Health Consultation

MORRIS ROAD AIR QUALITY

YELM, THURSTON COUNTY, WASHINGTON

APRIL 6, 2009

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

MORRIS ROAD AIR QUALITY
YELM, THURSTON COUNTY, WASHINGTON

Prepared by:

The Washington State Department of Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
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 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. The findings in this report are relevant to conditions at the site during the time of this health consultation, and should not necessarily be relied upon if site conditions or land use changes in the future.

For additional information or questions regarding DOH or the contents of this health consultation, please call the health advisor who prepared this document:

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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/.

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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.
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 Risk Evaluation Guide (CREG)	The concentration of a chemical in air, soil or water that is expected to cause no more than one excess cancer in a million persons exposed over a lifetime. The CREG is a *comparison value* used to select contaminants of potential health concern and is based on the *cancer slope factor* (CSF).
Cancer Slope Factor	A number assigned to a cancer causing chemical that is used to estimate its ability to cause cancer in humans.
Carcinogen	Any substance that causes cancer.
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.
Dermal Contact	Contact with (touching) the skin (see **route of exposure**).
Dose (for chemicals that are not radioactive)	The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.
Environmental Media Evaluation Guide (EMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The EMEG is a *comparison value* used to select contaminants of potential health concern and is based on ATSDR's *minimal risk level* (MRL).

Environmental Protection Agency (EPA)	United States Environmental Protection Agency.
Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].
Groundwater	Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].
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	The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].
Ingestion rate	The amount of an environmental medium that could be ingested typically on a daily basis. Units for IR are usually liter/day for water, and mg/day for soil.
Inhalation	The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].
Inorganic	Compounds composed of mineral materials, including elemental salts and metals such as iron, aluminum, mercury, and zinc.
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)	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.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.

Minimal Risk Level (MRL)	An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **oral reference dose**].
Model Toxics Control Act (MTCA)	The hazardous waste cleanup law for Washington State.
No apparent public health hazard	A category used in ATSDR's public health assessments 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.
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.
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 that are not easily dissolved in water.
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.
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.
Reference Dose Media Evaluation Guide (RMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The RMEG is a *comparison value* used to select contaminants of potential health concern and is based on EPA's oral reference dose (RfD).
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].

Surface Water	Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].
Volatile organic compound (VOC)	Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Summary and Statement of Issues

The Washington State Department of Health (DOH) prepared this health consultation at the request of the Thurston County Public Health and Social Services Department (TCPHSS). The purpose of this health consultation is to evaluate whether contaminants found in house dust and air pose a health hazard to residents along Morris Road in Yelm, Washington. DOH prepares health consultations under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Background

A resident asked the TCPHSS, Environmental Health Division, to address air quality concerns (smoke and dust) along Morris Road SE in Yelm, Washington. Since December 2006, complaints have escalated, and issues brought forward have led TCPHSS to conduct more extensive investigations of neighboring properties. TCPHSS has engaged in numerous site visits, sampling activities, and coordination with other agencies including the U.S. Environmental Protection Agency (EPA), Olympic Region Clean Air Agency (ORCAA), Washington State Department of Ecology, and DOH.

TCPHSS staff coordinated with EPA Region 10 staff to have ambient air sampling equipment mobilized and installed at a residential property along Morris Road. This equipment was set up February 21, 2007, and remained at the property for approximately three months. In March 2007, a resident in the area collected indoor dust samples and had them analyzed for volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC). In April 2007, TCPHSS collected a water sample, a soil sample and several indoor dust samples from residences in the area for VOC and SVOC analysis (see Table 1) to identify compounds from burning and to confirm data collected by a resident. The water sample was analyzed for VOCs only.

In May 2007, TCPHSS asked the DOH Office of Environmental Health Assessments to evaluate compounds found in dust samples and for guidance on how to proceed with environmental sampling. DOH and TCPHSS provided the evaluation results to residents. In June 2007, TCPHSS collected additional water samples for VOC analysis and air samples using Tedlar bags for use as a screening tool until SUMMA air canisters were available, as DOH had advised. In July 2007, SUMMA air canisters arrived and samples were obtained for VOC analysis. Air sampling results are shown in Table 2. DOH also received an executive correspondence from the Governor's office asking for information about the chemicals found in Morris Road neighborhood homes. DOH responded to the Governor's office and residents along Morris Road by providing the evaluation results. In response to a resident's claim that underground burning was occurring in the area, ORCAA, in conjunction with the State Patrol Aviation Division, used Forward Looking Infrared (FLIR) technology to identify heat signatures from combustion sources in the area. The FLIR flyover events took place in October 2007. No heat signatures from underground combustion sources were identified in the area.

Another round of indoor and ambient air sampling was conducted in the area in January 2008. Maximum contaminant results of the various sampling efforts are summarized in Tables 1 and 2. The 2000 census indicated approximately 380 people live within a one-mile radius of the site.

Table 1. List of compounds identified in house dust samples in Morris Road neighborhood homes and comparison values.

Compound	Maximum Concentration (ppm)	Comparison Value (ppm)	EPA Cancer Class	Comparison Value Reference	Contaminant of concern
Acetone	0.91	50,000		RMEG	No
2-Chlorophenol	ND	300	D	RMEG	No
2-Methylnaphthalene	0.77	200		RMEG	No
Dimethylphthalate*	0.62	5,000	D	RMEG	No
Butyl benzyl phthalate	89	10,000	C	RMEG	No
Bis(2-ethylhexy) phthalate	520	3000	B2	EMEG	No
		50		CREG	**Yes**
Dibutylphthalate	22.8	6,100		Region 9	No
Phenol	2.51	20,000	D	RMEG	No
Naphthalene	0.86	1,000	C	RMEG	No
Diethylphthalate	15.3	40,000	D	RMEG	No
Di-n-octylphthalate	38	20,000		IM EMEG	No
Phenanthrene**	0.59	2,000	D	RMEG	No
m-p-Cresol	1.24	3,000	C	RMEG	No
Eicosane***					No
n-Hexadecanoic Acid***					No
Benzyl Benzoate**					No
Octanal***					No
Decanal***					No
Triethylene glycol***					No
Benzenedicarboxylic Acid****					No

CREG - ATSDR's Cancer Risk Evaluation Guide (child)
RMEG - ATSDR's Reference Dose Media Evaluation Guide (child)
EMEG - ATSDR's Environmental Media Evaluation Guide (child)
IM EMEG - ATSDR's Intermediate Environmental Media Evaluation Guide (child)
B2 - EPA: Probable human carcinogen (inadequate human, sufficient animal studies)
C - EPA: Possible human carcinogen (no human, limited animal studies)
D - EPA: Not classifiable as to health carcinogenicity
Region 9 – EPA: Preliminary Remediation Goals
* 1,4- Dimethylphthalate RMEG value was used as a surrogate for Dimethylphthalate
** Fluoranthene RMEG value was used as a surrogate for Phenanthrene
*** Tentatively identified compounds were not confirmed, commonly seen in plant's and animal's breakdown matter and soil. Also, many are used in perfume, cosmetics, candle, confectioneries, food, and pharmaceutical industries.
**** 1,2-Benzenedicarboxylic Acid mono(2-ethylhexyl)ester = Mono-2-ethylhexylphthalate breakdown product of Bis(2-ethylhexy) phthalate
ND – Not detected

Table 2. List of compounds identified in indoor air and ambient air samples along Morris Road neighborhood homes and comparison values.

Compound	Maximum Concentration (ppb)	Comparison Value (ppb)	EPA Cancer Class	Comparison Value Reference	Contaminant of concern
Acetone	12.21	13,000		EMEG	No
Benzene	0.94	3	A	EMEG	No
		0.03		CREG	See background levels - No
2-Butanone (MEK)	3.1	2000		RfC	No
Carbon disulfide	9.95	300		EMEG	No
Chloromethane	1.4	50	D	EMEG	No
Dichlorodifluoromethane	2.52	10,000*	D	RfC	No
4-Ethyltoluene	1.16	80**		EMEG	No
Ethylbenzene	1.15	300	D	EMEG	No
Methylene Chloride	0.49	0.9	B2	CREG	No
Styrene	0.92	200	C	EMEG	No
Toluene	9.0	80		EMEG	No
1,2,4-Trimethylbenzene	1.2	80**		EMEG	No
Xylene (Total)	6.68	50		EMEG	No
n-Butane	1.8				See background levels - No
Chlorodifluoromethane	0.23	10,000	D	RfC	No
Trichlorofluoromethane	0.24	10,000*	D	RfC	No

CREG - ATSDR's Cancer Risk Evaluation Guide (child)
RMEG - ATSDR's Reference Dose Media Evaluation Guide (child)
EMEG - ATSDR's Environmental Media Evaluation Guide (child)
IM EMEG - ATSDR's Intermediate Environmental Media Evaluation Guide (child)
B2 - EPA: Probable human carcinogen (inadequate human, sufficient animal studies)
C - EPA: Possible human carcinogen (no human, limited animal studies)
D - EPA: Not classifiable as to health carcinogenicity
Region 9 – EPA: Preliminary Remediation Goals
* Chlorodifluoromethane RfC value was used as a surrogate for Dichlorodifluoromethane and Trichlorofluoromethane
** Toluene EMEG value was used as a surrogate for 4-Ethyltoulene and 1,2,4-Trimethylbenzene
RfC – EPA: Reference Concentration

Discussion

Contaminants of Concern

Environmental sampling data were compared to the ATSDR, EPA health-based criteria, or comparison values. Comparison values (CVs) are concentrations of a substance in air, water, food, or soil that are unlikely to cause adverse health effects in exposed individuals. Substances found in amounts greater than their CVs are selected for further evaluation. CVs are based on exposure assumptions resulting in values that should be protective of public health in all exposure situations. If the concentrations of chemicals are less than the CVs, the chemicals are not of health concern and no further analysis is required. When a concentration is greater than the CV, it does not necessarily mean there will be adverse effects. Depending on site-specific environmental exposure factors (for example, duration of exposure) and human activities that result in exposure (time spent in the area of contamination), exposure to levels above the CV may or may not lead to a health effect.

Comparison values used include ATSDR's environmental media evaluation guide (EMEG), ATSDR's reference dose media evaluation guide (RMEG), ATSDR's cancer risk evaluation guide (CREG), and EPA's Region 9 Preliminary Remediation Goals (PRGs). Several other trace organic compounds with no health CVs were tentatively identified. Some of these compounds are found naturally in plants and some are breakdown products of plants, animals and insects. These compounds will not be further evaluated because of the vast amount of uncertainty associated with attempting to quantify health hazards and risks for chemicals with little or no toxicological information.

Background ambient and indoor air levels

The wide use of natural and synthetic chemicals is a part of modern life and as a result, it is not uncommon for ambient and indoor air to contain low levels of chemicals. Background levels of benzene and n-butane were determined in order to evaluate whether levels found along Morris Road are typical of suburban and rural ambient and indoor air. The median background rural and suburban levels of benzene ranged from 0.5 ppb to 3.1 ppb [1, 2]. Measured levels of benzene in outdoor air have ranged from 0.02 ppb to 34 ppb [3]. The median background rural levels of n-butane ranged from 0.2 ppb to 34 ppb [4]. Both benzene and n-butane are within the normal background range. Therefore, no further analysis is required.

Chemical Specific Toxicity

Bis(2-ethylhexyl) phthalate / Di(2-ethylhexyl)phthalate (DEHP)

Bis(2-ethylhexyl) phthalate is also known as Di(2-ethylhexyl)phthalate (DEHP). It is present in numerous plastic products such as furniture upholstery, shower curtains, wall coverings, tablecloths, rainwear, baby pants, dolls, some toys, shoes, floor tiles, garden hoses, swimming pool liners, automobile upholstery and tops, packaging film and sheets, sheathing for wire and cable, medical tubing, blood storage bags, and polyvinyl chloride (PVC) products [5].

Bis(2-ethylhexyl)phthalate can move out of plastic materials into the environment over long periods of time. Therefore, indoor releases of DEHP to the air from plastic materials can lead to higher indoor levels than that found in outdoor air. Bis(2-ethylhexyl)phthalate has been found in indoor dust in the United States and European countries with a 50th percentile range from 340 ppm to 858 ppm, and in children's bedrooms with and without PVC flooring at a median concentration of 868 ppm and 700 ppm respectively [6]. Blood products that are stored in plastic bags and used for transfusions have shown to contain from 4.3 to 1,230 parts of DEHP per million parts of blood [5]. Most of the DEHP and its breakdown products leave the human body within 24 hours of exposure in urine and feces [5].

Bis(2-ethylhexyl)phthalate is categorized as a Group B2 probable human carcinogen. This means that there is sufficient evidence of carcinogenicity in animal studies, but inadequate evidence in human epidemiological studies. Bis(2-ethylhexyl)phthalate is a chemical for which there appears to be a threshold for carcinogenicity. In other words, there is a dose of DEHP below which there is no cancer risk, but above which results in some cancer risk. The evidence for this threshold comes from studies of rats and mice dosed with DEHP. Liver cancer in these animals is thought to result from the process of peroxisome proliferation after exposure to DEHP. Without peroxisome proliferation, there were no signs of carcinogenicity. Studies determined a no-observed adverse effect level (NOAEL) for peroxisome proliferation at 20 mg/kg/day in mice. Furthermore, rats and mice are considered to be especially sensitive to peroxisome proliferation compared to humans and other primates.

Evaluating non-cancer hazards

Exposure assumptions for estimating DEHP dose from dust exposures are found in Tables A1 – A2 in Appendix A. In order to evaluate the potential for non-cancer adverse health affects that may result from exposure to contaminated media (i.e., air, water, soil, and sediment), a dose is estimated for each contaminant of concern. These doses are calculated for situations (scenarios) in which a person might be exposed to the contaminated media. The estimated dose for each contaminant under each scenario is then compared to EPA's oral reference dose (RfD). RfDs are doses below which non-cancer adverse health effects are not expected to occur ("safe" doses). They are derived from toxic effect levels obtained from human population and laboratory animal studies. These toxic effect levels can be either the lowest observed adverse effect level (LOAEL) or a no-observed adverse effect level (NOAEL). In human or animal studies, the LOAEL is the lowest dose at which an adverse health effect is seen, while the NOAEL is the highest dose that does not result in any adverse health effects.

Because of data uncertainty, the toxic effect level is divided by "safety factors" to produce the lower and more protective RfD. If a dose exceeds the RfD, this indicates only the potential for adverse health effects. The magnitude of this potential can be inferred from the degree to which this value is exceeded. If the estimated exposure dose is only slightly above the RfD, then that dose will fall well below the observed toxic effect level. The higher the estimated dose is above the RfD, the closer it will be to the actual observed toxic effect level. This comparison is called a hazard quotient (HQ) and is given by the equation below:

HQ = Estimated Dose (mg/kg-day)
RfD (mg/kg-day)

Estimated exposure doses, exposure assumptions, and hazard quotients are presented in Appendix A for DEHP found in dust. Based on exposure estimates quantified in Appendix A, the general population is not likely to experience adverse non-cancer health effects from exposure to DEHP along Morris Road since the exposure dose did not exceed the RfD.

Evaluating Cancer Risk

Some chemicals have the ability to cause cancer. Theoretical cancer risk is estimated by calculating a dose similar to that described above and multiplying it by a cancer potency factor, also known as the cancer slope factor. Some cancer potency factors are derived from human population data. Others are derived from laboratory animal studies involving doses much higher than are encountered in the environment. Use of animal data requires extrapolation of the cancer potency obtained from these high dose studies down to real-world exposures. This process involves much uncertainty.

Current regulatory practice assumes there is no "safe dose" of a carcinogen. Any dose of a carcinogen will result in some additional cancer risk. Theoretical cancer risk estimates are, therefore, not yes/no answers but measures of chance (probability). Such measures, however uncertain, are useful in determining the magnitude of a cancer threat because any level of a carcinogenic contaminant carries an associated risk. The validity of the "no safe dose" assumption for all cancer-causing chemicals is not clear. Some evidence suggests that certain chemicals considered to be carcinogenic must exceed a threshold of tolerance before initiating cancer. For such chemicals, risk estimates are not appropriate. Recent guidelines on cancer risk from EPA reflect the potential that thresholds for some carcinogenesis exist. However, EPA still assumes no threshold unless sufficient data indicate otherwise [7].

Theoretical Cancer Risk

Theoretical Cancer risk estimates do not reach zero no matter how low the level of exposure to a carcinogen. Terms used to describe this risk are defined below as the number of excess cancers expected in a lifetime:

Term		# of Excess Cancers
moderate	is approximately equal to	1 in 1,000
low	is approximately equal to	1 in 10,000
very low	is approximately equal to	1 in 100,000
slight	is approximately equal to	1 in 1,000,000
insignificant	is less than	1 in 1,000,000

This document describes theoretical cancer risk that is attributable to site-related contaminants in qualitative terms like low, very low, slight and insignificant. These terms can be better understood by considering the population size required for such an estimate to result in a single cancer case. For example, a low increase in cancer risk indicates an estimate in the range of one cancer case per ten thousand persons exposed over a lifetime. A very low estimate might result in one cancer case per several tens of thousands exposed over a lifetime and a slight estimate would require an exposed population of several hundreds of thousands to result in a single case.

DOH considers theoretical cancer risk insignificant when the estimate results in less than one cancer per one million exposed over a lifetime. The reader should note that these estimates are for excess cancers that might result in addition to those normally expected in an unexposed population.

Cancer is a common illness and its occurrence in a population increases with the age of the population. There are many different forms of cancer resulting from a variety of causes; not all are fatal. Approximately 1/4 to 1/3 of people living in the United States will develop cancer at some point in their lives [8]. Theoretical cancer risk estimates for exposure to DEHP in dust is very low (1 cancer estimated per 100,000 exposed) and furthermore, the calculated dose was well below the threshold level of 20 mg/kg/day.

Children's Health Concerns

The potential for exposure and subsequent adverse health effects often increases for younger children compared with older children or adults. ATSDR and DOH recognize that children are susceptible to developmental toxicity that can occur at levels much lower than those causing other types of toxicity. The following factors contribute to this vulnerability:

- Children are more likely to play in contaminated outdoor areas.
- Children often bring food into contaminated areas resulting in hand-to-mouth activities.
- Children are smaller and receive higher doses of lead exposure per body weight.
- Children are shorter than adults are; therefore, they have a higher possibility of breathing in dust and soil.
- Fetal and child exposure to lead can cause permanent damage during critical growth stages.

These unique vulnerabilities of infants and children demand special attention in communities with contaminated water, food, soil, or air. Children's health was considered in the writing of this health consultation and the exposure scenarios treated children as the most sensitive population being exposed.

Conclusions

Based on sampling results of outdoor air, indoor air, water and soil along Morris Road, no apparent public health hazard exists currently for children or adults exposed.

Recommendations

DOH has no recommendations at this time.

Public Health Action Plan

Actions completed

1. Sampling and analysis of water, soil, dust, outdoor and indoor air for contaminants has been conducted to determine whether chemical contaminants are present at levels of health concern.

2. Evaluation of sampling data to determine whether chemical contaminants are present at levels of health concern at the Morris Road site.

Action Planned

DOH will send copies of the health consultation to concerned parties.

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Appendix A

This section provides calculated exposure doses and assumptions used for exposure to Di(2-ethylhexyl)phthalate (DEHP) in dust along Morris Road. Three different exposure scenarios were developed to model exposures that might occur. These scenarios were devised to represent exposures to a child (0-5 yrs), an older child, and an adult. The following exposure parameters and dose equations were used to estimate exposure doses from direct contact with chemicals in soil (see Table A1 for parameter descriptions).

Exposure to chemicals in soil via ingestion, inhalation, and dermal absorption.

Total dose $_{\text{(non-cancer)}}$ = Ingested dose + inhaled dose + dermally absorbed dose

Ingestion Route

$$\text{Dose}_{\text{(non-cancer (mg/kg-day)}} = \frac{C \times CF \times IR \times EF \times ED}{BW \times AT_{\text{non-cancer}}}$$

$$\text{Cancer Risk} = \frac{C \times CF \times IR \times EF \times CPF \times ED}{BW \times AT_{\text{cancer}}}$$

Dermal Route

$$\text{Dermal Transfer (DT)} = \frac{C \times AF \times ABS \times AD \times CF}{ORAF}$$

$$\text{Dose}_{\text{(non-cancer (mg/kg-day)}} = \frac{DT \times SA \times EF \times ED}{BW \times AT_{\text{non-cancer}}}$$

$$\text{Cancer Risk} = \frac{DT \times SA \times EF \times CPF \times ED}{BW \times AT_{\text{cancer}}}$$

Inhalation of Particulate from Sediment Route

$$\text{Dose}_{\text{non-cancer (mg/kg-day)}} = \frac{C \times SMF \times IHR \times EF \times ED \times 1/PEF}{BW \times AT_{\text{non-cancer}}}$$

$$\text{Cancer Risk} = \frac{C \times SMF \times IHR \times EF \times ED \times CPF \times 1/PEF}{BW \times AT_{\text{cancer}}}$$

Table A1. Exposure assumptions for exposure to Di(2-ethylhexyl)phthalate (DEHP) in dust sample from Morris Road residence - Thurston County, Washington.

Parameter	Value	Unit	Comments
Concentration (C)	Variable	mg/kg	Maximum detected value
Conversion Factor (CF)	0.000001	kg/mg	Converts contaminant concentration from milligrams (mg) to kilograms (kg)
Ingestion Rate (IR) – adult	100	mg/day	Exposure Factors Handbook [9]
Ingestion Rate (IR) – older child	100		
Ingestion Rate (IR) - child	200		
Exposure Frequency (EF)	350	days/year	Two weeks vacation
Exposure Duration (ED)	30 (5, 10, 15)	years	Number of years at residence (child, older child, adult).
Body Weight (BW) - adult	72	kg	Adult mean body weight
Body Weight (BW) – older child	41		Older child mean body weight
Body Weight (BW) - child	15		0-5 year-old child average body weight
Surface area (SA) - adult	5700	cm^2	Exposure Factors Handbook
Surface area (SA) – older child	2900		
Surface area (SA) - child	2900		
Averaging $Time_{non\text{-}cancer}$ (AT)	1825	days	5 years
Averaging $Time_{cancer}$ (AT)	27375	days	75 years
Cancer Potency Factor (CPF)	1.4E-2	$mg/kg\text{-}day^{-1}$	Source: EPA
24 hr. absorption factor (ABS)	Variable	unitless	Source: EPA Chemical Specific SVOC – 0.1
Oral route adjustment factor (ORAF)	1	unitless	Cancer (c) – default
Adherence duration (AD)	1	days	Source: EPA
Adherence factor (AF)	0.2	mg/cm^2	Child, older child
	0.07		Adult
Inhalation rate (IHR) - adult	15.2	m^3/day	Exposure Factors Handbook
Inhalation rate (IHR) – older child	14		
Inhalation rate (IHR) - child	8.3		
Soil matrix factor (SMF)	1	unitless	Cancer (c) – default
Particulate emission factor (PEF)	6.00E+8	m^3/kg	Model Parameters (no grass coverage)

Dust Exposure Route – Non-cancer

Table A2. Non-cancer hazard calculations resulting from exposure to Di(2-ethylhexyl)phthalate (DEHP) in dust sample from Morris Road residence - Thurston County, Washington.

Contaminant	Maximum Concentration (ppm)	Scenarios	Estimated Ingested Dose (mg/kg/day)			Total Dose	RfD (mg/kg/day)	Hazard quotient
			Incidental Ingestion of dust	Dermal Contact with dust	Inhalation of Particulates			
DEHP	520	Child	6.65E-3	1.93E-3	4.60E-7	8.58E-3	2.0E-2	0.43
		Older Child	1.22E-3	7.05E-4	2.84E-7	1.92E-3		0.10
		Adult	6.93E-4	2.76E-4	1.76E-7	9.69E-4		0.048

ppm - parts per million

Dust Exposure Route – Cancer

Table A3. Cancer hazard calculations resulting from exposure to Di(2-ethylhexyl)phthalate (DEHP) in dust sample from Morris Road residence - Thurston County, Washington.

Contaminant	Concentration (ppm)	EPA Cancer Group	Cancer Potency Factor ($mg/kg\text{-}day^{-1}$)	Scenarios	Increased Cancer Risk			Total Cancer Risk
					Incidental Ingestion of Soil	Dermal Contact with Soil	Inhalation of Particulates	
DEHP	520	B2	1.4E-2	Child	6.21E-6	1.80E-6	4.30E-10	8.00E-6
				Older Child	2.27E-6	1.32E-6	5.30E-10	3.59E-6
				Adult	1.94E-6	7.74E-7	4.92E-10	2.71E-6

ppm - parts per million

Lifetime dose = 8.00E-6 + 3.59E-6 + 2.71E-6 = 1.43E-5 mg/kg/day

Certification

This Morris Road Health Consultation was prepared by the Washington State Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

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

for Alan Yarbrough

Alan Yarbrough
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