Health Consultation

Evaluation of Potential Health Effects from Air Toxics

TREASURE VALLEY AIR MONITORING 2007-2008

ADA AND CANYON COUNTIES, IDAHO

Prepared by the
Idaho Division of Public Health

September 1, 2010

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Foreword

The Idaho Division of Public Health's Bureau of Community and Environmental Health (BCEH) jointly prepared this public health consultation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to environmental contaminants. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The health consultation is an approach used by ATSDR and BCEH to respond to requests from concerned residents for health information on hazardous substances in the environment. The health consultation process evaluates sampling data collected from sites impacted by environmental contamination, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

SUMMARY	
INTRODUCTION	The Idaho Department of Health and Welfare's Bureau of Community and Environmental Health (BCEH) recognizes that air pollution is a health concern for many in the Treasure Valley and is committed to helping residents understand how air pollution may affect their health. This Public Health Consultation looks at the levels of specific air contaminants and compares those levels to levels established by health and environmental agencies that are known to be protective of health. The estimated duration and frequency of exposure are considered when evaluating potential health effects. The contaminants measured include volatile organic compounds, carbonyls, and some metals. Based on the evaluation of air toxics data, BCEH concludes the following:
CONCLUSION 1	Breathing the air in the Treasure Valley is not expected to harm people's health or cause non-cancer chronic disease. However, during times of inversions (stagnant air periods) it is possible that those with asthma along with those with lung or heart disease may be at increased risk of health issues from air pollution.
BASIS FOR DECISION	All pollutants measured were compared to acute and chronic air quality standards that have been set at levels that protect people's health. The levels of air pollution in the Treasure Valley area were below those standards for the contaminants measured, so people in the Treasure Valley area will not be harmed by breathing the air. Since there were no measurements at these sites for general air pollution, namely ozone and particulate matter, the report cannot assess what risks there may be from those compounds.
CONCLUSION 2	Breathing the air in the Treasure Valley area will not result in an elevated cancer risk above background levels of cancer normally found in the general population.
BASIS FOR DECISION	Further evaluation of the levels found that some contaminants were above their cancer screening levels but none were high enough to increase the risk of getting cancer sufficiently above what would normally occur in the community from other causes. In other words, since cancer is a very common disease, it would be unlikely that the levels of air pollution in the Treasure Valley would increase the rates of cancer so that it would be noticeable above normal levels. The site in the body at greatest potential risk for developing cancers above background levels from lifetime exposure to ambient air in the region is the upper respiratory tract; however, this risk is still considered to be low.
NEXT STEPS	BCEH will work with the Idaho Department of Environmental Quality (IDEQ) to relay the findings to the public. BCEH recommends that another year-long air toxics monitoring project be undertaken by IDEQ in 2012-2013 as a five year follow-up to the

	2007-2008 monitoring discussed here. BCEH will continue to provide the IDEQ Air Quality Program with technical assistance as requested. Finally, BCEH will work with IDEQ to educate those in the Treasure Valley on ways to reduce air pollutants which will have the effect of reducing cases of lung and heart disease.
FOR MORE INFORMATION	If you have concerns about your health, you should contact your medical provider. You can also call ATSDR at 1-800-CDC-INFO and ask for information on the Treasure Valley Air Toxics Study.

Statement of Issues

In 2006, the Idaho Department of Health and Welfare's Bureau of Community and Environmental Health (BCEH) completed a report (*Evaluation of Air Contaminants in the Treasure Valley Area, Ada and Canyon Counties*) which reviewed air monitoring data collected by the Idaho Department of Environmental Quality (IDEQ). The review of data collected at one fixed-point site in the Treasure Valley found that though some air contaminants were above their health comparison values, that there was no elevated health risk that would be above normal background health risk levels. Since the monitoring was conducted at only one site in the large valley, the report recommended that more sampling or modeling take place to better understand how air quality might differ in various parts of the valley. IDEQ requested and was provided funding from the U.S. Environmental Protection Agency (EPA) to conduct one year of air toxics monitoring in the Treasure Valley. These EPA funded projects are designed to help environmental and health agencies characterize the air toxic pollutants present in their communities. This information can then be used to help determine activities that can be implemented to reduce the emissions of toxic air pollutants and thus reduce the negative health effects associated with air toxics. The monitoring, which occurred from February 2007 to February 2008, was conducted to help develop a baseline of ambient concentrations of air toxics in one of the fastest-growing areas in the nation. The study collected volatile organic carbon compounds, carbonyls—in this case primarily aldehydes, and selected toxic metals/trace elements. Some other common air pollutants, such as ozone and particulate matter, were not sampled and are not part of this study. IDEQ completed a report of the findings entitled *2007 Treasure Valley Idaho Air Toxics Study - Final Report* in November 2009. Prior to the finalization of the report, IDEQ had requested that BCEH's Environmental Health Education and Assessment Program (EHEAP) provide a further investigation into the possible health effects associated with the levels of contaminants found in the air toxics study.

Background and Site Description

The Treasure Valley is located in southwest Idaho and stretches for nearly 100 miles from the divide separating Mountain Home from Boise, Idaho northwest to Ontario, Oregon. The area includes the two counties of Ada and Canyon. The valley is flanked to the west-southwest by the Owyhee Mountains and Snake River and to the northeast by the Boise Front range. The valley lies at 2,150 to 2,870 feet elevation along the two mountain ranges and its width varies from 10 to 40 miles. The 2008 estimated population of the Treasure Valley is over 0.5 million. Boise, with an estimated population of 205,314 (2008 U.S. Census estimates), is the largest city and lies near the eastern end of the valley. Other populous cities are Meridian (66,916) on the eastern end, Nampa (80,362) and Caldwell (42,331) in the center, and Ontario, Oregon (10,991) on the far western side of the valley. The agricultural area of the Treasure Valley, predominantly in the western section, focuses on dairy and beef cattle operations and sugar beet, potato, onion, and other crops. Nampa-Caldwell-area industry includes food processing facilities, some of which use coal-fired boilers. A high-tech/semiconductor industry which represented a significant manufacturing industry has been greatly reduced in recent years as production has been sent overseas. Much of the urban and suburban workforce is involved in sectors such as call centers, health care, education, corporate headquarters or office operations, tourism, and local, state, and federal government.

According to 2007 data from EPA's Toxic Release Inventory, there are 33 facilities in Ada and Canyon counties that emit toxic substances into the air or water. Of those 33, there are 16 facilities that report that they emit more than one pound per year of a toxic substance into the air. In 2007, these 16 facilities emitted 826,790 pounds of toxic substances into the air either through fugitive escape or direct emission. It is important to note that the EPA Toxic Release Inventory is self reported by industries and is not necessarily a true accounting of the number or amount of toxics released into the environment, rather the amount reported is only an estimate. Further, there are also many mobile sources of pollution including motor vehicles, agriculture, and construction that contribute large quantities of air pollutants into the Treasure Valley airshed.

Due to the geography of the valley's location, the area is prone to inversions during wintertime and stagnation events in the summer. Winter inversions can last from a few hours to several days and summertime temperatures contribute to the production of ozone when stagnation occurs. There have been ongoing health concerns associated with air quality in the Treasure Valley and IDEQ has issued numerous warnings over the past several years for susceptible populations, such as asthmatics, to limit their outdoor activities due to high levels of pollutants like ozone and particulate matter. It must be noted that this report does not look at levels of ozone or particulate matter since these two contaminants are not included in the data collected by IDEQ for their study. This report evaluates the specific air toxics data collected by IDEQ and assesses potential public health hazards associated with the levels of contaminants and the estimated duration and frequency of exposure.

From February 2007 to February 2008, IDEQ operated five air monitoring stations across the Treasure Valley. IDEQ collected 24-hour samples on a one-in-six day schedule from mid-February 2007 through mid-February 2008. The five monitoring sites are briefly described below and presented in Figure 1.

White Pine Elementary. White Pine Elementary School is located in southeast Boise in a rapidly growing residential area about 5 kilometers (km) (3 miles) from downtown. It is surrounded by residential subdivisions and relatively low-volume traffic. It is close to the Boise Airport, a light industrial area that includes a semiconductor fabricating facility and a locomotive refurbishing/testing facility. IDEQ identified this site as a downwind monitoring location. However, they noted that it receives drainage winds for part of the day from the industrial facilities south and southeast of the site.

Mountain View Elementary. Mountain View Elementary School is located northwest of downtown Boise. It is in a residential area approximately 0.5 km (0.3 miles) from a major traffic arterial with mixed light industrial and commercial areas along its length. This arterial carries over 10,000 vehicles during the morning and evening commutes. This site is also about 5 km (3 miles) downwind of the urban core. IDEQ determined that this site is representative of concentrations in areas of high population density and downwind of an area with high volume traffic entering downtown Boise.

St. Luke's Regional Medical Center. St. Luke's Regional Medical Center, Meridian campus, is located near the intersection of Interstate 84 and Eagle Road (one of the state's busiest intersections) and is approximately 16 km (10 miles) west of downtown Boise, half way between Boise and Nampa. Eagle Road, approximately 500 meters (5000 feet) to the west, is a principal urban arterial with traffic volumes of up to 50,000 vehicles per day. Interstate 84 just south of the site, carries heavy commuter traffic and approaches 100,000 vehicles per day. The area is characterized by a variety of land uses including light industrial, several "big box" retail centers, residential subdivisions, a large planned senior community, and a large hospital. The immediate surroundings are undeveloped land and sparsely used parking lots.

Northwest Nazarene University. Northwest Nazarene University (NNU) is located in Nampa, Idaho, the second largest city in Idaho (pop. 80,362). Nampa is centrally located in the Treasure Valley, about 30 km (18.5 miles) from Boise and 64 km (40 miles) from the Oregon border. Nampa's air is affected by a diverse source profile including light and heavy industry, and sprawling residential areas feeding heavy commuter traffic. The NNU campus, located near the center of the Nampa urbanized area, serves approximately 1,600 full-time students and 8,236 continuing education students each year. Monitored air pollution concentrations at this site are often the highest in the Treasure Valley.

Parma. Parma is a small farming town located at the western end of the Treasure Valley and was chosen by IDEQ to serve as a background site. In 2008, Parma had an estimated population of 1,870. The monitoring site was located on the western edge of town at the Parma wastewater treatment facility.

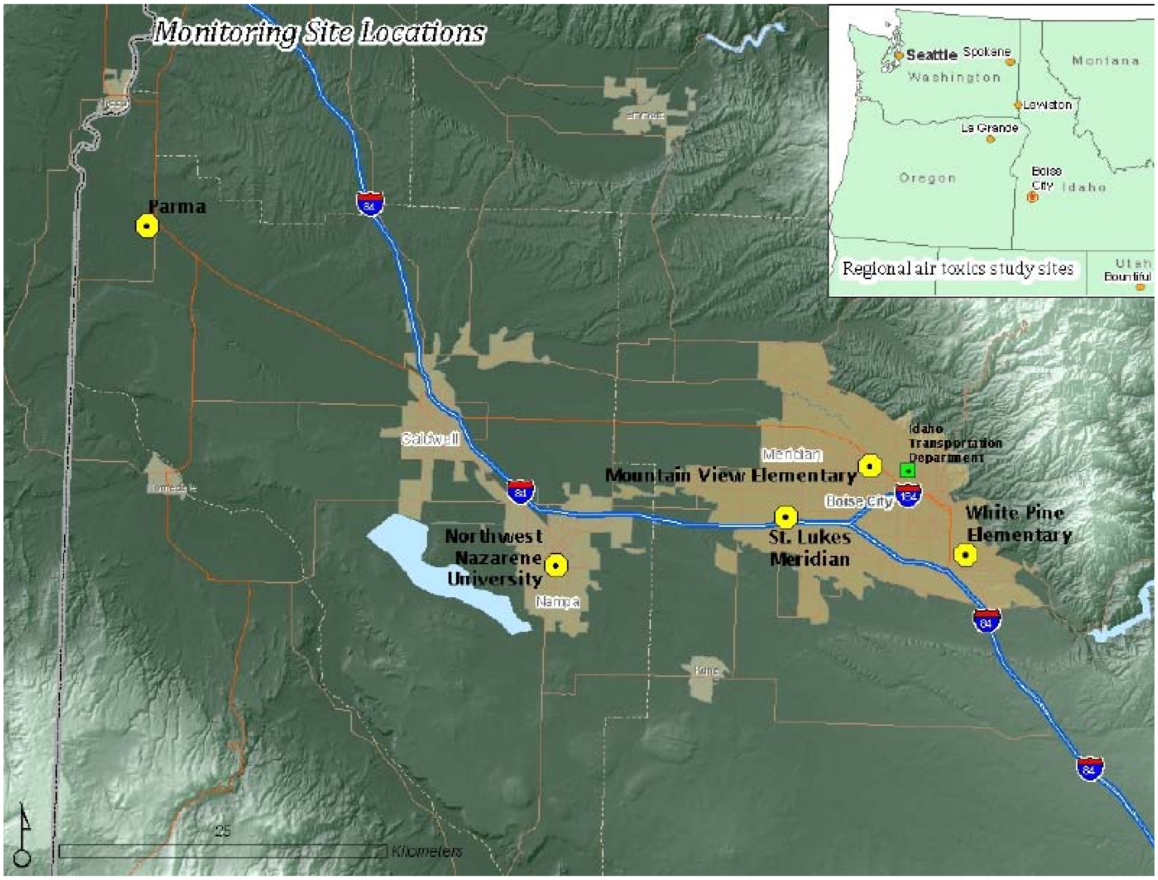

Figure 1: Monitoring Site Locations (Source: IDEQ).

Methods

Data Quality

Between 38 and 57 samples were collected throughout the year at monitors depending on the location and the compound sampled. The percent of those samples collected that were above the lab minimum reporting limit (i.e., they were measurable using certified lab techniques) varied from 0 to 100% depending on the location and the compound sampled. For example, the contaminant acrylonitrile which is used to make plastics, synthetic rubber and acrylic fibers, was only detected in 19 (6%) of the 314 samples that went to the lab. After some discussion, BCEH staff decided that if the contaminants were not found in at least 25% of the samples submitted to the lab that they would not be included in the analysis. The rationale for using this cutoff is based on the use of chronic exposure comparison values. Since the chronic exposure comparison values are to be used to determine risk from continual exposure over the course of months or years, it would be unrealistic to assess exposure to those contaminants that were rarely detected and are not continually in the air. While including contaminants that were only found in 25% or more of the samples may overestimate exposures, it does allow for more contaminants to be examined in this assessment and is a more realistic assessment for the area as a whole.

Non-Detects

For those contaminants in samples the lab could not detect, a value of half the minimum reporting limit was used when calculating the yearly averages. This is a widely used convention in air toxics monitoring, and was the method used by IDEQ in their report (EPA 2007; IDEQ 2009).

Means Used

The yearly average (arithmetic mean) for each contaminant was used for all risk calculations used in this evaluation. BCEH did not see any trends in the data to suggest using other measures of central tendency. Table 1 shows the highest mean or average level of each of the contaminants monitored. The mean was chosen over the median value for comparison since the mean was the higher value in 93% of the results. The highest mean was derived by taking each monitoring station and calculating the mean level for each contaminant over the sampling year for each station. These yearly station-specific mean levels were then compared to each other and the highest mean for each contaminant was selected to compare with its comparison value (CV). This is an approach that likely overestimates chronic exposure, but provides a conservative estimate of exposure.

Health Assessment

In order to evaluate public health concerns related to air contamination in the Treasure Valley area, BCEH followed a 3-step methodology. First, BCEH obtained the air monitoring results from the five sites from IDEQ. Second, BCEH gathered the health-based CVs, which reflect an estimated contaminant concentration level for which an exposure at or below that level is *not expected* to cause adverse health effects, and compared them to the air monitoring results to determine which contaminants were not likely to cause harmful health effects. Third, for the contaminants that were above their health-based CVs, BCEH made further determinations to evaluate whether the level of environmental pollutants and exposure indicated a possible public health risk.

Comparison values ***are not*** *thresholds for adverse health effects*. That is, CVs do not represent a level at which a person exposed to a contaminant level above the CV will likely suffer health effects. This is because CVs are typically set at levels many times lower than the levels at which health effects were observed in experimental animal or human epidemiologic studies. CVs are deemed protective because they include safety or uncertainty factors that account for more sensitive populations, such as young children.

Again, if the concentration of a chemical contaminant is less than its CV, it is unlikely that exposure would result in adverse health effects, and further evaluation of exposures to that chemical is not necessary. If the concentration of a chemical exceeds a CV, adverse health effects from exposure are not automatically expected, but potential exposures to that chemical should be further evaluated.

The primary resource for CVs was the Agency for Toxic Substances and Disease Registry (ATSDR) Environmental Media Evaluation Guide (EMEG) and Cancer Risk Evaluation Guide (CREG) values. The ATSDR values used were last updated in April 2010 and were considered first. CVs derived by the Environmental Protection Agency (EPA), and the California Environmental Protection Agency (CalEPA) were used when ATSDR values were not available. The CV values from these agencies are available at:
http://www.epa.gov/ttn/atw/toxsource/summary.html and

http://www.epa.gov/region9/superfund/prg/index.html. The air screening CVs in the Region 9 resource were last updated in December 2009. The chronic CV for lead used in this evaluation is the EPA National Ambient Air Quality Standard for lead. Tables showing the contaminants *at each individual monitoring site* that were above a CV are presented in Appendix A.

Results

Exposure Pathways

To determine whether people are, were, or could be exposed in the future to the contaminants sampled and analyzed in this study, the environmental and human components that lead to exposure were evaluated. Exposure is said to exist if the five elements of an exposure pathway exist, have existed, or may exist in the future. An exposure pathway is composed of: 1) a source of contamination; 2) a movement of the contamination through air, water, and/or soil; 3) human activity where the contamination exists; 4) human contact with the contaminant through touching, breathing, swallowing and/or drinking; and 5) a population that can potentially be exposed. If all five elements are present, a completed exposure pathway is said to exist.

Based on the exposure pathway analysis and environmental data, it was determined that a completed exposure pathway exists for residents of the Treasure Valley. This means it is likely that residents are currently exposed to the contaminants listed in Table 1 through breathing the ambient air.

Table 1. All Monitors—Highest Mean Concentrations and Comparison Values

Note that many of these compounds were detected less frequently than the 25% cutoff specified (see Methods section) to warrant consideration of cancer risk assessment.

Compound	Highest Mean[1,2]	Chronic CV[2]	Exceeds Non-Cancer CV?	Cancer CV[2]	Exceeds Cancer CV?	Greater than 25% detection frequency?
1,1,2,2-tetrachloroethylene	0.35	280[7]	No	0.41[7]	No	No
1,2,4-trichlorobenzene	1.43	4.2[7]	No	No CV	NA	No
1,2,4-trimethylbenzene	0.77	7.3[7]	No	No CV	NA	No
2-hexanone	0.95	30[6]	No	No CV	NA	No
Acetaldehyde	2.18	9.0[6]	No	0.5[5]	**Yes***	**Yes**
Acrylonitrile	0.31	2.0[6]	No	0.01[5]	**Yes**	No
Arsenic	0.00053	0.016[7]	No	0.0002[5]	**Yes***	**Yes**
Benzene	1.58	10[5]	No	0.1[5]	**Yes***	**Yes**
Beryllium	0.000013	0.02[6]	No	0.0004[5]	No	No
Bromomethane	0.23	5.2[7]	No	No CV	NA	No
Cadmium	0.00012	0.01[5]	No	0.0006[5]	No	No
Carbon disulfide	0.15	900[5]	No	730[7]	No	No
Carbon tetrachloride	0.45	200[5]	No	0.2[5]	**Yes***	**Yes**
Chlorobenzene	0.27	52[7]	No	No CV	NA	No
Chlorodibromomethane	0.46	No CV	NA	0.09[7]	**Yes**	No
Chloroethane	1.97	10000[7]	No	No CV	NA	No
Chloroform	0.27	100[5]	No	0.04[5]	**Yes**	No
Chloromethane	1.21	94[7]	No	No CV	NA	No
Chromium	0.00167	0.2[3]	No	0.0002[3]	**Yes**	No

Compound	Highest Mean[1,2]	Chronic CV[2]	Exceeds Non-Cancer CV?	Cancer CV[2]	Exceeds Cancer CV?	Greater than 25% detection frequency?
Cis- or Trans-1,3-Dichloropropene	3.98 (cis)	21[7]	No	0.3[5]	**Yes**	No
Cobalt	0.00013	0.1[5]	No	0.00027[7]	No	No
Cyclohexane	0.99	6300[7]	No	No CV	NA	No
p-Dicholorobenzene	0.5	60[5]	No	0.22[7]	**Yes**	No
Dichlorodifluoromethane	1.99	210[7]	No	No CV	NA	No
Ethylbenzene	0.5	1000[5]	No	0.97[7]	No	No
Formaldehyde	4.61	10[5]	No	0.08[5]	**Yes***	**Yes**
Hexachloro-1,3-butadiene	0.56	No CV	NA	0.05[5]	**Yes**	No
n-Hexane	1.22	730[7]	No	No CV	NA	No
Isopropanol	63.6	7300[7]	No	No CV	NA	No
Lead	0.00222	0.15[4]	No	No CV	NA	No
Manganese	0.01000	0.3[5]	No	No CV	NA	No
Methylene chloride	0.64	1000[5]	No	2.0[5]	No	No
Methyl isobutyl ketone	0.28	3100[7]	No	No CV	NA	No
Nickel	0.000529	0.09[5]	No	0.005[8]	No	No
o-xylene	0.81	730[7]	No	No CV	NA	No
m,p-xylene	2.26	100[7]	No	No CV	NA	No
Propionaldehyde	0.44	8.3[7]	No	No CV	NA	No
Selenium	0.00022	21[7]	No	No CV	NA	No
Styrene	0.21	900[5]	No	No CV	NA	No
Toluene	4.64	300[5]	No	No CV	NA	No
Trichlorofluoromethane	1.69	730[7]	No	No CV	NA	No
Trichlorotrifluoroethane	0.49	31000[7]	No	No CV	NA	No

*Highlighted rows indicate compounds selected for further health analysis (>25% samples detectable).
NA – Not applicable since no cancer CV value exists
BOLD values indicate --- monitored value exceeds CV
[1]The highest mean for each contaminant is the highest mean of all the monitoring stations.
[2]All values are in μg/m^3.
[3]These are the CVs for a 1:6 ratio of Chromium VI:Chromium III. The chronic CV comes from the California Office of Environmental Health Hazard Assessment.
[4]Environmental Protection Agency's National Ambient Air Quality Standards value
[5]ATSDR's Chronic Environmental Media Evaluation Guide/Minimal Risk Level or Cancer Risk Evaluation Guide
[6] Environmental Protection Agency's Reference Concentration
[7] Environmental Protection Agency Region 9's Preliminary Remediation Goals
[8] This is the cancer CV for Nickel disulfide; no total Nickel cancer CV is available.

Comparison with Health-Based CVs and Background Levels

In order to compare the monitored levels of contaminants with health-based screening values, the highest yearly mean of each contaminant was compared to the most protective chronic CV and the most protective cancer CV. The levels were also compared to urban and rural background levels which were derived by calculating the median averages for urban and rural areas from many locations across North America.

Comparison with Chronic CVs

To gauge if air contaminants may be causing chronic disease, the highest mean levels of contaminants were compared to their chronic (non-cancer) CV. As Table 1 reflects, there were no contaminants that were above a chronic CV. The chronic CVs are generally used for continuous or near continuous inhalation exposures that occur for a year or more. The chronic CVs typically have safety factors built in so that the margin of safety is large and people exposed to levels at or below the chronic CV are not likely to experience any adverse health effects when daily exposure occurs for many years.

Comparison with Cancer CVs

To determine the risk of cancer from exposure to contaminants, the CVs for cancer risk were compared to the highest means for each of the contaminants. Several of the contaminants were found to be above their cancer CV. However, it is important to note that the CVs for cancer risk do not establish a level at which people exposed above the CV are expected to get cancer. Rather, cancer CVs allow health assessors to estimate the number of unexpected (extra/excess) cancers that might be caused if a group of people were exposed to a contaminant whose levels is above the cancer CV. The estimated cancer risk assumes a daily exposure, 24 hours a day for 30 years over a 70-year lifetime.

Comparison with Background Levels

To determine how the Treasure Valley air compared to other regions of the U.S., contaminant levels from the five monitoring stations were compared to ambient background levels in North America. These background levels are taken from the published paper *Background concentrations of 18 air toxics for North America* (McCarthy et al., 2006). In this paper the authors use measurements available from monitoring networks in North America to estimate background concentrations of hazardous air pollutants. Comparing monitored levels to background levels does not provide an estimate of risk but it does provide an idea of how levels of air contaminants in one location compare to averages in rural and urban areas in North America.

Discussion

Acute and Chronic Risks

By comparing the highest mean levels of each contaminant to its acute and chronic CV value it was found that exposure is not likely to result in any acute or chronic adverse non-cancer health effects. Most of the highest mean values were many times below their chronic CV value, and even further below their acute CV value. Also, no individual 24-hour sample at any of the locations exceeded any of the acute CV values. These data are available in IDEQ's Treasure Valley Air Toxics Final Report (2009). The only two contaminants that were close to their chronic CVs were acetaldehyde and formaldehyde. The highest mean for acetaldehyde was 2.18 $\mu g/m^3$ and its chronic CV is 9.0 $\mu g/m^3$ or 4.1 times greater than the highest mean. The highest mean for formaldehyde was 4.61 $\mu g/m^3$ and the CV is 10.0 $\mu g/m^3$ or 2.1 times greater than the highest mean. Since no contaminant was above its chronic CV, it is thought that breathing the air is not expected to harm health or increase risks for chronic diseases.

It is important to note that this report looks at individual contaminants and determined if those contaminants were above health screening values. For those individual contaminants, BCEH concludes that the levels reported in this report are not expected to harm health or increase the risk for chronic diseases. This report did not have data on particulate matter (PM) or ozone levels, two air pollutants known to cause health problems for those with asthma and those with heart or lung disease, so BCEH can not comment on their possible health effects.

Cancer Risks

When comparing the contaminants with their respective cancer CVs, it was found that acetaldehyde, arsenic, benzene, carbon tetrachloride and formaldehyde were above their cancer screening CV. The extra cancer calculations are shown in Appendix B.

To determine extra cancer risk, the following formula was used:

Extra Cancer Risk = C x IUR

C = highest mean concentration of the contaminant
IUR = Inhalation Unit Risk (EPA)

When reviewing the extra cancer risk, it is important to know that the methods used to derive the Inhalation Unit Risk values result in upper bound estimates of extra cancers, that is, the true risk is not likely to exceed this value and may be much lower. The calculations in Appendix B estimated that:

- The highest cancer risk level for this continual exposure to <u>benzene</u> is 12 extra cancers per one million people exposed or 1 extra cancer in 100,000 people. The cancer endpoint considered is leukemia.
- The highest cancer risk level for this continual exposure to <u>formaldehyde</u> is 60 extra cancers per one million people exposed or 6 extra cancers in 100,000 people. The cancer endpoint considered is upper respiratory tract cancer.
- The highest cancer risk level for this continual exposure to <u>acetaldehyde</u> is 4.8 extra cancers per one million people exposed. The cancer endpoint considered is upper respiratory tract cancer.
- The highest cancer risk level for this continual exposure to <u>arsenic</u> is 2.3 extra cancers per one million people exposed. The cancer endpoint considered is skin, lung and bladder cancer.
- The highest cancer risk level for this continual exposure to <u>carbon tetrachloride</u> is 6.8 extra cancers per one million people exposed. The cancer endpoint considered is liver cancer.

The Inhalation Unit Risk is the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 $\mu g/m^3$ in air. For example, it is possible that for every one million people there could be 60 extra (unexpected) cases of cancer in people exposed to the highest average of formaldehyde under these circumstances. These extra cases might be attributable to formaldehyde exposure. Formaldehyde was clearly the highest extra risk of all contaminants measured. It is important to note that cancer risk estimates do not provide definitive answers about whether or not a person will get cancer; rather, they are measures of chance (probability).

At first glance, it may seem intuitive to add up the cancer risks for all the contaminants to arrive at a single risk number. However, this is only valid for cancers that occur at the same site in the body. The cancer endpoints listed above for each contaminant are for a specific site in the body. We may add together the cancer risks for the two aldehydes to get the following:

- Acetaldehyde + formaldehyde = *65 extra upper respiratory tract cancers* in 1 million or 6-7 extra cancers per 100,000

Thus, the site in the body at greatest risk for developing cancers from lifetime exposure to ambient air in the region is the upper respiratory tract; however, this risk is still considered to be low.

Cancer is a common illness, with many different forms that result from a variety of causes; not all are fatal. According to the American Cancer Society, men have almost a 1 in 2 lifetime risk of developing cancer and for women the risk is a little more than a 1 in 3 lifetime risk. Lifetime risk refers to the probability that an individual, over the course of a lifetime, will develop or die from cancer. Since cancer is very common and the highest site-specific risk estimate for the estimated exposure is 6-7 excess cancers per 100,000 people exposed, it is likely impossible to distinguish these potential excess cases from normal levels of cancer in the area. It must also be noted that using the highest mean value to calculate the extra cancer risk is a conservative approach and will likely overestimate the cancer risk since not everyone will be exposed to the highest concentration for 24 hours a day for a lifetime.

Comparison with Background Levels

According to the McCarthy et al. paper on ambient background levels of hazardous air pollutants in North America, the formaldehyde, acetaldehyde and benzene levels in the Treasure Valley are comparable to levels that are found in urban areas, but much higher than what is found in rural areas across North America. See Table 2 below. Note that median values are used for comparison. The study does not list mean levels for urban areas due to outliers in the data, but it does list mean levels for remote areas. In remote areas, the mean formaldehyde concentration was 0.2 $\mu g/m^3$, the mean acetaldehyde concentration was 0.16 $\mu g/m^3$, and the mean benzene concentration was 0.142 $\mu g/m^3$. Clearly, all monitors in the 2007 Treasure Valley study regularly exceed these remote background levels, but are similar to levels found in cities across the U.S. Median arsenic concentration was found to be much higher in the Treasure Valley than in the 'regional background' cited by McCarthy et al. This is not surprising, however, since Idaho and much of the west has higher naturally-occurring arsenic in soil and dust than the rest of the country. Median carbon tetrachloride in the Treasure Valley was approximately half of the urban background level reported nationwide.

Table 2. Urban Background Levels of Contaminants Above Their Cancer CVs
Sampling median values are the median from the highest single site sampled.

Contaminant	Urban Background (UB) Median[1] Level (µg/m^3)	Treasure Valley (TV) Median[1] Values (µg/m^3)	Ratio of TV Median to UB Median (%)
Acetaldehyde	1.62	1.85	114%
Arsenic	0.00013*	0.00029	223%
Benzene	1.09	1.43	131%
Carbon tetrachloride	0.62	0.30	48%
Formaldehyde	2.55	2.71	106%

[1]Only median values were available in the literature on urban background values.
*Arsenic is given as a regional Arsenic PM 2.5 background, not specifically urban and not necessarily total arsenic.

Uncertainties
It was decided that only those contaminants that were found in 25% or more of the samples would be used in the health effects analysis. The cutoff point of 25% or greater is arbitrary and may have overestimated actual exposure, but provides a conservative estimate for exposure. The rationale for using this cutoff is based on the use of chronic exposure comparison values. Since the chronic exposure comparison values are based on continual exposure over the course of months or years, it would be unrealistic to assess exposure to those contaminants that were rarely detected and are not continually in the air. While including contaminants that were only found in 25% or more of the samples may overestimate exposures, it does allow for more contaminants to be examined to in this assessment and is a more realistic assessment for the area as a whole.

Assigning non-detects to the value of half the lab minimum detection limit is arbitrary and may over- or underestimate exposure.

As with most ambient air monitoring, the data reviewed in this health consultation were collected at fixed-position monitoring stations and, thus, only reflect air quality at these specific locations. It is possible that other parts of the valley that have not been sampled could have higher or lower concentrations of air contaminants than those reported here. Also, since the sampling was done on a once in every six days schedule, it is not possible to know the levels of contaminants on the other days; therefore, there is the possibility that some of the maximum air contaminant levels were not captured and that could possibly change the mean values used in the risk analysis.

While it is possible to introduce bias by assigning non-detects a value of one half the detection limit, the detection limit for all compounds measured was well below the CV for each contaminant.

ATSDR Child Health Considerations

ATSDR and BCEH recognize that children may be more sensitive to contaminant exposures than adults. This sensitivity is a result of several factors: 1) children may have greater exposures to environmental toxicants than adults because, pound for pound of body weight, children drink more water, eat more food, and breathe more air than adults; 2) children play outdoors close to the ground, increasing their exposure to toxicants in dust, soil, water, and air; 3) children have a tendency to put their hands in their mouths while playing, thereby exposing them to potentially contaminated soil particles at higher rates than adults (also, some children ingest non-food items, such as soil, a behavior known as “pica”); 4) children are shorter than adults, meaning that they can breathe dust, soil, and any vapors close to the ground; and 5) children grow and develop rapidly; they can sustain permanent damage if toxic exposures occur during critical growth stages.

As discussed earlier, exposure to the measured contaminants in ambient air is unlikely to result in any adverse non-cancer public health effects to children or adults. The health endpoint considered in this consultation is an increased risk of cancer in the exposed population. Since cancer risk is based on lifetime exposure, the risk is considered the same for both adults and children.

Conclusions

Since the levels of contaminants in the air were all below the chronic exposure CVs, BCEH concludes that breathing the air in the Treasure Valley is not expected to harm people’s health or result in any increase in chronic non-cancer diseases. Further, although some of the individual contaminants in air were above their cancer CV, none were high enough to increase the cancer risk sufficiently above what would normally occur in the community from other causes. In other words, based on cancer statistics the estimated increase in cancer risk is not very different from the normal background cancer risk for populations living in urban areas. The site in the body at greatest potential risk for developing cancers above background levels from lifetime exposure to ambient air in the region is the upper respiratory tract; however, this risk is still considered to be low. Therefore, BCEH concludes that breathing the air in the Treasure Valley will not result in an elevated cancer risk above background risk levels for residents.

Since the urban areas of the Treasure Valley have the highest levels of contaminants, it is important that efforts be made to address ways to reduce these levels which will help to lower levels of particulate matter and ozone producing chemicals. Also by further reducing the levels of air toxics, the predicted risks could be lowered even more. Decreasing the levels of formaldehyde and acetaldehyde would benefit the community and reduce risks throughout the airshed. An overall decrease in air pollutants would also likely help to reduce cases of asthma as well as decrease lung and heart disease in the Treasure Valley.

Recommendations

- BCEH will work with IDEQ to relay the findings to the public.
- BCEH recommends that another year-long air toxics monitoring project be undertaken by IDEQ in 2012-2013 as a five year follow-up to the 2007-2008 monitoring discussed in this report.

Public Health Action Plan

Actions underway

BCEH is coordinating with the IDEQ Air Quality Program to present the findings of the reports to the public in the Boise metro area.

Actions planned
BCEH will continue to provide the IDEQ Air Quality Program with technical assistance as requested.

BCEH will work with IDEQ to inform the public and private sectors in the Treasure Valley on ways to reduce air pollution.

Appendix A

Monitoring Sites and the Maximum and Mean Levels of Contaminants that Exceeded Cancer CV

Table A1: White Pine Elementary				
Compound	**Maximum**	**Mean**	**Cancer CV**	**% Above Reporting Limit**
Benzene	3.10	1.26*	0.1	100
Formaldehyde	8.06	2.36*	0.08	98
Acetaldehyde	6.12	1.81	0.5	100
Arsenic	0.00107	0.00027	0.0002	96
All values are in µg/m^3. Note that CV values are for chronic exposure scenarios and cannot be directly compared to maximums. *Denotes mean value is more than 10x the cancer CV.				

Table A2: Mountain View Elementary				
Compound	**Maximum**	**Mean**	**Cancer CV**	**% Above Reporting Limit**
Benzene	3.77	1.58*	0.1	96
Formaldehyde	6.52	1.94*	0.08	100
Acetaldehyde	6.01	1.38	0.5	100
Arsenic	0.00125	0.00034	0.0002	93
All values are in µg/m^3. Note that CV values are for chronic exposure scenarios and cannot be directly compared to maximums. *Denotes mean value is more than 10x the cancer CV.				

Table A3: St. Luke's Regional Medical Center, Meridian Campus				
Compound	**Maximum**	**Mean**	**Cancer CV**	**% Above Reporting Limit**
Benzene	1.92	0.78	0.1	92
Formaldehyde	15.06	4.61*	0.08	100
Acetaldehyde	5.59	2.18	0.5	100
Arsenic	0.00104	0.00031	0.0002	96
Carbon tetrachloride	0.88	0.45	0.16	32
All values are in µg/m^3. Note that CV values are for chronic exposure scenarios and cannot be directly compared to maximums. *Denotes mean value is more than 10x the cancer CV.				

Table A4: Northwest Nazarene University				
Compound	**Maximum**	**Mean**	**Cancer CV**	**% Above Reporting Limit**
Benzene	2.78	0.96	0.1	92
Formaldehyde	4.77	1.94*	0.08	98
Acetaldehyde	3.42	1.45	0.5	100
Arsenic	0.00289	0.00040	0.0002	91
Carbon tetrachloride	0.90	0.44	0.16	29
All values are in µg/m^3. Note that CV values are for chronic exposure scenarios and cannot be directly compared to maximums. *Denotes mean value is more than 10x the cancer CV.				

Table A5: Parma				
Compound	**Maximum**	**Mean**	**Cancer CV**	**% Above Reporting Limit**
Benzene	4.03	0.80	0.1	92
Formaldehyde	5.58	1.64*	0.08	98
Acetaldehyde	3.66	1.38	0.5	98
Arsenic	0.00145	0.00053	0.0002	98
All values are in µg/m^3. Note that CV values are for chronic exposure scenarios and cannot be directly compared to maximums. *Denotes mean value is more than 10x the cancer CV.				

Appendix B
Cancer Calculations

Benzene Risk Calculation

Benzene: using highest measured 1 year average concentration at a single site (Mountain View Elementary)

Lifetime
Inhalation Unit Risk = 7.8×10^{-6} ($\mu g/m^3$)$^{-1}$
Risk = Concentration ($\mu g/m^3$) x Unit Risk ($\mu g/m^3$)$^{-1}$ = $1.58 \times (7.8 \times 10^{-6})$
= 12.32×10^{-6}

12.32 in 1 million excess cancer risk

Cancer Risk Comparison Levels = $\mathbf{1 \times 10^{-6}}$

Formaldehyde Risk Calculation

Formaldehyde: using highest measured 1 year average concentration at a single site (St. Luke's Regional Medical Center, Meridian Campus)

Lifetime
Inhalation Unit Risk = 1.3×10^{-5} ($\mu g/m^3$)$^{-1}$
Risk = Concentration ($\mu g/m^3$) x Unit Risk ($\mu g/m^3$)$^{-1}$ = $4.61 \times (1.3 \times 10^{-5})$
= 59.9×10^{-6}

59.9 in 1 million excess cancer risk

Cancer Risk Comparison Levels = $\mathbf{1 \times 10^{-6}}$

Acetaldehyde Risk Calculation

Acetaldehyde: using highest measured 1 year average concentration at a single site (St. Luke's Regional Medical Center, Meridian Campus)

Lifetime
Inhalation Unit Risk = 2.2×10^{-6} ($\mu g/m^3$)$^{-1}$
Risk = Concentration ($\mu g/m^3$) x Unit Risk ($\mu g/m^3$)$^{-1}$ = $2.18 \times (2.2 \times 10^{-6})$
= 4.80×10^{-6}

4.80 in 1 million excess cancer risk

Cancer Risk Comparison Levels = $\mathbf{1 \times 10^{-6}}$

Arsenic Risk Calculation

Arsenic: using highest measured 1 year average concentration at a single site (Parma)

Lifetime

Inhalation Unit Risk = 4.3×10^{-3} $(\mu g/m^3)^{-1}$

Risk = Concentration $(\mu g/m^3)$ x Unit Risk $(\mu g/m^3)^{-1}$ = $0.00053 \times (4.3 \times 10^{-3})$

= 2.28×10^{-6}

2.28 in 1 million excess cancer risk

Cancer Risk Comparison Levels = $\mathbf{1 \times 10^{-6}}$

Carbon Tetrachloride Risk Calculation

Carbon Tetrachloride: using highest measured 1 year average concentration at a single site (St. Luke's Regional Medical Center, Meridian Campus)

Lifetime

Inhalation Unit Risk = 1.5 x 10-^{5} $(\mu g/m^3)^{-1}$

Risk = Concentration $(\mu g/m^3)$ x Unit Risk $(\mu g/m^3)^{-1}$ = $0.45 \times (1.5 \times 10^{-5})$

= 6.75×10^{-6}

6.75 in 1 million excess cancer risk

Cancer Risk Comparison Levels = $\mathbf{1 \times 10^{-6}}$

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Certification

This health consultation, *Treasure Valley Air Toxics Monitoring 2007-2008: Evaluation of Potential Health Effects from Air Toxics*, was prepared by the Idaho Division of Public Health (IDPH) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

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Glossary

Acute - Occurring over a short time.

Agency for Toxic Substances and Disease Registry (ATSDR) - The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.

Airshed - A part of the atmosphere that behaves in a coherent way with respect to the dispersion of contaminants.

Cancer Slope Factor - A number assigned to a cancer causing chemical that is used to estimate its ability to cause cancer in humans.

Carcinogen - A substance that causes cancer.

Chronic - Occurring over a long time (more than 1 year).

Comparison value (CV) - Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Contaminant - A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Cancer Risk Evaluation Guide (CREG) - A concentration in air, water, or soil (or other environmental media), that is derived from EPA's cancer slope factor and carcinogenic risk of 10E-6 for oral exposure. It is the concentration that would be expected to cause no more than one excess cancer in a million persons exposed over a lifetime.

Dose - The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Environmental Media Evaluation Guide (EMEG) - A concentration in air, soil, or water (or other environmental media), that is derived from ATSDR's MRL, and below which adverse non-cancer health effects are not expected to occur. Separate EMEGs can be derived to account for acute, intermediate, or chronic exposure durations.

Exposure - Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute**], of intermediate duration [**intermediate**], or long-term [**chronic**].

Hazardous substance - Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.

IDEQ - The Idaho Department of Environmental Quality.

Inhalation rate - The amount of an environmental medium which could be inhaled typically on a daily basis. Units for inhalation rate are typically in cubic meters per day.

Inhalation unit risk - The upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 ug/m 3 in air.

Intermediate - Occurring over a time more than 14 days and less than one year.

Media - Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.

Minimal Risk Level (MRL) - An **MRL** is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects.

Organic - Compounds composed of carbon, including materials such as solvents, oils, and pesticides which are not easily dissolved in water.

Plume - A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Public Health Hazard - A category used in ATSDR’s health consultation reports for sites that pose a risk to health because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances that could result in harmful health effects.

Route of exposure - The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].