

# Health Consultation

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BROADWAY CLEANERS SITE

Indoor Air Data Evaluation & Risk Assessment,  
Boise State University Campus

BOISE, ADA COUNTY, IDAHO

SEPTEMBER 28, 2007

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

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

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

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HEALTH CONSULTATION

BROADWAY CLEANERS SITE

Indoor Air Data Evaluation & Risk Assessment,  
Boise State University Campus

BOISE, ADA COUNTY, IDAHO

Prepared By:

The Idaho Department of Health and Welfare  
Division of Health  
and  
The Agency for Toxic Substances and Disease Registry  
Division of Regional Operations

## **Foreword**

The Bureau of Community and Environmental Health (BCEH), Idaho Department of Health and Welfare, Idaho Division of Health (IDOH) 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 IDOH 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 a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

For more information about ATSDR, contact the ATSDR Information Center at 1-888-422-8737 or visit the agency's Web site: [www.atsdr.cdc.gov/](http://www.atsdr.cdc.gov/).

## **Summary**

In July 2000, the Idaho Department of Environmental Quality (IDEQ) cited the Broadway Center Laundry (BCL) for pouring separator water containing perchloroethylene (PCE) into a storm drain located in the south end of the BCL parking lot. An investigation by IDEQ determined that the former BCL owner had been dumping PCE-containing water for a number of years into the storm drain. By the time it was discovered, the PCE had moved down through the soil into the groundwater. The groundwater, moving in a general northwestern direction, has spread the PCE contamination underground through an area of the Boise State University (BSU) campus. Both PCE and the related compound trichloroethylene (TCE) are detectable at many monitoring wells across campus. As a result of the BSU Administration's concern about groundwater contamination, the Bureau of Community and Environmental Health (BCEH), Idaho Division of Health (IDOH) was asked to determine if there are any human health risks associated with the contamination. BCEH was specifically asked to evaluate whether employees, students, and residents of the BSU campus are being exposed to harmful levels of these contaminants in indoor areas.

### **What is Perchloroethylene (PCE)?**

PCE is a chemical widely used for dry cleaning of fabrics and enters the environment mostly by evaporating into the air during use. However, dumping this chemical into storm drains, sewage systems, or directly onto land can lead to groundwater and soil contamination. Due to the large amount of PCE-containing water dumped into a storm drain by BCL, the groundwater and surrounding soil has remained contaminated despite remediation in the immediate vicinity of the storm drain. The PCE has also spread as a result of coming into contact with the groundwater.

### **How could someone be exposed to PCE?**

PCE can enter the body when someone breathes air, eats food or drinks water that contains it. People are routinely exposed to small amounts of PCE from clothes that have been dry cleaned. On the BSU campus, it is possible that vapor from contaminated groundwater could get into human-occupied buildings. Breathing this vapor could be potentially hazardous to human health.

### **What are the possible health effects?**

With proper controls, PCE has generally been used safely by industry, including dry cleaners. If someone is exposed to PCE, most of it leaves the body from the lungs within a few days. This is true whether someone takes in the chemical by breathing, eating or drinking it. At extremely high levels, sometimes found in work environments, individuals may suffer health effects that include dizziness, headache, confusion, nausea and loss of consciousness. PCE is known to cause cancer in animals at high doses, and is considered a possible human carcinogen. However, it is not known if low levels of PCE in air increase the risk of cancer in people. Because of these possible health effects, BSU

Environmental Health and Safety conducted indoor air monitoring of the affected buildings in 2003 and BCEH repeated indoor air monitoring with BSU in 2007.

### **Findings**

Based on a thorough examination of the air monitoring results, BCEH has determined that the indoor PCE levels pose *no apparent public health hazard* to students, staff, or others at BSU. No TCE was detected in indoor air. This means that although there is PCE and TCE contamination in the groundwater and detectable PCE in the air of a few BSU buildings, the levels are low enough that if someone were to be exposed 40 hours per week (a typical work week) for 25 years, this exposure would not be expected to cause harmful health effects.

### **Recommendations**

Since the exposure to PCE in indoor air is not expected to cause harmful health effects, there are no actions that need to be taken at this time to change students' or employees' behaviors or to modify buildings.

### **Planned Actions**

BCEH, with the support of BSU Environmental Health and Safety, will hold an informational meeting on the BSU campus to communicate findings of this health consultation.

## **Purpose and Statement of Issues**

The Bureau of Community and Environmental Health (BCEH), Idaho Division of Health (IDOH) has conducted this health consultation at the request of Boise State University (BSU). The purpose of this consultation is to evaluate whether employees, students, and residents of the Boise State University campus are being exposed to harmful levels of the solvents tetrachloroethylene/perchloroethylene (PCE) and its related by-products, such as trichloroethylene (TCE). Since solvents are known to be present and mobile in groundwater under the BSU campus, this assessment focuses on vapor intrusion from groundwater and soil vapor into human-occupied buildings. Vapor intrusion which allows chemicals to enter into buildings can cause the indoor air to be harmful. This health consultation by BCEH was completed under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

## **Background**

In July 2000, the business, Broadway Center Laundry (BCL), was discovered to be illegally pouring separator water containing PCE into a storm drain located in the south end of their parking lot. At that time, the Idaho Department of Environmental Quality (IDEQ) determined from the BCL manager that the former BCL owner/operator had been dumping PCE-containing water for an indeterminate number of years. This storm drain is being considered the point source for the groundwater PCE/TCE plume that continues to spread under the BSU campus. The owner/operator responsible for the dumping is no longer in business, and the new owner of the property and surrounding shopping center, Broadway Plaza Limited Partnership (BPLP) has agreed to perform reasonable actions to address the problem. HDR Engineering, a Boise area consulting firm, was hired by BPLP and has conducted sampling and analysis of groundwater, soil and soil vapor since June 2001. BPLP also entered into a Voluntary Consent Order with IDEQ in 2003 to address the contamination. Monitoring wells were constructed and monitoring at these wells and at irrigation wells across the BSU campus has been conducted quarterly since 2003. In October 2005, the remaining contamination source was removed through excavation of the existing storm drain and surrounding soils. Clean fill was put back in the hole, and a new storm drain constructed. As a result of university officials' concern about known groundwater contamination and potential vapor intrusion into BSU buildings on campus, BCEH began a health consultation for the site in 2006.

## **Site Description**

BSU is an urban campus located in Boise, ID. The majority of the site is on the grounds of the BSU campus with the remainder on public city streets and right-of-ways. There are no private residences or businesses in the path of the PCE plume, though a number of houses used as offices by BSU are affected. The campus is bounded by the Boise River to the north, Beacon Avenue to the south, Broadway to the east, and Capitol Way to the west (Figure 1).

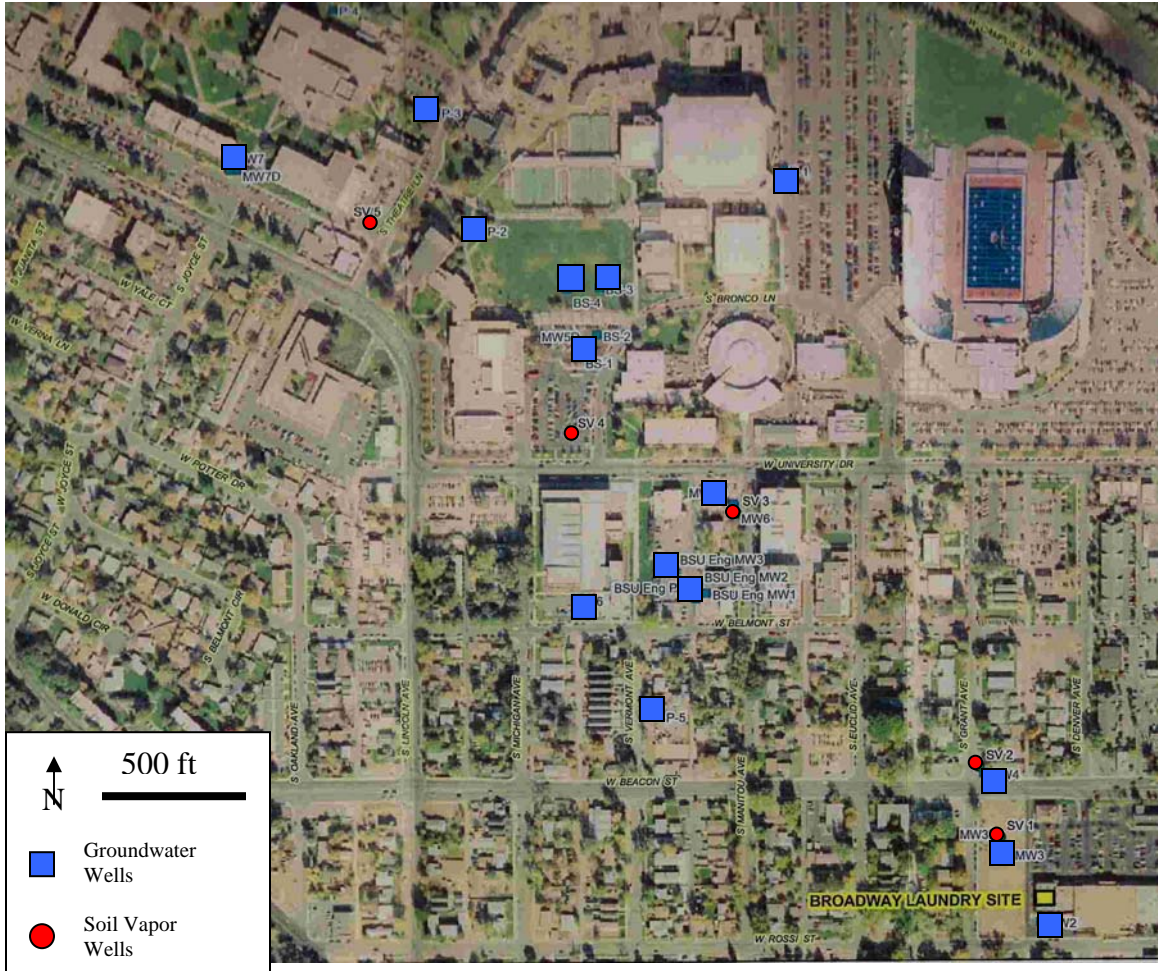


Figure 1. Map of Broadway Center Laundry Site and Boise State University Campus showing sampling locations for groundwater and soil vapor. Several groundwater wells exist in some locations marked here.



## Source of Contamination

PCE and TCE have been detected in groundwater samples and soil vapor samples collected from monitoring wells across the BSU campus. The source of this contamination was the acknowledged dumping of waste from a dry cleaner located at 1217 Broadway Avenue, in the southwest corner of the Broadway Plaza shopping center and faces Rossi Street to the south (Figure 2).

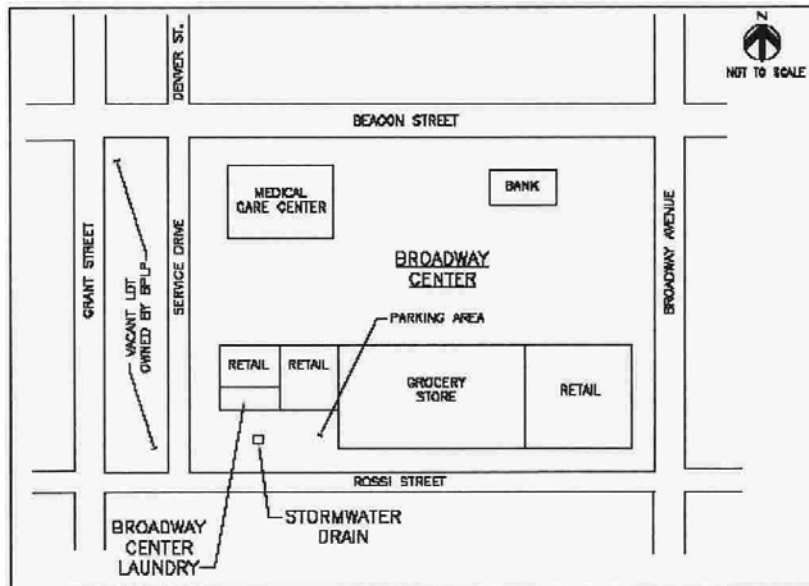


Figure 2: Broadway Center Laundry Site, Source of Contamination

## Rationale for Indoor Air Sampling

Often when vapor intrusion is suspected, vapor intrusion air models will be run to predict indoor concentration from nearby soil vapor concentrations. Recent studies have shown that outdoor soil vapor samples must be taken immediately adjacent to the building of interest in order to obtain meaningful indoor vapor estimates (EPA 2002; Hers et al. 2001). None of the soil vapor sampling wells at Boise State was very close to the buildings of concern for vapor intrusion. In fact, the nearest vapor well to any of the buildings of concern was approximately 100 meters away. It was decided that vapor concentration next to and underneath the buildings of concern could not be inferred by using these far away soil vapor concentrations. Thus, indoor air sampling was indicated.

Buildings of concern included those with basements, those very close to the highest soil vapor levels, and/or those whose occupants are more susceptible to chemicals such as children. Basements are typically prone to greater vapor intrusion than buildings on or above soil grade (Sheehan et al. 2005) because they are closer to the water table, where groundwater and concurrent volatile organic chemicals are present (Figure 3). At BSU, basements were of a particular concern because they all had floor drains, because the

groundwater is actively pumped from around the foundations of these buildings to keep water from entering, and because this pumped water has consistent levels of PCE in it at the point of outfall.

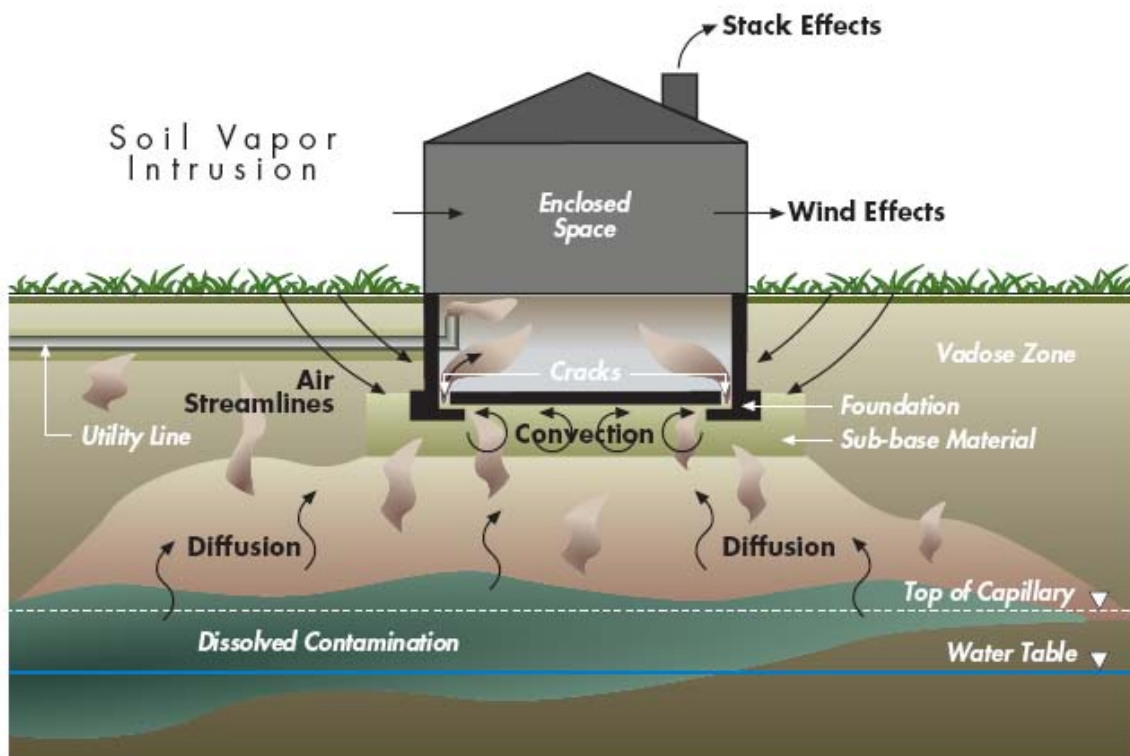


Figure 3: Cross section of ground and building showing pathways of soil vapor intrusion (Source: Exponent Inc.).

## Sampling

### Environmental Sampling

Ongoing monitoring with groundwater wells, GeoProbe samplers, and soil vapor sampling has helped delineate a consistent Northwesterly movement of the plume. Recent monitoring suggests the plume has widened and now includes dormitories on the north edge of campus near the Boise River (Figure 4). In this health consultation, environmental samples were used solely to determine which buildings were best candidates for indoor air sampling.

### Buildings of Concern Selected for Indoor Air Sampling

Buildings within the plume were of a concern, and in particular, those buildings with occupied below grade space. Two of these buildings are dormitories that have occupied dwelling space in the basement below grade. Other buildings of concern for potential inhalation exposure to PCE/TCE include a child development center (all above grade with a vented crawl space), the sporadically-occupied basement of the Administration Building, the occupied offices/lab space in the half basement of the Hemmingway Center,

and the office/work space below grade in the heat plant. All below grade building spaces have floor drains that can be a conduit for soil vapor intrusion. The heat plant also has an open sump where groundwater collects.



Figure 4: Map of BSU campus showing location of sampled buildings in relation to general path of the PCE plume.

Indoor air sampling in 4 buildings on the BSU campus took place in the Fall of 2003. Since that time the plume has spread (see Figure 4 for plume's current extent). Sampling was jointly conducted by the BSU Environmental Health and Safety Office and Bionomics, a Boise-based consulting firm. Locations of the 2003 indoor sampling are shown in Table 1. Since two of these buildings (Boise/Meridian School District Building, Micron Engineering Building) had non-detectable levels in 2003 and do not have permanently occupied or dwelling space below grade, we are not currently concerned about vapor intrusion. It was deemed important to re-sample the child development center, since it is very close to the source of the plume, it is close to the sampling wells with the highest PCE levels, and it is occupied by children. Also, it was deemed important to re-sample the basement of the Administration Building since office space is being developed.

Table 1: October 2003 Charcoal Tube Indoor Air Sampling Locations

<b>Building</b>	<b>Sampled Location</b>	<b>Notes</b>
Child Development Center	Office, West side of building	Carpeted, wood subfloor; above grade with crawl space below
Administration Building	Basement, East side	Carpeted, concrete subfloor
Boise/Meridian Schools Building	Main floor, South side of kitchen	Linoleum, slab subfloor
Micron Engineering Building	Main floor, South side lecture hall	Carpeted, concrete subfloor

Indoor air sampling was repeated in June and August 2007 by BCEH, in collaboration with Boise State University's Department of Environmental and Community Health, in inhabited spaces below grade (basement or half basement). Sampling was conducted during break when no students were present on campus. This helped decrease the chances of intentional or accidental interference with the sampling equipment. This also meant buildings and rooms remained closed most of the day, which should represent a 'worst case scenario' because closed and unoccupied rooms are more likely to concentrate chemical vapors since little air exchange occurs. Furthermore, the temperature of these below grade spaces remains fairly constant year-round since all are climate controlled.

The buildings sampled were the child development center; two dormitories, Morrison Hall and Driscoll Hall; the Administration Building; the Hemmingway Center (Department of Anthropology); and a building that houses the campus heat plant and offices for physical plant workers. Table 2 below shows the site of current indoor air sampling within each of these buildings. Figure 4 shows the location of each building on campus and in relationship to the plume.

Table 2: June and August 2007 Summa Canister Indoor Air Sampling Locations

<b>Building</b>	<b>Sampled Location</b>	<b>Notes</b>
Child Development Center	Main activity room	Carpeted, wood subfloor; above grade with crawl space below
Morrison Hall	Lounge/TV/Game Room	Carpeted, concrete subfloor; basement
Driscoll Hall	Lounge/TV/Game Room	Carpeted, concrete subfloor; basement
Administration Building 1	Office/Storage Room	Concrete floor, next to floor drain; basement
Hemmingway Center	Anthropology Department Lab Space	Concrete floor, next to floor drain; half basement
Heat Plant 1	South building, workshop area	Concrete floor, near floor drain; garage door closed
Heat Plant 2	North building, office area	Concrete floor, next to open groundwater sump; garage door closed

### **Indoor Air Sampling**

#### *2003 Sampling*

Indoor air sampling and sample analysis was conducted according to the National Institute of Occupational Safety and Health (NIOSH) Method 1003 (NIOSH 2003) and the Occupational Safety and Health Administration (OSHA) Method 7 (OSHA 2000). Low flow air pumps (0.2 Liters/minute) were used to draw air across charcoal sampling media encased in glass tubes. PCE and TCE vapor that might be in the indoor air is trapped on charcoal when air is drawn across it. Sampling took place during normal work hours, in the range of 8 am to 6 pm. Samplers were set for 8 hours; a few ran for a slightly longer or shorter duration; one ran for only approximately 3 hours due to a malfunction. Sample time was recorded and total volume of air computed in order to determine how much PCE and/or TCE was present per volume of air.

#### *2007 Sampling*

Summa canister sampling was conducted according to EPA Method TO-15. Samples were collected using 6-liter Summa canisters with preset constant flow control devices that allowed time-weighted samples to be collected over a 24-hr period. The 2007 sampling was funded with support from Dr. Dale Stephenson and the Department of Community and Environmental Health at BSU.

## **Analyses**

### **Environmental**

Groundwater and soil vapor samples were collected from 2000-present by HDR Engineering, Boise, ID. Samples were analyzed at Alchem Laboratories, Boise, ID using EPA method 8260, Gas Chromatography/Mass Spectrometry for Volatile Organics: Capillary Column Technique (EPA, 1990).

### **Indoor Air**

Indoor air samples collected in 2003 were analyzed at Wisconsin Occupational Health Laboratories, Madison, WI using the OSHA Method 7, Organic Vapors: Gas Chromatography with Flame Ionization Detection (OSHA 2000). Samples taken in 2003 were analyzed for PCE only. Summa canister samples taken in 2007 were analyzed for both TCE and PCE by DataChem Laboratories, Inc, Salt Lake City, Utah using EPA Method TO-15.

## **Results**

No TCE was detected in indoor air samples. PCE was detected in indoor air at two locations at very low levels in 2003 using the charcoal tube sampling method. Samples were above the reporting limit, but were not quantifiable due to interferences. Given known limitations of the charcoal tube method, Summa canisters were selected as the method of choice for the 2007 sampling.

The results of Summa canister sampling in the summer of 2007 are shown below. The method detection limit for this method is  $0.57 \mu\text{g}/\text{m}^3$ .

Table 3. Summa Canister Sampling, Perchloroethylene Concentrations in Occupied Below Grade Spaces on BSU Campus, June and August 2007

Building	Concentration ( $\mu\text{g}/\text{m}^3$ )	Comparison Values (CV) ( $\mu\text{g}/\text{m}^3$ )		
		Chronic CV <sup>1</sup>	Acute CV <sup>2</sup>	Cancer CV <sup>3</sup>
Administration	1.9	300	1000	0.33
Dorm 1 (Morison or Driscoll Hall)	ND	300	1000	0.33
Dorm 2 (Morison or Driscoll Hall)	ND	300	1000	0.33
Heat Plant	ND	300	1000	0.33
Heat Plant 2*	0.95	300	1000	0.33
Child Development Center	2.4	300	1000	0.33
Hemingway Center	2.6	300	1000	0.33

ND = non detection

\*Sampled in early August 2007

CV sources:

<sup>1</sup> ATSDR's Environmental Media Evaluation Guide

<sup>2</sup> ATSDR's Environmental Media Evaluation Guide

<sup>3</sup> EPA Region 6 Human Health Medium-Specific Screening Levels

BCEH uses ATSDR and U.S. Environmental Protection Agency (EPA) health-based comparison values for determining if the levels of contaminants may be harmful. Comparison values are based on health studies and toxicological studies. Contaminant concentrations below comparison values are not likely to pose a health threat, and are not further evaluated. If the level of a contaminant is found to be higher than its comparison value, further investigation is necessary to determine if the level of the contaminant really could cause harmful effects. The ATSDR non-cancer chronic comparison value for PCE is  $300 \mu\text{g}/\text{m}^3$ , and the acute comparison value is  $1000 \mu\text{g}/\text{m}^3$ . None of the samples exceeded the chronic or acute comparison values. The EPA Region 6 cancer comparison value (Human Health Medium-Specific Screening Level) for PCE is  $0.33 \mu\text{g}/\text{m}^3$ . Three locations exceeded this value: the Administration Building, the Child Development Center, and the Hemingway Center. However, none of these locations was above the average PCE background level (see Discussion below).

## Discussion

The purpose of this health consultation is to determine whether a public health hazard exists from exposure to PCE or TCE on the BSU Campus as a result of contamination from illegal dumping into the storm sewer at the Broadway Center Laundry site. Inhalation of indoor PCE/TCE vapor was the only potential exposure of concern at BSU. While detectable PCE/TCE exists in groundwater underlying most of campus, there is no

plausible exposure pathway by which people might be exposed to an amount of groundwater that would be a concern. PCE/TCE are also present as vapor in soil at various sites on campus, but this vapor either stays below the surface or, upon reaching the soil surface in outdoor areas, rapidly dissipates and mixes with the ambient air.

### **Background Levels**

The wide use of natural and synthetic chemicals is a part of modern life, and as a result, ambient and indoor air always contains low levels of these chemicals. Therefore, background levels of PCE must be examined in order to determine whether or not levels found at BSU are typical of urban indoor air. In a national study reported by Shah and Heyerdahl and Shah and Singh (1988), the background levels of PCE indoors were in the range of 1-10  $\mu\text{g}/\text{m}^3$  (25<sup>th</sup> to 75<sup>th</sup> percentile). In general, a mean indoor background level of 5  $\mu\text{g}/\text{m}^3$  is considered realistic for urban environments.

Table 3 shows that PCE levels were not above background level in any location on the BSU campus. It is therefore possible that what is found in our sampling at BSU is no different than what we might find inside any home or other building in an urban environment.

### **Findings and Comparison Values**

#### *Non-Cancer Endpoint*

Detectable PCE was approximately 115 times lower than the chronic non-cancer comparison value, and approximately 380 times lower than the acute comparison value. Therefore, BCEH believes that the low levels of PCE do not pose a non-cancer risk to any exposed populations.

#### *Cancer Endpoint*

The cancer comparison value for PCE is 0.33  $\mu\text{g}/\text{m}^3$  (EPA Region 6) and the detectable levels found on campus in 2007 were greater than this value. Cancer risk estimates are not yes/no answers but instead are measures of chance or probability of getting cancer. PCE is considered to be a probable cancer causing chemical by the International Agency for Research on Cancer. The EPA cancer health comparison value for PCE is set at the  $10^{-6}$  risk level. If exposure occurs at this level, it is possible that there will be one excess cancer for every 1 million people who are exposed to this concentration in air. Refer to Appendix A for a list of screening and acceptable risk values.

The comparison values for cancer risk do not establish a level where people exposed above the comparison value are expected to get cancer. The comparison values only provide an estimate of the number of unexpected cancers that might be caused if a group of people were exposed to contaminant levels above the comparison value every day for an assumed duration of 70 years. EPA Region 6 Human Health Medium-Specific Screening Levels assume continual 24 hour-a-day exposure for 70 years when calculating the chronic cancer comparison value cited here. However, none of the below-grade areas of buildings on campus are places where people spend 24 hours-a-day, so calculations must be adjusted accordingly to account for a more realistic exposure duration. None of the buildings of concern are residences. The dormitory basements contain lounge areas,



computer lab, and a kitchen, but not private residence or sleeping space. A student might be expected to live in one of these buildings for up to 4 years, but not any longer. The Administration building basement and Child Development Center are both workplaces where a single employee might spend an entire career. It is possible that a person might therefore have 8 hour-a-day, 5 day-a-week exposure at these locations. For these types of estimates, a period of 25 years is often used to approximate a person's tenure at a single job. Therefore, the realistic length of exposure was thought to be 250 days a year for 25 years. Using the highest level of PCE ( $2.6 \mu\text{g}/\text{m}^3$  at the Hemingway Center) in the analysis, BCEH determined that the estimated worker daily exposure dose is approximately  $4.5 \times 10^{-5}$  mg/kg-workday. This dose is below the EPA  $10^{-6}$  risk level. The risk level for this exposure dose is  $9 \times 10^{-7}$  or  $0.9 \times 10^{-6}$ . This means that it is possible to have slightly less than 1 excess cases of cancer in a million people exposed under these circumstances. 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). 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, nearly half of all men and one-third of all women in the U.S. population will develop cancer at some point in their lives. Since cancer is very common and the highest risk estimate for this estimated exposure is 0.9 excess cancers per 1 million people exposed, *BCEH believes that no apparent public health hazard exists*. Also, BCEH believes that no public health hazard exists because the highest concentration of PCE found was approximately half what is considered normal background level in urban environments. See Appendix B for exposure calculation assumptions and Appendix C for calculations.

### **Uncertainties**

There is one main limitation of this study which should be addressed. Sampling was not repeated in all seasons of the year, and sampling only lasted for at most 24-26 hours. Vapor concentration within a building can fluctuate appreciably depending on factors related to time of year (Zarus 2006). It is possible that the periods sampled here did not capture the peak levels or the lowest levels for the season or for the year, and that the mean time weighted average could be higher or lower than what was measured. The 2007 sampling in the summer was likely to capture near-peak concentration because the season for highest soil vapor concentration, based on 5 years of data at this site, is the summer season.

## **BSU Health Concerns**

The primary concern of BSU's Office of Environmental Health and Safety was that students and staff might be exposed to PCE or TCE in indoor air at levels that may pose a risk to human health. We have determined that no health hazard exists from exposure to indoor air sampled on campus. We believe that no buildings besides those sampled in 2007 are currently: 1) in the path of the PCE plume; and 2) have occupied rooms below ground level.

## **Children's Health Considerations**

The only concern for children's health at this site was the potential vapor intrusion at the Child Development Center. There are no other facilities within the plume path where children are present. Despite detectable PCE being slightly above the  $10^{-6}$  cancer screening level, this level will not pose a public health hazard because children spend only 4-5 hours per day at the center for a maximum of 2-3 years, not every day for an extended life period. Recent soil vapor monitoring data (2007) near this building (approximately 100 meters away) shows a marked decrease in PCE compared to soil vapor concentrations measured in 2003 at the same location. With the removal of the remaining source in 2005, soil vapor concentrations will continue to decline in this location.

## **Conclusions**

BCEH has determined that there is *no apparent public health hazard* from exposure to PCE or TCE at Boise State University (BSU) based on the indoor air monitoring results performed. While EPA screening guidelines were exceeded for PCE, it must be understood that these guidelines are meant as a starting point for further analysis, not as an explicit rule. Also, maximum levels of PCE found in this investigation were *below* what is considered to be the ambient indoor background level for urban areas in the U.S. In other words, it is possible that PCE exposure may be lower inside these buildings than the expected nationwide urban average. Cancer is very common and the highest risk estimate for this estimated exposure is less than 1 excess cancer per 1 million people exposed. Since lifetime exposure is not practically possible in the buildings of concern, and since the real exposure duration is likely short, risk due to exposure falls below a public health hazard level. This was demonstrated by the calculated 25 year, 40 hour-a-week scenario, which showed that risk from exposure would be less than a  $10^{-6}$  (1 in 1,000,000) cancer risk screening levels. PCE levels are expected to continue declining at this site given the removal of the remaining source in 2005.

## **Recommendations**

No action needs to be taken at this time to change students' or employees' behaviors or to modify buildings.

## **Public Health Advice/Public Health Action Plan**

### **Completed Actions**

The following is a list of actions that have already been completed:

- 1) BCEH staff met with Mark Jeffers and Dr. Jeff Fromm of IDEQ to discuss trends in groundwater and soil vapor data and to map the PCE plume path.
- 2) BCEH staff met with Cal Gillis, Director of Environmental Health & Safety, to discuss trends in groundwater and soil vapor data, and to walk through all buildings in the PCE plume path to determine a need for indoor air sampling.
- 3) BCEH staff discussed findings with Cal Gillis and Wendy Campbell, Occupational Hygienist with BSU Environmental Health & Safety.

### **Planned Actions**

BCEH, with the support of BSU Environmental Health and Safety, will hold an informational meeting on the BSU campus to communicate findings of this health consultation.

## **Author of Report**

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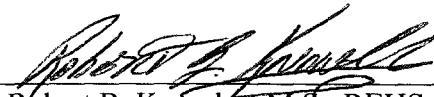
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## Certification

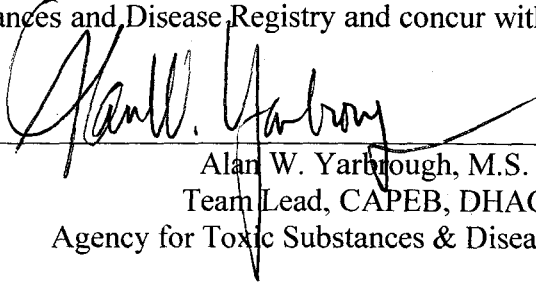
This health consultation, the Broadway Cleaners Site Indoor Air Data Evaluation & Risk Assessment, Boise State University Campus, Idaho, was prepared by the Bureau of Community and Environmental Health, Idaho Department of Health and Welfare, Idaho Division of Health (IDOH) under a cooperative agreement 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 ATSDR.



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Robert B. Knowles, M.S., REHS  
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Agency for Toxic Substances & Disease Registry

I have reviewed this health consultation, as the designated representative of the Agency for Toxic Substances and Disease Registry and concur with its findings.



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Alan W. Yarbrough, M.S.  
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Agency for Toxic Substances & Disease Registry

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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.

### **Aquifer**

An underground formation composed of materials such as sand, soil, or gravel that can store and/or supply groundwater to wells and springs.

### **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.

### **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.



**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**].

**Groundwater**

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces.

**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.

**Health Advisory (HA)**

Health Advisories (HA's) provide information on contaminants that do not have an MCL but that can cause human health effects and are known or anticipated to occur in drinking water.

**IDEQ**

The Idaho Department of Environmental Quality.

**Indeterminate public health hazard**

The category used in ATSDR's health consultation documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

**Ingestion rate**

The amount of an environmental medium which could be ingested typically on a daily basis. Units for ingestion rate are usually liter/day for water, and mg/day for soil.

**Intermediate**

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

**Lowest Observed Adverse Effect Level (LOAEL)**

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

**Maximum Contaminant Level (MCL)**

Enforceable drinking water quality standard set by US Environmental Protection Agency (EPA).

**Media**

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

**Monitoring wells**

Special wells drilled at locations on or off a hazardous waste site so groundwater can be sampled at selected depths and studied to determine the movement of groundwater and the amount, distribution, and type of contaminant.

**No apparent public health hazard**

A category used in ATSDR's health consultation reports for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

**Nonaqueous phase liquids**

Nonaqueous phase liquids (NAPLs) are chemicals that are present in the subsurface as a liquid. These can be individual chemicals like trichloroethylene (TCE), a solvent, or a mixture such as gasoline. Light NAPLs (i.e. LNAPLs) are liquids that float on the groundwater table and include chemicals like gasoline. Dense NAPLs (i.e. DNAPLs) are heavier than water and sink forming lenses or pockets of the chemical in a groundwater aquifer. Both LNAPLs and DNAPLs can also be found in the vadose zone as residue on soil particles or in pools or pockets on low permeability soil lenses.

**No Observed Adverse Effect Level (NOAEL)**

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

**No public health hazard**

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

**Oral Reference Dose (RfD)**

An amount of chemical ingested into the body (i.e., dose) below which health effects are not expected. RfDs are published by EPA.

**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.

**Remedial investigation**

The process of determining the type and extent of hazardous substance contamination at a site.

**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**].

**Appendix A**  
Contaminant Screening and Risk Values

<b>Chemical</b>	<b>Max Concentration</b> ( $\mu\text{g}/\text{m}^3$ )	<b>Noncancer Health Comparison Value</b> -ATSDR MRL ( $\mu\text{g}/\text{m}^3$ )	<b>Cancer Health Comparison Value -EPA</b> ( $10^{-6}$ excess risk) ( $\mu\text{g}/\text{m}^3$ )	<b>Cancer Acceptable Risk Value</b> -EPA ( $10^{-4}$ excess risk) ( $\mu\text{g}/\text{m}^3$ )
Perchloroethylene (PCE), also called Tetrachloroethylene	2.6	300	0.33	33

## Appendix B

Exposure assumptions for converting lifetime cancer risk to workplace exposure risk estimate

Parameter	Value	Unit	Comments
Max Concentration (C)	2.6	$\mu\text{g}/\text{m}^3$	
Inhalation Volume (IV), 8 hr	5	$\text{m}^3/\text{work day}$	24 hour volume = 15 $\text{m}^3/\text{day}$ , EPA Exposure Factors Handbook
Body Weight (BW)	70	kg	Low-end adult (female)
Exposure Frequency (EF)	250	Days/year	Assumes weekends off and two weeks' vacation per year
Exposure Duration (ED)	25	years	Assumed number of years working at one job
Averaging Time (AT)	70	years	Cancer risk lifetime assumption
Days per Year (DPY)	365.24	Days/year	Mean days per year, including leap years
Cancer Slope Factor (CSF)	0.002 ( $10^{-5}$ ) 0.02 ( $10^{-6}$ )	Kg-day/mg	EPA Region 9 ( $10^{-5}$ ) Superfund ( $10^{-6}$ )

## Appendix C

### Exposure Calculations

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Cancer risk is calculated by first determining an average daily dose over a person's working lifetime, then multiplying the dose by a cancer slope factor to produce a number that represents the probability of cancer related to that exposure.

C = concentration ( $\mu\text{g}/\text{m}^3$ )

CF = conversion factor ( $\mu\text{g}$  to  $\text{mg}$ )

IR = inhalation rate ( $\text{m}^3$  per day)

ET = workday exposure time (8 hours or 0.33 days)

EF = work schedule exposure frequency (days/year)

ED = working life exposure duration (years)

BW = body weight (kg)

AT = averaging time for cancer (years)

CF2 = conversion factor (years to days)

$$\begin{aligned}\text{DOSE (mg/kg-day)} &= \frac{\text{C} \times \text{CF} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times \text{CF2}} \\ &= \frac{2.6 \times 0.001 \times 15 \times 0.33 \times 250 \times 25}{70 \times 70 \times 365.24} \\ &= 4.5 \times 10^{-5} \text{ mg/kg-workday}\end{aligned}$$

$$\text{Risk} = \text{Exposure Dose (mg/kg-day)} \times \text{CSF (kg-day/mg)} = 4.5 \times 10^{-5} \times 0.02 = \mathbf{9 \times 10^{-7}}$$

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Cancer Risk Comparison Levels =  $\mathbf{1 \times 10^{-5}}$  and  $\mathbf{1 \times 10^{-6}}$