Health Consultation

Review of Ambient Air Sampled near the R360 Environmental Solutions, Inc. (a/k/a US Liquids of Louisiana, LP) and the Community of Grand Bois

Bourg, Lafourche Parish, Louisiana

August 20, 2012

Prepared by

Louisiana Department of Health and Hospitals
Office of Public Health
Section of Environmental Epidemiology and Toxicology
Under a Cooperative Agreement With the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
COC	contaminant of concern
CREG	cancer risk evaluation guide
EMEG	environmental media evaluation guide
ESL	Effects screening levels
LDEQ	Louisiana Department of Environmental Quality
LDHH	Louisiana Department of Health and Hospitals
MAML	Mobile Air Monitoring Lab
NAAQS	National Ambient Air Quality Standards
NMOC	non-methane organic compounds
NO_2	nitrogen dioxide
OPH	Office of Public Health
PAH	polycyclic aromatic hydrocarbon
ppb	parts per billion
RBC	risk-based concentration
RfC	reference concentration
SEET	Section of Environmental Epidemiology and Toxicology
THC	total hydrocarbons
ug/m^3	micrograms per cubic meter
US EPA	United States Environmental Protection Agency
VOC	volatile organic compound
USLL	US Liquids of Louisiana, LP

Summary and Statement of Issues

INTRODUCTION

Residents of Grand Bois, Louisiana have expressed concerns about possible exposures to hazardous substances through the emissions and odors arising from the open air bioremediation ponds at the R360 Environmental Solutions, Inc. facility.

The Louisiana Department of Environmental Quality (LDEQ) sampled ambient air near the Bourg facility. Through our cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the Louisiana Department of Health and Hospitals/Office of Public Health/Section of Environmental Epidemiology and Toxicology (LDHH/OPH/SEET) has evaluated these samples to determine whether emissions from the site pose harm to public health.

CONCLUSION

The majority of the contaminants detected in ambient air samples near the R360 Environmental, Inc. site pose no harm to public health, with the following possible exceptions:

- In a worst-case scenario, a lifetime exposure to the concentrations of benzene detected near the site is estimated to pose a very small increase in the risk of developing cancer. Because this type of estimation is accurate within one order of magnitude greater or less than calculated, these concentrations may pose no significant increase in cancer risk.
- Very small to small increases in the risk of developing cancer due to a lifetime exposure were estimated for acrylonitrile, benzyl chloride, 1,3-butadiene, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,2-dichloroethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethane, 1,1,12-trichloroethane, and vinyl chloride. The estimated lifetime cancer risk for exposure to 1,2-dibromoethane exceeds EPA's acceptable cancer risk of 1 excess cancer per 10,000 people exposed (1×10^{-4}). However, these estimates are based on nine samples collected over three days' time and may not be representative of concentrations of these contaminants present in ambient air near the site over the long term.
- The chlorinated compounds detected near the R360 site would not be a component of the wastes normally bioremediated at the site. These compounds may have originated at other facilities nearby or from activities aboard

	ships moored or in transit along the Intracoastal Waterway
BASIS FOR DECISION	Estimated lifetime cancer risks for some of the carcinogens detected near the site exceed the risk level above which cancer may be due to an external cause rather than to population variation (1.00E+06). However, the estimated cancer risks for data from June 2011 were based on a small number of samples collected over a short period of time and may not reflect actual long-term exposures.
NEXT STEPS	The information produced within this health consultation will be made available to the community members and stakeholders in Bourg, LA.
FOR MORE INFORMATION	If you have further concerns about the R360 Environmental Solutions, Inc. facility, questions may be directed to DHH/OPH/SEET at 1-888-293-7020.

Background and Site History

The R360 Environmental Solutions, Inc. Bourg facility is located at 843 Bourg Larose Hwy (Hwy 24) in Bourg, Lafourche Parish, Louisiana, 70343 (Figure A-1) [1, 2]. R360 Environmental Solutions, Inc. acquired the site from US Liquids of Louisiana, LS in 2010, though the facility continued to function under the US Liquids name until January 2012 [3, 4]. US Liquids of Louisiana had acquired the facility in December 1996, prior to which it was known as the Campbell Wells facility [5].

The R360 Environmental Solutions (R360 facility) site is located along the Gulf Intracoastal Waterway and is adjacent to a community known as Grand Bois (Figure A-1) [1, 2]. The community of Grand Bois includes residential properties, an orange grove, and the Intracoastal Iron Works shipbuilding company. Within a 2-3 mile radius of Grand Bois, there are also natural gas production facilities, a small oil and gas well site with a flare to the west, and large vessels moored or in transit along the Intracoastal Waterway [1].

The R360 facility treats exploration and production wastes from the oil and gas industries, such as oil-and water-based drilling fluids. These wastes commonly include volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene, and xylene, as well as polynuclear aromatic hydrocarbons (PAHs), hydrogen sulfide, acids and alkalis, heavy metals, salts, glycols, and amines. On-site treatment of these wastes begins with bioremediation in shallow open air ponds, in which microbes present in soil begin to break down the hydrocarbons.

This form of treatment has been a source of concern for decades for residents from the community of Grand Bois, who have expressed issues with foul odors, dust, and oil sheens reported to originate from the R360 facility. In the mid 1990s, the community reported health complaints that they associated with emissions from the R360 facility include lightheadedness, headaches, eye and throat irritation, and nausea [6].The Louisiana Department of Environmental Quality responded to these concerns by conducting facility inspections, collecting “grab” air samples, and establishing temporary air monitoring stations between the R360 facility (then known as US Liquids) and the Grand Bois community in 1996 and across from Intracoastal Iron Works (then known as the Acadian Shipyard company) in 1998. US Liquids responded to the community’s concerns by closing the two treatment cells closest to the Grand Bois community in August 1999. The temporary air monitoring stations ceased operations in 2000 [1].

As an exploration and production waste facility, the R360 facility has been exempt from the Resource Conservation and Recovery Act hazardous waste regulations and chemical emission reporting requirements of the Toxic Release inventory. The facility therefore has not been required to report the amount of chemical emissions it releases. However, R360 Environmental Solutions, Inc. has recently applied for a minor source air permit, and the LDEQ subsequently began testing ambient air quality around the facility [1].

In July 2011, the LDEQ released a document titled “Mobile Air Monitoring Laboratory Report: US Liquids of Louisiana, LP, Bourg Treatment Facility”. The samples assessed in this report were collected in support of the air permitting process and to address the ongoing concerns of the Grand Bois community. The report found that the mean chemical concentrations detected in the ambient air near the facility were “protective of human health for long-term periods of exposure in a residential setting” [1]. Using guidelines from the Agency for Toxic Substances and Disease

Registry's health-based site assessment process, the Louisiana Department of Health and Hospitals/Office of Public Health/Section of Environmental Epidemiology and Toxicology (DHH/OPH/SEET) has reassessed the data from the MAML report to determine whether any contaminants detected in ambient air around the R360 facility could pose harm to public health.

Demographics

The 2010 Census results reported a total population of 2,579 within Bourg, LA. The largest ethnic group in the city is Caucasian (90.7%), followed by American Indian and Alaskan Native (6.5%), those identifying themselves as belonging to 2 or more races (1.9%), African-American (0.5%), and Asian (0.1%). One point one percent (1.1%) of the population identified themselves as Hispanic or Latino of any race. An estimated 43.2 % of the population who were 25 years of age in the year 2010 had earned at least a high school diploma. The median household income was $56,797. The largest employers in were in sales and office work; management, business, science, and art occupations; and natural resources, construction, and maintenance occupations [7].

The Mobile Air Monitoring Laboratory Report for the US Liquids of Louisiana facility describes the community of Grand Bois as having a population of approximately 300 [1]. The private residences of Grand Bois are located within less than 500 feet of the R360 facility's perimeter. There are no schools within 2 miles of the site [2].

Discussion

Data Used

LDEQ continuously sampled the ambient air near theR360 facility over a one week period from Friday, January 21, 2011 to Friday, January 28, 2011, using a Mobile Air Monitoring Laboratory (MAML) stationed at an empty parking lot of Intracoastal Iron Works (located at 723 Bourg Larose Highway). The samples collected by the MAML during this time period were analyzed for sulfur dioxide, hydrogen sulfide, methane, non-methane organic compounds (NMOC), total hydrocarbons (THC), nitrogen oxides, and VOCs. The MAML results analyzed in this assessment were from ten minute averages for NMOC, THC, and methane; from 45 minute cycles for the VOCs; and from five minute averages for the other compounds [1].

MAML sampling was hindered at times by wind direction variability and by limited access to the facility's borders. The MAML samples were supplemented by Summa canister sampling at the R360 facility's fence line along Hwy 24, which bisects the facility and is therefore central to the R360 bioremediation ponds and property (see Figure A-2). Canister samples were collected every four hours at a location downwind from the facility. The 36 samples collected in this manner provided data on air quality directly adjacent to the R360 facility and were analyzed for VOC content only. One canister sample, which was collected during a time of heavy odors, was sent to a contract laboratory for further analysis when the initial analysis noted large peaks of

unknown chemical composition [1]. Because this was the only January 2011 sample analyzed using this method, data from this sample's second analysis was not included in the assessment of ambient air data collected during this sampling period.

Additional Summa canister samples were collected near the facility on June 2, 8, and 14, 2011 to obtain more detailed information on ambient benzene concentrations. On each of these days, one grab sample was collected at each of three locations downwind of the facility: the site's front gate (#1), just east of the facility (#2), and just west of the facility (#3) (see Figure A-3), for a total of nine samples [1].

Samples assessed for VOCs during both sampling periods were analyzed using multiple types of gas chromatography to increase detection of a range of compounds [1].

Exposure Pathways

An exposure pathway consists of five elements: a source of contamination, transport through an environmental medium (air, water, or soil), a point of exposure, a route of human exposure (ingestion, dermal exposure, or inhalation), and a population. Completed pathways require that all five necessary elements exist and that exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present.

Ambient air in the vicinity of the R360 facility serves as both the transport medium and point of exposure for the contamination. The route of exposure to these contaminants is through inhalation of air. The exposed population includes residents of the community of Grand Bois as well as other residents of Bourg, LA.

As the MAML report notes, a number of potential sources of VOC emissions exist within a 2-3 mile radius of Grand Bois, including shipyards, boats in transit or moored along the Gulf Intracoastal Waterway, natural gas facilities, and the small oil and gas well site to the west [1].

Evaluation Process

The evaluation process used to assess the potential public health hazard posed by ambient air sampled near the R360 facility is described in Appendix B. Contaminant concentrations were initially screened using comparison values (CVs) appropriate for their media. These conservative screening values are only used to determine which environmental contaminants need further evaluation. CVs are not used to predict adverse human health effects. Contaminant concentrations that exceeded CVs are identified as contaminants of concern (COCs) and are listed in bold red text.

No comparison values were available for nitrogen oxide; total hydrocarbons; the nonmethane organic compounds; 2,2,4-trimethylpentane; 2,2-dimethylbutane; chloroacetonitrile; cis-1,2-dichloroethylene; and methane, ethane, and propane (which are classified as a simple asphyxiants).

Health Effects Evaluation

MAML Non-VOC Samples

As shown in Table B-1, nitric oxide, sulfur dioxide, and hydrogen sulfide were identified as COCs among the non-VOC MAML samples. The maximum concentrations of nitric oxide and hydrogen sulfide detected during the sampling period were present for too brief a period of time to pose harm to public health.

The maximum 5-minute average concentration of sulfur dioxide detected was 10 parts per billion (10 ppb), which is ten times lower than the inhalation lowest-observable-adverse-effects-level (LOAEL) for sulfur dioxide that could cause significant increase in airway resistance in sensitive individuals during moderate exercise (100 ppb) [9]. Sulfur dioxide concentrations detected by the MAML near the R360 facility therefore pose no harm to public health.

The MAML report observed a trend between elevated nitrogen oxide levels and decreases in wind speed, suggesting that MAML generator exhaust may have contaminated some of the air samples on days with wind speeds at or below 2 miles per hour. The MAML report also points out that though methane/non-methane organic compound/total hydrocarbon levels were "slightly higher than state-wide averages", they are "considered normal background levels for a wet swampy area like that of Grand Bois" [1].

MAML VOC Samples and January 2011 Canister samples

Benzene and 1,2,4-trimethylbenzene were identified as COCs among the MAML VOC samples (Table B-2) and the canister samples collected during January 2011 (Table B-3). Benzene was identified as a COC for carcinogenic risk.

The maximum concentrations of 1,2,4-trimethylbenzene detected in ambient air near the R360 facility during these sampling periods exceeded the reference concentration (RfC) of 7 ug/m^3. However, these concentrations were still several orders of magnitude below the inhalation no-observable-adverse-effects-level (NOAEL) of 21,800 ug/m^3[10]. 1,2,4-trimethylbenzene therefore poses no harm to public health near the R360 facility.

Exposure to benzene is a concern for communities near industrial facilities that use this chemical as part of their processes. Benzene can be formed from both natural processes, such as volcanoes and forest fires, and human activities, such as oil and gas refining and cigarette smoke. It is widely used in the United States to make other chemicals and used directly in the production of rubber, lubricants, dyes, detergents, drugs, and pesticides [11]. Benzene can arise from many sources, and the concentrations detected in the ambient air samples may not be due solely to emissions from the R360 facility.

Table B-5 lists the worst-case scenario increases in the risk of developing cancer after a lifetime (70-year) exposure to the lowest and highest concentrations of benzene detected in ambient air sampled near the R360 facility (see Appendix B, Calculation of Carcinogenic Risk, for more detail). The highest estimated increases in lifetime cancer risks were two excess cancers per 10,000 people (1.58×10^{-4}) for canister samples and three excess cancers per 1,000 people (3.11

x 10^{-3}) for MAML samples) Benzene was not persistently detected in the ambient air sampled during this period in high enough concentrations to pose these potential increases in cancer risk. However, lifetime exposures to the lowest concentrations of benzene detected during this sampling period were estimated to pose very small potential increases in lifetime cancer risk (six excess cancers per 1,000,000 people (5.46 x 10^{-6}) for the MAML samples; seven excess cancers per 1,000,000 people (6.71 x 10^{-6}) for the canister samples).

No comparison values were available for 2,2,4-trimethylpentane; 2,2-dimethylbutane; chloroacetonitrile; cis-1,2-Dichloroethylene; and ethane and propane (which are classified as simple asphyxiants)

Extended Sampling

As shown in Table B-4, acrylonitrile; benzene; benzyl chloride; 1,3-butadiene; carbon tetrachloride; chloroform; 1,2-dibromoethane; 1,2-dichloroethane; hexachlorobutadiene; isoprene; methylene chloride; 1,1,2,2-tetrachloroethane; tetrachloroethylene; 1,1,12-trichloroethane; and vinyl chloride were identified as COCs for the samples collected in June 2011.

The chlorinated compounds detected in the ambient air near the R360 site during canister sampling events are man-made and would not be a component of the exploration and production wastes normally bioremediated at the site. These compounds may have originated at other facilities nearby or from activities aboard ships moored or in transit along the Intracoastal Waterway. The sensitivity of the equipment used to analyze air samples allow for detection of such compounds at very low levels.

Isoprene concentrations were well below the RfC of 18,000 ug/m^3 for isoprene [12]. Isoprene in ambient air near the R360 facility should therefore pose no harm to public health.

The remaining COCs from this sampling period are carcinogens. Table B-6 lists the worst-case maximum estimated increases in the risk of developing cancer after a lifetime (70-year) exposure to the lowest and highest concentrations of each of these contaminants. Of these contaminants, methylene chloride and tetrachloroethylene were not present at concentrations high enough to pose potential increases in cancer risk or noncancer health effects and pose no harm to public health near the R360 facility.

As shown in Table B-6, the majority of carcinogenic COCs identified for the June 2011 sampling period are estimated to pose potential very small or small increases (in the 10^{-6}-10^{-5} range) in the risk of developing cancer after a lifetime exposure. The exception to these estimates is 1,2-dibromoethane. Lifetime cancer risks estimated for exposure to 1,2-dibromoethane exceed EPA's acceptable cancer risk of 1 excess cancer per 10,000 people exposed (1 x 10^{-4}). 1,2-Dibromoethane is a manmade pesticide and gasoline additive that can also be naturally found in the ocean in small amounts. It evaporates quickly and breaks down easily in the air. Originally added to leaded gasoline for better fuel efficiency, its use as a gasoline additive has dropped as the use of leaded gasoline has been discontinued [13].

Long-term health effects such as lifetime cancer risks cannot be effectively assessed by evaluating nine samples collected over three days. Additional sampling over an extended period of time would be useful in determining whether the concentrations of the COCs observed during

this sampling period are representative of concentrations normally present in ambient air in this community.

Child Health Considerations

The physical differences between children and adults demand special emphasis in assessing public health hazards. Children may be at greater risk than are adults from exposures to hazardous substances. Children play outdoors and engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults and breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate result in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage.

Children should have similar responses as adults to most of the chemicals identified as COCs for ambient air collected near the R360 facility. Possible exceptions are as follows:

- Inhaled concentrations of acrylonitrile that are mildly irritating to adults have been observed to be fatal to children [14].
- There is some indication that parental occupational exposure to benzene may play a role in childhood leukemia; however, no evidence suggests that children may be at greater risk than adults for benzene toxicity [11].
- Animal studies suggest that infants and young children may be more susceptible to cancer due to vinyl chloride exposures [15].

Conclusions

SEET and ATSDR are committed to addressing community concerns about the risks involved in exposure to airborne contaminants. Our agencies are committed to providing the community of Grand Bois and the other residents of Bourg, LA with the best science-based information available to keep the community safe.

The majority of the contaminants detected in ambient air samples near the R360 facility pose no harm to public health, with the following possible exceptions:

- In a worst-case scenario, a lifetime exposure to the concentrations of benzene detected near the site is estimated to pose a very small increase in the risk of developing cancer. Because this type of estimation is accurate within one order of magnitude greater or less than calculated, these concentrations may pose no significant increase in cancer risk.
- Very small to small increases in the risk of developing cancer due to a lifetime exposure were estimated for acrylonitrile, benzyl chloride, 1,3-butadiene, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,2-dichloroethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethane, 1,1,12-trichloroethane, and vinyl chloride The estimated lifetime cancer risk for exposure to 1,2-dibromoethane exceeds EPA's acceptable cancer risk of 1 excess cancer per 10,000 people exposed (1×10^{-4}). However, these estimates are based

on nine samples collected over three days' time and may not be representative of concentrations of these contaminants present in ambient air near the site over the long term.

- The chlorinated compounds detected near the R360 site would not be a component of the wastes normally bioremediated at the site. These compounds may have originated at other facilities nearby or from activities aboard ships moored or in transit along the Intracoastal Waterway.

If you have further concerns about the R360 Environmental Solutions, Inc. facility, questions may be directed to DHH/OPH/SEET at 1-888-293-7020.

Recommendations

Additional sampling over an extended period of time would be useful in determining whether the carcinogenic COCs are present in ambient air in this community for long enough periods to increase cancer risk.

SEET will be available to assess future ambient air samples collected in the vicinity of the R360 facility and the community of Grand Bois.

Public Health Action Plan

The information produced within this health consultation will be disseminated to the community members and stakeholders in Bourg, LA.

Report Preparation

This Review of Ambient Air Sampled near the R360 Environmental Solutions, Inc. (a/k/a US Liquids of Louisiana, LP) and the Community of Grand Bois Health Consultation was prepared by the Louisiana Department of Health and Hospitals under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR).

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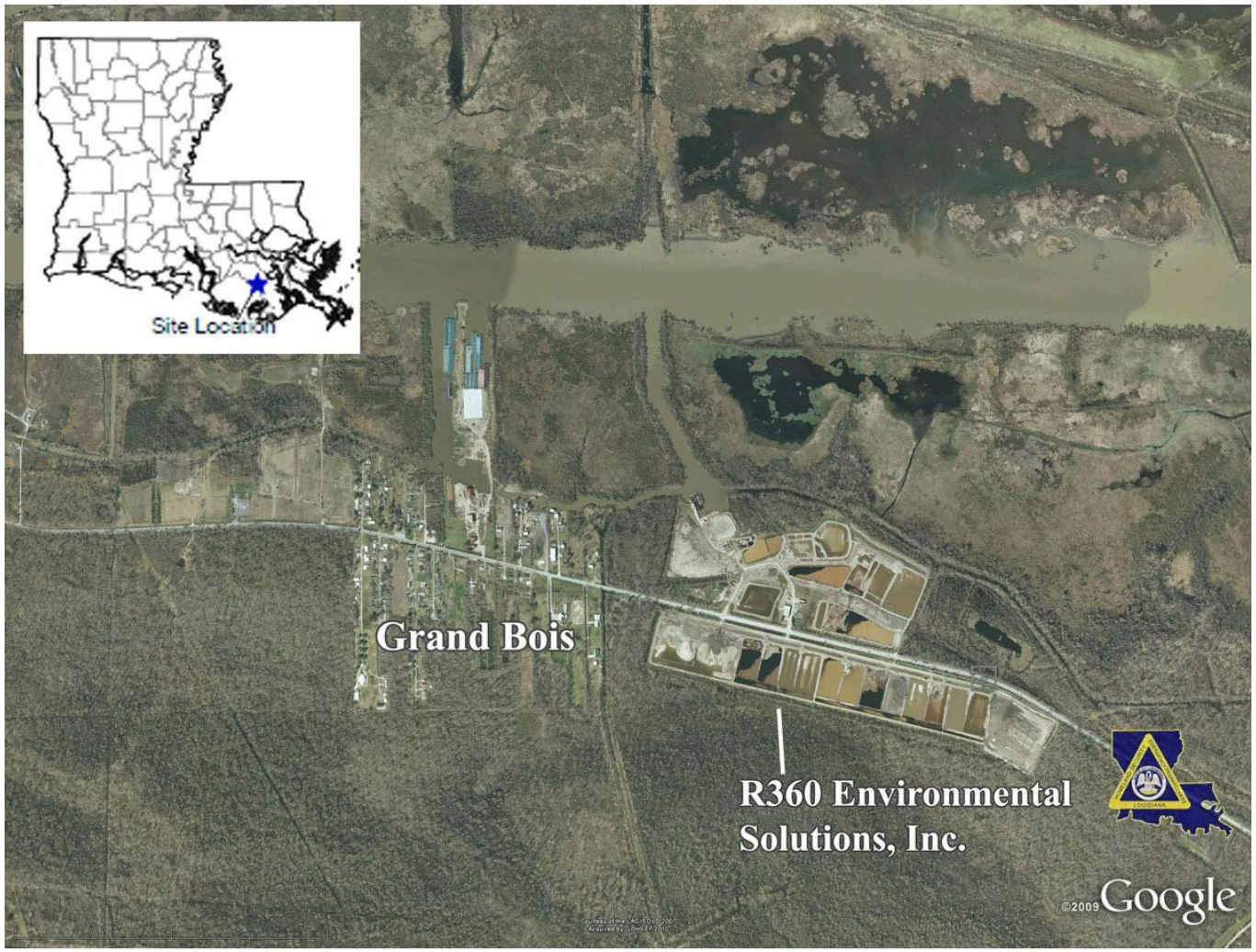
References

1. Louisiana Department of Environmental Quality. Mobile Air Monitoring Laboratory Report: US Liquids of Louisiana, LP, Bourg Treatment Facility. 29 Jul 2011.
2. **Google Earth.** "843 Bourg Larose Hwy, Bourg, LA.". 29°32'55.51" N and 92°38'09.12" W. Accessed 3 May 2011.
3. R360 Environmental Solutions, Inc. About US Liquids of Louisiana. Accessed 10 Apr 2012 at: http://www.r360environmentalsolutions.com/index.php?id=69
4. Louisiana Department of Environmental Quality. Re: Company Name and Facility Name Changes for Eleven Facilities Listed on the Attachment. AI# 33872. Document ID 8282968. Accessed 10 Apr 2012 at: http://edms.deq.louisiana.gov
5. SEC Info. US Liquids Inc. 10-Q for 3/31/98. SEC File 1-13259. Accessed 10 Apr 2012 at: http://www.secinfo.com/dR5M9.7vh.htm
6. Agency for Toxic Substances and Disease Registry. Health Consultation: Grand Bois Community (a/k/a Grand Bois Area). Atlanta: US Department of Health and Human Services; 14 Aug 2001.
7. United States Census Bureau. American FactFinder: Bourg CDP, Louisiana. Accessed 9 Apr 2012 at: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml#none
8. United States Environmental Protection Agency. National Ambient Air Quality Standards (NAAQS). Accessed 13 Apr 2012 at: http://www.epa.gov/air/criteria.html
9. Agency for Toxic Substances and Disease Registry. Toxicological profile for sulfur dioxide. Atlanta: US Department of Health and Human Services; 1998 Dec.
10. The Risk Assessment Information System. Chemical Toxicity Metadata. Accessed 24 Apr 2012 at: http://rais.ornl.gov/tools/metadata.php
11. Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Benzene. Accessed 11 Jan 2012 at: http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=38&tid=14
12. Texas Commission on Environmental Quality. TRRP Protective Concentration Levels: Toxicity and chemical/physical properties. Accessed 25 Apr 2012 at: http://www.tceq.texas.gov/remediation/trrp/trrppcls.html
13. Agency for Toxic Substances and Disease Registry. Toxicological profile for 1,2-dibromoethane. Atlanta: US Department of Health and Human Services; 1992 Jul.
14. Agency for Toxic Substances and Disease Registry. Toxicological profile for Acrylonitrile. Atlanta: US Department of Health and Human Services; 1990 Dec.
15. Agency for Toxic Substances and Disease Registry. Toxicological profile for Vinyl Chloride. Atlanta: US Department of Health and Human Services; 2006 Jul.

APPENDIX A: Maps

Figure A-1: Location of the R360 Environmental Solutions, Inc. site and Grand Bois

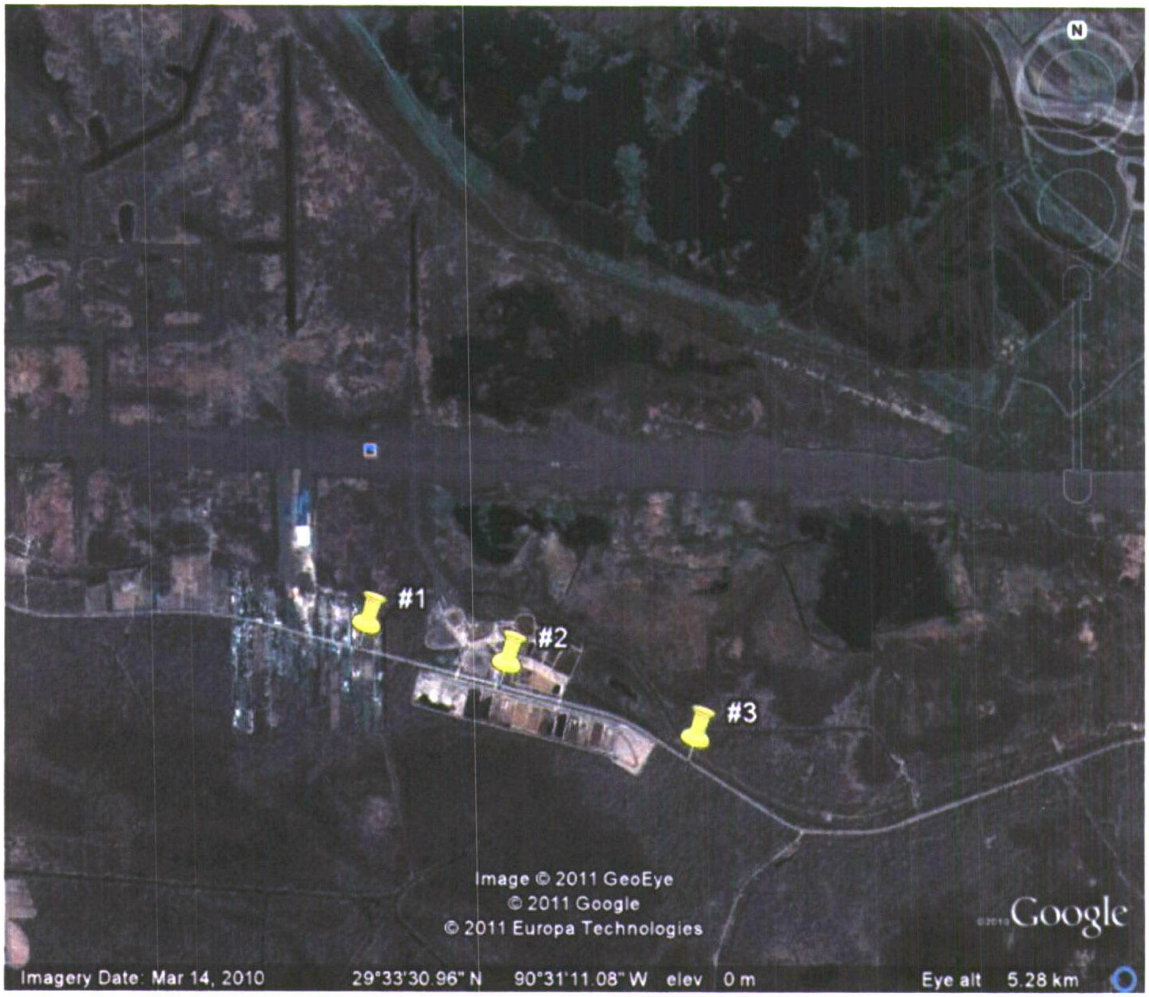


Adapted from: **Google Earth.** "843 Bourg Larose Hwy, Bourg, LA.". 29°32'55.51" N and 92°38'09.12" W. Accessed 3 May 2011.

Figure A-2: Mobile Air Monitoring Lab (MAML) air sampling location near the R360 Environmental Solutions, Inc. site (red lines demark the range of optimal wind direction from the R360 site to the MAML)

Adapted from: Louisiana Department of Environmental Quality. Mobile Air Monitoring Laboratory Report: US Liquids of Louisiana, LP, Bourg Treatment Facility. 29 Jul 2011.

Figure A-3: Ambient air sampling locations near the R360 Environmental Solutions, Inc. site



Adapted from: Louisiana Department of Environmental Quality. Mobile Air Monitoring Laboratory Report: US Liquids of Louisiana, LP, Bourg Treatment Facility. 29 Jul 2011.

APPENDIX B: Data Evaluation

Screening Process

Comparison values were used in the initial screening process to determine which samples needed to be closely evaluated. Comparison values are media-specific concentrations of chemicals that are used by health assessors to screen environmental contaminants for further evaluation. These values are not used as predictors of adverse health effects.

Environmental media evaluation guides (EMEGs) are estimated contaminant concentrations at which noncarcinogenic health effects are unlikely. They are calculated from the Agency for Toxic Substances and Disease Registry's (ATSDR) minimal risk levels (MRLs). EMEGs apply to acute (14 days or less), intermediate (15–365 days) and chronic (365 days or more) exposures.

C*ancer risk evaluation guides* are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in 1 million exposed persons over a lifetime. CREGs are calculated from the United States Environmental Protection Agency's (EPA's) cancer slope factors (CSFs).

Risk-based concentrations (RBCs) are estimated contaminant concentrations in a media at which noncarcinogenic or carcinogenic health effects are unlikely. The RBCs used in this health consultation were last updated in July 2011.

National Ambient Air Quality Standards (NAAQS)[1] are standards set by the EPA to protect public health and the environment from the effects of six principle ambient air pollutants, designated as "criteria" pollutants.

Effects screening levels (ESLs) were used for screening contaminants when no other health-based comparison values were available. ESLs, which are calculated by the Texas Commission on Environmental Quality, are based on data concerning health effects, the potential for odors to be a nuisance, effects on vegetation, and corrosive effects. "Long-term" ESLs are used for data based on an annual averaging period. "Short-term" ESLs are generally used for data based on one-hour averaging periods[2].

Table B-1 lists the ranges of non volatile organic contaminant concentrations detected in air samples collected by the Mobile Air Monitoring Lab (MAML) near the R360 Environmental Solutions, Inc. facility (R360 facility) and their corresponding comparison values. Table B-2 lists the ranges and comparison values for volatile organic contaminant concentrations detected by the MAML near the R360 facility. Table B-3 lists ranges and comparison values for contaminants detected in canister samples collected near the R360 facility. Table B-4 lists concentration ranges and comparison values for contaminants detected in canister samples collected near the R360 facility during the extended sampling period held in June 2011.

No comparison values were available for nitrogen oxide; total hydrocarbons; the nonmethane organic compounds; 2,2,4-trimethylpentane; 2,2-dimethylbutane; chloroacetonitrile; cis-1,2-

[1] United States Environmental Protection Agency. National Ambient Air Quality Standards (NAAQS). Accessed 13 Apr 2012 at: http://www.epa.gov/air/criteria.html

[2] Texas Commission on Environmental Quality. Download Effects Screening Levels (ESLs). Accessed 16 Apr 2012 at: http://www.tceq.texas.gov/toxicology/esl/list_main.html#esl_1

dichloroethylene; and methane, ethane, and propane (which are classified as a simple asphyxiants).

Table B-1: Ranges of 5- or 10-minute averages for non volatile organic compounds detected by the Mobile Air Monitoring System near the R360 Environmental Solutions, Inc. facility, January 21-28, 2011.
(Contaminant concentrations exceeding their screening values are listed in bold red)

Contaminant	Range of concentrations detected (ppb*) Minimum	Maximum	Date Sampled, Maximum	CV† (ppb)	CV reference
Nitric oxide (NO)	ND‡	**224**	1/22/2011, 22:00	25	Long-term ESL§ (interim)
Nitrogen oxides (NO_x)	2.00	223	1/22/2011, 22:00	NA**	NA
Nitrogen dioxide (NO_2)	3.00	48	1/22/2011, 19:25	100E	NAAQS†† (8-hour)
Sulfur dioxide (SO_2)	ND	**10**	1/27/2011, 10:50	10	Acute EMEG‡‡
Hydrogen sulfide (H_2S)	ND	**20.9**	1/22/2011, 22:55	20	Int. §§ EMEG
Non-methane organic compounds (NMOC)	ND	5.08	1/27/2011, 2:50	NA	NA
Methane	1.89	3.67	1/23/2011, 2:10	NA	NA
Total hydrocarbons (THC)	1.87	8.33	1/27/2011, 2:50	NA	NA

* ppb= parts per billion
† CV = comparison value
‡ ND = not detected
§ ESL = effects screening level
** NA = not available
†† NAAQS = National Ambient Air Quality Standards
‡‡ EMEG = environmental media evaluation guide
§§ int. = intermediate

MAML detection limits[3]:
For SO_2, H_2S, NO_X, = 1 part per billion by volume (ppbv)
For methane/NMOC/THC = 1000 ppbv

[3] Personal communication, David Wagenecht, Louisiana Department of Environmental Quality. 3 May 2012.

Table B-2: Ranges of averages for volatile organic compounds (VOCs) detected by the Mobile Air Monitoring System in 45-minute cycles near the R360 Environmental Solutions, Inc. facility, January 21-28, 2011.
(Contaminant concentrations exceeding their screening values are listed in bold red)

Contaminant	Range of concentrations detected (ug/m^{3*}) Minimum	Maximum	Date Sampled, Maximum	CV† (ug/m^3)	CV reference
Benzene	**0.7**	**399**	1/24/2011, 17:72-18:12	0.1	CREG‡
Ethylbenzene	0.83	24.1	1/27/2011, 3:33-4:18	300	Chronic EMEG§
Isopropylbenzene	ND**	3.10	1/21/2011, 18:57-19:42	250	Long-term ESL†† (under review)
Styrene	0.89	26.6	1/22/2011, 20:27-21:12	900	Chronic EMEG
Toluene	0.75	153	1/24/2011, 17:27-18:12	300	Chronic EMEG
1,2,4-Trimethylbenzene	0.16	**38**	1/22/2011, 20:27-21;12	7.30	RBC‡‡
1,3,5-Trimethylbenzene	0.2	11.9	1/23/2011, 13:42-14:27	125	Long-term ESL (interim)
meta-/para-Xylene	0.15	62	1/22/2011, 20:27-21:12	100	RBC
ortho-Xylene	0.87	9.64	1/27/2011, 7:18-8:03	100	RBC
total Xylenes	2.56	70.1	1/22/2011, 20:27-21:12	100	RBC

* ug/m^3 = micrograms per cubic meter
†CV = comparison value
‡CREG = cancer risk evaluation guide
§EMEG = environmental media evaluation guide
**ND = not detected
††ESL = effects screening level
‡‡RBC = risk-based concentration

MAML detection limits for VOCs = 0.5 parts per billion by volume (ppbv)[4]

[4]Personal communication, David Wagenecht, Louisiana Department of Environmental Quality. 3 May 2012.

Table B-3: Ranges of contaminants detected in canister samples collected near the R360 Environmental Solutions, Inc. facility, January 21-28, 2011.
(Contaminant concentrations exceeding their screening values are listed in bold red)

Contaminant	Range of concentrations detected (ug/m^3[*])		Date Sampled, Maximum	CV[†] (ug/m^3)	CV reference
	Minimum	Maximum			
Benzene	**0.86**	**20.3**	1/23/2011, 9:23	0.1	CREG[‡]
Ethylbenzene	1.26	12.7	1/23/2011, 5:00	300	Chronic EMEG[§]
Methylene chloride	ND[**]	0.69	1/22/2011, 13:05	250	CREG
Styrene	1.06	15.8	1/23/2011, 5:00	900	Chronic EMEG
Toluene	1.32	79.6	1/26/2011, 21:25	300	Chronic EMEG
1,2,4-Trimethylbenzene	0.79	**18.4**	1/23/2011, 5:00	7.30	RBC[††]
1,3,5-Trimethylbenzene	0.74	5.36	1/25/2011, 1:00	125	Long-term ESL[‡‡] (interim)
meta-/para-Xylene	1.17	35.7	1/23/2011, 5:00	100	RBC
ortho-Xylene	1.35	9.90	1/25/2011, 13:05	100	RBC
total Xylenes	2.69	41.3	1/23/2011, 5:00	100	RBC

[*] ug/m^3 = micrograms per cubic meter
[†] CV = comparison value
[‡] CREG = cancer risk evaluation guide
[§] EMEG = environmental media evaluation guide
[**] ND = not detected
[††] RBC = risk-based concentration
[‡‡] ESL = effects screening level

Table B-4: Ranges of contaminants detected during extended canister sampling near the R360 Environmental Solutions, Inc. facility, June 2, 8, and 14, 2011.
(Contaminant concentrations exceeding their screening values are listed in bold red)

Contaminant	Range of concentrations detected (ug/m^{3*}) Minimum	Maximum	Site Sampled, Maximum	CV† (ug/m^3)	CV reference
Acetone	9.10	19.9	6/2/2011, #2‡	30,000	Chronic EMEG§
Acetonitrile	0.420	0.67	6/14/2011, #1**	63	RBC††
Acetylene	0.17	0.48	6/2/2011, #1, #2	2,660	Long-term ESL‡‡ (interim)
Acrylonitrile	ND§§	**0.37**	6/2/2011, #1	0.01	CREG***
Benzene	**0.22**	**0.63**	6/2/2011, #2	0.1	CREG
Benzyl chloride	**0.16**	**0.31**	6/2/2011, #2	0.05	Carcinogenic RBC
Bromomethane	0.23	0.43	6/2/2011, #1	20	Chronic EMEG
1,3-Butadiene	ND	**0.2**	6/8/2011, #1, 6/14/2011, #3	0.03	CREG
n-Butane	0.45	2.74	6/2/2011, #2	2,380	Long-term ESL (interim)
2-Butanone (Methyl ethyl ketone)	0.5	2.39	6/2/2011, #1	5,200	RBC
1-Butene	0.05	0.26	6/2/2011, #2	820	Short-term ESL (final)
cis-2-Butene	0.03	0.07	6/14/2011, #2	4,800	Short-term ESL (final)
trans-2-Butene	ND	0.08	6/8/2011, #3†††	4,800	Short-term ESL (final)
Carbon disulfide	0.16	0.340	6/8/2011, #2	900	Chronic EMEG
Carbon tetrachloride	**0.82**	**1.13**	6/2/2011, #2, #3	0.2	CREG
Chlorobenzene	0.18	0.370	6/2/2011, #1	52	RBC
Chloroform	**0.34**	**0.63**	6/8/2011, #3	0.04	CREG
Chloromethane	1.53	1.98	6/8/2011, #2	100	Chronic EMEG
Cyclohexane	0.05	0.36	6/2/2011, #2	6,300	RBC
Cyclopentane	0.02	0.11	6/8/2011, #2	340	Long-term ESL (interim)
n-Decane	0.05	0.43	6/2/2011, #2	1,000	Long-term ESL (interim)
1,2-Dibromoethane	**0.23**	**0.46**	6/2/2011, #1, #2	0.002	CREG

m-Dichlorobenzene	0.18	0.3	6/2/2011, #2: 6/8/2011, #3	32	Long-term ESL (interim)
o-Dichlorobenzene	0.18	0.36	6/8/2011, #1	32	Long-term ESL (interim)
p-Dichlorobenzene	0.18	0.3	6/2/2011, #1, #2; 6/8/2011, #1	32	Long-term ESL (interim)
1,1-Dichloroethane	0.2	0.32	6/2/2011, #1	1.50	Carcinogenic RBC
1,2-Dichloroethane	**0.24**	**0.36**	6/2/2011, #1	0.04	CREG
1,1-Dichloroethene	0.12	0.28	6/2/2011, #1, #3; 6/8/2011, #3	80	Int. ‡‡‡ EMEG
cis-1,2-Dichloroethylene	0.12	0.24	6/2/2011, #1	NA§§§	NA
1,2-Dichloropropane	ND	0.28	6/2/2011, #3	30	Int. EMEG
m-Diethylbenzene	ND	0.11	6/2/2011, #2	250	Long-term ESL (interim)
p-Diethylbenzene	ND	0.36	6/8/2011, #1	250	Long-term ESL (interim)
Diethyl ether	ND	0.15	6/2/2011, #1	930	Short-term ESL (under review)
2,2-Dimethylbutane	0.04	0.13	6/2/2011, #1, #2; 6/14/2011, #3	NA	NA
2,3-Dimethylbutane	0.05	0.19	6/14/2011, #3	350	Long-term ESL (interim)
2,3-Dimethylpentane	0.05	0.26	6/8/2011, #2	350	Long-term ESL (interim)
2,4-Dimethylpentane	0.03	0.18	6/2/2011, #2	350	Long-term ESL (interim)
Ethane	2.37	19.7	6/2/2011, #1	NA	NA
Ethylbenzene	0.05	0.42	6/2/2011, #1	300	Chronic EMEG
Ethylene	0.13	0.95	6/2/2011, #1	34	Long-term ESL (final)
m-Ethyltoluene	0.04	0.23	6/2/2011, #1	125	Long-term ESL (interim)
o-Ethyltoluene	0.1	0.94	6/2/2001, #3	125	Long-term ESL (interim)
p-Ethyltoluene	0.03	0.21	6/8/2011, #1	125	Long-term ESL (interim)
Freon-11	1.63	2.25	6/2/2011, #2	2,800	Long-term ESL (interim)
Freon-113	1.00	1.38	6/2/2011, #3	3,800	Long-term ESL (interim)
Freon-114	0.4.9	0.84	6/2/2011, all sites	7,000	Long-term ESL (interim)
Freon-12	2.87	3.51	6/2/2011, #2, #3	5,000	Long-term ESL (interim)
n-Heptane	0.07	0.35	6/2/2011, #2	350	Long-term ESL (interim)
Hexachlorobutadiene	**0.53**	**0.96**	6/8/2011, #1	0.05	CREG

n-Hexane	0.12	0.86	6/2/2011, #1	2,000	Chronic EMEG
2-Hexanone	ND	0.53	6/8/2011, #1	31	RBC
1-Hexene	0.03	0.07	6/2/2011, #1	70	Short-term ESL (under review)
Isobutane	0.29	2.07	6/8/2011, #2	1,900	Long-term ESL (under review)
Isopentane	0.38	2.29	6/14/2012, #3	3,800	Short-term ELS (final)
Isoprene	1.01	**14.6**	6/2/2011, #3	6.00	Long-term ESL (under review)
Isopropylbenzene	ND	0.1	6/8/2011, #1	250	Long-term ESL (under review)
Methyl acrylate	ND	0.25	6/2/2011, #1	7.00	Long-term ESL (interim)
4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	ND	0.37	6/8/2011, #1	3,100	RBC
Methyl-tert-butyl-ether	ND	0.14	6/2/2011, #1	2,000	Chronic EMEG
Methylcyclohexane	0.1	0.54	6/8/2011, #2	600	Short-term ESL (under review)
Methylcyclopentane	0.09	0.37	6/14/2011, #3	350	Long-term ESL (interim)
Methylene chloride	0.59	**3.30**	6/8/2011, #3	2.00	CREG
2-Methylheptane	0.04	0.19	6/14/2011, #2	350	Long-term ESL (interim)
3-Methylheptane	0.03	0.15	6/14/2011, #2	350	Long-term ESL (interim)
2-Methylhexane	0.06	0.23	6/2/2011, #2; 6/14/2011, #3	30.7	Long-term ESL (interim)
3-Methylhexane	0.06	0.63	6/14/2011, #3	30.7	Long-term ESL (interim)
2-Methylpentane	0.18	2.55	6/2/2011, #1	290	Short-term ELS (under review)
3-Methylpentane	0.13	0.51	6/2/2011,#1	350	Long-term ESL (interim)
n-Nonane	0.06	0.37	6/14/2011, #2	210	RBC
n-Octane	0.06	0.39	6/14/2011, #2	350	Long-term ESL (interim)
n-Pentane	0.26	1.53	6/14/2011, #3	1,000	RBC
1-Pentene	0.01	0.13	6/14/2011, #3	290	Short-term ESL (final)
cis-2-Pentene	ND	0.05	6/2/2011, #2; 6/14/2011, #3	7,500	Short-term ESL (final)

trans-2-Pentene	0.02	0.09	6/2/2011, #2	7,500	Short-term ESL (final)
Propane	0.95	5.22	6/8/2011, #2	NA	NA
n-Propylbenzene	0.02	0.15	6/8/2011, #1	1,000	RBC
Propylene	0.12	0.57	6/2/2011, #1	3,100	RBC
Styrene	0.01	0.36	6/8/2011, #1	900	Chronic EMEG
1,1,2,2-Tetrachloroethane	**0.27**	**0.41**	6/2/2011, all sites	0.02	CREG
Tetrachloroethylene	**0.27**	**0.47**	6/2/2011, #1, #2; 6/8/2011, #2	0.2	CREG
Toluene	0.15	1.23	6/2/2011, #2	300	Chronic EMEG
1,2,4-Trichlorobenzene	0.15	0.59	6/8/2011, #1	2.10	RBC
1,1,1-Trichloroethane	0.27	0.44	6/2/2011, all sites	4,000	Int. EMEG
1,1,2-Trichloroethane	**0.22**	**0.38**	6/2/2011, #1	0.06	CREG
Trichloroethylene	0.16	0.32	6/2/2011, #1	0.5	CREG
1,2,3-Trimethylbenzene	0.02	0.15	6/2/2011, #2; 6/14/2011, #3	5.20	RBC
1,2,4-Trimethylbenzene	0.04	0.32	6/14/2011, #3	7.30	RBC
1,3,5-Trimethylbenzene	0.03	0.2	6/8/2011, #1	125	Long-term ESL (interim)
2,2,4-Trimethylpentane	0.06	0.43	6/2/2011, #2	NA	NA
2,3,4-Trimethylpentane	ND	0.11	6/2/2011, #1, #2	350	Long-term ESL (interim)
n-Undecane	0.03	0.76	6/2/2011, #2	350	Long-term ESL (interim)
Vinyl chloride	**0.13**	**0.26**	6/2/2011, #1	0.1	CREG
meta-/para-Xylene	0.1	1.33	6/2/2011, #1	100	RBC
ortho-Xylene	0.07	0.58	6/2/2011, #1	100	RBC

[*] ug/m^3= micrograms per cubic meter
[†]CV = comparison value
[‡]#2 = east of the R360 facility
[§] EMEG = environmental media evaluation guide
[**]#1 = front gate of the R360 facility
[††]RBC = risk-based concentration
[‡‡]ESL = effects screening level
[§§]ND = not detected
[***]CREG = cancer risk evaluation guide
[†††]#3 = west of the R360 facility
[‡‡‡]interim = currently under review
[§§§]NA = not available

Noncancer Health Effects

The ambient air contaminant concentrations that exceeded their screening values were compared to reference concentrations (RfCs) for each contaminant. An RfC is an estimated daily lifetime exposure to an airborne chemical that is unlikely to cause adverse noncancer health effects to human populations. RfCs may be found in the EPA's Integrated Risk Information System (IRIS) at http://www.epa.gov/iris and in the Risk Assessment Information System at http://rais.ornl.gov/tools/metadata.php.

Exposure concentrations that exceeded the RfCs (and those for which no RfC was available) were compared to the *no-observed-adverse-effects level* (NOAEL) or *lowest-observed-adverse-effects level* (LOAEL) for that contaminant. The NOAEL is the lowest level of continuous exposure to a contaminant that has been observed to cause no adverse health effects. The LOAEL is the lowest level of continuous exposure to a contaminant that has been observed to result in adverse health effects.

Calculation of Carcinogenic Risk

To determine whether concentrations of the COCs detected in ambient air sampled near the R360 facility would increase an individual's risk of developing cancer, SEET estimated the lifetime excess cancer risk (LECR) for exposure to the reported ranges of these contaminants. The LECR represents the increase in the probability of an individual developing cancer as a result of being exposed to a contaminant over a lifetime. Because of the uncertainties involved in estimating carcinogenic risk, ATSDR employs a weight-of-evidence approach in describing carcinogenic risk, using words as well as numeric terms.[5]

The estimated risks of developing cancer were calculated by multiplying each exposure concentration (in micrograms per cubic meter (ug/m^3)) over a 70-year (lifetime) period by an *inhalation unit risk*, using the following equation:

Cancer Risk = (Air Exposure Dose) *X* (Inhalation Unit Risk) *X* (Exposure Years/70)

where Air Exposure Dose = concentration of the contaminant

Exposure Years = 70 (a lifetime exposure)

For example, the theoretical cancer risk for the highest concentration of benzene detected by the MAML near the R360 facility would be calculated as follows for a 70-year (lifetime) exposure duration:

The highest benzene concentration detected by the MAML was $3.99 \times 10^{+2}$ micrograms per cubic meter (ug/m^3).

Cancer Risk = $(3.99 \times 10^{+2}\ ug/m^3)$ *X* $(7.80 \times 10^{-6}\ (ug/m^3)^{-1})$ *X* (70/70)

$= 3.11 \times 10^{-3}$

[5] Agency for Toxic Substances and Disease Registry. Cancer policy framework. Atlanta: US Department of Health and Human Services; 1993.

Table B-5: Ranges of estimated cancer risks for air contaminants of concern sampled near the R360 Environmental Solutions, Inc. site in January 2011.

Contaminant	Inhalation Unit Risk ($(ug/m^{3*})^{-1}$)	Cancer Risk Range Low	High
Benzene from MAML† samples	7.80×10^{-6}	5.46×10^{-6}	3.11×10^{-3}
Benzene from Jan 2011 Canisters	7.80×10^{-6}	6.71×10^{-6}	1.58×10^{-4}

*ug/m^3 = micrograms per cubic meter
†MAML = Mobile Air Monitoring Lab

Table B-5 lists the estimated cancer risks for benzene sampled by the MAML and for canister samples collected near the site in January 2011. Table B-6 lists the estimated cancer risks for COCs detected during the extended sampling period in June 2011.

The results of the carcinogenic risk calculations estimate the worst-case maximum increase in the risk of developing cancer after exposure to the contaminant. This estimation is accurate within one order of magnitude greater or less than calculated. Therefore, a calculated cancer risk of 2 excess cancers per 10,000 people might actually be 2 excess cancers per 1,000 people or 2 excess cancers per 100,000 people. The lifetime excess cancer risk of 10^{-4} (or 1.0×10^{-4}), which is 1 excess cancer per 10,000 people, is the upper bound of the range used by EPA's Superfund program to make decisions about the need to take action at contaminated sites[6]. Estimates of theoretical cancer risks that fall below 1.0×10^{-6} are considered to pose no significant increase in cancer risk.

[6] US EPA. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).* Accessed 2010 July 12 at http://epa-prgs.ornl.gov/radionuclides/HHEMB.pdf

Table B-6: Ranges of estimated cancer risks for air contaminants of concern sampled near the R360 Environmental Solutions, Inc. site in June 2011.

Contaminant	Inhalation Unit Risk ($(ug/m^{3*})^{-1}$)	Cancer Risk Range	
		Low	High
Acrylonitrile	6.80×10^{-5}	0	2.52×10^{-5}
Benzene	7.80×10^{-6}	1.72×10^{-6}	4.91×10^{-6}
Benzyl chloride	4.90×10^{-5}	7.84×10^{-6}	1.52×10^{-5}
1,3-Butadiene	3.00×10^{-5}	0	6.00×10^{-6}
Carbon tetrachloride	6.00×10^{-6}	4.92×10^{-6}	6.78×10^{-6}
Chloroform	2.30×10^{-5}	7.82×10^{-6}	1.45×10^{-5}
1,2-Dibromoethane	6.00×10^{-4}	1.38×10^{-4}	2.76×10^{-4}
1,2-Dichloroethane	2.60×10^{-5}	6.24×10^{-6}	9.36×10^{-6}
Hexachlorobutadiene	2.20×10^{-5}	1.17×10^{-5}	2.11×10^{-5}
Methylene chloride	5.00×10^{-7}	2.95×10^{-7}	1.65×10^{-7}
1,1,2,2-Tetrachloroethane	5.80×10^{-5}	1.57×10^{-5}	2.38×10^{-5}
Tetrachloroethylene	2.60×10^{-7}	7.02×10^{-8}	1.22×10^{-7}
1,1,2-Trichloroethane	1.60×10^{-5}	3.52×10^{-6}	6.08×10^{-6}
Vinyl chloride	8.80×10^{-6}	1.14×10^{-6}	2.29×10^{-6}

*ug/m^3 = micrograms per cubic meter