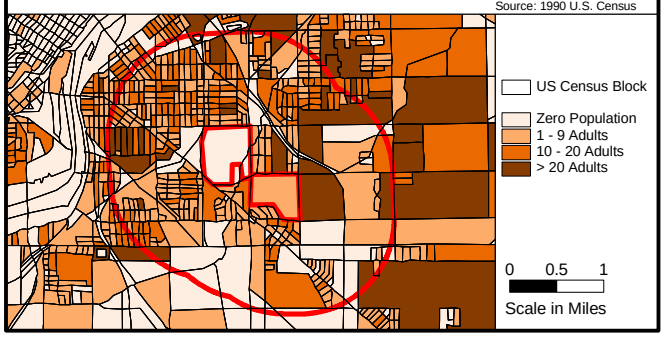
Population Density



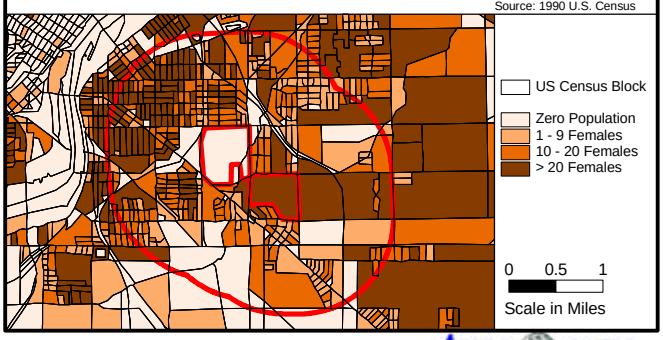
Children 6 Years and Younger



Adults 65 Years and Older



Females Aged 15 - 44



ATSDR GIS SAIDS

IMH 011102

Sunoco Mid America
Oregon, Ohio

Lucas County Emergency Services
2144 Monroe St
Toledo, Ohio 43624
419-213-6532

July, 8, 2004

Appendix B
Tables

Table 1: Monitoring Station W

Chemical	Maximum Concentration* (ppb†)	Comparison Value (ppb)	Chemical	Maximum Concentration (ppb)	Comparison Value (ppb)
acetone	2.90	13,000‡	trans-1,3-dichloropropene	0.00	
acetonitrile	0.00	36§	1,2-dichloro-1,1,2,2-tetrafluoroethane	0.00	
acrylonitile	0.64	100¶	n-dodecane	0.00	
benzene	0.87	9§	ethylbenzene	0.00	1,000 **
benzyl chloride	0.00		4-ethyltoluene	0.15	
bromodichloromethane	0.00		n-heptane	0.21	
bromoform	0.00		hexachlorobutadiene	0.00	
bromomethane	0.00	5‡	hexane	1.30	600 ‡
1,3-butadiene	0.00	1§	methyl-butyl ether	0.00	700 ‡
n-butane	9.20		methylene chloride	0.00	300 ‡
2-butanone	0.00	1700§	4-methyl-2-pentanone	0.00	
carbon disulfide	0.00	300‡	a-methylstyrene	0.00	
carbon tetrachloride	0.11	30‡	naphthalene	0.00	0.7 ‡
chlorobenzene	0.00		n-nonane	0.00	
chlorodifluoromethane	0.24	14,000§	n-octane	0.00	
chloroethane	0.00	3,800 §	n-pentane	3.80	
chloroform	0.00	20‡	propylene	4.40	
chloromethane	0.43	50‡	n-propyl benzene	0.14	
3-chloropropene	0.00		styrene	0.00	60 ‡
cumene	0.00	81§	1,1,2,2-tetrachloroethane	0.00	400 **
cyclohexane	0.17	1700§	tetrachloroethylene	0.00	40 ‡
decane	0.00		toluene	0.71	80 ‡
dibromochloromethane	0.00		1,2,4-trichlorobenzene	0.00	
1,2-dibromoethane	0.00		1,1,1-trichloroethane	0.00	700 **
dibromomethane	0.00		1,1,2-trichloroethane	0.00	
1,2-dichlorobenzene (ortho)	0.00		trichloroethene	0.00	100 **
1,3-dichlorobenzene (meta)	0.00		trichlorofluoromethane	0.30	
1,4-dichlorobenzene (para)	0.00	100‡	1,1,2-trichloro-1,2,2-trifluoroethane	0.00	
dichlorodifluoromethane	0.51		1,2,4-trimethylbenzene	0.22	
1,1-dichloroethane	0.00		1,3,5-trimethylbenzene	0.00	
1,2-dichloroethane	0.00	600‡	n-undecane	0.00	
1,1-dichloroethene	0.00	20**	vinyl acetate	0.35	10 **
cis-1,2-dichloroethene	0.00		vinyl chloride	0.00	30 **
trans-1,2-dichloroethene	0.00	200**	o-xylene	0.00	100 ‡
1,2-dichloropropane	0.00	7**	total m+p-xylene	0.21	100 ‡
Cis-1,3-dichloropropene	0.00				

* ppb = parts per billion
† 24-hour sample
‡ ATSDR chronic air Environmental Media Evaluation Guide
§ EPA Reference Concentration
¶ ATSDR acute Environmental Media Evaluation Guide
** ATSDR intermediate chronic air Environmental Media Evaluation Guide

Table 2: Monitoring Station E

Chemical	Maximum Concentration* (ppb†)	Comparison Value (ppb)	Chemical	Maximum Conc. (ppb)	Comparison Value (ppb)
acetone	2.60	13,000‡	trans-1,3-dichloropropene	0.00	
acetonitrile	0.39	36§	1,2-dichloro-1,1,2,2-tetrafluoroethane	0.00	
acrylonitile	0.00	100¶	n-dodecane	0.32	
benzene	2.80	9§	ethylbenzene	0.37	1,000 **
benzyl chloride	0.00		4-ethyltoluene	0.15	
bromodichloromethane	0.00		n-heptane	1.40	
bromoform	0.00		hexachlorobutadiene	0.00	
bromomethane	0.00	5‡	hexane	6.60	600 ‡
1,3-butadiene	0.00	1§	methyl-butyl ether	0.00	700 ‡
n-butane	15.0		methylene chloride	0.00	300 ‡
2-butanone	0.91	1700§	4-methyl-2-pentanone	0.00	
carbon disulfide	0.00	300‡	a-methylstyrene	0.00	
carbon tetrachloride	0.11	30‡	naphthalene	0.44	0.7 ‡
chlorobenzene	0.00		n-nonane	0.10	
chlorodifluoromethane	0.30	14,000§	n-octane	0.33	
chloroethane	0.00	3,800 §	n-pentane	15.00	
chloroform	0.00	20‡	propylene	7.40	
chloromethane	0.47	50‡	n-propyl benzene	0.15	
3-chloropropene	0.00		styrene	0.00	60 ‡
cumene	0.00	81§	1,1,2,2-tetrachloroethane	0.00	400 **
cyclohexane	1.10	1700§	tetrachloroethylene	0.00	40 ‡
decane	0.00		toluene	3.40	80 ‡
dibromochloromethane	0.00		1,2,4-trichlorobenzene	0.00	
1,2-dibromoethane	0.00		1,1,1-trichloroethane	0.00	700 **
dibromomethane	0.00		1,1,2-trichloroethane	0.00	
1,2-dichlorobenzene (ortho)	0.00		trichloroethene	0.00	100 **
1,3-dichlorobenzene (meta)	0.00		trichlorofluoromethane	47.00	
1,4-dichlorobenzene (para)	0.00	100‡	1,1,2-trichloro-1,2,2-trifluoroethane	0.00	
dichlorodifluoromethane	0.52		1,2,4-trimethylbenzene	0.24	
1,1-dichloroethane	0.00		1,3,5-trimethylbenzene	0.00	
1,2-dichloroethane	0.00	600‡	n-undecane	0.29	
1,1-dichloroethene	0.00	20**	vinyl acetate	0.51	10 **
cis-1,2-dichloroethene	0.00		vinyl chloride	0.36	30 **
trans-1,2-dichloroethene	0.00	200**	o-xylene	1.60	100 ‡
1,2-dichloropropane	0.00	7**	total m+p-xylene	0.21	100 ‡
cis-1,3-dichloropropene	0.00				

* ppb = parts per billion
† 24-hour sample
‡ ATSDR chronic air Environmental Media Evaluation Guide
§ EPA Reference Concentration
¶ ATSDR acute Environmental Media Evaluation Guide
** ATSDR intermediate chronic air Environmental Media Evaluation Guide

Table 3: Residential Summa Canisters

Chemical	Maximum Concentration* (ppb†)	Comparison Value (ppb)	Chemical	Maximum Conc. (ppb)	Comparison Value (ppb)
acetone	4.50	13,000‡	trans-1,3-dichloropropene	0.00	
acetonitrile	0.00	36§	1,2-dichloro-1,1,2,2-tetrafluoroethane	0.00	
acrylonitile	0.50	100¶	n-dodecane	0.00	
benzene	0.87	9§	ethylbenzene	0.00	1,000 **
benzyl chloride	0.00		4-ethyltoluene	0.00	
bromodichloromethane	0.00		n-heptane	0.70	
bromoform	0.00		hexachlorobutadiene	0.00	
bromomethane	0.00	5‡	hexane	2.90	600 ‡
1,3-butadiene	0.00	1§	methyl-butyl ether	0.00	700 ‡
n-butane	10.00		methylene chloride	0.14	300 ‡
2-butanone	1.40	1700§	4-methyl-2-pentanone	0.00	
carbon disulfide	0.00	300‡	a-methylstyrene	0.00	
carbon tetrachloride	0.00	30‡	naphthalene	0.00	0.7 ‡
chlorobenzene	0.00		n-nonane	0.00	
chlorodifluoromethane	0.17	14,000§	n-octane	0.13	
chloroethane	0.00	3,800 §	n-pentane	5.40	
chloroform	0.00	20‡	propylene	0.00	
chloromethane	0.46	50‡	n-propyl benzene	0.00	
3-chloropropene	0.00		styrene	0.00	60 ‡
cumene	0.00	81§	1,1,2,2-tetrachloroethane	0.00	400 **
cyclohexane	0.53	1700§	tetrachloroethylene	0.00	40 ‡
decane	0.00		toluene	1.00	80 ‡
dibromochloromethane	0.00		1,2,4-trichlorobenzene	0.00	
1,2-dibromoethane	0.00		1,1,1-trichloroethane	0.00	700 **
dibromomethane	0.00		1,1,2-trichloroethane	0.00	
1,2-dichlorobenzene (ortho)	0.00		trichloroethene	0.00	100 **
1,3-dichlorobenzene (meta)	0.00		trichlorofluoromethane	0.27	
1,4-dichlorobenzene (para)	0.00	100‡	1,1,2-trichloro-1,2,2-trifluoroethane	0.00	
dichlorodifluoromethane	0.49		1,2,4-trimethylbenzene	0.00	
1,1-dichloroethane	0.00		1,3,5-trimethylbenzene	0.00	
1,2-dichloroethane	0.00	600‡	n-undecane	0.10	
1,1-dichloroethene	0.00	20**	vinyl acetate	1.40	10 **
cis-1,2-dichloroethene	0.00		vinyl chloride	0.00	30 **
trans-1,2-dichloroethene	0.00	200**	o-xylene	0.11	100 ‡
1,2-dichloropropane	0.00	7**	total m+p-xylene	0.24	100 ‡
cis-1,3-dichloropropene	0.00				

* ppb = parts per billion
† grab sample (< 1minute)
‡ ATSDR chronic air Environmental Media Evaluation Guide
§ EPA Reference Concentration
¶ ATSDR acute Environmental Media Evaluation Guide
** ATSDR intermediate chronic air Environmental Media Evaluation Guide

Appendix C
Figures

Figure 1. Sulfur Dioxide Concentrations (ppb) for Station E
Ambient Concentrations For SO2 Displayed in 5-minute Intervals
Dates: 10/29/03 - 01/20/04

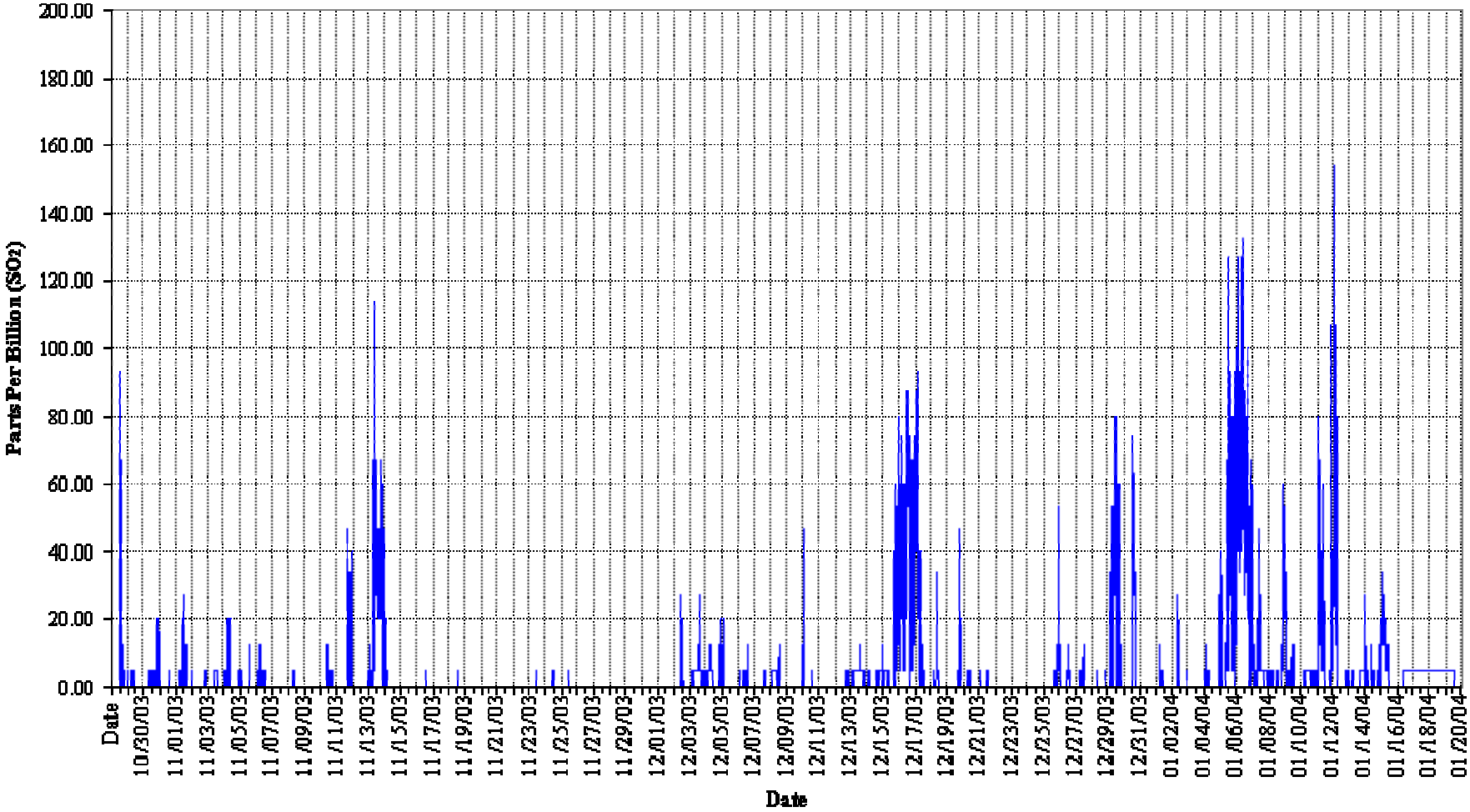


Figure 2. Sulfur Dioxide Concentrations (ppb) at Station E
Daily 15-Minute and 1-Hour Maximum Average Concentrations
Dates: 10/29/03 - 01/20/04

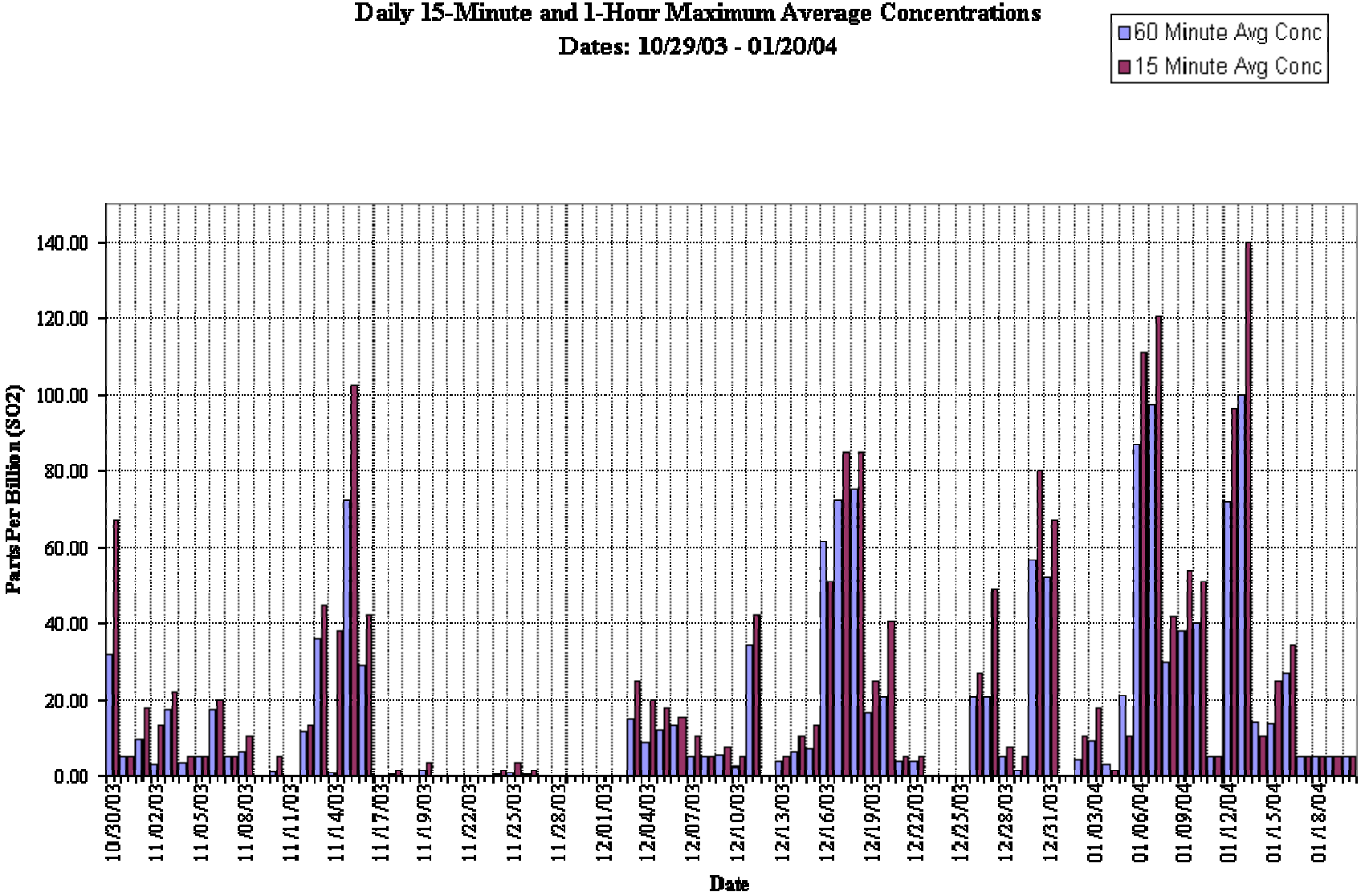


Figure 3. Sulfur Dioxide Concentrations (ppb) for Station E
24-Hour Average Concentrations
Dates: 10/29/03 - 01/20/04

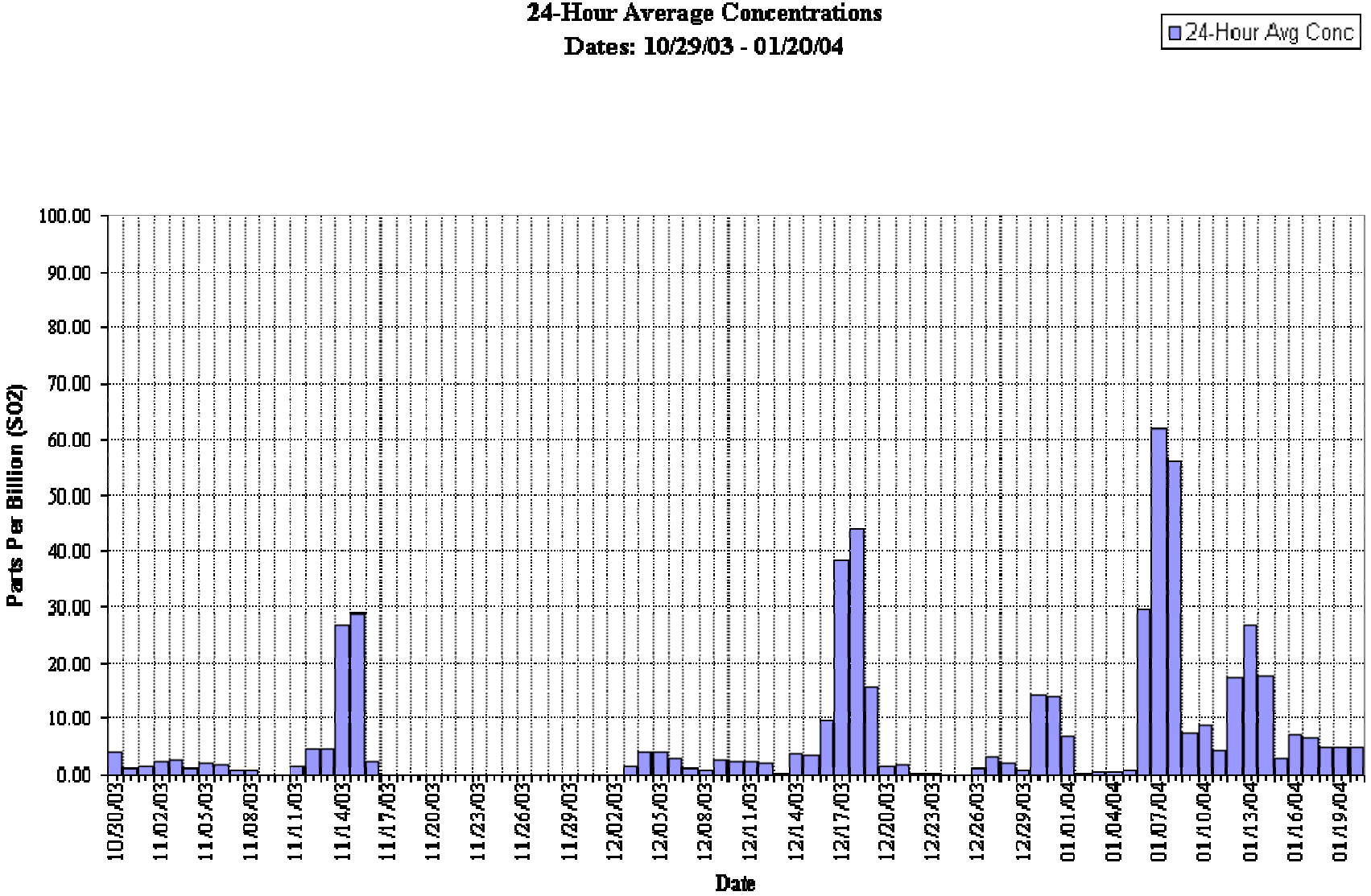


Figure 4. Sulfur Dioxide Concentrations (ppb) for Station W
Ambient Concentrations For SO2 Displayed in 5-minute Intervals
Dates: 10/29/03 - 01/20/04

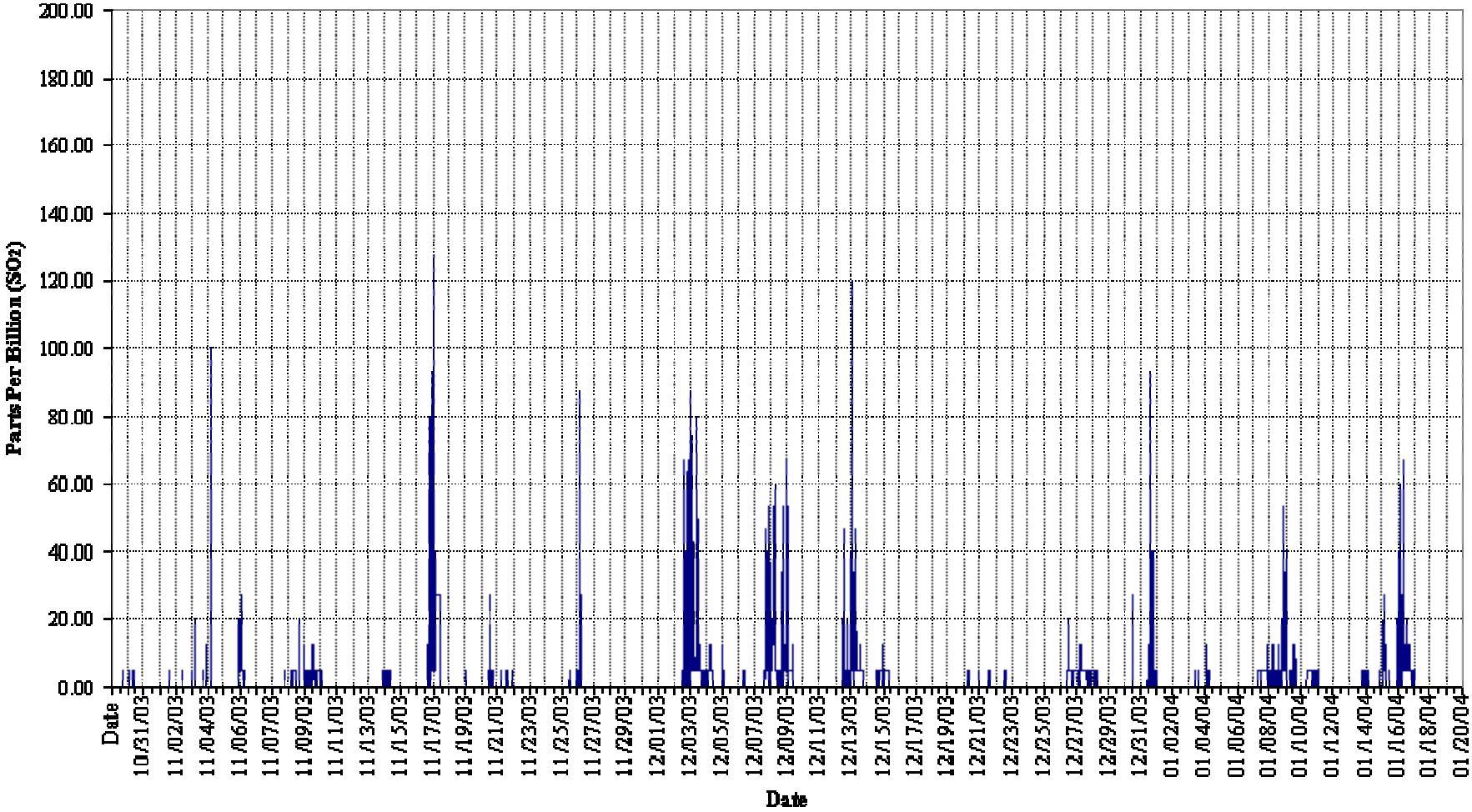


Figure 5. Sulfur Dioxide Concentrations (ppb) for Station W
Daily 15-Minute and 1-Hour Maximum Average Concentrations
Dates: 10/29/03 - 01/20/04

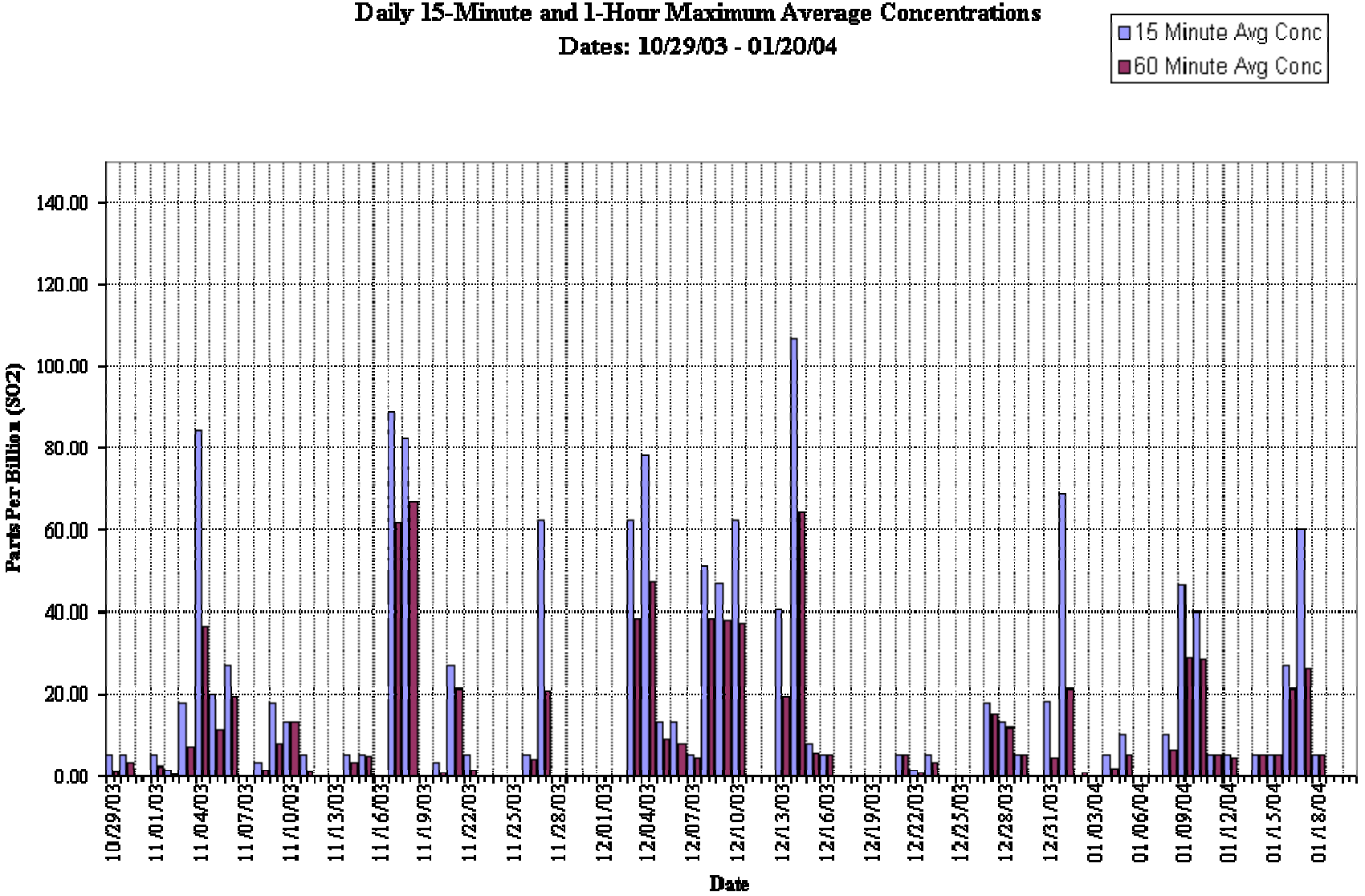
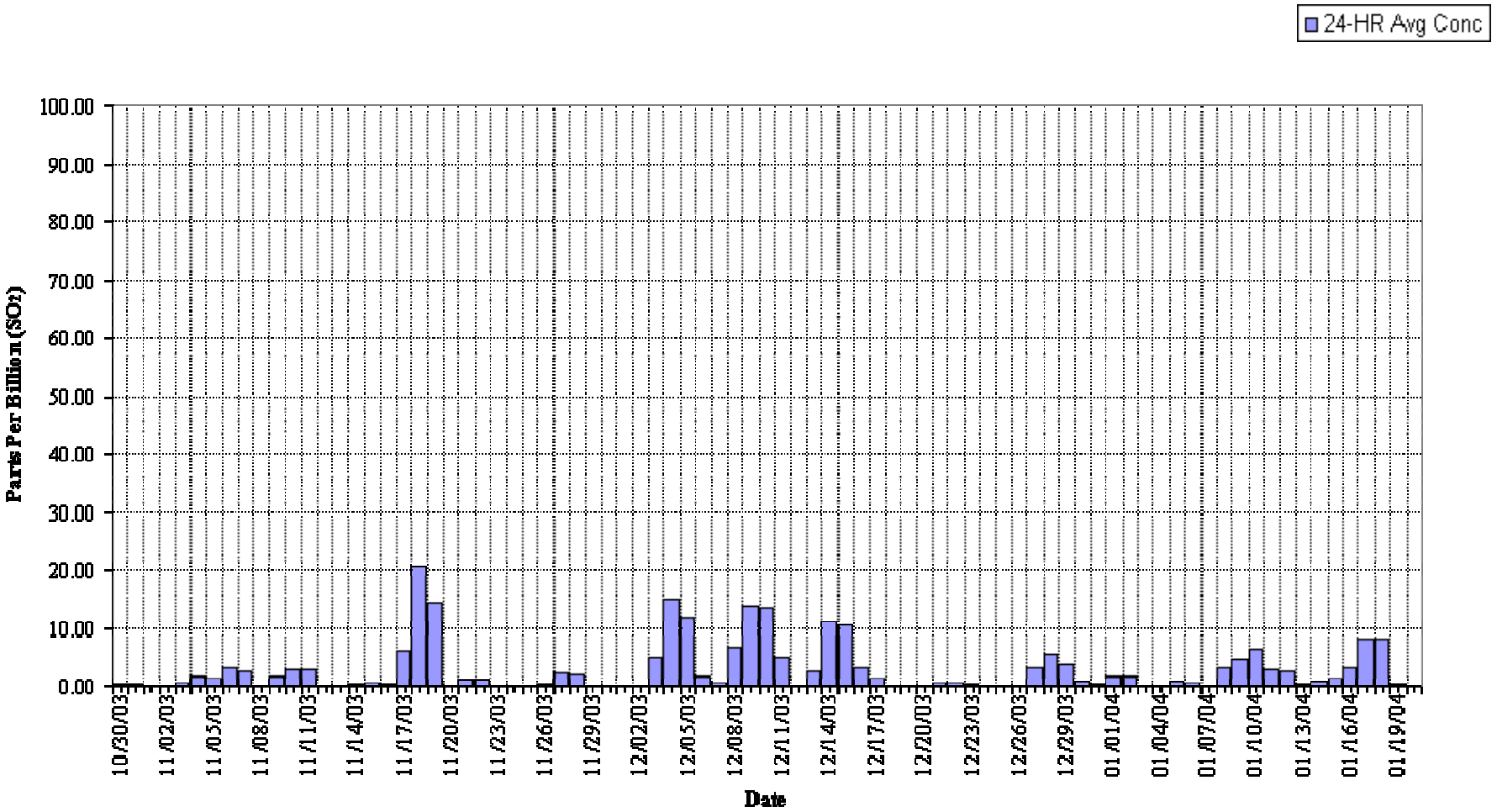


Figure 6. Sulfur Dioxide Concentrations (ppb) for Station W
24-Hour Average Concentrations
Dates: 10/29/03 - 01/20/04



Appendix D
Public Comments

Responses to Public Comments

The Agency for Toxic Substances and Disease Registry (ATSDR) issued a draft public comment version of the petitioned public health consultation on August 19, 2004, for the Sunoco Refinery site. From August 19, 2004, through October 5, 2004, the public had the opportunity to comment on the draft public health consultation. Upon request, ATSDR extended the public comment period until February 15, 2005. ATSDR received written comments and questions from the industry and the community. Where possible, these comments and questions are presented unchanged below. However, for the sake of clarity and brevity, some comments or questions were either paraphrased or summarized. The full correspondence is available upon request. Each comment or question is followed by a response from ATSDR.

Public Comments from Community Members

Written comments received from the community are summarized below:

- How does excessive sulfur dioxide affect long-term health?
- Cancer study should include people who work close to the refinery.
- When spills occur at the refinery, the fumes remain in the school for a long time.
- Air monitoring was inadequate because Sunoco emitted 18 million pounds of sulfur dioxide in 2004 and the monitors were too close to the plant to pick up stack emissions.
- Air monitoring should have been completed in the summer because that is when odors are strongest.
- The pollution problem in the area should be taken care of because it causes breathing problems, eye problems, and cancer. Noise is also a problem.

ATSDR Response: ATSDR monitored air in the community in an attempt to answer many of these community concerns. The refinery operates year-round, and ATSDR was not aware of any seasonal variations in production. ATSDR does not agree that the locations of the air monitors were too close to the facility to capture air emissions. The locations of the air monitors were chosen on the basis of many factors, including availability of an area with electricity and shelter. ATSDR reviewed the results of the sulfur dioxide sampling and did not find any levels that would be a concern for long-term health effects. The cancer study being completed in the area is being done through the cancer registry in Ohio, and does not involve actively recruiting participants in the community. Any person with cancer diagnosed during the years in the cancer study will be included.

Public Comments from Industry

Background and Statement of Issues section

1. Comment: Sunoco believes that sufficient information was already available to demonstrate that the facility posed "no apparent health hazard". The available information includes volatile organic compounds emission data from USEPA's Toxic Release Inventory database, predicted air concentrations of sulfur dioxide, hydrogen sulfide and other compounds generated by the Sunoco Toledo Refinery, and regional sulfur dioxide monitoring data measured by Ohio EPA. Sunoco believes that a full review of these data by ATSDR would have indicated that additional ambient air monitoring near the Sunoco Toledo Refinery was not warranted.

Response: Toxic Release Inventory (TRI) data or emissions data, by themselves, are not indicators of off-site ambient air concentrations of contaminants. When based on accurate source terms and validated by site-specific monitoring data, modeled data can provide useful information. However, ATSDR believes that ambient air monitoring provides the best unequivocal source of data for health evaluation purposes. The locations of the regional sulfur dioxide monitoring were not sufficient to determine community exposure; the monitors were too far from the affected community.

2. Comment: The document should be more consistent with its description of the area surrounding Sunoco. The second sentence of the section states that the area is heavy industrial and residential, while the demographics section states that the facility is surrounded by residences, commercial areas, light industry, heavy industry, highways and railroad tracks. The background should be revised to include more detail on the surroundings, including other possible sources of air contaminants. Without such additional text, the reader is lead to believe that community concerns could only be related to Sunoco.

Response: The background was modified to include more detail on the surrounding area. ATSDR acknowledges that the area in question is typical of an urban area, with a variety of air contaminant sources.

3. Comment: Using the word "community's" in this section suggests the entire community shares the views of some of the small number of individuals who attended ATSDR meetings. Using "belief" suggests that a technical basis exists for the concern that emissions from Sunoco are affecting area residents.

Response: ATSDR used the word community in the context that ATSDR held a public meeting to gather concerns from any interested members of the community. This is a generic term, that does not have the connotation suggested. ATSDR changed the word belief, and added the word "some" before "community members", to clarify that not all community members had these concerns.

4. Comment: ATSDR states that there is a "lack of responsiveness to complaints" and a "lack of evacuation procedures for use during possible accidental releases" on the part of Sunoco, but does not provide any information or data to support these statements.
Response: ATSDR included these statements because they were concerns relayed to ATSDR from

some community members. Sunoco submitted information on these issues to describe their complaint and evacuation procedures. This information is given below for any interested members of the community.

> "The Sunoco Refinery has an existing system to respond to, investigate, and document all complaints reported to the Sunoco Refinery. This system includes the following components: posting of a contact phone number (available 24 hours per day) for residents with inquiries and/or complaints in Sunoco's quarterly *Neighbors* publication; a standard complaint form to record information to investigate the complaint; prompt investigation of the complaint by the Operations Shift Supervisor and Security personnel to determine the potential issue that may be the reason for the complaint; documentation of the findings of the complaint investigation; a return telephone call to the complainant after conclusion of the investigation to explain the findings of the investigation; and entry of all complaints and supporting documentation into a database. In addition to responding to all complaints and inquiries, Sunoco also participates in the following community organizations and activities to continually enhance communication with the surrounding community: City and County meetings; the Community Advisory Panel; Neighborhood Task Force; Area school systems; Public Emergency Response Systems/Local Emergency Planning Commissions (LEPCs); and local community parks and recreation groups and activities.
>
> The Sunoco Refinery has in place a set of procedures for immediate notification of and cooperation with local authorities during possible accidental releases and has used these procedures whenever a potential release has occurred. These procedures include: immediate notification of the fire department and other local authorities regarding the nature and extent of the emergency; answering all questions the fire department, local authorities, and other emergency responders may have; and providing assistance to the fire department, local authorities, and other emergency responders as requested. Concerned citizens should note that the decision to evacuate areas during an emergency response and the development and initiation of specific evacuation procedures is the jurisdiction of local authorities and the Local Emergency Planning Commission."[1]

5. Comment: ATSDR's statement regarding the temporary evacuation of Coy Elementary School and the surrounding community may be misinterpreted, and should be further explained or deleted. ATSDR failed to state that OEPA has never found that evacuees from Coy Elementary experienced any adverse health effects that could be attributed to releases from the Sunoco Refinery.

Response: The statement regarding evacuations of the elementary school and surrounding area were included to show the potential for community members to be affected by Sunoco refinery emissions. ATSDR did not state that these evacuations or incidents caused any adverse health effects. ATSDR feels the statement is appropriate.

6. Comment: The three bullets on the bottom of page 2 should be expanded to include other common sources of these contaminants in ambient air.

1 Memorandum from Sunoco Inc to Jennifer Freed, ATSDR. December 1, 2004.

Response: This health consultation focuses on Sunoco Refinery. During an ATSDR evaluation, it is common to describe potential emissions from the facility in question to determine if community concerns are plausible, what data to review, and whether sampling is needed.

7. Comment: ATSDR states, "*No data were available to characterize off-site ambient air concentrations of VOCs or sulfur compounds*". However, Sunoco collects data regarding emissions from the refinery and reports such data to local, state and federal regulatory agencies. Sunoco also provides these agencies with the results of modeling of the impacts of facility emissions on ambient air quality during certain maintenance activities and upset incidents using agency-recommended approaches.

Response: To evaluate off-site community exposures to ambient air, ATSDR needs to have ambient air data. Emissions data only does not give ATSDR community exposure information. When based on accurate source terms and validated by site-specific monitoring data, modeled data can provide useful information. However, ATSDR believes that ambient air monitoring provides the best unequivocal source of data for health evaluation purposes.

8. Comment: The "*Background and Statement of Issues*" section does not mention the collection and evaluation of odor reports. The original scope of ATSDR's study included the collection and evaluation of odor reports from citizens near the Sunoco refinery. It should be included.

Response: ATSDR added a short paragraph about the odor logs to the background on page 3.

Discussion Section

9. Comment: The Health Consultation did not indicate what quality control procedures were followed for collection and analysis of VOCs in ambient air using portable Summa canisters.

Response: Quality control procedures were discussed in the document under the section on VOCs under Exposure Investigation Methodology. Method TO-14 is a standard EPA method with numerous QA/QC checks, e.g., calibration procedures, internal QC spikes, duplicates, etc. For more information, see: http://www.epa.gov/Region9/qa/pdfs/dqi/vocs_gc.pdf

10. Comment: Usage of the term "*scented*", in the first paragraph on page 4, is confusing and likely incorrect in the context of this statement. The term "*aromatic*" in the context of this statement appears to refer to the structure of the compound (e.g., containing a benzene ring). The term "*scented*" also implies that odor has been added to potentially otherwise odorless constituents.

Response: ATSDR deleted "aromatic" and "scented" from the statement. It does not affect the meaning or purpose of the sentence.

11. Comment: ATSDR states that instruction was provided to area residents regarding procedures to be followed in collecting grab air samples. However, these procedures are not discussed in the Health Consultation.

Response: ATSDR and TES provided oral instructions to the residents collecting grab air samples. No further details exist regarding the procedures for these samples besides what is discussed in the document.

12. Comment: The term "*duration*", in the third paragraph on page 4 appears to be a typographical error. Meteorological equipment typically measures wind "*direction*".

Response: The word "duration" was changed to "direction".

13. Comment: In the second paragraph of page 5, ATSDR notes that TCFM was detected at monitoring station E at levels that were significantly higher than expected background, although well below concentrations that might pose a health hazard. There is no indication that the refinery is the source of TCFM. However, if ATSDR is concerned regarding the levels of TCFM detected then it should investigate other potential sources nearby such as dry cleaners and businesses with commercial refrigeration devices.

Response: ATSDR stated that the source of TCFM was not known. ATSDR has sufficient information to conclude that the measured levels of TCFM are not a health hazard, regardless of the source.

14. Comment: The table on page 5, entitled "*Summary of Sulfur Dioxide Concentrations*" does not put the air concentrations measured near the Sunoco refinery into context. ATSDR should add National Ambient Air Quality Standards along with any relevant state standards.

Response: The comparison of the measured levels of sulfur dioxide with air quality standards is discussed in the section after the table. Not all of the time averages have a comparable air quality standard; therefore, ATSDR believes they are more appropriately placed in the discussion of the data.

15. Comment: The first two full paragraphs on page 6 should be revised to clarify that: 1) the primary NAAQS for sulfur dioxide has been established to protect potentially "sensitive" populations such as asthmatics and children; and 2) the MRL is not a regulatory standard. The second full paragraph on page 6 should also be revised to clarify that the ATSDR is not recommending a more thorough toxicological evaluation than already presented in the Health Consultation.

Response: ATSDR added information that the NAAQS for sulfur dioxide includes sensitive populations, and that ATSDR MRLs are not regulatory standards. After carefully considering the commentator's suggested revisions to the text, ATSDR is keeping the rest of the discussion as is. If a contaminant exceeds an MRL, examination of toxicological data is appropriate to help form conclusions about potential health hazards. In this case, the 24-hour average sulfur dioxide exceeded the acute MRL; therefore, ATSDR reviewed additional toxicological data.

16. Comment: The section of the report entitled "*Environmental Data and Public Health - Sulfur Dioxide*" concludes that none of the measurements of sulfur dioxide exceeded the USEPA primary

ambient air quality standards, for either annual average or 24-hr average periods. However, ATSDR indicates that concentrations are "*near the threshold for minor health effects in exercising asthmatics*", based on a study conducted by Sheppard et al. (1981). However, the comparison to the results of the Sheppard et al. (1981) study may be misleading, for the following reasons:

- According to the study, inhalation of 250 ppb sulfur dioxide did not cause wheezing or shortness of breath in any of the seven asthmatic individuals in the study, even during exercise,
- the slight increase in airway restriction reported at 100 ppb sulfur dioxide in two asthmatics did not result in clinical symptoms of exposure (e.g., wheezing or shortness of breath), even during exercise, and the results for the two individuals are not statistically significant, since no increase in airway restriction was reported in the other five exercising asthmatics,
- the subjects in the study breathed through a mouthpiece. As noted by Sheppard et al. (1981), this procedure may overstate the effect of sulfur dioxide concentrations in ambient air because, under normal conditions, individuals would be expected to use oronasal breathing and a greater percentage of sulfur dioxide is probably removed from air inspired through the nose than through the mouth.

Response: Bullet 1 and 2 – ATSDR's minimum LOAEL (lowest observable adverse effect level) for sulfur dioxide inhalation is 100 ppb. This is discussed on pages 66-67 of ATSDR's Toxicological Profile on sulfur dioxide. ATSDR measured levels of sulfur dioxide near and above 100 ppb on several occasions. ATSDR feels it is appropriate to say that sulfur dioxide levels are near the levels needed to cause minor adverse health effects in exercising asthmatics. Bullet 2 – ATSDR acknowledges in the text of this document on page 6 that the study subjects did not report any clinical symptoms at exposures of 100 ppb. Nonetheless, it is still considered as a health effect, and is used as the basis for ATSDR's minimum LOAEL, and corresponding MRL. Bullet 3 – Exercising asthmatics may have exposure to similar dioxide similar to the subjects in the Sheppard et al (1981) study because people exercising commonly use their mouth as the primary passageway for air intake. More research is needed in this area.

17. Comment: The measured sulfur dioxide concentrations are not higher than would be anticipated in an urban area. For example, annual-average sulfur dioxide concentrations calculated from sulfur dioxide monitoring data collected by Ohio EPA from January 1999 through November 2003 at two monitoring stations in the metropolitan Toledo area were between 3.2 ppb and 5.8 ppb at 348 South Erie Street (approximately 2 miles northwest of the Sunoco Refinery) and between 5.3 ppb and 9.2 ppb at 600 Collins Park (approximately 2.5 miles northeast of the facility). Maximum 24-hour average concentrations calculated from monitoring data collected at these two locations from January 1999 through November 2003 ranged from 19.6 ppb to 29.4 ppb at 348 South Erie Street and 21.2 ppb to 68.9 ppb at 600 Collins Park. Maximum 1-hour concentrations collected at these two locations from January 1999 through November 2003 were between 65 ppb and 123 ppb at 348 South Erie Street and between 77 ppb and 151 ppb at 600 Collins Park. The annual-average, 24-hour maximum, and hourly maximum concentrations of sulfur dioxide at these two monitoring stations between January 1999 and November 2003 are approximately the same as or greater than the levels of sulfur dioxide measured at the monitoring stations located near the Sunoco refinery, over the period of the ATSDR study.

Response: Although this data was collected at locations further from the facility than the ATSDR

air monitors, an ATSDR evaluation of this data would lead to the same conclusions and recommendations. The data for these Toledo, OH air monitors cannot be extrapolated to other areas in the US.

18. Comment: ATSDR should provide windroses or wind directional data used to determine that the results of ATSDR's evaluation of meteorological data for time periods when sulfur dioxide concentrations were considered elevated suggested that the refinery was the source of the elevated sulfur dioxide measurements. Please also discuss the "background" levels of sulfur dioxide in the context of other nearby sources of sulfur dioxide and Sunoco's contribution to the total measured concentrations of sulfur dioxide.

Response: The wind directional data was collected and reviewed to make sure that the air monitors were located in appropriate places, and that the elevated sulfur dioxide levels found *could* be from the Sunoco refinery. As stated in the text, this data does not conclusively prove that the refinery is the source of the sulfur dioxide. ATSDR does not have any data to determine what amount of sulfur dioxide Sunoco contributes to the overall sulfur dioxide levels in the area.

19. Comment: ATSDR did not define the terms "*significant*" or "*sustained*." Based on the information presented, it appears that no events *at all* were recorded for hydrogen sulfide. Thus, ATSDR should delete the terms "*significant*" and "*sustained*" in the second paragraph on page 7.

Response: The words "*significant*" and "*sustained*" were deleted.

Health Outcome Data Section

20. Comment: The wording of the fourth sentence of the first paragraph on page 8 implies that leukemia is a concern of the entire community. In the fourth sentence of the first paragraph on page 8, please change the wording within parentheses to say *"(identified as a concern by some in the community)*".

Response: This change was made in the text.

Recommendations Section

21. Comment: ATSDR's reference to the group of people experiencing adverse health effects is not accurate. ATSDR should state that the group of people that may potentially experience adverse health effects are "*the most sensitive exercising*" asthmatics.

Response: ATSDR made changes to the wording in recommendation number three.

22. Comment: The results of the ATSDR study do not support the third recommendation, regarding additional monitoring for VOCs and sulfur dioxide. The ATSDR study does not indicate that the refinery is causing either VOCs or sulfur dioxide concentrations in ambient air that pose a health hazard, or that are higher than expected in an urban area. Please delete the third recommendation at the top of page 9.

Response: To be protective of public health and err on the side of caution, ATSDR feels that it is appropriate to recommend additional, and ideally, continuous air monitoring for a contaminant that exceeds the ATSDR MRL, and for a contaminant that varies in concentration depending on seasonal and atmospheric conditions, and also refinery operational conditions.