

# **Letter Health Consultation**

Health Risk Evaluations for Populations Exposed to Trichloroethylene and  
Tetrachloroethylene from Trex Properties, Charlotte, North Carolina

CHARLOTTE, MECKLENBURG COUNTY, NORTH CAROLINA

**Prepared by the**

**North Carolina Department of Health and Human Services**

January 4, 2016

*This report was supported in part by funds provided through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. The findings and conclusions in these reports are those of the author(s) and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services. This document has not been revised or edited to conform to agency standards.*

## **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.

*This report was supported in part by funds provided through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. The findings and conclusions in these reports are those of the author(s) and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services. This document has not been revised or edited to conform to agency standards.*

## LETTER HEALTH CONSULTATION

Health Risk Evaluations for Populations Exposed to Trichloroethylene and Tetrachloroethylene  
from Trex Properties, Charlotte, North Carolina

CHARLOTTE, MECKLENBURG COUNTY, NORTH CAROLINA

Prepared By:

North Carolina Department of Health and Human Services  
Division of Public Health

*This report was supported in part by funds provided through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. The findings and conclusions in these reports are those of the author(s) and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services. This document has not been revised or edited to conform to agency standards.*

January 4, 2016

John McCulloch  
Environmental Supervisor  
Charlotte-Mecklenburg Storm Water Services  
700 N. Tryon Street  
Charlotte, NC

Dear Mr. McCulloch,

The Health Assessment, Consultation and Education Program (HACE) in the Division of Public Health (DPH), North Carolina Department of Health and Human Services (NC DHHS) was contacted by N.C. Department of Environmental Quality (DEQ) regarding the Trex Properties site located at 3114 and 3124 Cullman Avenue in Charlotte, North Carolina. Prior data indicated the presence of chlorinated solvents, such as trichloroethylene (TCE) and tetrachloroethylene (PCE) in soil and groundwater both on- and off-site. Potentially exposed populations include workers at the site, workers at a nearby leather recycling company (Leather Trimmings), congregants at a nearby church (Nexus Church), and possibly a small group of transients with an encampment near the site. NC DEQ requested DPH's assistance with risk assessment of groundwater, surface water, and indoor air data, especially with respect to the vapor intrusion pathway.

There are currently no full time employees who work inside the Trex facilities, so exposure at the site property is not expected to harm people's health. TCE levels measured in indoor air at Leather Trimmings were elevated, indicating vapor intrusion. The DPH concludes that employee exposure to TCE at this site over long periods of time could harm people's health, especially sensitive subpopulations including pregnant women and their fetuses, and persons who are immunocompromised. Recommendations for the employer included increasing ventilation, introducing outdoor air, and resampling to confirm that TCE levels drop to an acceptable concentration. TCE levels measured at the nearby church were below non-residential levels of concern. The DPH concludes that TCE exposure at the church is not expected to harm people's health. Follow-up indoor air sampling is recommended for all affected businesses during the winter to fully assess the vapor intrusion pathway. Lastly, TCE and PCE levels measured in surface water in Little Sugar Creek at and downstream of the site were elevated above North Carolina's surface water human health standards<sup>1</sup>. There are no known uses of the creek, but there have been reports of a group of transients living nearby. If used for bathing and drinking by this encampment over a long period of time, exposure to these chemicals could harm people's health. The local health department took immediate action to post warning signs in English and

---

<sup>1</sup> North Carolina Surface Water Quality Standards are state regulations or rules that serve to protect the surface waters of the state from pollution. Surface waters are protected based on their classification established in Title 15A of the North Carolina Administrative Code (NCAC) subchapter 02B.

Spanish along the affected portions of the creek. The remainder of this letter will describe our assessment process and how we arrived at our conclusions and recommendations.

## **Background and Statement of Issues**

The Trex Properties site, located at 3114 and 3124 Cullman Avenue, Charlotte, North Carolina, has operated as a treatment, storage and disposal facility under a Resource Conservation and Recovery Act (RCRA) permit since 1983. Products, non-RCRA, non-hazardous, and other solid wastes such as used oil, are also stored at the facility (SAP 2014). The presence of volatile organic compounds (VOCs) in soil and groundwater is from past releases at the site in association with the containerization, distribution, and solvent recycling operations. These releases may have originated from leaks from connections between lines such as from the railcars to inside containers, leaking foot valves on rail cars, and overflowing of containers associated with the recycling still within the building (SAP 2014). TCE levels in groundwater collected in 2012 and 2014 exceeded the N.C. DEQ Division of Waste Management Non-Residential Vapor Intrusion Screening Level of 4.35 µg/L (DEQ 2015), with a maximum concentration of 422,000 µg/L in shallow groundwater collected in December 2014 (W&R 2015a). The DEQ contacted DPH in August 2015, just prior to surface water and indoor air sampling. Surface water results taken from Little Sugar Creek showed elevated levels of TCE and PCE. Indoor air sample results from Trex Properties, Leather Trimmings, and Nexus Church had detectable TCE levels, indicating the completion of the vapor intrusion pathway. The DPH advised on potential human health risk and provided recommendations for reducing or eliminating exposures from this site.

## **Discussion**

### *Environmental Analytical Data*

#### *Surface Water – Little Sugar Creek*

Surface water samples were collected from five locations in Little Sugar Creek<sup>2</sup> on August 18, 2015, including two upstream samples and three samples in the immediate vicinity of Trex Properties. To further delineate the extent of surface water contamination, follow-up sampling was conducted on Little Sugar Creek downstream from Trex on August 27 (6 locations) and September 3 (3 locations). TCE was detected at 10 locations, with a maximum concentration of 98 µg/L (SWS 2015), exceeding the North Carolina's surface water human health standard of 30 µg/L (NC 15A-2B). PCE was detected at seven locations, with a maximum concentration of 270 µg/L (SWS 2015), exceeding the North Carolina's surface water human health standard of 3.3 µg/L (NC 15A-2B). PCE was not detected at the furthest downstream sample, taken at a

---

<sup>2</sup> Little Sugar Creek in North Carolina is classified for use as "Class C" – waters protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner.

municipal park, and TCE concentration was 7 µg/L, below the North Carolina's surface water human health standard.

### *Indoor Air*

Indoor air and ambient air samples were collected at Trex properties and Nexus Church in August 2015. Indoor air and ambient samples were collected at Leather Trimmings on September 1, 2015. Air samples at Trex facilities were collected using the EPA TAGA bus, with measured concentrations of TCE in the 2000-3000 µg/m<sup>3</sup> range, far exceeding the N.C. DEQ Division of Waste Management Non-Residential Vapor Intrusion Screening Level of 1.75 µg/m<sup>3</sup> (DEQ 2015). Air samples at Nexus church were collected using the EPA approved 24-hour SUMMA canister collection method. Maximum PCE levels measured in indoor air at the church were 6.2 µg/m<sup>3</sup> (W&R 2015b), below the N.C. DEQ Division of Waste Management Non-Residential Vapor Intrusion Screening Level of 35 µg/m<sup>3</sup> (DEQ 2015). Maximum TCE levels measured in indoor air at the church were 6.2 µg/m<sup>3</sup> (W&R 2015b), exceeding the N.C. DEQ Division of Waste Management Non-Residential Vapor Intrusion Screening Level of 1.75 µg/m<sup>3</sup>. Air samples at Leather Trimmings were collected using the EPA approved 24-hour SUMMA canister collection method. Maximum PCE levels measured in indoor air at Leather Trimmings were 20.2 µg/m<sup>3</sup>, below the N.C. DEQ Division of Waste Management Non-Residential Vapor Intrusion Screening Level of 35 µg/m<sup>3</sup>. Maximum TCE levels measured in indoor air at Leather Trimmings were 27.8 µg/m<sup>3</sup> (W&R 2015c), exceeding the N.C. DEQ Division of Waste Management Non-Residential Vapor Intrusion Screening Level of 1.75 µg/m<sup>3</sup>. In all cases, indoor air samples had higher levels of TCE than ambient air. Corresponding soil gas data supports vapor intrusion as the exposure pathway.

### *Health Effect Evaluation*

#### *Non-Cancer Adverse Health Effects*

The ATSDR health effects evaluation process involves screening environmental analytical data from the site by comparing site contaminant concentrations to screening levels (SLs). Screening levels are developed by ATSDR as chemical concentrations in environmental media such as air. SLs are set at levels that are highly health protective, well below concentrations known or anticipated to result in adverse health effects. Contaminant concentrations at or below the SL may reasonably be considered safe and require no additional evaluation. When chemicals are found on a site at concentrations greater than the SL, it does not mean that adverse health effects would be expected, but it does identify that a more in-depth evaluation is warranted, such as comparing exposure concentrations to levels studied in human health effect and animal laboratory studies for the chemicals of concern.

### *Surface Water – Little Sugar Creek*

TCE and PCE concentrations in Little Sugar Creek exceeded North Carolina's surface water human health standards in the vicinity of Trex Properties, prompting further investigation. The potentially exposed population is a transient encampment located near the property. In order to estimate the amount, or dose, of TCE or PCE that transients may be exposed to, DPH considered an exposure scenario where the exposed population would bathe in the stream every other day and use the stream as the sole source of their drinking water. Health-protective assumptions were used, such as using the 95<sup>th</sup> percentile skin surface area for dermal exposure while bathing and the 95<sup>th</sup> percentile drinking water ingestion rate. These assumptions lead to a likely overestimate of the dose of TCE and PCE received by the exposed population. The estimated dose is then compared to health guideline values, which are daily doses of chemicals that are not anticipated to cause adverse health effects over long periods of exposure.

Using the maximum measured concentration of TCE in Little Sugar Creek, 98 µg/L, the maximum estimated dose received by a person bathing in the creek every other day and using the creek as a drinking water source is 4 µg/kg/day, which is nearly an order of magnitude higher than the chronic oral minimal risk level (MRL) of 0.5 µg/kg/day. Persons using the creek solely for bathing every other day, but not as a drinking water source, may receive a daily dose of TCE of 0.2 µg/kg/day, which is below the MRL. DPH concludes that people drinking water from Little Sugar Creek in the vicinity of Trex may be at risk of adverse health effects from TCE exposure. Long term ingestion of TCE-contaminated water may result in adverse immunological health effects, such as decreased thymus weight and decreased numbers of lymphocytes in the blood. Long term TCE exposure may also result in kidney toxicity. Additionally, exposure to elevated levels of TCE during the first trimester of pregnancy may cause fetal heart malformations (EPA 2011). It is important to note that Little Sugar Creek is not classified as a drinking water source, and its use by transients camping nearby is unknown.

Using the maximum measured concentration of PCE in Little Sugar Creek, 270 µg/L, the maximum estimated dose received by a person bathing in the creek every other day and using the creek as a drinking water source is 11 µg/kg/day, which is nearly twice as high as the EPA reference dose (RfD) of 6 µg/kg/day. People using the creek solely for bathing every other day, but not as a drinking water source, may receive a daily dose of PCE of 0.8 µg/kg/day, which is below the MRL. DPH concludes that people drinking water from Little Sugar Creek in the vicinity of Trex may be at risk of adverse health effects from PCE exposure. Long term PCE exposure may harm the nervous system, liver, kidneys, and reproductive system, and may be harmful to unborn children (ATSDR 2014). Most adverse health effects observed in human subjects occur at exposure doses approximately 200 times higher than those estimated here. It is important to note that Little Sugar Creek is not classified as a drinking water source, and its use by transients camping nearby is unknown.

### *Indoor Air*

PCE levels measured in indoor air at the Trex site and surrounding non-residential properties did not exceed screening levels, and therefore are not anticipated to cause adverse health effects.

TCE levels measured in indoor air at the Trex site and surrounding non-residential properties exceeded screening levels, and warrant further investigation. TCE levels at Trex facilities reached 2000-3000  $\mu\text{g}/\text{m}^3$ , far exceeding the health guideline established for TCE, the chronic Environmental Media Evaluation Guideline of 2.1  $\mu\text{g}/\text{m}^3$ . Inhalation of contaminated air containing these levels of TCE may result in adverse health effects, but there are no known current full time employees at the site. Over the summer, Trex employed a security guard who may have been exposed to elevated TCE levels while patrolling the facility. DPH has reached out to the employee and provided fact sheets about TCE exposure and health effects, but no adverse health effects were reported.

TCE levels measured in indoor air at Nexus Church and Leather Trimmings exceeded the health guideline of 2.1  $\mu\text{g}/\text{m}^3$ . The health guideline was developed for continuous daily exposure, which is an unrealistic exposure scenario for people using these non-residential facilities. A more accurate health guideline is 8.8  $\mu\text{g}/\text{m}^3$  when considering an exposure scenario for a place of employment where exposure is likely to occur over the course of an 8 hour workday, five days a week, 50 weeks per year. The maximum TCE levels measured at Nexus Church were below this concentration, and therefore no adverse health effects are anticipated for people exposed to TCE at this site. However, maximum TCE levels measured in indoor air at Leather Trimmings was approximately 3 times higher than the adjusted health guideline. Workers exposed to TCE in indoor air at Leather Trimmings over a long period of time may be at risk of adverse health effects. Inhalation of TCE at high concentrations over a long period of time may result in adverse immunological health effects, such as decreased thymus weight and decreased numbers of lymphocytes in the blood. Long term TCE exposure may also result in kidney toxicity. Additionally, exposure to elevated levels of TCE during the first trimester of pregnancy may cause fetal heart malformations (EPA 2011).

### *Cancer Risk*

The U.S. EPA classifies TCE as “carcinogenic to humans” and PCE as “likely to be carcinogenic to humans.” For this reason, DPH estimated an increased cancer risk from exposure to these compounds at the concentrations measured in surface water and indoor air near the Trex site. For a detailed explanation of the cancer risk evaluation process, see Attachment A. Briefly, when estimating an increased cancer risk, DPH calculates what is likely an overestimation of increased cancer incidence over a lifetime for a specified exposure period, compared to expected cancer incidence (referred to as the background cancer level). The expected cancer rate in North Carolina is considered to be 40% in that, on average, 4 out of 10 North Carolina residents will be diagnosed with cancer during their lifetime (North Carolina Central Cancer Registry). The



expression of the estimated cancer risk is not a prediction that cancer will occur, it represents the upper bound estimate of the probability of additional cancers, and merely suggests that there is a possibility. For example, a 1 in a million cancer risk means that if one million people were exposed to a given level of a chemical, one additional cancer case may occur over the expected cancer incident rate of 40%, or 400,000 in one million. The actual risk may be much lower.

#### *Surface Water – Little Sugar Creek*

Using an exposure scenario in which a transient person bathes in Little Sugar Creek every other day and uses the creek as their sole drinking water source for a period of one year, the estimated increased cancer risk from TCE and PCE exposure is less than 3 in a million. These calculations were completed using the maximum measured TCE and PCE levels in water, which fluctuate over time and may not represent the true concentration of these chemicals in the part of the creek used by people in the encampment.

#### *Indoor Air*

Using an exposure scenario of an adult employee working at the Trex facilities for 8 hours a day, five days a week, fifty weeks a year for 30 years, the estimated increased cancer risk from TCE exposure is about 3 in a million. These calculations were completed using a maximum TCE concentration of 3000  $\mu\text{g}/\text{m}^3$ . There are currently no known full time employees with this level of exposure on site.

For cancer risk analysis for Nexus Church, DPH made the assumption that some congregants may be minors in order to remain health-protective. TCE has a mutagenic mode of action, which means children are more susceptible to carcinogenic potential from chemical exposure. As such, age-dependent adjustment factors (ADAF) were used to calculate cancer risk for TCE exposure at Nexus Church, with an assumed exposure to begin at birth to account for the most sensitive population (children under two years old), and exposure duration lasting until age 33, as 33 years is the 95<sup>th</sup> percentile residence time. Using information gathered from the pastor, exposure was expected to occur three hours a week, 52 weeks a year. There is no increased estimated cancer risk for persons exposed to TCE at Nexus Church at a TCE concentration of 6.2  $\mu\text{g}/\text{m}^3$ , the maximum measured concentration.

DPH estimated no increased cancer risk from TCE exposure using an exposure scenario of an adult employee working at the Leather Trimmings facilities for 8 hours a day, five days a week, fifty weeks a year for 30 years. These calculations were completed using a maximum TCE concentration of 27.8  $\mu\text{g}/\text{m}^3$ .

#### *Sources of uncertainties*

In the health assessment process there are inherent sources of uncertainty. For instance, when considering the likelihood of adverse health effects from exposure to contaminants, many

substances are lacking in data of adverse human health effects, and DPH must rely on animal laboratory studies. To account for this discrepancy, large margins of safety, or uncertainty factors, are used to extrapolate from animal data to human exposures.

Other sources of uncertainty are a result of the sampling or laboratory analysis. In the case of this vapor intrusion study, one factor to consider is the lack of long-term or temporal monitoring of indoor air or soil vapor levels. The likelihood and extent of vapor intrusion can vary widely depending on weather, temperature, and other environmental factors that change over time. The assessment presented in this Letter Health Consultation considers samples taken at one specific point in time with the assumption that these concentrations are representative of average conditions. Risk of adverse health effects will increase or decrease if the actual long term chemical concentrations are greater or lesser than those measured here. The exposure period can also impact the likelihood of adverse health effects.

## **Conclusions**

The DPH reviewed the environmental data collected at and near the Trex Properties site and concluded:

1. Use of Little Sugar Creek for drinking water over a long period of time may harm people's health. Little Sugar Creek is not classified as a drinking water source, but a homeless encampment located nearby may use the water for bathing, cooking, and drinking.
2. Exposure to TCE via inhalation of contaminated indoor air at Trex properties is currently an incomplete exposure pathway because there are no known full time employees on the premises. Should the use of the facility change, further air testing and assessment is necessary to ensure that exposure will not adversely affect people's health.
3. Exposure to TCE and PCE via inhalation of contaminated indoor air at Nexus Church is not expected to harm people's health.
4. Employee exposure to TCE via inhalation of contaminated indoor air at Leather Trimmings over a long period of time could harm people's health, especially sensitive subpopulations including pregnant women and their fetuses, and persons who are immunocompromised.

## **Recommendations**

Based on the conclusions of our evaluation, DPH recommends that:

1. Mecklenburg County Health Department posts signs along the affected portions of the creek warning that the water is contaminated and should not be used for drinking, fishing, or bathing. Signs should be posted in English and Spanish.
2. EPA resamples indoor air at Trex Properties, Nexus Church, and Leather Trimmings during the winter months to more fully assess the vapor intrusion pathway.
3. N.C. DPH assesses future indoor air sampling data to ensure that public health is protected.

4. The operators of Leather Trimmings take immediate steps to reduce indoor TCE levels, including introduction of outdoor air, increased ventilation of the building, and resampling to confirm that TCE levels have been reduced.

Please do not hesitate to contact me at (919) 707-5900 if you have any questions regarding this letter.

Sincerely,

Beth Dittman, M.S.

Health Assessor, Health Assessment, Consultation & Education Program  
Occupational and Environmental Epidemiology Branch, Division of Public Health  
N.C. Department of Health and Human Services

Cc: Kathleen Lawson  
NC Hazardous Waste Section  
NC Department of Environmental Quality  
1646 Mail Service Center  
Raleigh, NC 27699

## References

- (ATSDR 2014) *Draft Toxicological Profile for Tetrachloroethylene*. October 2014. Agency for Toxic Substances and Disease Registry. <http://www.atsdr.cdc.gov/ToxProfiles/tp18.pdf>
- (DEQ 2015) *Division of Waste Management Non-Residential Vapor Intrusion Screening Concentrations*. September 2015. N.C. Department of Environmental Quality.
- (EPA 2011) *Toxicological Review of Trichloroethylene Chapter 7*. September 2011. U.S. Environmental Protection Agency.  
[http://cfpub.epa.gov/ncea/iris/iris\\_documents/documents/toxreviews/0199tr/Chapter7\\_0199tr.pdf](http://cfpub.epa.gov/ncea/iris/iris_documents/documents/toxreviews/0199tr/Chapter7_0199tr.pdf)
- (NC 15A-2B) *North Carolina Surface Water Quality Standards*. Title 15A of the North Carolina Administrative Code subchapter 02B.  
[http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=ad77b198-aa3d-4874-9723-54ce730b3a8d&groupId=38364](http://portal.ncdenr.org/c/document_library/get_file?uuid=ad77b198-aa3d-4874-9723-54ce730b3a8d&groupId=38364)
- (SAP 2014) *Phase III Sampling and Analysis Plan and Conceptual Approach to Remediation*. March 18, 2014. Trex Properties, LLC.
- (SWS 2015) Charlotte-Mecklenburg Storm Water Services. September 1, 2015. Map prepared by Andrew DeCristofaro.
- (W&R 2015a) *Analytical Results for TCE in Groundwater Map*. January 13, 2015. Withers & Ravenel.
- (W&R 2015b) *Analytical Report for Nexus Church Samples*. August 28, 2015. Withers & Ravenel.
- (W&R 2015c) *Analytical Report for Leather Trimmings*. September 8, 2015. Withers & Ravenel.

## Attachment A – Cancer Risk Evaluation Process

For inhalation exposures, estimates of increased numbers of cancers are calculated for known or suspected cancer-causing contaminants using the measured air concentration and the Inhalation Unit Risk (IUR) provided in ATSDR health guideline documents. For ingestion exposures, estimates of increased numbers of cancers are calculated for known or suspected cancer-causing contaminants using the estimated dose and the Cancer Slope Factor (CSF). DPH evaluates cancer health effects in terms of estimates of possible increased cancer risk over background levels. In North Carolina, approximately 30% of women and 50% of men (about 40% combined), will be diagnosed with cancer in their lifetime from a variety of causes (North Carolina Central Cancer Registry). This is referred to as the “background cancer risk”. The term “excess” or “increased cancer risk” represents the risk on top of the background cancer risk. A “one-in-a-million” excess cancer risk (1/1,000,000 or  $10^{-6}$  cancer risk) means that if 1,000,000 people are exposed to the cancer-causing substance at a certain level every day of their lifetime (considered 78 years), then one cancer above the background number of cancers may develop in those 1 million people. In numerical terms, the background number of cancers expected in 1 million people over their lifetime is 400,000. If they are all exposed to the cancer-causing substance daily throughout their lifetime, then one additional person may get cancer, instead of the expected 400,000. The expression of the estimated cancer risk is not a prediction that cancer will occur, it represents the upper bound estimate of the statistical probability of additional cancers, and merely suggests that there is a possibility. The actual risk may be much lower, or even no risk.

The estimated increased cancer risk calculation for inhalation exposure is:

$$\text{Estimated Increased Cancer Risk} = \text{Concentration} \times \text{IUR}$$

Where:

$$\begin{aligned} \text{Estimated Increased Cancer Risk} &= \text{Expression of the cancer risk (unitless)} \\ \text{Concentration} &= \text{Measured contaminant concentration in air sample (mg/m}^3\text{)} \\ \text{IUR} &= \text{Inhalation Unit Risk [(mg/m}^3\text{)}^{-1}] \end{aligned}$$

The estimated increased cancer risk calculation for exposure via ingestion is:

$$\text{Estimated Increased Cancer Risk} = \text{Estimated dose} \times \text{CSF}$$

Where:

$$\begin{aligned} \text{Estimated Increased Cancer Risk} &= \text{Expression of the cancer risk (unitless)} \\ \text{Estimated dose} &= \text{Estimate of amount of contaminant a person is exposed to on a daily} \\ &\text{basis (mg/kg/day)} \\ \text{CSF} &= \text{Cancer Slope Factor [(mg/kg/day)}^{-1}] \end{aligned}$$

These calculations are based on the assumption that there is no safe level of exposure to a chemical that causes cancer, which is a health-protective assumption that usually applies to

mutagenic carcinogens. In order to be health-protective the calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. This increased cancer risk estimate does not equal the increased number of cancer cases that will actually occur in the exposed population, but estimates an increased cancer risk expressed as the proportion of a population that may be affected by a carcinogen during a lifetime or other selected period of exposure. Qualitative assessment of the predicted increased numbers of cancers is also used.

For specific exposure situations DPH may use exposure periods of less than a lifetime to provide a more realistic estimation of the risks that are known or predicted to have occurred for a particular area. If information on the specifics of the exposure situations at a particular site is not known, then DPH will always use health protective values to estimate the maximum level of risk that we believe to be realistic.