

Health Consultation

Indianola Landfill
Indianola, Kitsap County, Washington

May 3, 2001

Prepared by

**The Washington State Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry**



Foreword

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation 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 hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on specific health issues so that DOH can respond quickly to requests from concerned residents or agencies for health information on hazardous substances. DOH 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 additional information or questions regarding DOH, ATSDR or the contents of this health consultation, please call the health advisor who prepared this document:

Gary Palcisko
Public Health Advisor
Washington State Department of Health
Office of Environmental Health Assessments
PO Box 47846
Olympia, WA 98504-7846
Phone: (360) 236-3377
Toll free: 1-877-485-7316
Website: <http://www.doh.wa.gov/consults>

Glossary

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.
Carcinogen	Any substance that can cause or contribute to the production of cancer.
Chronic	A long period of time. A chronic exposure is one which lasts for a year or longer.
Comparison value	A concentration of a chemical in soil, air or water that, if exceeded, requires further evaluation as a contaminant of potential health concern. The terms comparison value and screening level are often used synonymously.
Contaminant	Any chemical that exists in the environment or living organisms that is not normally found there.
Dose	A dose is the amount of a substance that gets into the body through ingestion, skin absorption or inhalation. It is calculated per kilogram of body weight per day.
Exposure	Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). Exposure may be short term (acute) or long term (chronic).
Groundwater	Water found underground that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater often occurs in quantities where it can be used for drinking water, irrigation, and other purposes.
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.
Ingestion rate	The amount of an environmental medium which could be ingested typically on a daily basis. Units for IR are usually liter/day for water, and mg/day for soil.

Lowest Observed Adverse Effect Level (LOAEL)	LOAEL's have been classified into "less serious" or "serious" effects. In dose-response experiments, the lowest exposure level at which there are statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control.
Maximum Contaminant Level (MCL)	A drinking water regulation established by the federal Safe Drinking Water Act. It is the maximum permissible concentration of a contaminant in water that is delivered to the free flowing outlet of the ultimate user of a public water system. MCLs are enforceable standards.
Model Toxics Control Act (MTCA)	The hazardous waste cleanup law for Washington State.
No apparent public health hazard	Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.
No Observed Adverse Effect Level (NOAEL)	The dose of a chemical at which there were no statistically or biologically significant increases in frequency or severity of adverse effects seen between the exposed population and its appropriate control. Effects may be observed at this dose but were judged not to be "adverse".
Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition size swimming pool, the water will contain about 1 ppb of TCE.
Route of exposure	The way in which a person may contact a chemical substance that includes ingestion, skin contact and breathing.
U.S. Environmental Protection Agency (EPA)	Established in 1970 to bring together parts of various government agencies involved with the control of pollution.
Volatile organic compound (VOC)	An organic (carbon-containing) compound that evaporates (volatilizes) easily at room temperature. A significant number of the VOCs are commonly used as solvents.

Background and Statement of issues

This health consultation was prepared at the request of the Bremerton-Kitsap County Health District to evaluate the potential health hazard posed by tetrahydrofuran (THF) in drinking water to residents living near the Indianola Landfill in Indianola, Kitsap County, Washington. DOH prepares health consultations under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

The Indianola Landfill site is a closed and abandoned unlined landfill located about 1/4 mile south of Mahoney Ln NE on S. Kingston Rd NE (Figure 1). The landfill was operated by Kitsap County and permitted by the Bremerton-Kitsap County Health District. It accepted mixed municipal solid waste from 1948-1954, and encompassed an estimated surface area of 2 to 3 acres. It was reportedly capped with clean fill. The Washington State Department of Ecology (Ecology) listed the site on the Confirmed or Suspected Contaminated Sites list.

The site is part of a larger parcel owned by Arness Tree Farms and the area surrounding the dump has recently been logged. It is not enclosed by a fence, but vehicle entry is limited by a cable gate that stretches across an access road. The former dump site itself is vacant, undeveloped, and overgrown with trees and brush, however, up to 10 residences are served by private or shared wells located less than 1000 ft away. A common concern regarding old landfills is the migration of buried contaminants in groundwater and subsequent human exposure through drinking water from wells down gradient.

Soil and nearby private wells were sampled to determine the nature and extent of contamination on and around the site as part of a Site Hazard Assessment (Figure 2). Four soil samples from the site were analyzed for a wide array of contaminants (Table 1). Lead was found in one soil sample at a level of 340 ppm, slightly exceeding the MTCA residential cleanup level of 250 ppm. No other contaminants were detected at levels of health based or regulatory concern in soil.

Three wells nearest the former dump were also sampled and analyzed in order to determine if contaminants have migrated from the dump to the surrounding area through groundwater. The majority of target compounds were not detected in any of the wells and no contaminants exceeded established regulatory limits. One sample from residential well #1 (Figure 2) had a tentatively identified^a concentration of 5.4 micrograms THF per liter of water ($\mu\text{g/l}$). The EPA and the state of Washington have not established drinking water standards for tetrahydrofuran.

Well #1 was resampled and analyzed and no contamination was found. The residents stated that prior to the initial test, they had recently added a connection to their well using polyvinyl chloride (PVC) pipes and fittings. The source of THF in well # 1 is likely from use of cement used to glue PVC pipe fittings.

^a A chemical is labeled as “tentatively identified” when the analytical method is not designed to test for that specific compound, but a “peak” or “hit” is registered that corresponds to the compound in question by the analytical instrument. Since the laboratory does not use a standard to compare the result to, a tentatively identified compound may or may not be present in the material being analyzed. If the chemical does indeed exist in the sample, then the analytical result is only an estimate.

Table 1 - Summary of samples taken on and around Indianola landfill ¹

Sample type	Number of samples	Target analytes	Contamination exceeding regulatory standards or causing concern
Soil	4	Metals Pesticides Semi-volatile Organic Contaminants Total Petroleum Hydrocarbons	1 sample with lead concentration of 340 ppm (MTCA residential cleanup standard is 250 ppm)
Private Wells	3	Metals Pesticides Semi-volatile Organic Contaminants Total Petroleum Hydrocarbons Volatile Organic Compounds	1 well with tetrahydrofuran concentration of 5.4 ppb. No standard for comparison. Follow-up sample revealed no contamination.

Discussion

Lead was detected in soil, and Tetrahydrofuran (THF) was detected in a drinking water well near the Indianola landfill. The following discussion will address the exposure and potential health hazards associated with lead in soil, and THF in drinking water on or near the site.

Lead

Lead causes a wide array of health effects in different systems of the body, but the primary target is the nervous system. Children less than seven years old are more susceptible to lead exposure and more sensitive to its toxicity than adults. Health effects include decreased IQ, decreased attention span, and irritability.² The Center for Disease Control (CDC) considers a level of 10 µg/dl or more to be an indication of excessive lead exposure.

At the Indianola Landfill site, children may be exposed to lead in soil through inadvertent soil ingestion, or inhalation of resuspended soil particles. Assuming the maximum concentration of lead found in soil at the site, or 340 ppm, the EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK - Version 0.99D) predicts that blood lead levels of children who play frequently in this area would not likely exceed a level of concern. Furthermore, the EPA's recently announced lead hazard standards define lead levels above 400 ppm in bare soil in the play area of a yard as being a hazard.³ The maximum levels found at the Indianola Landfill are not only below this level, but also not located in bare soil areas in a yard. The area of the landfill is not residential property, and is overgrown with brush. Therefore, lead in soil at the site does not present a significant health hazard.

Tetrahydrofuran

THF (C₄H₈O) is a solvent with a wide variety of uses, but is primarily used in the formation of synthetic fibers (e.g. spandex). It is also widely used in cement for PVC pipe. THF is soluble in water, and relatively persistent in groundwater making it a threat to drinking water wells ⁴.

The bulk of documented human exposure to THF comes from an occupational setting. Workers exposed to THF vapor have experienced irritation of the eyes and mucous membranes, dizziness, headaches and nausea. ⁵ Direct skin contact can cause dermatitis. No studies have documented human health effects from THF exposure via drinking water.

Few animal studies have focused specifically on cancer. In one study, male and female mice exposed to high levels (3000 ppm) of THF in air for eight hours a day over a period of 20 months did not develop cancer ⁵, however, another study showed evidence of cancer in female mice exposed to 1800 ppm THF in air over 24 months⁶. THF's carcinogenicity remains uncertain. The EPA classifies THF as a Group D carcinogen, meaning that it is not classified with respect to its ability to cause cancer in humans. This classification is used when no human data is available and animal data is inadequate.

No federal or Washington state regulatory limits have been designated for THF in drinking water. At least four states, however, have established an enforcement standard (Table 2). The most stringent standard is Wisconsin's level of 50 µg/l.

Table 2 - Existing standards for THF in drinking water ⁵

State	Standard (µg/l)
Massachusetts	1300
Michigan	230
New Hampshire	154
Wisconsin	50

Wisconsin's standard is based on a long-term study in which groups of white mice, albino rats, and rabbits were exposed to THF over a period of up to 5 to 6 months. The author concluded that a dose of 5 milligrams per kilogram of body weight per day (mg/kg/day) had no detrimental effect in the animals. The Wisconsin Department of Health and Social Services (DHSS) determined 5 mg/kg/day to be the no observable adverse affect level (NOAEL) that was used to establish their enforcement standard. An uncertainty factor of 1000 was also included in the calculation used to compute the THF standard. Uncertainty factors are included in risk calculations to account for unknown physiological differences between animals and humans, and are intended to be protective of human health. Appendix A shows the calculation and derivation of Wisconsin's THF drinking water standard ⁷.

The concentration of THF found in the single well near Indianola landfill is almost 10 fold lower than Wisconsin's 50 µg/l standard. Based on this standard, THF contamination in the well does not pose a threat to human health.

Children's Exposure / Child Health Initiative

ATSDR recognizes that infants and children may be more vulnerable to exposures than adults when faced with contamination of air, water, soil, or food ⁸. This vulnerability is a result of the following factors:

- C Children are more likely to play outdoors and bring food into contaminated areas.
- C Children are shorter and their breathing zone is closer to the ground, resulting in a greater likelihood to breathe dust, soil, and heavy vapors.
- C Children are smaller and receive higher doses of chemical exposure per body weight.
- C Children's developing body systems are more vulnerable to toxic exposures, especially during critical growth stages in which permanent damage may be incurred.

In the case of lead in soil and THF contaminated drinking water near Indianola landfill, exposure scenarios were used with children's health in mind. The IEUBK model that predicts a child's blood lead levels assumes child body weights and ingestion rates. The calculation used to derive Wisconsin's THF drinking water standard assumes the body weight of a child thereby adequately accounting for children's vulnerability.

Conclusions

No apparent public health hazard exists for children and adults exposed to lead in soil and THF in drinking water near the Indianola landfill. An elevated lead level in one of four samples was found on the site of the abandoned landfill. Though access to the site is not restricted, lead in soil is not likely to contribute to adverse health effects based on EPA's IEUBK model. Furthermore, the site is removed from residences, and is overgrown with brush making contact with the soil less likely.

Initial sampling of a drinking water from a well near the former Indianola landfill contained THF at a level of 5.4 µg/l. The EPA and the state of Washington do not currently have a drinking water standard for this chemical. The state of Wisconsin, however, has established a drinking water standard of 50 µg/l based on health or protective assumptions. Using this standard as a guideline, the concentration of THF found in the well is not likely to contribute to adverse health effects in humans. Furthermore, follow-up sampling was unable to detect any contamination. The contamination, possibly a result of a new PVC connection added to the well, was transient and does not appear to be a chronic problem, therefore posing no continued threat to human health.

Recommendations / Public Health Action Plan

Maintain the landfill cap in order to cover contaminants at the surface and prevent buried contaminants from reaching the surface.

With regards to THF in drinking water, it appears that contamination was transient. There are no recommendations at this time.

Action

DOH is available to evaluate future sampling data gathered from this site.

Preparer of Report

Gary Palcisko
Public Health Advisor
Office of Environmental Health Assessment
Washington State Department of Health

References

1. Bremerton-Kitsap County Health District. Site Hazard Assessment for Indianola Landfill. April 25, 2001.
2. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Lead. July 1999.
3. United States Environmental Protection Agency. Residential Lead Hazard Standards. Federal Register. January 5, 2001.
4. Mallinkrodt Chemicals. Material Safety Data Sheet for Tetrahydrofuran. June 30, 1998.
5. National Library of Medicine Toxicology Network. Hazardous Substance Database data file for tetrahydrofuran. Last revised June 12, 2000.
6. National Toxicology Program Working Group. Toxicology and carcinogenesis studies of Tetrahydrofuran in F 344/N rats and B6C3F1 mice (inhalation studies). National Toxicology Program. Technical report series PG:244 p YR:1998 IP: VI:475.
7. Wisconsin Department of Health and Social Services. Background documentation for Wisconsin's tetrahydrofuran groundwater standard. Facsimile received April 27, 2001.
8. Agency for Toxic Substances and Disease Registry. Interim guidance on including child health issues in Division of Health Assessment and Consultation Documents. Atlanta: US Department of Health and Human Services, Public Health Service, July 1998.

Appendix A - Derivation of Wisconsin's THF drinking water standard

Assumptions:

- No observable adverse effect level (NOAEL) = 5 mg/kg/day
- Body weight of a child = 10 kg
- Drinking water ingestion rate = 1 liter per day (l/day)

Uncertainty factors:

100	(extrapolation of animal data NOAEL in absence of human data)
<u>x 10</u>	(sub-chronic exposure duration used in the animal study)
1000	(total uncertainty factor)

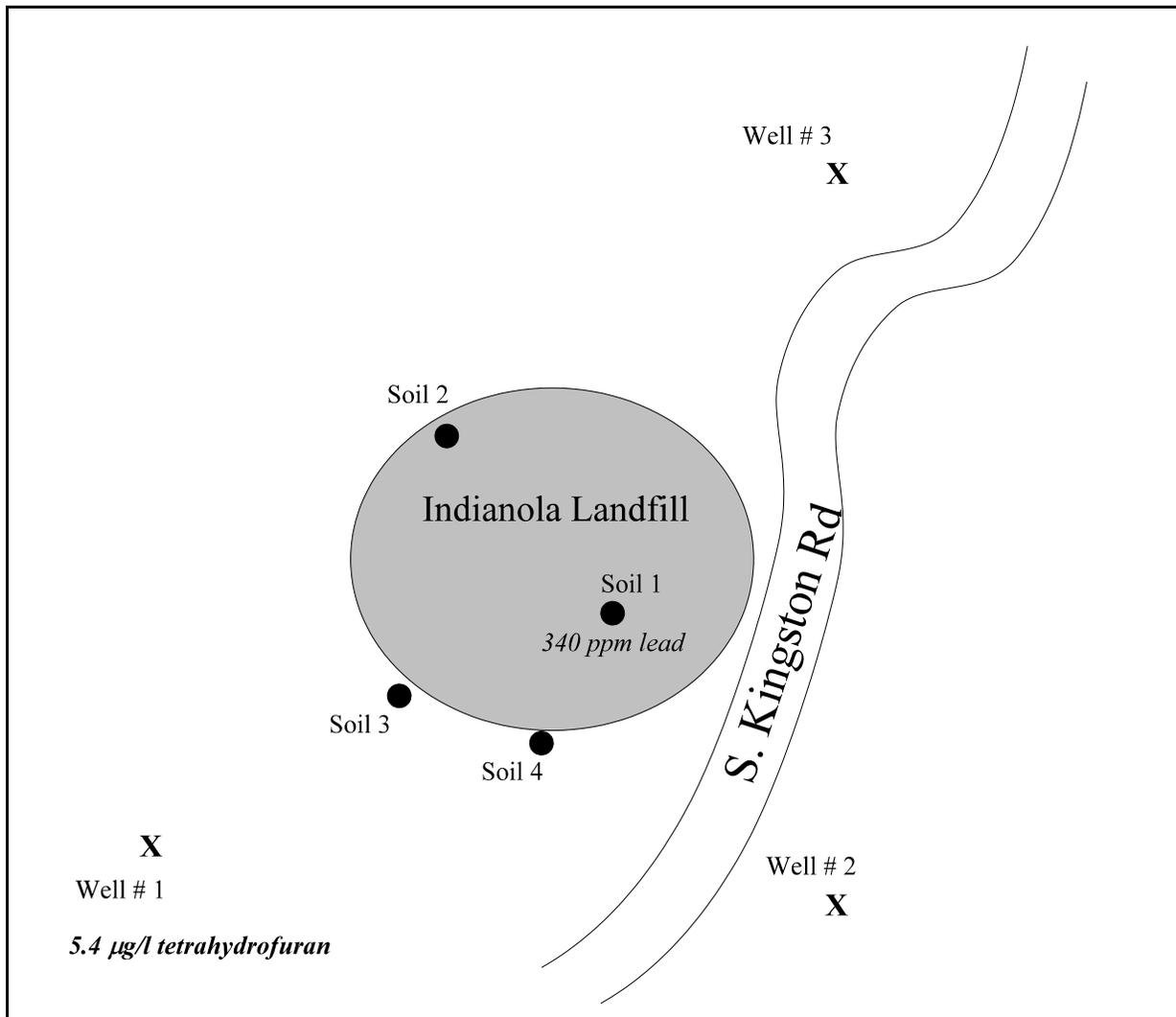
Calculation:

$$\begin{aligned}\text{Acceptable Daily Intake (ADI)} &= \text{NOAEL} / \text{Uncertainty Factor} \\ &= 5 \text{ mg/kg/day} / 1000 \\ &= 0.005 \text{ mg/kg/day or } 5 \text{ } \mu\text{g/kg/day}\end{aligned}$$

In order to be protective of children, the standard was calculated assuming a body weight of a 10 kg child, and a drinking water ingestion rate of 1 liter per day.

$$\begin{aligned}\text{Enforcement Standard} &= (\text{ADI} * \text{Body Weight}) / \text{Drinking water ingestion rate} \\ &= (5 \text{ } \mu\text{g/kg/day} * 10 \text{ kg}) / 1 \text{ l/day} \\ &= 50 \text{ } \mu\text{g/l}\end{aligned}$$

Figure 2 - Indianola landfill sampling map¹



Certification

This Health Consultation was prepared by the Washington State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

Debra Gable
Technical Project Officer, SPS, SSAB, DHAC
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

Richard Gillig
Chief, SPS, SSAB, DHAC
ATSDR