



Health Consultation

Final Release

Willamette Cove East Parcel Beach

Portland, Oregon

April 11, 2013

Prepared by:
Oregon Public Health Division
Environmental Health Assessment Program (EHAP)

Foreword

The Environmental Health Assessment Program (EHAP) prepared this health consultation with funds from a cooperative agreement 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 federal public health agency responsible for health issues related to hazardous substances in our environment.

ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. EHAP carries out ATSDR's mission in Oregon, working to assess human exposures and their public health implications at sites all throughout the state.

The purpose of a 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 EHAP can respond to requests from concerned residents or agencies for health information on hazardous substances. EHAP evaluates sampling data collected from a contaminated 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 Willamette Cove 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 EHAP or the contents of this health consultation, please contact Todd Hudson, Public Health Toxicologist, at (971) 673-0024, or by email at todd.hudson@state.or.us.

EHAP works with many partners, including the Environmental Protection Agency (EPA), Oregon Department of Environmental Quality (DEQ), local health departments, non-profit organizations and the communities that are affected by environmental contamination.

About this document

This Health Consultation for the Willamette Cove East Parcel Beach was prepared by the Oregon Environmental Health Assessment Program (EHAP) under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Department of Health and Human Services. ATSDR has not reviewed or cleared this document. Review and approval of this report was completed by the Oregon Health Authority (OHA).

Contents

Summary	7
Purpose and Public Health Issues	9
Background	9
Site Description.....	9
Site History	10
Past cleanup activities.....	10
Site Visit.....	11
Demographics	11
Discussion	22
Nature and Extent of Contamination	22
Exposure Pathways	22
Completed Exposure Pathways.....	23
Potential Exposure Pathways.....	23
Eliminated Exposure Pathways.....	23
Public Health Implications.....	26
Dioxin	26
Dose Calculation.....	29
Non-cancer risk.....	30
Cancer Risk.....	31
Lead Exposure	31
Sample results	32
Physical Hazards.....	35
Uncertainty.....	35
Children’s Health Considerations	36
Conclusions.....	37
Recommendations.....	37
Public Health Action Plan.....	40
Report Preparation	42
References.....	43
Appendix A. Response to Public Comments.....	45
Appendix B. Comparison Values and Contaminant Screening	51
Appendix C. Dose and Health Risk Calculation for Dioxin.....	53

Appendix D. ATSDR Fact Sheets for Lead and Dioxin..... 55
Appendix E. Glossary 60

List of Tables

Table 1. Summary of exposure pathways at the Willamette Cove site.....	25
Table 2. Concentrations of dioxin samples	27
Table 3. Concentrations of lead samples.....	33

List of Figures

Figure 1. Map of the Willamette Cove site.....	12
Figure 2. An overhead photo of the East Parcel beach area of Willamette Cove.....	13
Figure 3. The East Parcel beach of Willamette Cove.....	14
Figure 4. A path that crosses through the upland portion of the Willamette Cove site.....	15
Figure 5. Bicycles and personal items on the East Parcel beach	16
Figure 6. Remnants of cooking fires at the east parcel beach.....	17
Figure 7. Boats anchored at the East Parcel beach.....	18
Figure 8. A stranded boat on the East Parcel beach.....	19
Figure 9. Metal debris sticking out of the ground at the East Parcel beach.....	20
Figure 10. An old scaffolding structure near the East Parcel Beach.....	21
Figure 11. Approximate locations of dioxin sample areas.....	28
Figure 12. Approximate locations of lead sample areas.....	34

Summary

Introduction	At Willamette Cove, EHAP’s purpose is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent people from coming into contact with harmful toxic substances.
Overview	EHAP reached <i>three</i> important conclusions in this Health Consultation.
Conclusion 1	<i>Incidentally swallowing lead-containing beach soil at the East Parcel beach in the Willamette Cove site on a regular basis could harm the health of children and adults who use this area.</i> EHAP considers the East Parcel beach an area of public health concern. Although the data were not sufficient for a full analysis, the levels that were found greatly exceeded health-based standards.
Basis for Decision	High levels of lead measured in the soil could cause decreased intelligence and impaired neurobehavioral development in children and fetuses. There is no “safe” level for blood lead concentration in children or adults.
Next Steps	EHAP recommends that people not go to Willamette Cove. However, if they do, make sure to: <ul style="list-style-type: none">• Avoid direct contact with soil on the East Parcel beach.• Wear shoes and avoid sitting in the soil.• Remove shoes before entering the home to avoid tracking soil into living areas. <p>EHAP will:</p> <ul style="list-style-type: none">• Evaluate future data as they become available, for lead and other chemicals on the East Parcel beach.
Conclusion 2	<i>There is not enough evidence to conclude that people could experience health effects from contacting dioxin-containing surface soil on the East Parcel Beach of the Willamette Cove.</i>
Basis for Decision	This is because EHAP does not have evidence that people are coming into contact with dioxin-contaminated soil on a regular basis.
Next Steps	EHAP will: <ul style="list-style-type: none">• Further characterize dioxin contamination in the upland area, when data become available.• Evaluate contamination data for other chemicals in the upland area.

Conclusion 3 *Trespassing on the upland area near the East Parcel beach on old scaffoldings, walking or playing on the East Parcel beach where metal debris is sticking out of the ground, or going into the water along the East Parcel where numerous underwater hazards are present could result in physical injury. This is a physical safety hazard.*

Basis for Decision There are structures near the East Parcel beach that are old and unmaintained. People could also be cut by or trip over pieces of metal sticking out of the ground. People could trip on or be cut by physical hazards in the water. Boaters could collide with underwater hazards.

Next Steps EHAP recommends that:

- Avoid playing on or going near areas where physical hazards are present on or near the East Parcel Beach.

EHAP will:

- Communicate with partner agencies to reduce access to physical hazards in the area.

Purpose and Public Health Issues

The Oregon Office of Environmental Public Health's Environmental Health Assessment Program (EHAP) has prepared this Health Consultation (HC) regarding Willamette Cove in Portland, Oregon, at the request of the Oregon Department of Environmental Quality (DEQ). This HC addresses the potential public health impacts of exposure to the contaminants of lead, dioxin, and physical hazards on the East Parcel beach at Willamette Cove.

Background

Site Description

On December 1, 2000, the US Environmental Protection Agency (EPA) and Oregon DEQ designated Portland Harbor a Superfund site under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). As part of the Superfund investigation process, EHAP investigated environmental exposures and human health at multiple sites within Portland Harbor. Willamette Cove is within the boundaries of the Portland Harbor Superfund site.

The Willamette Cove property consists of 27 acres (Figure 1) along the east bank of the Willamette River, between river miles 6 and 7. It is bounded by the Willamette River to the southwest and a steel facility to the northwest. The Union Pacific rail line forms the northern boundary of the site. The Burlington Northern Santa Fe (BNSF) rail line and the approach to the Willamette River railroad bridge form the east side of the site boundary. On the opposite side of the BNSF tracks is the former McCormick and Baxter Creosoting Company, another federal Superfund facility. The Cathedral Park neighborhood of Portland is on the other side of the rail line; some residences (at a higher elevation) are less than 500 feet from the site.

The site is elongated, from east to west, along the Willamette River. The Willamette Cove site is divided into an East Parcel, a Central Parcel, and a West Parcel (Figure 1). The site also consists of two distinct ecological areas: the shoreline and the upland area.

The shoreline is unique because there are two sandy beach areas in the East and Central Parcel, and beaches are rare along the Willamette River. The "cove", or sheltered bay area, is a river feature on the East Parcel and part of the Central Parcel (Figures 2 and 3). The shoreline of the cove within the East Parcel is a sandy beach and is the focus of this Health Consultation. In this report, EHAP refers to it as the East Parcel beach but it is sometimes referred to by others as the "inner cove" or "inner cove beach". The East Parcel beach is relatively far from where site personnel or police can enter, and is a popular place for people to congregate. The other beach area is further downstream and is not addressed in this Health Consultation.

The "upland" area of the site (the area above and away from the shoreline) has many traversing trails and is heavily vegetated. (Figure 4). Although signs are posted to discourage trespassing and the trails are blocked to vehicle access, many people still use the trails. The East Parcel and Central Parcel beaches can be accessed by these trails.

Both the shoreline and upland area is owned and managed by Metro, the regional governmental agency for the Portland area.

Site History

Activity at Willamette Cove began in 1903. The site was used as a lumber and plywood mill, a cooperage (barrel making) plant, and a ship repair dry dock facility. Some of these industrial activities continued until the 1960s (DEQ, 2012). Although the ship repair facility was not located on the East Parcel, there were significant industrial operations in this area, including the lumber/plywood operations, as well as illegal dumping and derelict/grounded barges (Port of Portland, *Personal Communication*, September 2012). Because most of these activities pre-dated most environmental reporting requirements, the specific manner and time of chemical releases on the site are not known. Since there was a legacy of many different operations, EHAP believes that chemical releases occurred in water and on the shore.

By the early 1980s, the remaining buildings on the site were demolished (Ash Creek, 2007). Since then, the land on the site has re-vegetated. Vegetation is quite dense in some places, with a mixture of native and invasive plants.

Metro acquired Willamette Cove in 1996 with the intent to develop the site into an urban natural area with passive recreation opportunities (City of Portland, 2009). Initially, they planned to encourage and restore native vegetation and build a multi-use trail through the site as part of the Willamette River Greenway. However, no restoration or development activity has taken place.

Past cleanup activities

There have been previous cleanup actions at the site. In 1999, an abandoned underground storage tank and 127 tons of oil-contaminated soil was removed from the upland area. In 2004, test pits were dug in the East Parcel beach area and petroleum products were discovered in these pits – twenty tons of petroleum-contaminated material was disposed of off-site. When the shoreline along the neighboring McCormick & Baxter site was capped, part of the shoreline of the East Parcel beach was also capped to prevent further migration of McCormick and Baxter contamination to the Willamette Cove beaches and the Willamette River. This cap prevents people from coming into contact with wood-preserving contaminants.

When the Portland Harbor Public Health Assessments (PHAs) were released in 2006 and 2011, EHAP only had limited data about contamination at Willamette Cove. New sampling data only became available as the 2011 Recreational Use PHA was being finalized.

Site Visit

EHAP visited Willamette Cove in November 2010, August 2011, and July 2012. Access to the site from Edgewater drive is restricted by a secured gate and concrete barriers. According to Metro personnel, this locked gate has in the past been breached multiple times. Access to this gate is shared with other agencies and railroad contractors. There are numerous trails and unofficial entrances to the site; some of these trails can be seen in the overhead map in Figure 1. EHAP observed that some of the “No Trespassing” signs had been defaced or were covered by growing vegetation. Although trails were blocked to motor vehicles, they can be easily accessed on foot and on bicycle. During the site visits, EHAP also observed people using the site. During the 2011 site visit, the Metro site manager had to ask people to leave the upland area. Also during this visit, EHAP observed bicycles and bicycle trailers full of peoples’ personal belongings, parked on the East Parcel beach (Figure 5). There were also multiple campfire remnants on the beach, one of which was used for cooking (Figure 6). There was one boat anchored in the cove (Figure 7), and a hand-made raft was parked on the beach, indicating boat-to-shore activity (Figure 7).

Demographics

The people potentially affected by contaminants from Willamette Cove are those who trespass onto the site. It should be noted that while this site is under the ownership of a public entity, there is no public access allowed. “No trespassing” signs are posted throughout the upland area. Metro, the site owner, routinely patrols this area, to reduce trespassing. EHAP identified at least five different categories of people who routinely visit the site: (1) Transient populations; (2) Groups of partying teenagers and young adults; (3) People coming ashore on boats; (4) People who are out walking their dogs, or biking, walking or running through the site; and (5) people who come to fish from the shore. The East Parcel beach often attracts boaters since it is protected from river currents and ship traffic. Both OHA and DEQ, on repeated site visits (Ken Theissen, *Personal Communication*, December 2012), have seen transient boaters (*i.e.*, people who use small boats as their primary home) anchored in the cove area (Figure 7). Metro cannot prohibit boaters from anchoring along Willamette Cove, because the river is regulated by the Division of State Lands. In spring 2011, DEQ observed a boat that became stranded on the beach after the river level dropped. The owners re-floated the boat by digging a large amount of sand away from under the boat (Figure 8).

S:\GIS\PRJ\2\10115\F1\DCORAS00\FIG1_2_2_W3_SITE_FEATURES_BFA.MXD

Figure 1. 2007 map of the Willamette Cove site. (Photo courtesy of Ash Creek Associates)

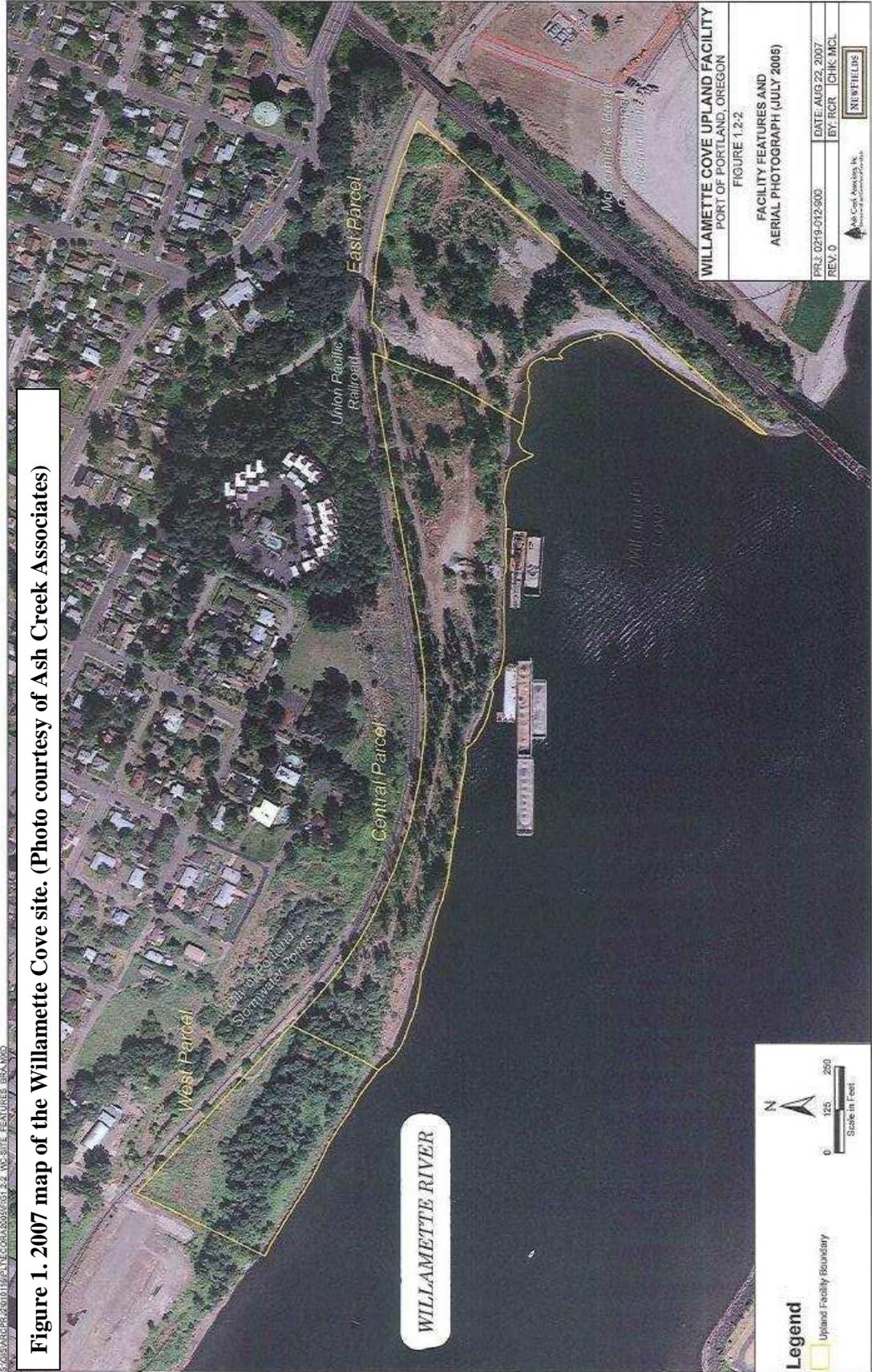




Figure 2. An overhead photo of the East Parcel beach area of Willamette Cove (photo courtesy of Google Maps).

Figure 3. The East Parcel beach of Willamette Cove (2010).



Figure 4. A path that crosses through the upland portion of the Willamette Cove site. Some of these paths lead to the beach areas along the river (2010).



Figure 5. Bicycles and personal items on the East Parcel beach of Willamette Cove. To the left of the bicycles are a sleeping bag and a crate with personal items (2011).



Figure 6. Remnants of a fire used for cooking at the east parcel beach of Willamette Cove. Remnants of fire pits have been observed at both East Parcel and West Parcel beaches (2011).



Figure 7. Boats anchored near the East Parcel beach of the Willamette Cove site. A handmade raft sits near the shore. These boats have been observed being anchored in the cove for long periods of time (2011).



Figure 8. A stranded boat on the East Parcel beach of Willamette Cove. To the right of the boat is a large pile of displaced soil removed during an attempt to re-float the boat (2011).



Figure 9. Metal and concrete debris sticking out of the ground at the East Parcel beach of the Willamette Cove site (2011).



Figure 10. An old scaffolding structure near the East Parcel Beach (2010).



Discussion

Nature and Extent of Contamination

This section describes the types of data that EHAP considered in deciding whether people's health could be harmed by chemical contaminants found in the East Parcel beach. This is also the section where details about the assessment process and results can be found. All environmental sampling data used in this assessment were obtained using EPA-approved methods and technology by certified professionals and technicians.

The data used for this health consultation were collected between 2001 and 2010 [Ash Creek, 2011; LWG, 2008; Ash Creek, 2013; Ash Creek, 2011; Ash Creek, 2007]. They were originally collected with the purpose of evaluating pollution source control into the Willamette River. EHAP evaluated samples taken on the East Parcel beach, and in an upland area about 100 feet from the beach area. Some samples were taken from surface soil (*i.e.*, less than six inches deep), while others were collected from greater depths. EHAP evaluated lead levels on and near the East Parcel beach. EHAP also evaluated dioxin in three samples from the upland area, and from two samples near the beach area.

When the maximum measured concentrations of a given contaminant were higher than the comparison value (CV), that contaminant was identified as a "contaminant of potential concern" (COPC). It is important to note that just because a COPC has been identified, it does not mean that we expect harmful health effects from exposure to that contaminant. Rather, it simply flags these contaminants for closer evaluation. In the East Parcel beach, several lead samples exceeded EPA's Regional Screening Level (RSL) of 400 parts per million (ppm). The dioxin concentrations from samples collected in a densely vegetated area near the beach were above ATSDR's child-chronic Environmental Media Evaluation Guide (EMEG) of 0.00005 ppm. For more information about the CVs used, see Appendix B. The next section will explain how the concentrations of lead and dioxin could affect human health.

Exposure Pathways

In order for a chemical contaminant to harm human health, there must be a way for people to come into contact with the chemical. An "exposure pathway" describes how a chemical moves from its source and comes into physical contact with people. An exposure pathway has five elements:

- (1) A contaminant source or release
- (2) A way for the chemical to move through the environment to a place where people could come into contact with it
- (3) A place where people could contact the contaminant

- (4) A route of exposure to a contaminant (breathing it, swallowing it, absorbing it through the skin)
- (5) A population that comes into contact with the contaminant

An exposure pathway is “completed” if all five of the elements are known to be in place and occurring. If it is unknown whether one or more of the elements is in place, then it is called a “potential” pathway. If it is known that one of the five elements is *not* in place, then that pathway is “eliminated.”

Table 1 describes completed, potential, and eliminated exposure pathways for the Willamette Cove East Parcel Health Consultation.

Completed Exposure Pathways

EHAP has evidence that people are coming into contact with areas of lead contamination on the East Parcel beach.

Potential Exposure Pathways

Samples taken from the densely vegetated area near the beach exceeded the CV for dioxin. Although there is potential for exposure in this area, the area is not very accessible. To reach the area, EHAP staff had to walk over steep rip-rap (*i.e.*, large rocks) and through heavy vegetation (much of this vegetation is blackberry bushes with thorns). Vegetation also obstructs the approach from the upland side of the site. There was only a small amount of exposed ground in the spot where this sample was taken (and this was the result of clearing the vegetation to collect the sample).

In the absence of concrete evidence to the contrary, EHAP assumed that some people have come to this particular spot where the sample was taken. Therefore, EHAP assessed the potential health risks to individuals who may hypothetically come into contact with the soil.

Eliminated Exposure Pathways

Breathing contaminated dust is an eliminated exposure pathway. In most cases, the dose of a contaminant from accidentally swallowing soil is much greater than the dose from breathing it into the lungs. This is because most of the dust that is visible consists of particles that are too large to go very deep into the lungs. These larger particles are trapped in mucus that lines the respiratory tract and are carried back up to the throat where they are swallowed.

Portland receives rain, on average, 154 days per year. This makes it unlikely that the site will remain dry enough for a sufficient amount of time for dust to enter the air and migrate off the

property. In addition to rain, the entire East Parcel beach is less than 100 feet from the shore of the Willamette River, which keeps much of the soil saturated.

The Willamette Cove East Parcel beach is also surrounded by the upland area, which is heavily vegetated with mature, tall trees and extremely dense ground vegetation. It is unlikely that any dust blown from the East Parcel beach can penetrate through this area to nearby residences. Finally, the nearest residences in the Cathedral Park neighborhood are located above a heavily vegetated bluff behind the northern boundary of the site. The East Parcel beach is over 500 feet from the nearest residence.

For the reasons outlined above, breathing contaminated dust was eliminated as an exposure pathway. This pathway was not further evaluated in this public health assessment.

Table 1. Summary of exposure pathways at the Willamette Cove site.

	Pathway	Time	Source	Media and Transport	Point of Exposure	Route of Exposure	Exposed Population
<i>Completed</i>	Contact with soil with elevated lead levels	Past Present Future	Historical industrial activity	Surface layer of soil	Contaminated areas in the East Parcel Beach area	Swallowing, touching the skin	People who walk on and use the beach
<i>Potential</i>	Contact with soil in the area with elevated dioxin levels	Past Present Future	Historical industrial activity	Surface layer soil	A small, contaminated area in the upland area, less than 100 feet from the East Parcel beach	Swallowing, touching the skin	People who access this area (unknown if people are actually here)
<i>Eliminated</i>	Inhalation of contaminants from site	Past Present Future	Historical industrial activity	Dust carried in wind to places where people could inhale it (the site is heavily vegetated and dust is unlikely)	Beaches, upland area, or offsite properties adjacent the site	Breathing in airborne dust	People who trespass on the site, nearby residents

Public Health Implications

To accurately assess whether environmental contaminants could harm the health of people who are exposed to them, it is necessary to determine how much of each contaminant could be getting into people's bodies. For this assessment, EHAP calculated doses for each of the COPCs based on specific exposure scenarios. These exposure scenarios were developed using information and assumptions about the age of the individuals accessing the site and type of activities known to occur there.

Dioxin

Dioxins are a family of 75 similar compounds. They can be found everywhere in the environment, mostly at low levels. Dioxins are released into the environment through combustion (*e.g.*, from burning of fossil fuels, wood, trash, and cigarette smoke) and from industrial releases (*e.g.*, the manufacture of pesticides and paper). When they are released into soil they can remain there for a long time, because they do not readily break down.

Most people are exposed to very small amounts of dioxins when they breathe air, consume food and milk, or have skin contact with dioxin-contaminated material. People exposed to high levels of dioxins, through industrial accidents or workplace exposures, have experienced a severe skin disease called chloracne. Other skin effects may occur, including skin rashes and discoloration. People and animals that were exposed to dioxin have also experienced reproductive, developmental, and immune system effects. There is some evidence that dioxin may cause cancer in humans, because many studies have shown that dioxin causes cancer in multiple organs in animals. If you swallow soil containing dioxin, a small amount will pass through the intestines into the blood stream. If your skin comes into contact with dioxin-contaminated soil, some of the dioxin molecules will enter the body. Body fat and the liver can store dioxins for many years before they are eliminated from the body. ATSDR's Environmental Media Evaluation Guide (EMEG), a comparison value for dioxin concentration in soil, is 0.00005 ppm.

The data used to evaluate dioxin contamination in this health consultation were collected as part of pollution source control evaluations (LWG, 2008; Ash Creek, 2011) (Table 2 and Figure 11). Two samples taken from the shoreline in the Central Parcel were evaluated. Both of these samples were below the EMEG for dioxin. Three samples were taken from a heavily vegetated area located upland from the beach in the Central Parcel (Figure 11). All three of these samples were above the EMEG for dioxin. Several types of dioxin compounds were analyzed in the soil samples. EHAP evaluated these concentrations using what is called the dioxin toxic equivalent (TEQ) concentration. Each dioxin-like compound was multiplied by a Toxic Equivalency Factor (TEF) to produce the dioxin TEQ.

Table 2 – Concentrations of dioxin in samples taken from the East Parcel beach and nearby upland area.

Sample Name	Sample Type	Depth (inches)	Dioxin Conc. (ppm) ^a	Source	Comments
Wharf Beach-1 ^b	Sediment Sample ^c	12-18	0.0000015	Ash Creek, 2011	Taken from Central Parcel, near low water mark ^d .
LW3-GWC1	Composite from several sediment samples	12	0.0000000125	LWG, 2008	Taken from Central Parcel, below low water mark.
WC-1	Surface Sample	4-10	0.0006^e	Ash Creek, 2011	Taken from upland area
WC-2	Surface Sample	3-9	0.000130^e	Ash Creek, 2011	Taken from upland area
WC-3	Surface Sample	3-9	0.0057^e	Ash Creek, 2011	Taken from upland area

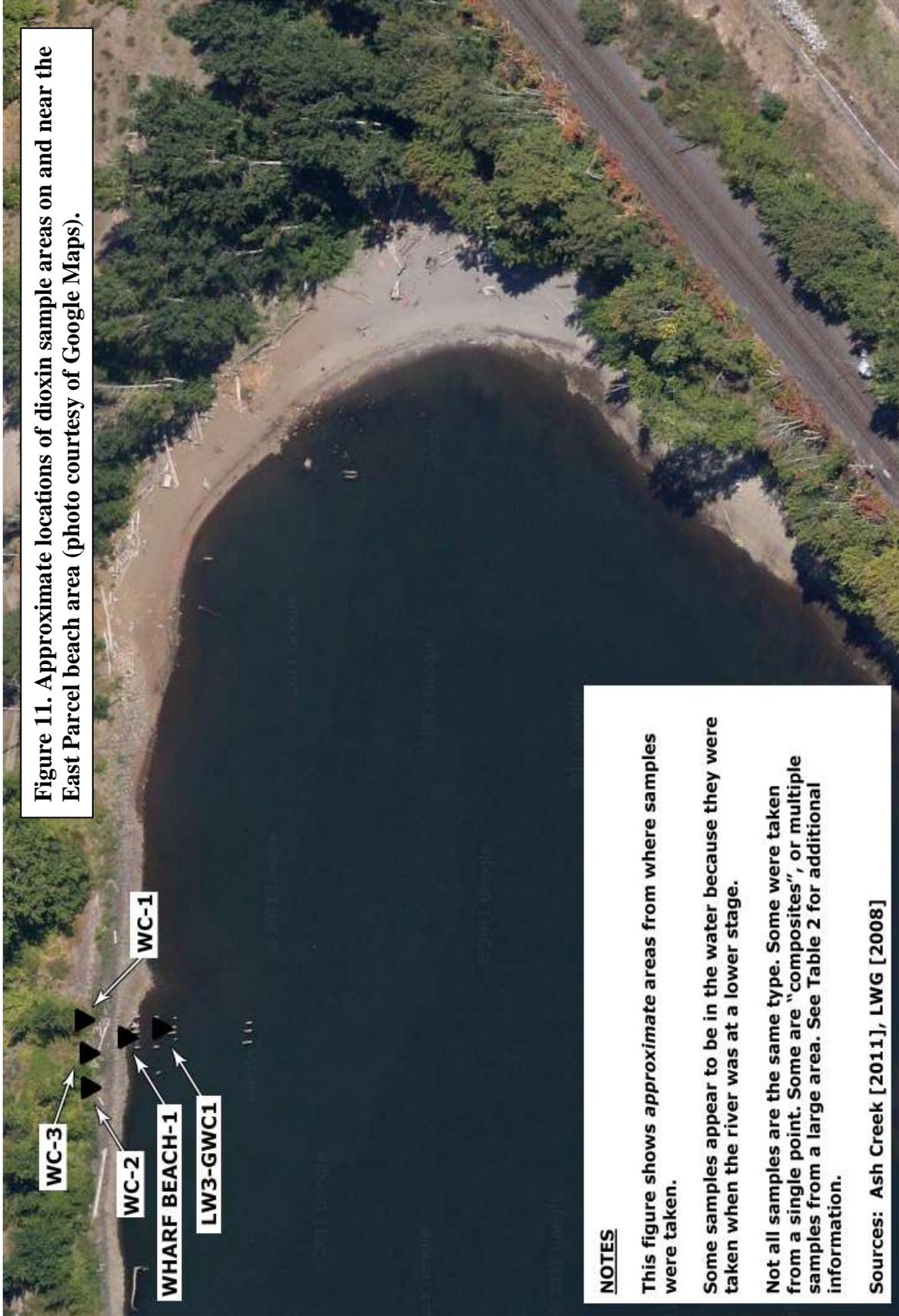
a. Several dioxin and furan congeners were analyzed in soil. A single value, called a dioxin toxic equivalent (TEQ), is presented in this health consultation. Each dioxin/furan, or dioxin-like compound, is multiplied by a Toxic Equivalency Factor (TEF) to produce the dioxin TEQ.

b. Samples are named as they are listed in their respective reports.

c. Sediment is waterlogged soil that was taken from near the water.

d. The low water mark is the level where waters normally recede when the river is at low flow.

e. These values are above ATSDR's child chronic Environmental Media Evaluation Guide (EMEG) for dioxin (0.00005 ppm).



As previously explained in the pathways analysis, exposure to dioxin is a *potential exposure pathway*. The area where dioxin was measured above the CV is not on the beach and is obstructed by dense vegetation and steep concrete rip-rap. EHAP does not know whether people recreate or play in this area. It is important to note that only people actually sitting or playing in this hard-to-reach area would come into contact with dioxin-contaminated soil.

Dose Calculation

Dose calculation requires EHAP to make assumptions about the frequency and intensity with which people contact dioxin. Wherever possible, site-specific information is used, but when that information is not available, EHAP uses default values that are established by ATSDR or EPA. Where default values are unavailable, EHAP uses best professional judgment. See Appendix C for details about the methods and assumptions used to calculate doses of dioxin.

People can potentially contact dioxin in soil at Willamette Cove through two routes. These include swallowing and touching soil particles that contain dioxin. The most protective way to calculate a total dose is to add the calculated dioxin doses from both of these routes.

For the dioxin exposure analysis, EHAP used one scenario of a person playing directly in this area. Since there are not enough samples to statistically calculate an overall concentration, EHAP used the sample with the maximum concentration (0.0057 ppm) to calculate the dose and risk to an adolescent child (age 11 years and up) playing directly in this area. The exposure scenario assumes that an adolescent would be playing in this area one day a week for two continuous years, and incidentally swallowing 100 mg of soil each time they are there. This amount of soil is roughly equal to the volume of a few drops of water. For skin exposure, EHAP assumed that the hands, upper arms, and lower legs of an adolescent would be exposed to the soil while they are playing here. Appendix C details the methods and assumptions used to calculate the doses and risk.

There is uncertainty about whether people actually trespass into the area where these dioxin levels were found. It is less attractive than the beach around the cove, and people must cross obstacles to get there. Because of this reason, an exposure scenario was chosen that reflects this. There is no specific risk assessment guidance for trespassers. Because not all sites provide the same opportunities and access for trespassers, scenarios must be developed on a site-specific basis (EPA, 1991). Trespassing scenarios require best professional judgment based on the individual characteristics of each site.

Non-cancer risk

Non-cancer risk, the risk of any health problem other than cancer, was calculated by dividing the total calculated dose for dioxin for each scenario (*i.e.*, by swallowing and from skin contact) by the health guideline for dioxin. A health guideline is the daily dose of a chemical, below which scientists consider it unlikely to harm people's health. EHAP followed ATSDR guidance (ATSDR, 2005) by using health guidelines, called Minimal Risk Levels (MRLs), whenever available. A MRL is an estimate of daily human exposure to a substance that is unlikely to cause non-cancerous health effects during a specific amount of time. The MRL is set well below levels that are known or anticipated to result in non-cancerous, adverse health effects (ATSDR, 2005). ATSDR's chronic MRL for dioxin is 1E-09 (0.000000001) mg/kg/day.

EHAP divided the calculated dose by the MRL, (see equation below). The resulting number for each pathway is called the hazard quotient (HQ). By adding together all the HQs for each pathway, the Hazard Index (HI) is identified. If the HI or the HQ in any given scenario is greater than 1, it is an indication that the estimated dose is above the safe dose, and there could be concern for potential health effects (EPA, 1989). An elevated HI only tells us there is *potential* for adverse health effects, and that further evaluation should be considered. A HQ or HI below 1 indicates that the estimated dose is below the safe dose and non-cancer effects are unlikely.

$$\text{Hazard Quotient} = \text{Calculated Dose} \div \text{Health Guideline (MRL)}$$

The HQs for swallowing and having skin contact with soil that contains dioxin were included in calculating the HI.

EHAP assumed that an adolescent child (age 11 years or older) would access this dioxin-contaminated area 52 days per year, swallowing 100 mg of soil each time they are playing, and getting soil on their hands, forearms, and lower legs. The estimated total dose from swallowing and absorbing dioxin was calculated to be 1E-09 (0.000000009) mg/kg/day. The HI for non-cancer effects is calculated as 1, which is approximately the same value as the threshold for increased potential of health effects.

As previously stated in the pathways analysis, the area where this soil sample was taken is surrounded by dense vegetation and is upland from the Each Parcel beach. Because of the location, EHAP believes that this exposure scenario is very conservative, *i.e.*, it overestimates actual exposures, if they are actually occurring. Because the HI does not exceed 1, EHAP does not believe that people accessing this area would experience adverse health effects. Due to the small number of samples, however, the extent of dioxin contamination is not fully known.

An acute exposure, or an exposure of 14 days or less, would result in an even lower HI at this concentration. Therefore, EHAP concludes that the dioxin concentration from this one soil sample is not expected to cause any non-cancer health problems for children.

Cancer Risk

Theoretical cancer risk was calculated by multiplying the calculated cancer dose (cancer dose is averaged over a 78-year lifetime instead of the duration of exposure) by the cancer slope factor (CSF) (see equation below). EHAP used EPA's oral cancer slope factor of 1.5×10^5 (150,000) per mg/kg/day (EPA, 2000).

Cancer Risk = Calculated Cancer Dose x Cancer Slope Factor

Cancer risk is expressed as a probability, which can be thought of in terms of additional cancer cases in a theoretical population where everyone in that population would get the same dose of the same chemical. EHAP considers 1 additional case of cancer out of 10,000 (1×10^{-4}) people exposed every day for an entire lifetime to be low risk. A cancer risk of 1 cancer case out of every 100,000 people (1×10^{-5}) would be a very low risk. A cancer risk out of 1 additional case out of 1,000,000 (1×10^{-6}) would be a negligible risk.

For cancer effects, the lifetime cancer risk for an older child was 5×10^{-6} , or approximately 5 additional cases of cancer out of 1,000,000 people. This is far less than EHAP's threshold of one additional case of cancer out of 10,000 people (1×10^{-4}), and is considered to be a very low to negligible level of additional cancer risk.

Lead Exposure

Lead is a heavy metal that occurs naturally in the Earth's crust, and can be detected at background levels in soil. Lead and lead alloys are commonly found in pipes, batteries, fishing weights, shot and ammunition and radiation shields. Lead compounds are also used as pigments in dyes and ceramic glazes. Lead was once used more frequently than it is today. It was used as an additive in gasoline and in paint. Lead does not break down when it is released into the environment. Even when industrial activity at a site ends, lead contamination can remain in the soil for long periods of time. As a result, lead concentrations in industrial (and sometimes residential) areas can be much higher than normal background levels.

Young children (0-7 years) and developing fetuses are the most sensitive to the toxic effects of lead. Blood lead levels as low as 5 $\mu\text{g}/\text{dL}$ are associated with decreased intelligence and impaired neurobehavioral development in growing children (CDC, 1991), and research has shown that measured health effects can occur at levels as low as 2.5 $\mu\text{g}/\text{dL}$ (EPA, 2000). There is no demonstrated safe level of lead in blood. Children and teenagers who trespass on the East Parcel

beach are at higher risk for lead exposure because they engage in behaviors that put them more at risk than adults.

EHAP uses 5 µg/dL as the threshold blood lead level for adverse health effects in children. This means that when exposure to lead will result in blood lead concentrations higher than 5 µg/dL, action should be taken to eliminate exposure. For adults, the reference value for blood lead levels is 25 µg/dL.

Sample results

From 2001-2010, samples were taken on and near the East Parcel beach area and tested for lead (Table 3, Figure 12). Some samples show high levels of lead, while other samples do not. EHAP does not consider the data to be sufficient to calculate health risks for people who may come into contact with soil on the East Parcel beach. To estimate risk from lead exposure, EHAP needs a sufficient number of surface samples, taken over the entire area during one time period.

High lead concentrations were found along the shore, in the Central Parcel – this area is less than 300 feet from the sandy area of the East Parcel beach and is within the geographical area of the cove. EHAP evaluated five samples from this area that were collected in 2007 and 2010 (Table 3, Figure 12). The highest lead level from this area was 13,400 ppm, which is over 30 times higher than EPA's Regional Screening Level (RSL) of 400 ppm. The other samples taken from this area ranged from 35.4 to 8,660 ppm.

EHAP evaluated eight soil sample analyses that were taken directly from the East Parcel beach (Figure 11). The concentrations of lead from these samples ranged from 35.7 to 1,160 ppm (Table 3). One of these samples exceeded EPA's RSL of 400 ppm. Only four of the eight samples were taken from the surface of the sandy beach area, which is where activity is regularly observed. These concentrations ranged from 35.7 to 70 ppm, below EPA's RSL. All four of these surface samples are located within 60 feet of each other.

Though the Willamette Cove site is officially closed to the public, EHAP staff have seen evidence that people are entering the site and coming into contact with soil at the East Parcel Beach. Further, EHAP and DEQ have observed activities that could potentially put trespassers on the site at risk for coming into contact with lead-contaminated soil, including people walking on the beach. There is also evidence that people cook food, leave blankets and backpacks, and throw parties on the beach area (Figures 5 and 6). The site is also frequented by transient boaters who anchor in the Cove and travel to shore using rafts (Figure 7).

Table 3. Concentrations of lead in samples taken from the East Parcel beach and nearby areas.

Sample Name	Sample Type	Depth (feet)	Surface Sample?	Conc. (ppm)	Year	Source	Comments
Wharf Beach - 1	Sediment ^d Sample	1.0-1.5	No	8,660 ^b	2010	Ash Creek, 2011	Taken from Central Parcel, near low water mark ^b .
LW3 – GWC1	Composite from several surface samples	0-1.0 ^c	Yes	13,400 ^b	2007	LWG, 2008	Taken from Central Parcel, below low water mark.
DL-1	Sediment Sample	1.0-1.5	No	35.4	2007	Ash Creek, 2013	Taken from Central Parcel, near low water mark.
DL-2	Sediment Sample	1.0-1.5	No	3,910 ^b	2007	Ash Creek, 2013	Taken from Central Parcel, near low water mark.
DL-3	Sediment Sample	1.0-1.5	No	538 ^b	2007	Ash Creek, 2013	Taken from Central Parcel, near low water mark.
Beach Cove - 1	Sediment sample	1.0-1.5	No	1,160 ^b	2010	Ash Creek, 2011	Taken from East Parcel on beach, near low water mark.
Beach Cove – 2	Sediment sample	1.0-1.5	No	59.4	2010	Ash Creek, 2011	Taken from East Parcel on beach, near low water mark.
Trench 1/2	Composite from two samples	8.0	No	92.3	2010	Ash Creek, 2011	Sample taken from East Parcel on beach, from the bottom of a trench.
Trench 3/4	Composite from two samples	8.0	No	137	2010	Ash Creek, 2011	Sample taken from East Parcel on beach, from the bottom of a trench.
SS-33	Surface Soil	0-0.5	Yes	35.7	2002	Ash Creek, 2007	Taken from East Parcel, on beach.
SS-34	Surface Soil	0-0.5	Yes	36.7	2002	Ash Creek, 2007	Taken from East Parcel, on beach.
SS-35	Surface Soil	0-0.5	Yes	48.5	2002	Ash Creek, 2007	Taken from East Parcel, on beach.
HA-7	Surface Soil	0.5-1.0	No	70	2001	Ash Creek, 2007	Taken from East Parcel, on beach.

a. Sediment is waterlogged soil that was taken from near the water.

b. These values are above EPA's Regional Screening Level (RSL) of 400 ppm.

c. Shaded samples indicate samples were taken from soil surface.

d. The low water mark is the level where waters normally recede when the river is at its low level.

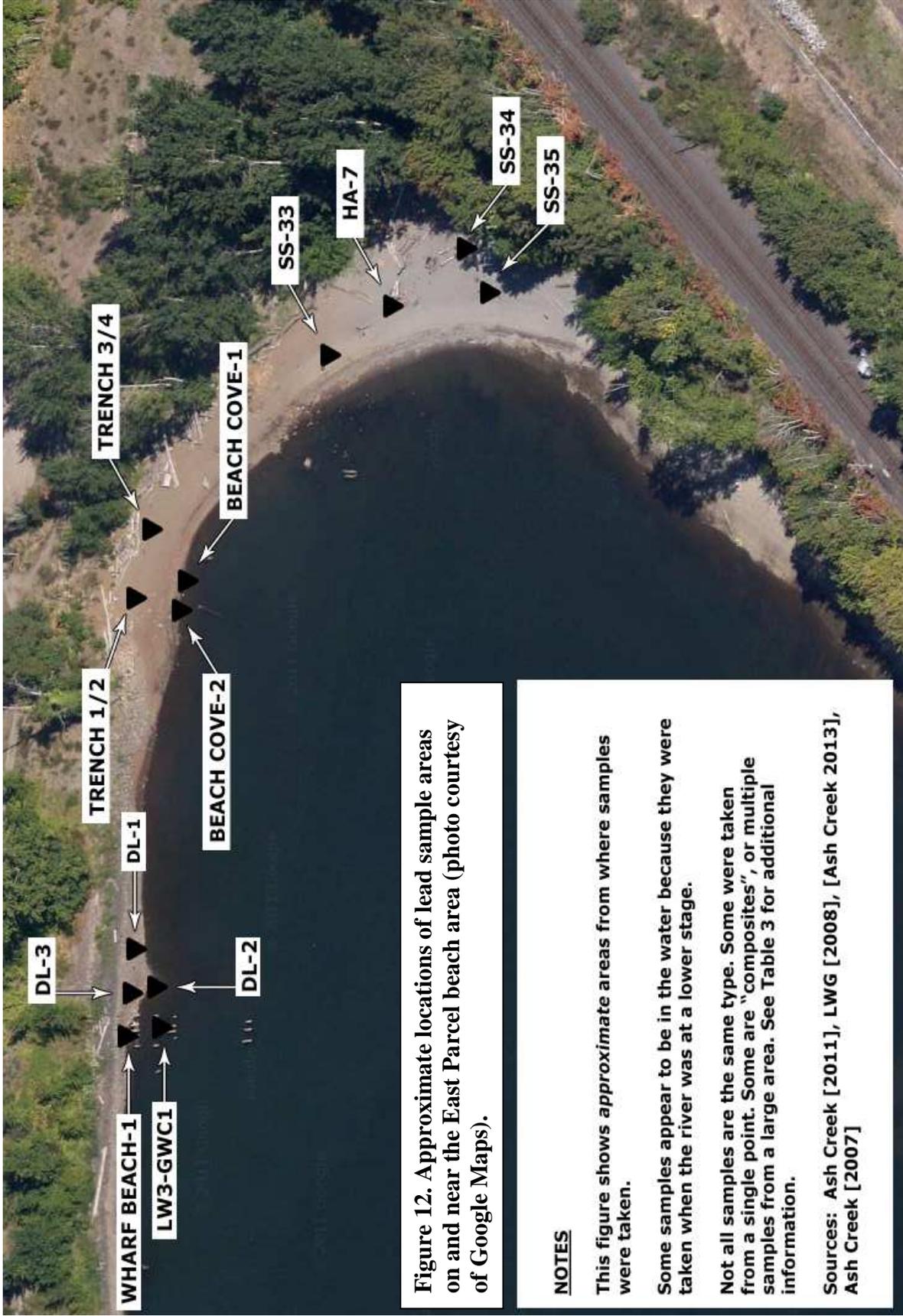


Figure 12. Approximate locations of lead sample areas on and near the East Parcel beach area (photo courtesy of Google Maps).

NOTES

This figure shows *approximate* areas from where samples were taken.

Some samples appear to be in the water because they were taken when the river was at a lower stage.

Not all samples are the same type. Some were taken from a single point. Some are "composites", or multiple samples from a large area. See Table 3 for additional information.

Sources: Ash Creek [2011], LWG [2008], [Ash Creek 2013], Ash Creek [2007]

EHAP is concerned that people may be coming into contact with lead in soil at the East Parcel beach, especially during periods of low river flow, when more beach area is exposed. There are high concentrations of lead observed on the shore of the Central Parcel. Because of this, and too few surface samples on the East Parcel beach, EHAP cannot rule out lead contamination on the beach area. EHAP would need additional sampling data to sufficiently characterize overall lead concentrations on the East Parcel beach. Specifically, samples collected at less than six inches of depth, along the entire beach area, are necessary in order to evaluate health risks. Samples taken deeper than one foot are not useful because recreational users are typically not expected to come into contact with this material.

Physical Hazards

Hazards on the East Parcel beach are shown in Figures 9 and 10. Areas of land that are below the high water mark are the responsibility of the Oregon Division of State Lands. These hazards were most obvious during the August 2011 site visit, when water levels are seasonally at their lowest. Evident features at the East Parcel beach include several jagged metal pieces sticking out of the sand and broken pilings sticking out of the sediment. The jagged pieces of metal present a risk to people walking on the beach. The pilings present a risk to waders, swimmers, and boaters at the site. It is unknown what else lies under the sand at the beach and under the sediment in the water. On the side of the East Parcel beach next to the railroad bridge, there is a large scaffold-type structure made of metal beams and concrete; this structure is covered with graffiti. There is no indication of how old or sturdy the structure is. The scaffolding could collapse, or someone could fall from the top of it. The entire area would be extremely dangerous for any water-based activity, especially at night and during high water when the hazards may not be visible.

Uncertainty

In any public health assessment there are uncertainties. Some of the uncertainty is related to the health guideline values used to assess toxicity (*i.e.*, MRLs and RfDs). These values have passed a rigorous multi-agency peer-review process; however, each person is unique and individuals vary in their sensitivity to toxic chemicals. To some extent, these uncertainties have been addressed by applying uncertainty factors (*e.g.* dividing the doses where effects were observed by numbers ranging from 10 to 1,000). The intent of this practice is to protect human health by building in a safety margin to these guideline values.

Another area of uncertainty has to do with the dose reconstruction. This type of uncertainty has two parts – the concentration in soil to be used for dose reconstruction, and the amount of soil people come into contact with. Due to the small number of samples of dioxin, it was not possible to statistically calculate an upper confidence limit of the mean. Therefore, EHAP used the maximum reported value. This is intended to protect human health by leaning towards

overestimation of the true average soil concentration. It should be noted that the samples EHAP evaluated are from one area of the East Parcel beach. The site has not been fully characterized.

It is impossible for EHAP to know exactly how much soil and dust a person accidentally swallows every day. In the absence of that type of specific information, we used standard default values that are developed by ATSDR, and are based on studies that measured how much soil people eat when they are doing every day activities. EHAP used the averages from these types of studies assuming that they would be representative of the people mentioned in this Willamette Cove East Parcel Beach Health Consultation. Where there was uncertainty about these defaults, EHAP tried to overestimate exposure to be protective of health despite unavoidable uncertainty.

Children's Health Considerations

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

- Children are more likely to play outdoors and bring food into contaminated areas.
- Children are shorter, resulting in a greater likelihood to breathe dust, soil, and heavy vapors close to the ground.
- Children are smaller, resulting in higher doses of chemical exposure per body weight.
- The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.
- Children are more likely to swallow or drink water during bathing or when playing in and around water.
- Children are more prone to mouthing objects and eating non-food items like toys and soil.

Because children depend on adults for risk identification and management decisions, EHAP is committed to evaluating their special interests at and around the Willamette Cove East Parcel beach site. In this HC, children are identified as especially vulnerable to exposure to lead and dioxin in the soil. Many children spend a significant amount of time playing outdoors, making contact with the ground, digging in the soil, and exploring. EHAP's conclusions and recommendations take children's activities into consideration and has designed conclusions and recommendations that, if followed, will protect children from potentially dangerous exposures to lead.

Conclusions

EHAP reached *three* important conclusions in this Health Consultation.

1) Incidentally swallowing lead-containing beach soil at the East Parcel beach in the Willamette Cove site on a regular basis could harm the health of children and adults who use this area.

EHAP considers the East Parcel beach an area of public health concern. Although the data were not sufficient for a full analysis, the levels that were found greatly exceeded health-based standards. High levels of lead measured in the soil could cause decreased intelligence and impaired neurobehavioral development in children and fetuses. There is no “safe” level for blood lead concentration in children and adults.

2) There is not enough evidence to conclude that people could experience health effects from contacting dioxin-containing surface soil on the East Parcel Beach of the Willamette Cove. This is because EHAP does not have evidence that people are coming into contact with dioxin-contaminated soil on a regular basis.

3) Trespassing on the upland area near the East Parcel beach on old scaffoldings, walking or playing on the East Parcel beach where metal debris is sticking out of the ground, or using the water along the East Parcel where numerous underwater hazards are present could result in physical injury. This is a physical safety hazard. The scaffold is old and not maintained. People could be cut by or trip over pieces of metal sticking out on the beach. People could trip on or be cut by physical hazards in the water. Boaters could collide with underwater hazards.

Recommendations

Based on EHAP’s analysis of the available information about the Willamette Cove East Parcel beach site, EHAP has developed recommendations that, if followed, will protect public health from the hazards identified in this Health Consultation.

EHAP is proposing the following specific recommendations and guidelines that will protect the public at the East Parcel beach of Willamette Cove.

EHAP recommends that:

- The public avoid the entire Willamette Cove site. If people choose to go into this area, take care to avoid direct contact with the soil on the East Parcel beach. People should wear shoes and avoid sitting in the soil. People on the beach should not have cooking fires or engage in other activities where hands and skin can come into contact with the soil.

- People walking through this area remove their shoes before entering their home to avoid tracking soil into living areas. For those walking dogs through this area, wash the dog's feet and legs thoroughly before allowing into the home.
- Anchored boats and other vessels in the cove along the East Parcel beach avoid bringing their boats too close to the shore, and not visit or walk on the sandy beach area.
- The public not play on or go near areas where there are physical hazards on or near the East Parcel Beach. This includes the old scaffolding along the shoreline, in-water hazards that are submerged or protruding from the water, and metal sticking out of the ground on and around the beach.
- Those who catch fish along the shores of the Willamette Cove site heed the Portland Harbor fish advisory, which states:
 - Women ages 18-45, particularly pregnant or breastfeeding women, children under 6, and people with weak immune systems, thyroid or liver problems, should avoid eating resident fish from Portland Harbor, especially carp, bass and catfish. "Resident" fish are those that spend their entire lives within a certain territory, and do not migrate. Non-resident, migratory fish such as Salmon, Steelhead, and Lamprey are not included in this advisory.
 - Large and older sturgeon is expected to have higher levels of PCBs and should be restricted like carp, bass and catfish.
 - Healthy women beyond childbearing age (over 45 years old) and healthy adult males should restrict the amount of resident fish eaten from Portland Harbor to no more than one meal per month.
 - All persons should reduce or avoid eating fatty parts of fish.
 - Removing and throwing away the skin, fat, eggs, and internal organs will reduce exposure to PCBs in fish.

Oregon fish advisories can be found at: www.healthoregon.org/fishadv

EHAP recommends that partner agencies and potentially responsible parties:

- Take further samples in order to remediate or characterize contamination in the area.
- Prioritize the Willamette Cove site clean-up, because the site is easily accessed and heavily used by the public. Partner agencies should take into consideration the lead contamination in the East Parcel beach as they move forward with the Portland Harbor cleanup.
- Further characterize dioxin in surface soils in the area adjacent to the East Parcel beach, as well as in other areas of the Willamette Cove site, to ensure that it does not pose a health risk.
- Post signs at the East Parcel beach, warning people of chemical contamination. These signs should be visible to people approaching the beach from the upland area and to boaters approaching the beach from the water.

- Consider characterizing potential contamination at the Central Parcel beach of the Willamette Cove site.
- Maintain current site closure and continue efforts to keep people from camping, making fires or recreating at Willamette Cove.
- Consider ways to further eliminate physical hazards in the area. This includes access to scaffoldings, in-water hazards, scrap metal, and rebar sticking out of the ground.

Public Health Action Plan

The public health action plan for this report contains a description of actions that have been or will be taken by EHAP and other government agencies at the Willamette Cove site. The action plan is designed to ensure that this Health Consultation both identifies public health hazards and provides a plan of action designed to reduce and prevent adverse health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of EHAP to follow up on this plan to ensure that it is implemented.

Public Health Actions that have been implemented to date:

- EHAP toured the site in November 2010, August 2011, and July 2012.
- DEQ has been working with responsible parties to identify and characterize contamination at the site. Their actions have included:
 - Oversight on past cleanup actions, including the removal of multiple physical hazards and clean-up actions upland of the beach.
 - Involvement in developing and approving site remediation plans.
 - RI/FS Process. DEQ works with responsible parties for Willamette Cove to complete comprehensive Remedial Site Investigations, prepare Human Health and Ecological Risk Assessments, and complete Feasibility Study leading to cleanup actions. This detailed work is required at Willamette Cove as part of the Portland Harbor Superfund Cleanup process.
 - Source Control. DEQ is the lead agency to ensure that shoreline and upland sources of contamination are evaluated, understood and stopped to prevent contamination from entering the Willamette River
 - Cleanup. Work with responsible parties to design comprehensive upland, in-river, and shoreline cleanup actions to eliminate chemical and physical hazards at the site to benefit future site users and protect ecological receptors in the river and on the shore.
- Metro actively discourages trespassing onto the site. Efforts to do this have included:
 - Maintaining a regular on-site presence to discourage public access.
 - Posting “no trespassing” signs around the site.
 - Placing large permanent signs at the East Parcel beach, informing the public the site is closed due to human health exposure risk.
 - Mailing a flyer to 3,000 nearby households, alerting neighbors to the potential health risks of the site.
 - Entering in to an agreement with the Portland Police Bureau to conduct regular “trespasser sweeps”.
 - Having ongoing communications with the local neighborhood associations about the site.

- Informing the nearby University of Portland about potential health risks to students using the site for ROTC training purposes.
- Removing invasive plants in certain areas of the site to increase visibility and discourage people from setting up campsites.
- Working with the Multnomah County Sheriff's River Patrol to discourage boats from anchoring at the site.
- Posting the Portland Harbor fish advisory sign near the shore where observed fishing occurs.

Public Health Actions that will be implemented in the future:

- EHAP will work with Metro and nearby residential neighborhoods to identify effective ways to reduce the number of people accessing the site.
- EHAP will coordinate with DEQ and potential responsible parties to identify future public health concerns on the Willamette Cove site, including:
 - Evaluating additional data for lead contamination on the East Parcel beach, and dioxin contamination near the beach, when it becomes available.
 - Evaluating contamination data for other chemicals on the East Parcel beach.
 - Evaluating potential public health issues in the upland area of the Willamette Cove site.
 - Evaluating potential public health issues in the Central Parcel beach area of the Willamette Cove site.
- EHAP will continue to encourage partner agencies to remove physical hazards on the site or make sure they are not accessible. EHAP will conduct a community needs assessment for the community near Willamette Cove.
- EHAP will present the results of this document to interested parties.

Report Preparation

This Health Consultation for the Willamette Cove site was prepared by the Oregon Health Authority (OHA) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, and procedures existing at the date of publication.

Authors

Todd Hudson, MSPH
Toxicologist / Public Health Assessor
Environmental Health Assessment Program (EHAP)
Center for Health Protection (CHP)
Oregon Health Authority (OHA)

Julie Early-Alberts, MS
Program Manager
EHA/CHP/OHA
Sujata Joshi, MSPH
Epidemiologist / Public Health Assessor
EHAP/CHP/OHA

Karen Bishop, MPH
Public Health Educator
EHAP/CHP/OHA

Jae P. Douglas, MSW, PhD
Principal Investigator
Section Manager, Research & Education Services
CHP/OHA

References

Oregon DEQ. *Environmental Cleanup Site Information (ECSI) Database Site Summary Report – Details for Site ID 2066, Willamette Cove*. 2012. Available from:

<http://www.deq.state.or.us/lq/ECSI/ecsdetail.asp?seqnbr=2066>

Argonne National Laboratory. *Human Health Fact Sheet – Chromium*. 2005. Available from:

<http://www.ead.anl.gov/pub/doc/chromium.pdf>

Ash Creek Associates, Inc. *2010 Source Control Sampling Results – Willamette Cove Upland Facility*. 2011.

Ash Creek Associates, Inc. *Baseline Risk Assessment, Willamette Cove Upland Facility*. 2007.

Ash Creek Associates, Inc. *2010 Source Control Sampling Results Letter*. 2013.

Ash Creek Associates, Inc. *Removal Action Work Plan, Willamette Cove Upland Facility*. 2007b.

ATSDR. *Exposure Dose Guidance for Soil Ingestion*. 2012a.

ATSDR. *Exposure Dose Guidance: Draft Determining Doses for Dermal Exposures to Soil and Sediment*. 2012b.

ATSDR. *Public Health Assessment Guidance Manual (Update)*. 2005. Available from:

<http://www.atsdr.cdc.gov/hac/PHAManual/toc.html>

ATSDR. *Toxicological Profile for Lead*. 2007. Available from:

<http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=96&tid=22>

ATSDR. *Public Health Assessment for Portland Harbor*. 2011. Available from:

<http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/EnvironmentalHealthAssessment/Documents/Portland%20Harbor%20PHA%20%2009-07-2011%20Final.pdf>

ATSDR. *Public Health Consultation – Willamette Cove, Portland Harbor, Multnomah County, Oregon*. 2003.

Centers for Disease Control. *Preventing Lead Poisoning in Young Children*. 1991. Available from: <http://wonder.cdc.gov/wonder/prevguid/p0000029/p0000029.asp#head007001000000000>

Centers for Disease Control. *Interpreting and Managing Blood Lead Levels <10 µg/dL in children and Reducing Childhood Exposures to Lead: Recommendations of CDC's Advisory Committee on Childhood Lead Poisoning Prevention*. 2007. Available from:

<http://www.cdc.gov/mmwr/pdf/rr/rr5608.pdf>

City of Portland Bureau of Planning. *Willamette River Natural Resource Inventory Report: Riparian Corridors and Wildlife Habitat – Inventory Site WR9: Willamette Cove*. 2009.

Lower Willamette Group (LWG). *Portland Harbor RI/FS – Willamette Cove Sediment Data Report*. 2008.

Schantz SL, Ferguson SA, Bowman RE. *Effects of 2,3,7,8-tetrachlorodibenzo-p-dioxin on behavior of monkey in peer groups*. *Neurotoxicol Teratol* 14:433-446. 1992.

US Environmental Protection Agency. *America's Children and the Environment: Measures of Contaminants, Body Burden and Illnesses, Second Edition*. 2003

US Environmental Protection Agency. *Hazard Summary for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (2,3,7,8,-TCDD)*. 2000. Available from: <http://www.epa.gov/ttn/atw/hlthef/dioxin.html>

US Environmental Protection Agency. *Child-specific exposure factors handbook*. 2002. Available from <http://www.epa.gov/ncea/>

US Environmental Protection Agency. *Risk Assessment Guidance for Superfund, Chapter 8: Risk Characterization*. 1989. Available from <http://www.epa.gov/oswer/riskassessment/ragsa/index.htm>

US Environmental Protection Agency. *Risk Assessment Guidance for Superfund, Volume I: Supplemental Guidance*. 1991. Available from <http://rais.ornl.gov/documents/OSWERdirective9285.6-03.pdf>

US Environmental Protection Agency. *Regional Screening Level (RSL) Resident Soil Table*. 2011. Available from: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/pdf/ressoil_sl_table_run_NOV2011.pdf

Appendix A. Response to Public Comments

This appendix describes how public comments were addressed and/or incorporated into the final draft of the Willamette Cove Health Consultation. Comments were considered as anonymous, so no names or affiliations are listed with these comments. EHAP solicited statements and questions from the public after the public comment draft was released on August 1, 2012.

“Have you recovered the results of soil samples done by the LWG to see what they had prior to the barge removal?”

EHAP has not evaluated the area around the barge removal. It was removed after 2006. Although the stern end of the barge was beached on the cove, the vessel was in the river. The scope of this document focuses on contamination of soil and exposed sediment.

“There never used to be beaches at Willamette Cove until the McCormick and Baxter Superfund Site used sand to cover concrete retaining blocks that were placed there in an effort to protect the site from erosion, per NOAA fisheries instructions. The sand promptly washed around the corner into Willamette cove, depositing itself along the shoreline, making attractive beaches and forming a large sand bar and navigation hazard.”

It is unclear to EHAP when the sandy areas developed at Willamette Cove, and from where the sand originated. Thank you for your comment.

“Willamette Cove would make a great public marina and boat launch, which is badly needed on the river, and could be done in an environmentally safe manner. The site could still be part of the city trail system with public parking, picnic area, etc. The property upstream will eventually be absorbed as part of the University of Portland.”

Comment has been noted.

“Signs do not work to keep people out and I have encountered homeless and people with mental health issues camping in the area. Unless you maintain a full time security on site do expect to secure this area and I do not believe you have the right to close the beaches. Check with the ODSL.”

EHAP is aware of the amount of foot traffic through the entire Willamette Cove site, and is working with neighborhoods, Metro, and local community groups to raise awareness about our concerns there. Metro regularly sends personnel to remind people who are on the site that they should not be there.

“Signage should be placed high in trees where vandals cannot reach them.”

Noted. Thank you for your comment.

“[Willamette Cove] ought to be part of the [Portland Harbor] Superfund site if it isn’t already.”

Willamette Cove is within the Superfund site area. EPA is addressing the in-water portion of the site, and DEQ is addressing the “upland” area, above the mean high water mark. Metro is working with DEQ to clean up the areas above the mean water mark. Please see our website: <http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/EnvironmentalHealthAssessment/Pages/pbsite.aspx>

“This is a lawsuit waiting to happen; public entities have obviously – for well over a decade – been negligent in addressing a public health hazard.”

There has been activity to reduce potential hazards at Willamette Cove. The Port of Portland entered into a voluntary agreement to investigate contamination at the site, and has conducted removals (in 2008) where contamination was found. They are currently re-evaluating the post-removal conditions in the upland area and along the shore. Contamination from the adjacent McCormick and Baxter site was remediated in 2005. There have also been several actions taken along the shore. Since 1999, multiple physical hazards have been removed from the site. In 2004, a large amount of diesel-contaminated soil was also removed from the site.

The title and the text (page 9, fourth paragraph) of the health consultation state that the focus of the consultation is the East Parcel beach. This is not an accurate description of the assessment OHA performed. The assessment also fails to consider all available beach data. The lead data OHA used to assess risk and that leads to Conclusion 1 is on the Central Parcel, not the East Parcel. OHA excluded all 6 data points located on the East Parcel beach area from the assessment. In addition, the data used by OHA to assess the lead risk is below ordinary low water, and not considered a “beach” for the majority of the year. For these reasons, Conclusion 1 does not clearly communicate the risk and the location of the risk to the public and should be revised as follows:

- Include all beach data from both the Central and East Parcels. The beach area that the public uses includes the entire inner cove area that is located primarily on the East Parcel and the far north-eastern edge of the Central Parcel. Inclusion of all available data is not expected to significantly change the results of the assessment but will be more representative of actual exposure.*
- Clearly communicate the geographic area to the public. Reference the area as “the Willamette Cove beach” or “inner cove beach at Willamette Cove” instead of “the East Parcel beach.”*

- *Include a clear figure of the area where data were considered for the assessment. Alternatively, if OHA intended to perform the assessment for just the East Parcel because that is where the observed human activity occurs, the Central Parcel data that is located at or below ordinary low water should be excluded and the East Parcel beach data should be used in its place.*

EHAP has responded by evaluating additional lead data. We have also included additional figures that approximate where samples were taken. Regarding the name, we added text in the Site Description section explaining exactly where the beach is located. We also indicated that the LW3-GWC1 sample (as well as other samples taken near it) is located in the Central Parcel. We used these samples because while they were taken in the Central Parcel, they are within the geographic area of the cove, relatively near the beach area, and accessible by people.

The residences cited are also at a higher elevation.

The report was corrected accordingly.

The text states the site was used as “...a shipbuilding and ship maintenance dry dock facility owned and operated by the Port of Portland.” This statement is not accurate. First, no ship building occurred at the St Johns dry docks. Second, while the Port owned the dry dock, it did not operate (perform) the ship repair because it was prohibited by state law from doing so. The ship repair facility was a public common-user ship repair facility open to all vessels and ship repair contractors on equal terms in accordance with state law at that time, and therefore the ship repair was performed by private companies. Finally, the activity at the site began in 1903, so the date should be modified as well.

The report was corrected accordingly.

Also in this paragraph, the document states “Since there was a legacy of ship construction, EHAP believes that chemical releases occurred in water near the shore, and on the shore itself.” As stated above, no ship construction (building) occurred at the site. In addition, EHAP seems to link all contamination to the ship repair facility. In fact, the dry dock and ship repair facilities were not located on the East Parcel – they were located solely on the Central Parcel. In addition, the ship repair facility ceased to function in about 1950 and the facility was moved to Swan Island entirely by 1952. Land ownership records, tax records, and historical photographs show significant industrial operations on the East Parcel and (eastern) Central Parcel in 1952, including lumber mill and plywood manufacturing, illegal dumping, derelict and grounded barges, and other activities on these parcels and the river just offshore. This activity is just as relevant to the beach area that is being assessed by OHA.

The report was corrected accordingly.

It should be noted that approximately 20 tons of petroleum contaminated material was disposed of off-site in the 2004 removal action on the East Parcel beach.

The report was corrected accordingly.

“When the Portland Harbor Public Health Assessments (PHAs) were released in 2006 and 2011, EHAP only had limited data about contamination at Willamette Cove.” The validity and rational for this statement are unclear since almost all of the data that are available now, were also available in 2011. For example, LW3-GWC1 that OHA relies upon for Conclusion 1 was collected by the Lower Willamette Group and reported to EPA in 2008.

The 2011 Recreational Use PHA was nearing finalization when these data were brought to EHAP’s attention. EHAP could not incorporate new information during the extensive review process for the report. We did, however, commit to looking at new data as it became available. *EHAP does not cite its methods or sources of information that document the site uses presented here. Also, EHAP states “Many transient boaters (i.e., people who use small boats as their primary home) use this as a place to anchor their vessels (Figure 7).” The term ‘many’ is unsupported by the information in this document. It should also be noted that temporary offshore moorage is under the jurisdiction of the Division of State Lands and they are aware of the transient boaters in this area.*

We based site use on what we documented during visits to Willamette Cove. Similar accounts were provided by partner agencies. In the Demographics section, we noted that the river is under the jurisdiction of DSL.

[Figure 12] could improve transparency and readability by pointing out some of the locations of features noted in the text (e.g., sample locations, scaffold structure, etc.).

We have included new figures that include some of these suggestions.

Wharf Beach -1 was collected by the Port of Portland in 2010 (Ash Creek, 2011). This sample was taken from the eastern Central Parcel beach area at 1-1.5 feet below ground surface, and just above the Ordinary Line of Low Water. The results for lead concentration were inadvertently flagged with a “B” data qualifier, but were since corrected. The lead concentration for this sample should be reported as 8,660 ppm.

The report was corrected accordingly.

LW3-GEC1 is incorrectly identified. It should be identified as LW3-GWC1. LW3-GWC1 was collected by the Lower Willamette Group in 2007 (LWG, 2008). This sample was taken from the eastern Central Parcel beach area at 0-30 cm below ground surface, and just below the Ordinary Line of Low Water.

We corrected the error and updated the report accordingly.

WC-3 was collected by the Port of Portland in 2010 (Ash Creek, 2011). This sample was taken from the eastern Central Parcel upland area at 3-9 inches below ground surface, and just above the Ordinary Line of High Water. The results for lead concentration for this sample should be reported as 727 ppm. The data used by OHA listed above is actually on the Central Parcel. Other lead data is available that represents the East Parcel beach area where the majority of public activity occurs and should have been addressed in the health consultation. See the attached figures for other lead data.

The report was corrected accordingly.

The rip-rap is large rock, not large pieces of rubble.

The report was corrected accordingly.

The small area of exposed ground [where dioxin sample WC-3 was taken] was the result of clearing of vegetation to collect the sample.

The report was corrected accordingly.

The analysis presented here is based on one sample for lead, which happens to be the highest concentration observed in any sample at the site located below the ordinary line of low water (OLW) on the Central Parcel. While using one sample may be acceptable for a screening-level risk assessment, other data on lead concentrations are available from the beach area and should be considered in the assessment. The other samples, which are actually from the East Parcel beach area, are more representative of beach exposure because they are from the area of the beach that is more highly used (as shown in the photographs in this document). Some of the East Parcel beach samples also show elevated lead concentrations and should be used to generate a more representative exposure estimate. These facts should be relevant when considering the extent to which the exposure analysis is representative of the beach area.

EHAP agrees with the comment that more than one data point should be used. We have since re-evaluated data in addition to the maximum value found on the shoreline of the Central Parcel. These data, however, are not sufficient for us to do a quantitative analysis. For purposes of

protecting public health, EHAP needs similar samples taken. This includes taking samples at the soil surface, at the same time. Because high levels of lead were found close to the East Parcel beach, and too few samples taken where known activity occurs, EHAP still concludes that this area is of public health concern.

Change to “Areas of land that are below the ordinary low water mark are the responsibility of the Oregon Division of State Lands.”

The report was corrected accordingly.

The large scaffold-type structure is on the eastern side of the East Parcel, not the north side.

The report was corrected accordingly.

Lead data is already available for the East Parcel beach area and should have been considered in the health consultation. DEQ, Metro, and the Port have agreed that the East Parcel beach area is adequately characterized for potential contamination.

EHAP evaluated lead data from the East Parcel area, and included it in the final version of this HC. We modified this recommendation, recognizing that additional analysis of the East Parcel beach area is being done.

There is no West Parcel beach area. The Port and Metro recommend that this sub-bullet be deleted.

The report was corrected accordingly.

Appendix B. Comparison Values and Contaminant Screening

This appendix defines the various comparison values (CVs) that were used in this Health Consultation and describes the hierarchy by which they were chosen. This process is also explained in Chapter 7 of ATSDR's Public Health Assessment Guidance Manual [ATSDR, 2005]. Appendix B also explains the contaminant screening process.

CVs used in this document are listed below:

Environmental Media Evaluation Guides (EMEGs)

EMEGs are an estimate of contaminant concentrations low enough that ATSDR would not expect people to have a negative, non-cancerous health effect. EMEGs are based on ATSDR Minimal Risk Levels (MRLs, described below) and conservative assumptions about the public's contact with contaminated media, such as how much, how often, and for how long someone may be in contact with the contaminated media. EMEGs also account for body weight.

Minimal Risk Levels (MRLs)

A MRL is an estimate of daily human exposure – by a specified route and length of time - to a dose of a chemical that is likely to be without a measurable risk of negative, noncancerous effects. MRLs are based on ATSDR evaluations. Acute MRLs are designed to evaluate exposures lasting 14 days or less. Intermediate MRLs are designed to evaluate exposures lasting from 15-364 days. Chronic MRLs are designed to evaluate exposures lasting for 1 year or longer. Oral exposures (swallowing the contaminant) are measured in milligrams per kilogram per day [mg/kg/day] and inhalation exposures (breathing the contaminant) are measured in parts per billion [ppb] or micrograms per cubic meter [$\mu\text{g}/\text{m}^3$].

Regional Screening Levels (RSLs)

RSLs are contaminant concentrations in soil, water, or air, below which any negative health effects would be unlikely. RSLs are derived by EPA, using risk assessment guidance from the Superfund program. They are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. RSLs take into account both non-cancer and cancer risks. RSLs are available online at:

(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm)

EHAP uses the hierarchy shown in Figure A1 (Adapted from Figure 7-2 in ATSDR's Public Health Assessment Guidance Manual [ATSDR, 2005]) to choose CVs for screening purposes.

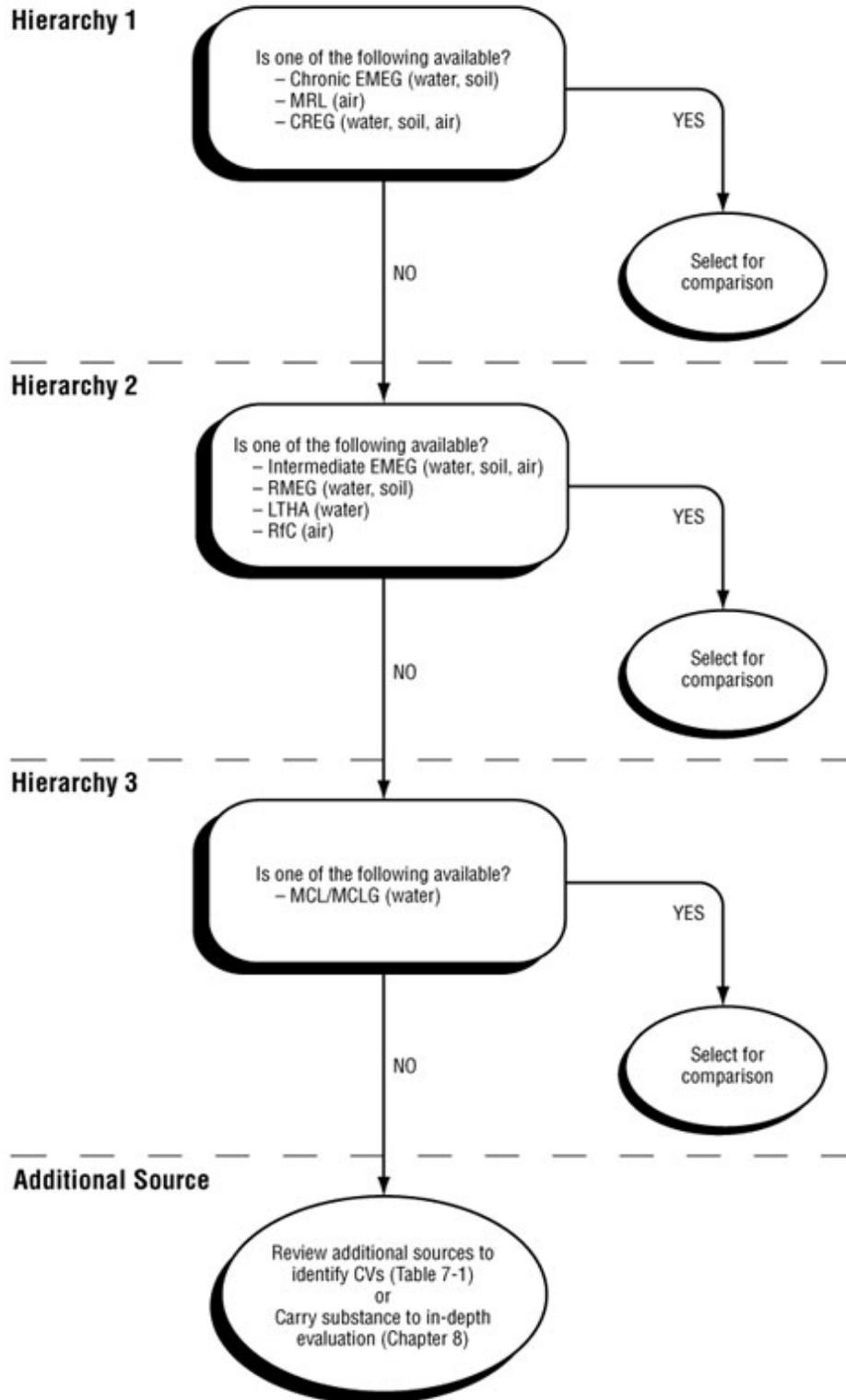


Figure A1. Environmental Guideline Hierarchy

Appendix C. Dose and Health Risk Calculation for Dioxin

This appendix describes the formulas, methods, and assumptions used to calculate dioxin doses. The doses calculated here were used to calculate the risk for people potentially exposed and to determine whether that exposure would result in illness because of dioxin from a small area near the East Parcel beach. This is protective of human health because it uses the highest concentration found at the site. People will likely be exposed to lower concentrations of these COPCs. To calculate dioxin doses, EHAP used the TEQ concentration that was reported (Ash Creek, 2011). This approach is conservative (*i.e.*, protective of nearly all populations) of health. See Table C-1 for more details about terms in the formula and the values used for each with their rationale. Doses were calculated as follows:

Dose from exposure to beach soil:

Chronic dose

These formulas were applied to the dioxin exposure scenario, where children could be exposed to dioxin-contaminated soil regularly over the course of months or years.

Total Dose = Oral Dose + Dermal Dose

$$\text{Oral Dose} = \frac{C \times IR \times CF \times EF \times ED}{AT \times BW}$$

$$\text{Dermal Dose} = \frac{C \times CF \times SA \times SAF \times DAF \times EF \times ED}{AT \times BW}$$

Where :

C = Concentration of dioxin measured in soil (mg/kg)

IR = Ingestion rate of soil (mg/day)

CF = Conversion factor (kg/mg)

SA = Skin surface area exposed to soil (cm²)

SAF = Soil Adherence factor – how much soil sticks to skin per square centimeter (mg/cm²/day)

DAF = Dermal Absorption factor – what percentage of chemical in soil can actually pass through the skin (chemical specific)

EF = Exposure Frequency (days/year)

ED = Exposure Duration (years)

AT = Averaging Time (days)

BW = Body Weight (kg)

Non-cancer vs. Cancer dose

Methods for calculating doses for use in assessing non-cancer risk and for cancer risk are identical except the way in which averaging time (AT) is calculated. See below for details:

Non-Cancer:

$$AT = ED \times 365 \text{ days}$$

Where:

AT = Averaging time

ED = Exposure duration (years)

Cancer:

$$AT = 28470 \text{ days (78 year lifetime} \times 365 \text{ days/year)}$$

The rationale for this difference in AT lies in the theory that cancer is the result of multiple defects/mutation in genetic material accumulated over an entire lifetime. Therefore, the averaging time is representative of an entire statistical lifetime (78 years) for agents that cause cancer.

Table C-1. Exposure Factors for Chronic Dose Calculation for a child trespasser exposed to dioxin

Term	Description	Value	Units	Rationale
C	Concentration	0.0057	mg/kg	Concentration of dioxin sample
IR	Intake rate for soil ingestion	100	mg/day	ATSDR Guidance (ATSDR, 2012a)
C ₁	Conversion Factor 1	0.000001	kg/mg	Converts kilograms of soil to milligrams of soil
EF	Exposure frequency for ingestion and dermal contact with of soil	52	Days/year	Professional judgment. A child playing in dioxin-contaminated area would access the site once per week.
ED	Exposure Duration	2	years	A two year, continuous exposure period for an adolescent (11 years and greater)
BW	Body weight	64.2	kg	ATSDR default for older children ages 11 through 20 years (ATSDR, 2012a)
AT _{nc}	Averaging time for non-cancer health effects	730	days	ED x 365 days
AT _c	Averaging time for cancer health effects	28470	days	78 year lifetime x 365 days – lifespan of 78 years recommended by ATSDR (ATSDR, 2012b)
SA	Exposed skin surface area for soil contact	4200	cm ²	Sum of surface area for hands, upper arms, and lower legs of child 11 years old and greater (ATSDR, 2012b)
SAF	Soil adherence factor	0.089	mg/cm ² -day	Based on ATSDR 2012 Revised Exposure Dose Guidance; average of recommended values for solid adherence to skin of arms (0.046), hands (0.17), and legs (0.51) (ATSDR, 2012b)
DAF	Dermal absorption factor	0.03	---	Dermal absorption factor for 2,3,7,8-TCDD (ATSDR, 2012b)

Appendix D. ATSDR Fact Sheets for Lead and Dioxin

(see preceding pages)

This fact sheet answers the most frequently asked health questions (FAQs) about lead. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to lead can happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in contaminated soil. Lead can damage the nervous system, kidneys, and reproductive system. Lead has been found in at least 1,272 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is lead?

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing.

Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. The use of lead as an additive to gasoline was banned in 1996 in the United States.

What happens to lead when it enters the environment?

- Lead itself does not break down, but lead compounds are changed by sunlight, air, and water.
- When lead is released to the air, it may travel long distances before settling to the ground.
- Once lead falls onto soil, it usually sticks to soil particles.
- Movement of lead from soil into groundwater will depend on the type of lead compound and the characteristics of the soil.

How might I be exposed to lead?

- Eating food or drinking water that contains lead. Water pipes in some older homes may contain lead solder. Lead can leach out into the water.

- Spending time in areas where lead-based paints have been used and are deteriorating. Deteriorating lead paint can contribute to lead dust.

- Working in a job where lead is used or engaging in certain hobbies in which lead is used, such as making stained glass.

- Using health-care products or folk remedies that contain lead.

How can lead affect my health?

The effects of lead are the same whether it enters the body through breathing or swallowing. Lead can affect almost every organ and system in your body. The main target for lead toxicity is the nervous system, both in adults and children. Long-term exposure of adults can result in decreased performance in some tests that measure functions of the nervous system. It may also cause weakness in fingers, wrists, or ankles. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people and can cause anemia. Exposure to high lead levels can severely damage the brain and kidneys in adults or children and ultimately cause death. In pregnant women, high levels of exposure to lead may cause miscarriage. High-level exposure in men can damage the organs responsible for sperm production.

How likely is lead to cause cancer?

We have no conclusive proof that lead causes cancer in humans. Kidney tumors have developed in rats and mice that had been given large doses of some kind of lead compounds. The Department of Health and Human Services

ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>

(DHHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens and the EPA has determined that lead is a probable human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans.

How can lead affect children?

Small children can be exposed by eating lead-based paint chips, chewing on objects painted with lead-based paint, or swallowing house dust or soil that contains lead.

Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead may develop blood anemia, severe stomachache, muscle weakness, and brain damage. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, lead can affect a child's mental and physical growth.

Exposure to lead is more dangerous for young and unborn children. Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead. Some of these effects may persist beyond childhood.

How can families reduce the risks of exposure to lead?

- Avoid exposure to sources of lead.
- Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint.
- If you have a water lead problem, run or flush water that has been standing overnight before drinking or cooking with it.
- Some types of paints and pigments that are used as make-up or hair coloring contain lead. Keep these kinds of products away from children
- If your home contains lead-based paint or you live in an area contaminated with lead, wash children's hands and faces

often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

Is there a medical test to determine whether I've been exposed to lead?

A blood test is available to measure the amount of lead in your blood and to estimate the amount of your recent exposure to lead. Blood tests are commonly used to screen children for lead poisoning. Lead in teeth or bones can be measured by X-ray techniques, but these methods are not widely available. Exposure to lead also can be evaluated by measuring erythrocyte protoporphyrin (EP) in blood samples. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter ($\mu\text{g}/\text{dL}$). These tests usually require special analytical equipment that is not available in a doctor's office. However, your doctor can draw blood samples and send them to appropriate laboratories for analysis.

Has the federal government made recommendations to protect human health?

The Centers for Disease Control and Prevention (CDC) recommends that states test children at ages 1 and 2 years. Children should be tested at ages 3–6 years if they have never been tested for lead, if they receive services from public assistance programs for the poor such as Medicaid or the Supplemental Food Program for Women, Infants, and Children, if they live in a building or frequently visit a house built before 1950; if they visit a home (house or apartment) built before 1978 that has been recently remodeled; and/or if they have a brother, sister, or playmate who has had lead poisoning. CDC considers a blood lead level of 10 $\mu\text{g}/\text{dL}$ to be a level of concern for children.

EPA limits lead in drinking water to 15 μg per liter.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for lead (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about dibenzo-p-dioxins. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because these substances may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chlorinated dibenzo-p-dioxins (CDDs) (75 chemicals) occurs mainly from eating food that contains the chemicals. One chemical in this group, 2,3,7,8-tetrachlorodibenzo-p-dioxin or 2,3,7,8-TCDD, has been shown to be very toxic in animal studies. It causes effects on the skin and may cause cancer in people. This chemical has been found in at least 91 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are CDDs?

CDDs are a family of 75 chemically related compounds commonly known as chlorinated dioxins. One of these compounds is called 2,3,7,8-TCDD. It is one of the most toxic of the CDDs and is the one most studied.

In the pure form, CDDs are crystals or colorless solids. CDDs enter the environment as mixtures containing a number of individual components. 2,3,7,8-TCDD is odorless and the odors of the other CDDs are not known.

CDDs are not intentionally manufactured by industry except for research purposes. They (mainly 2,3,7,8-TCDD) may be formed during the chlorine bleaching process at pulp and paper mills. CDDs are also formed during chlorination by waste and drinking water treatment plants. They can occur as contaminants in the manufacture of certain organic chemicals. CDDs are released into the air in emissions from municipal solid waste and industrial incinerators.

What happens to CDDs when they enter the environment?

- When released into the air, some CDDs may be transported long distances, even around the globe.
- When released in waste waters, some CDDs are broken down by sunlight, some evaporate to air, but most attach to soil and settle to the bottom sediment in water.
- CDD concentrations may build up in the food chain, resulting in measurable levels in animals.

How might I be exposed to CDDs?

- Eating food, primarily meat, dairy products, and fish, makes up more than 90% of the intake of CDDs for the general population.
- Breathing low levels in air and drinking low levels in water.
- Skin contact with certain pesticides and herbicides.
- Living near an uncontrolled hazardous waste site containing CDDs or incinerators releasing CDDs.
- Working in industries involved in producing certain pesticides containing CDDs as impurities, working at paper and pulp mills, or operating incinerators.

How can CDDs affect my health?

The most noted health effect in people exposed to large amounts of 2,3,7,8-TCDD is chloracne. Chloracne is a severe skin disease with acne-like lesions that occur mainly on the face and upper body. Other skin effects noted in people exposed to high doses of 2,3,7,8-TCDD include skin rashes, discoloration, and excessive body hair. Changes in blood and urine that may indicate liver damage also are seen in people. Exposure to high concentrations of CDDs may induce longterm alterations in glucose metabolism and subtle changes in hormonal levels.

In certain animal species, 2,3,7,8-TCDD is especially harmful and can cause death after a single exposure. Exposure to lower levels can cause a variety of effects in

ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>

animals, such as weight loss, liver damage, and disruption of the endocrine system. In many species of animals, 2,3,7,8-TCDD weakens the immune system and causes a decrease in the system's ability to fight bacteria and viruses. In other animal studies, exposure to 2,3,7,8-TCDD has caused reproductive damage and birth defects. Some animal species exposed to CDDs during pregnancy had miscarriages and the offspring of animals exposed to 2,3,7,8-TCDD during pregnancy often had severe birth defects including skeletal deformities, kidney defects, and weakened immune responses.

How likely are CDDs to cause cancer?

Several studies suggest that exposure to 2,3,7,8-TCDD increases the risk of several types of cancer in people. Animal studies have also shown an increased risk of cancer from exposure to 2,3,7,8-TCDD.

The World Health Organization (WHO) has determined that 2,3,7,8-TCDD is a human carcinogen.

The Department of Health and Human Services (DHHS) has determined that 2,3,7,8-TCDD may reasonably be anticipated to cause cancer.

How can CDDs affect children?

Very few studies have looked at the effects of CDDs on children. Chloracne has been seen in children exposed to high levels of CDDs. We don't know if CDDs affect the ability of people to have children or if it causes birth defects, but given the effects observed in animal studies, this cannot be ruled out.

How can families reduce the risk of exposure to CDDs?

- Children should avoid playing in soils near uncontrolled hazardous waste sites.
- Discourage children from eating dirt or putting toys or other objects in their mouths.

- Everyone should wash hands frequently if playing or working near uncontrolled hazardous waste sites.

- For new mothers and young children, restrict eating foods from the proximity of uncontrolled sites with known CDDs.

- Children and adults should eat a balanced diet preferably containing low to moderate amounts of animal fats including meat and dairy products, and fish that contain lower amounts of CDDs and eat larger amounts of fruits, vegetables, and grains.

Is there a medical test to determine whether I've been exposed to CDDs?

Tests are available to measure CDD levels in body fat, blood, and breast milk, but these tests are not routinely available. Most people have low levels of CDDs in their body fat and blood, and levels considerably above these levels indicate past exposure to above-normal levels of 2,3,7,8-TCDD. Although CDDs stay in body fat for a long time, tests cannot be used to determine when exposure occurred.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.00003 micrograms of 2,3,7,8-TCDD per liter of drinking water (0.00003 µg/L). Discharges, spills, or accidental releases of 1 pound or more of 2,3,7,8-TCDD must be reported to EPA. The Food and Drug Administration (FDA) recommends against eating fish and shellfish with levels of 2,3,7,8-TCDD greater than 50 parts per trillion (50 ppt).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. Toxicological Profile for Chlorinated Dibenzo-p-Dioxins. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-62, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



Appendix E. Glossary

This glossary defines words used by EHAP in communication with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call EHAP's toll-free number, 1-877-290-6767.

Absorption	How a chemical enters a person's blood after the chemical has been swallowed, has come into contact with the skin, or has been breathed in.
Adverse Health Effects	A change in body function or cell structure that might lead to disease or health problems.
ATSDR	The A gency for T oxic S ubstances and D isease R egistry. ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.
Blood Lead Level	A measure of lead in the body. It is measured in micrograms of lead per deciliter of blood ($\mu\text{g}/\text{dL}$).
Cancer	A group of diseases which occur when cells in the body become abnormal and grow, or multiply out of control.
Cancer Risk	The probability that cancer will occur over the course of a person's lifetime.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act. It is also known as Superfund . This act concerns releases of hazardous substances to the environment, and the cleanup of these substances and hazardous waste sites.
Chronic Exposure	A contact with a substance or chemical that happens over a long period of time. EHAP considers exposures of more than one year to be <i>chronic</i> .
Comparison Value	Concentrations of substances in air, water, food, and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media (air, water, food and soil) need additional evaluation while health concerns or effects are investigated.
Concentration	How much or the amount of a substance present in a certain amount of soil, water, air, or food.
Dermal Contact	A chemical getting onto your skin.

Dose	The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as “amount of substance(s) per body weight per day”.
Duration	The amount of time (days, months, years) that a person is exposed to a chemical.
Environmental Contaminant	A substance (chemical) that gets into a system (person, animal, or the environment) in amounts higher than the Background Level , or what would be expected.
US Environmental Protection Agency (EPA)	The federal agency that develops and enforces environmental laws to protect the environment and the public’s health.
Exposure	Coming into contact with a chemical substance.
Exposure Point Concentration (EPC)	An estimate of the concentration of a chemical in a medium at an exposure point.
Exposure Assessment	The process of finding the ways people come in contact with chemicals, how often and how long they come in contact with chemicals, and the amounts of chemicals with which they come in contact.
Exposure Pathway	<p>A description of the way that a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical.</p> <p>ATSDR defines an exposure pathway as having 5 parts:</p> <ol style="list-style-type: none"> 1. Source of Contamination, 2. Environmental Media and Transport Mechanism, 3. Point of Exposure, 4. Route of Exposure, and 5. Receptor Population. <p>When all 5 parts of an exposure pathway are present, it is called a Completed Exposure Pathway.</p>
Frequency	How often a person is exposed to a chemical over time; for example, every day, once a week, or twice a month.
Ingestion	Swallowing something, as in eating or drinking. It is a way a chemical can enter your body.
Hazard Index	A summation of the hazard quotients for all chemicals to which an individual is exposed.

Hazard Quotient	A comparison of an estimated chemical intake (dose) with a reference dose level below which adverse health effects are unlikely.
Health Consultation (HC)	A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue.
Health Guideline	A daily dose of a chemical, below which scientists consider it unlikely to harm people's health.
kg	Kilogram or 1000 grams. Usually used here as part of the dose unit mg/kg/day meaning mg (contaminant)/kg (body weight)/day.
Lowest Observed Adverse Effect Level (LOAEL)	The lowest concentration or amount of a substance found by experiment or observation that causes an adverse health effect in an organism.
mg	Milligram or 1 thousandth of 1 gram. Usually used here as in a concentration of contaminant in soil mg contaminant/kg soil or as in the dose unit mg/kg/day meaning mg (contaminant)/kg (body weight)/day.
Minimal Risk Level (MRL)	Minimal Risk Level. An estimate of daily human exposure – by a specified route and length of time -- to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used to predict adverse health effects.
National Priorities List (NPL)	The National Priorities List (which is part of Superfund). A list kept by the U.S. Environmental Protection Agency (EPA) of the most serious uncontrolled or abandoned hazardous waste sites in the country. An NPL site needs to be cleaned up or is being looked at to see if people can be exposed to chemicals from the site.
Non-cancer Risk	The probability that any adverse health effect that is not cancer will occur as the result of a person's exposure to a substance.
Point of Exposure	The place where someone can come into contact with a contaminated environmental medium (air, water, food or soil). Some examples include: the area of a playground that has contaminated dirt, a contaminated spring used for drinking water, or the backyard area where someone might breathe contaminated air.
Potentially Responsible Party (PRP)	A possible polluter who may eventually be held liable under CERCLA for the contamination or misuse of a particular property or resource.

Source of Contamination

The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an Exposure Pathway.

Toxic

Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.