Public Health Assessment

Initial/Public Comment Release

PORTAGE CANAL

CITY OF PORTAGE, COLUMBIA COUNTY, WISCONSIN

Prepared by
Wisconsin Department of Health Services

OCTOBER 16, 2015

COMMENT PERIOD ENDS: NOVEMBER 16, 2015

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR's Cooperative Agreement Partner has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR's Cooperative Agreement Partner will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Use of trade names is for identification only and does not constitute endorsement by the U.S. Department of Health and Human Services.

Please address comments regarding this report to:

Agency for Toxic Substances and Disease Registry
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1600 Clifton Road, N.E., MS F-09
Atlanta, Georgia 30333

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PUBLIC HEALTH ASSESSMENT

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FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Agency for Toxic Substances and Disease Registry
ATTN: Records Center
1600 Clifton Road, NE (Mail Stop F-09)
Atlanta, GA 30333

Summary

The Wisconsin Department of Natural Resources (DNR) requested assistance from the Wisconsin Department of Health Services (DHS) to investigate whether environmental contamination in the historical Portage Canal in the City of Portage was a health hazard, and was adversely affecting residents and visitors to the City of Portage. DHS conducted an exposure assessment and health assessment based on sediment and fish data provided by DNR.

DHS reached the following conclusions regarding the Portage Canal:

Contamination of Fish in the Portage Canal, City of Portage, Wisconsin

Conclusion #1 DHS concludes that consuming carp and gamefish[1] within the Portage Canal could harm people's health.

Basis For Decision The levels of mercury and polychlorinated biphenyls (PCBs) in carp and gamefish samples recently taken from the Canal are at elevated levels such that consuming fish from the Canal is a public health hazard. Small amounts of lead exposure can also affect our health. However, estimates of lead exposure based on fish from the Canal predicts that eating these fish will not raise child blood lead levels above the current blood lead action level of 5 µg/dL.

Due to the mercury and PCB levels in carp and gamefish, DHS recommends that an advisory be issue for the Canal as follows:

- All individuals – do not consume more than 1 meal per month of carp from the Canal.
- Children and women of childbearing age – do not consume more than 1 meal per month of gamefish from the canal.
- Adult men and adult women past childbearing age – do not consume more than 1 meal per week of gamefish from the Canal.

Next Steps Mercury and PCB contamination of fish is likely due to sediment contamination. Regulatory agencies ought to consider steps to remove or otherwise attenuate this source of fish contamination, and appropriate fish consumption advisories should be issued for the canal.

The lead found in fish is likely due to the presence of lead in the Canal sediments. Steps to reduce mercury and PCBs in the Canal will reduce the lead contamination as well. In addition, fish consumption advisories due to PCB and mercury exposure will serve to reduce exposure to lead via fish consumption.

1 Gamefish indicates fish pursued for sport which may or may not be eaten after being caught.

Sediment Contamination in the Portage Canal, City of Portage, Wisconsin

Conclusion #2: DHS cannot currently conclude whether lead contamination in the Canal sediment could harm people's health.

Basis For Decision: Lead contamination concentrations are at levels that *could* result in health effects, as exposures may contribute to an elevated blood lead level, and the Centers for Disease Control (CDC) states that no safe blood lead level in children has been identified (CDC 2012). The Agency for Toxic Substances and Disease Registry (ATSDR) notes there is no clear threshold for some of the more sensitive health effects associated with lead exposures. CDC and ATSDR recommend reducing lead exposure wherever possible. However, field evidence indicates that the public has limited direct contact with the contaminated sediment.

Next Steps: Further action may be required under state environmental rules. DHS will work with the appropriate Agencies to issue advisories to inform the public to limit their exposure to Canal sediments.

Sediment Contamination in the Portage Canal, City of Portage, Wisconsin

Conclusion #3: DHS concludes that mercury and PCB contamination in the Canal sediment is not expected to harm people's health.

Basis For Decision: Mercury and PCB contamination concentrations are below levels that constitute a health hazard from direct exposure to sediment at frequencies that the public comes into contact with the contaminated sediment.

Next Steps: Further action may be required under state environmental rules. DHS will work with the appropriate Agencies to issue advisories to inform the public to limit their exposure to Canal sediments.

Surface Water Contamination in the Portage Canal, City of Portage, Wisconsin

Conclusion #4: DHS concludes that exposure to surface waters within the Portage Canal is not expected to harm people's health.

Basis For Decision: Evidence indicates that the water in the Canal does not contain contaminants at concentrations constituting a health risk, and that the public does not have direct contact with the surface waters frequently enough to constitute a health risk.

Next Steps: Further action may be required under state environmental rules. However, no immediate action is required to protect public health.

Background

Site Description and History

In May 2013, the Wisconsin Department of Natural Resources (DNR) requested assistance from the Wisconsin Department of Health Services (DHS) to review whether environmental contamination in the historical Portage Canal is adversely affecting public health.

The Portage Canal is located in the city of Portage, Columbia County, Wisconsin. The Canal is a man-made channel that historically connected the Wisconsin River with the lower Fox River, and ultimately connected the Mississippi River Basin with the Great Lakes. Construction of the Canal began as early as 1838 and was completed in 1876. The Canal was operational until 1951 when the locks on both ends of the Canal were permanently closed (Portage Canal Society, 2013). The Canal runs through the City of Portage and abuts a number of private residences, commercial businesses, and several historical sites. The Canal itself is listed on the National Register of Historic Places.

Ownership of the Canal was transferred to the State of Wisconsin in 1961 from the US Army, and in 1981 the Department of Natural Resources was designated as the agency in charge of the Canal. According to the Portage Canal Society website, minimal preservation or maintenance of the historic sites on the Canal has occurred. The City of Portage used block grant funds to restore the downtown corridor between Adams Street and the Wisconsin River in 1983, and in 1987, the Canal became part of the National Ice Age Trail. The revitalization and future development and use of the Canal as a recreational and aesthetic centerpiece of Portage is an ongoing conversation, the goals of which include enhancement of city aesthetics, the tourist industry, and public health via recreational and physical health opportunities. The success of future Canal revitalization efforts, and the added economic and public health benefits, may depend in part upon the reduction of contamination in the Canal to within acceptable and/or regulatory levels.

The source(s) of the contamination in the Canal are unknown. According to a 1993 report, possible sources of contamination in the Canal sediment include the various former industrial and manufacturing uses along its banks, several (current and former) gas stations with underground storage tanks in proximity to the Canal, and the city's usage of the Canal as a receptacle for storm sewer run-off. The same report referenced an Army Corp of Engineers Draft Environmental Impact Statement, written as part of the Wisconsin River Flood Control Project that did not find any contamination in the Wisconsin River sediment. Thus, the contamination in the Canal may not be from upstream sources (Starr 1993). An earlier report, from 1967, alludes to sewage discharges into the Canal that were being mitigated via new sewer construction in Portage (Frank & Stein 1967).

Demographic Information

The population of the City of Portage is approximately 10,300. The majority of the population is White (90.9%), followed by Black/African American (5.0%), with other groups represented in the other 4%. Around 95% of the population speaks English, and approximately 2% speak Spanish. The median household income in Portage is $43,428 and the poverty rate is 16.3%

compared to the Wisconsin percentage of 12.0%, and the nationwide rate of 14.3% poverty (US Census 2010).

Canal usage

There is limited published data on the current use of the Canal. The majority of the information obtained regarding the Canal's current use and access by the public was based on a site visit on July 15, 2013, and on interviews with long-time residents of the area, and professionals whose work puts them in frequent interaction with the Canal.

Site Visit

Photographs from the July 15th site visit can be found in **Appendix A**. A site map giving an overview of the Canal and surrounding areas is provided below as **Figure 1.** The Canal is mostly filled in with sediment, is quite shallow for most of its length, and is approximately 80-100 feet wide for most of its length. The water is brown in color, but clear. The area from the Wisconsin River to Adams St. in the downtown area has been redeveloped, with cleared and accessible flat areas adjacent to the vertical retaining walls of the canal (See **Appendix A,** Photos 1, 2 and 5). A bike path runs along the length of the canal, ending at Adams Street. There are several grassy areas that could be used for picnics, sunbathing, etc.

From Adams St. the Canal enters a culvert, where it crosses over a weir with an approximately 12-18 inch vertical drop (See **Appendix A**, Photo 6). Downstream from the culvert, the stream bed in this segment is quite overgrown with brush. The flowing water cuts a narrow 5-6 foot wide path through a marshy sediment-laden area (See **Appendix A**, Photo 7). The Canal abuts residences on the northern bank, and a mix of residential and commercial properties on the southern bank. Eventually the stream widens and open water encompasses the entire width of the Canal (See **Appendix A**, Photo 10). The Canal continues underneath a railroad right of way and maintains an open, but more natural feel for the rest of its length. The Ice Age trail begins to follow the Canal in the vicinity of the railroad bridge, and no more residences are encountered for the remainder of the Canal's length. Here, several commercial facilities, such as a small tank farm and truck/asphalt paving facility, are visible. The Canal then passes through a large undeveloped lowlands area before coming to the historical Agency House, where the Canal crosses over a second weir with an approximately 4 foot vertical drop (Inman, 2014) (See **Appendix A**, Photo 14). From this weir, the Canal travels a few hundred more feet before its confluence with the Fox River.

The Canal is closed off from the Wisconsin River due to earthen levees. During construction of the Wisconsin River levees, underground-perforated pipes were placed, allowing groundwater to flow from the Wisconsin River to the Canal. This indicates some level of hydraulic connectivity between the two waterways. The Canal remains connected with the Fox River on its northern (downstream) end. This connection may only be intermittent, during periods of higher water, and primarily exists as overflow from the Fox River during periods of flooding. Because of this, there is potential for any Upper Fox Basin species to be in the Canal (Nadolski 2013). However, given the height of the observed weir at Agency House, it is not apparent how frequently (if ever) water from the Fox River actually overflows into the Canal past the Agency House weir. The elevation change at the weir appears large enough that it would impede any water or

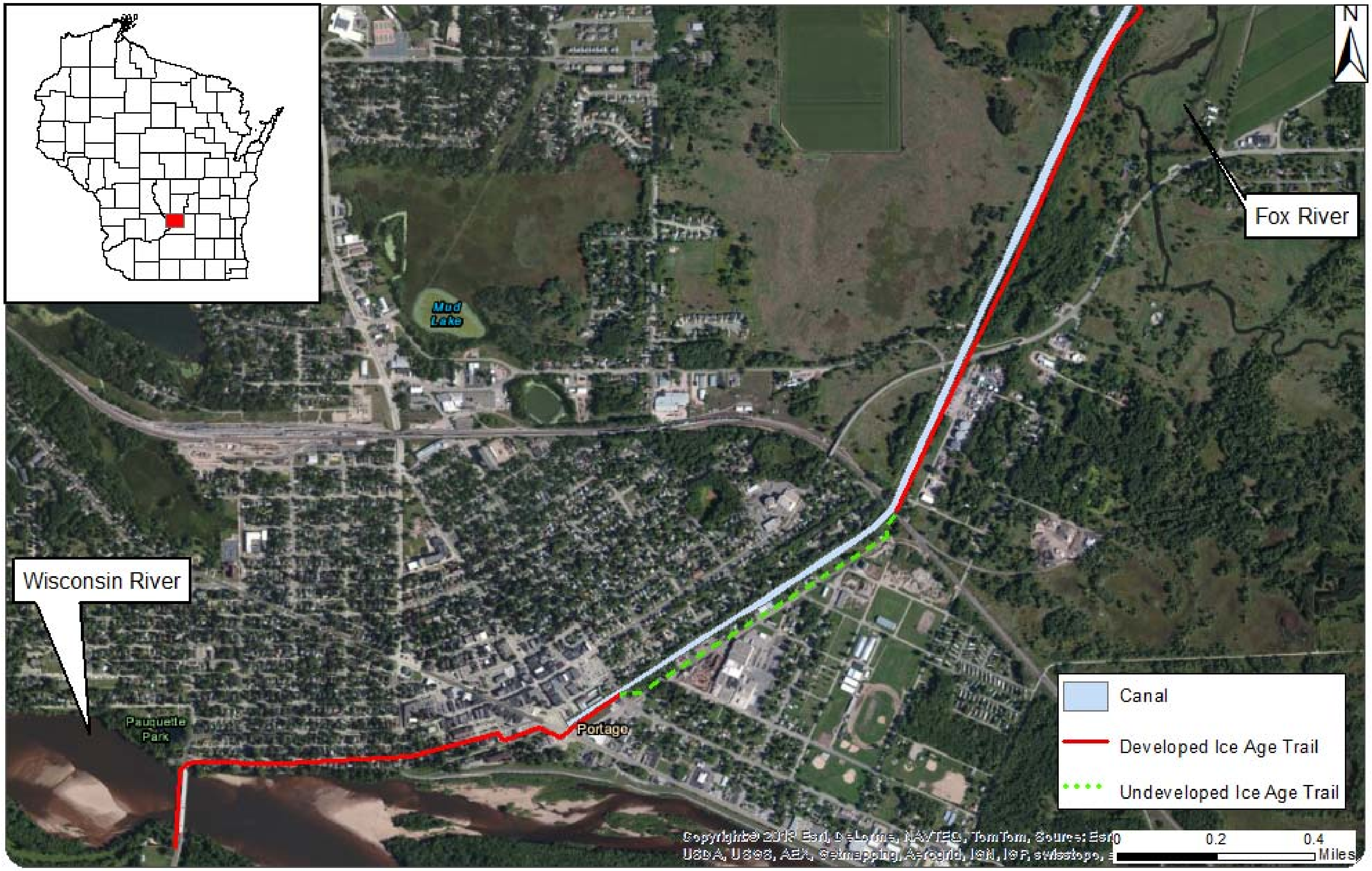


Figure 1
Site Map
Portage Canal Sediment Site
Columbia County
Portage, WI

Wisconsin Department of Health Services
Division of Public Health

Created: 07/23/2013
Source: Bing Maps Data)

fish from migrating upstream, except for possibly during periods of extreme flooding.

Residential and Commercial Uses
The southwestern (upstream) leg of the Canal passes through the downtown commercial area of Portage as it leaves the Wisconsin River. There are several businesses located on the Canal, including a Metal Recycling/scrap metal facility, an antique shop in a former feed mill, a dry cleaner, and several car repair garage type shops. None of the businesses use the Canal for any industrial/commercial uses, and only interact via physical proximity, as the businesses are situated adjacent to the Canal (Galley 2013). Also observed during the July site visit were several industrial storage tanks and a commercial asphalt/trucking facility on the northern (downstream) end of the Canal, past the railroad bridge.

As the Canal flows through Portage moving north, it passes through a residential area and abuts a number of residences. Per the president of the *Ad hoc* Portage Canal committee and a longtime Portage resident, the banks are steep on the Canal which limits access. He also states that most people have allowed the brush to grow up in their back yards along the Canal, because of the unattractive aesthetic of the Canal (Galley 2013). These comments generally agree with what we observed during our site tour: that there is limited current interaction of local businesses and residents with the Canal for non-recreational direct contact uses, and it appears that the only non-recreational use of the Canal is as a main channel for storm water drainage for the City of Portage (Nadolski 2013).

Recreational Uses
Some beautification/ improvement efforts have been undertaken in recent years to increase the aesthetic value of portions of the Canal. Most of these efforts have focused on recreational usage: for example, the development of the footpath in the downtown area from Wisconsin River to Adams St. This pathway ends after about 2 blocks and the Canal passes through the rest of Portage with no maintained trail for about 3,600 ft., until the trail starts up again as the Ice Age National Scenic Trail on the Northeast edge of town. Recreational uses of these trails include walking, biking, and jogging, as well as access for fishing. However, there are limited opportunities for direct contact with the soil/sediments along the trail (Galley 2013).

Also, it is reported that the Canal is very rarely used for kayaking or canoeing, and there is limited, if any, direct interaction with the Canal other than via fishing. Residents and other users of the area do not wade or swim in the Canal, as it is quite mucky (2-3 ft. deep of sediment), often does not have flowing water, and smells bad due to the muck (Galley 2013). In addition, water access is limited due to the steep slope of the bank in many areas. In general, these observations were verified during the July 2013 site visit. The Canal appears unappealing as a swimming hole due to access issues and the mucky sediment; generally one would not expect frequent swimming or wading in these waters. However, during our site visit, numerous houses were observed that back up to the Canal in the middle section of the Canal, with easy access for a curious child to enter, and come in contact with the Canal sediments. There is no evidence that children are, or are not playing in or along the Canal banks, or at what frequency.

According to DNR, no fish surveys or fish sampling have previously been performed in the Canal prior to the October 2013 survey. The Portage area DNR warden stated that people do fish in the Canal, but that it is almost exclusively children, as adults are prone to visit preferred fishing locations nearby (Nadolski 2013). The only fish believed to be in the Canal are panfish (including bluegills and pumpkin seeds), grass pickerel and carp. The area DNR warden reported the carp are only used for fertilizer and not consumed. There is likely some consumption of the panfish, but probably some catch-and-release occurring as well. It is illegal to keep or possess pickerel in Wisconsin. However, for the purposes of this public health assessment, we cannot assume based on its legal status that some consumption of this species does not occur.

Many large carp and several panfish were observed during the July 15th site visit (See **Appendix A**, Photos 3 & 4) in the southernmost section of the canal between the Wisconsin River and Adams Street. No one was observed fishing during our site visit; however it was a very hot and humid weekday morning, and does not indicate a general lack of fishing at the Canal. Subsequently, DNR personnel have observed people fishing (Inman, 2014). Per DNR, the observed individual indicated that he was aware of the contamination in the canal, and that any fish caught were used for bait only. In addition, DNR observed ice holes during the winter of 2013, which appeared to be ice fishing holes. Lastly, employees at the Agency House, a historic site on the lower Canal, indicate that they frequently observe fishing in the Canal, but did not know if the fish are consumed or not.

Discussion

Site Investigation & DHS Data Review

DHS was requested by DNR to review Canal sediment and fish sampling data from the recent October 2013 sampling event and assess the human health implications of the contamination levels observed. Sediment samples were collected at multiple depths along cross-sections of the canal. The sediment was evaluated for total mercury (Hg), lead (Pb), silver (Ag), cadmium (Cd), and methylmercury. Laboratory resources focused on mercury and lead, as prior sampling indicated that these two constituents were of primary concern. The analysis of sediment samples for polychlorinated biphenyls (PCBs) was not performed, as prior sampling and analysis indicated concentrations were below levels of concern. In addition, a total of 11 fish samples were collected and submitted for laboratory analysis of mercury, PCBs and lead (Pb).

Table 1 summarizes the sediment sample results. The average reported concentrations of total cadmium, total lead, and total mercury were 2.27 mg/kg (milligrams per kilogram), 136.35 mg/kg, and 1.63 mg/kg, respectively. Average methylmercury was detected at 0.007 mg/kg, and silver was not detected in sediment samples.

Prior sampling events (2004 and March 2013, respectively) reported average sediment concentrations of 338.3 and 137.7 mg/kg for total lead, and 3.93 and 1.92 mg/kg for total mercury. Silver was detected in 2004 with an average concentration of 2.54 mg/kg.

Table 2 presents the results of the fish sampling in Portage Canal. Fish samples were analyzed for total mercury, PCBs and Pb. Maximum total mercury levels were 0.299 µg/g (micrograms per gram), while average total mercury levels were 0.180 µg/g for all fish samples. Maximum total PCB levels were 1.40 µg/g, while average total PCB levels were 0.535 µg/g for all fish

Table 1: Sediment Screening Table
Portage Canal
City of Portage
Columbia County, Wisconsin

	CBSQG[1]			EPA Residential Screening Values (Soil)[2]	EPA Residential Screening Values (Soil)[2]	ATSDR Comparison Values (Soil)[3]	October 2013 Portage Canal Sediment Samples		March 2013 Portage Canal Sediment Samples		2004 Portage Canal Sediment Samples	
	TEC	MEC	PEC	HI=1, Noncarcinogenic	TR=1x10^{-6}, Carcinogenic	Child EMEG or RMEG	Maximum Result	Mean Result	Maximum Result	Mean Result	Maximum Result	Mean Result
Cadmium (Total)	1.6	1.9	2.2	70[4]	1,800[3]	5	2.95	2.27	---	---	---	---
Lead (Total)	36	83	130	400[5]	---	---	**416.0**	136.35	**615**	137.7	**998**	338.3
Mercury (Total)	0.18	0.64	1.1	---	---	---	**11.0**	1.63	**38.60**	1.92	**20.50**	3.93
Elemental Mercury	---	---	---	11	---	---	---	---	---	---	---	---
Methyl Mercury	---	---	---	7.8	---	15	0.001	0.0007	---	---	---	---
Silver (Total)	1.6	1.9	2.2	390[6]	---	250	ND (1.07)	ND (0.98)	---	---	7.4	2.54

Notes:
Bolded and Shaded results exceed Health Comparison Value
All units in mg/kg.
Dashes indicate that no data or screening values are available.
ND (0.982) - Not Detected above laboratory limit of detection (in parenthesis).
TEC - Threshold Effect Concentration
MEC - Midpoint Effect Concentration
PEC - Probable Effect Concentration
HI - Hazard Index
TR - Carcinogenic Target Risk

[1] Table 1. Consensus-Based Sediment Quality Guidelines. Interim Guidance. Wisconsin DNR. 2003
[2] Regional Screening Level (RSL) Resident Soil Table (HQ=1), May 2013
[3] ATSDR Sequoia database. Last updated 1/14/2013. Child chronic EMEGs are listed when available. If not available, child intermediate EMEGs are listed. If neither available, child RMEGs are listed.
[4] EPA RSL Residential Soil Table (HQ=1). Screening value based on Cadmium in diet, assumed to be best representative of actual exposure scenario.
[5] EPA RSL Residential Soil Table (HQ=1). Screening value for Lead and compounds, assumed to represent "total lead". EPA currently lists 400ppm as its soil screening level for lead. However, this number has not been updated to reflect recent CDC guidance that lowers the target blood lead level from 10 to 5 µg/dL. Additionally, it is generally accepted that no safe level of lead exposure exists. As such, the 400ppm EPA screening value should be considered one of several reference points for comparison and analysis when evaluating lead exposures.
[6] Assumed to represent "total silver".
Data source: Wisconsin Department of Natural Resources

Table 2: Fish Sampling Results Table
Portage Canal
City of Portage
Columbia County, Wisconsin
September 29, 2013

Field No.[1]	Species	Sample Form	Number of Fish	Avg. Length (Inch)	Avg. Weight (Kg)	Total Mercury (µg/g)	Total PCBs (µg/g)	Total Lead (µg/g)
1301	Grass pickerel	Whole fish	1	4	0.008	0.0547	0.16	NS
1302	Grass pickerel	Whole fish	2	4.8	0.013	0.0855	0.2	0.058
1303	Grass pickerel	Whole fish	3	5.17	0.017	0.0748	0.19	0.051
1304	Grass pickerel	Skin on fillet	1	8.8	0.078	0.297	0.041	NS
1305	Common carp	Skin on fillet	1	21.2	2.36	0.203	0.3	0.000
1306	Common carp	Skin on fillet	1	21.3	2.174	0.207	0.51	NS
1307	Common carp	Whole fish	1	22.3	2.59	0.182	0.57	0.091
1308	Common carp	Whole fish	1	23.3	3.308	0.153	1.4	0.177
1309	Common carp	Skin on fillet	1	23.4	2.576	0.198	0.56	NS
1310	Common carp	Skin on fillet	1	23.8	3.312	0.299	0.75	NS
1311	Common carp	Skin on fillet	1	25.5	4.276	0.229	1.2	NS
					N	**11**	**11**	**5**
					Average (all samples)	**0.180**	**0.535**	**0.075**
					Average (Skin on Fillet Only)	**0.239**	**0.560**	**NA***
					Max (all samples)	**0.299**	**1.400**	**0.177**
					Max (Skin on Fillet)	**0.299**	**1.200**	**NA***

Notes:
U - unidentified NS- Not Sampled
M - Male NA- Not Applicable
F - Female
[1] All samples collected from upstream of railroad bridge to downstream of railroad bridge about 0.75 mi.
Data source: Wisconsin Department of Natural Resources
* Only one skin on fillet sample. Insufficient for average calculation

samples. Maximum total Pb levels were 0.177 µg/g, while average total Pb levels were 0.075 µg/g for the five fish samples analyzed.

Sediment samples. As shown in **Table 1**, the average and maximum concentrations of the metals: lead, mercury and cadmium in sediments of the Portage Canal each exceed the Wisconsin DNR (2003) Consensus-Based Sediment Quality Guidelines (CBSQG). CBSQGs are screening levels considered protective of the ecological health of aquatic and benthic organisms. Due to the ecological sensitivity of sustained exposure to organisms in aquatic habitats, these guidelines tend to be more stringent than human health-based screening levels. Neither the US Environmental Protection Agency (EPA), Agency for Toxic Substance and Disease Registry (ATSDR), nor the State of Wisconsin has sediment-based screening standards for human health protection. As such, DHS used the lower of either ATSDRs comparison values, or EPA's Residential Soil Screening Values as the most appropriate available surrogate for evaluation (EPA RST 2013). Both are considered protective of human health for residential exposure to contaminated soils. It should be noted that mercury sediment samples were analyzed and reported as total mercury. Neither ATSDR or EPA have a residential soil screening value for total mercury, and as such EPA's elemental mercury screening value of 11 mg/kg was used as an approximate.

All maximum detected results for total lead and total mercury from the October 2013, March 2013 and 2004 events were at or above chosen screening values. Maximum results for total cadmium and total silver as well as all average results for these three events were below screening levels (**Table 1**). In addition, a laboratory analysis of methylmercury was performed on several of the samples from the latest round of sampling. Methylmercury results in the Canal sediments are well below soil screening levels protective of human health.

Fish samples. A total of 11 fish samples were collected and sent for laboratory analysis of total mercury, PBCs and Pb (**Table 2**). Concentrations of mercury, PCBs and Pb in fish versus fish length among Portage Canal fish are visually depicted in **Figures 2a, 2b and 2c**, below, respectively. One would predict that larger, older fish have more chemicals in meat fillets. In these samples, only one of the four pickerel samples was large enough to prepare the sample by filleting. The other three samples were prepared by homogenizing the whole fish. The three homogenized pickerel samples had significantly lower mercury concentrations than the one larger filleted sample. This is partially due to the dilution from analyzing the entire fish in the samples, versus just the skin and fillet, as mercury accumulates primarily in the muscle tissue (Hoffman, 2003). This is also partially due to the likely older age of the larger fish, allowing more bioaccumulation of mercury to occur.

The average mercury concentration was 0.180 µg/g for all fish samples and 0.239 µg/g in the skin-on-fillet samples. The average PCB concentration was 0.535 µg/g for all fish samples and 0.560 µg/g in the skin-on-fillet samples. Only five of the fish samples were analyzed for Pb, including only one skin-on-fillet sample. The skin-on-fillet sample concentration was non-detect for Pb, while the average Pb concentration for all five samples was 0.075 µg/g. It is not clear from the limited data, if this discrepancy is due to chance, or due to lead accumulation only occurring in the bone and viscera that are discarded during cleaning. A review of the literature indicates that Pb does accumulate in the muscle tissue of fish (ATSDR 2007).

We chose to analyze fish consumption using concentrations of the fillet-on-skin samples because 1) We cannot rule out consumption of carp; 2) The whole-fish samples are non-representative since fish bones and entrails are not generally eaten; 3) The three pickerel whole-fish samples were too small to fillet, and would reasonably be thrown back by an angler. As such, the skin-on-fillet samples best represent real world conditions. In addition, state fish advisories are generally based on skin-on-fillet samples, thus our analysis is in line with existing state methodologies.

Figure 2a. Hg vs Length Portage Canal Fish Samples September 2013

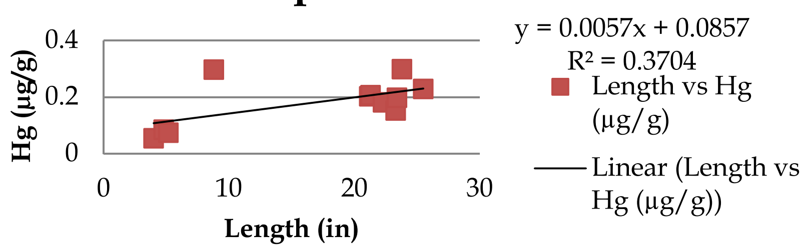
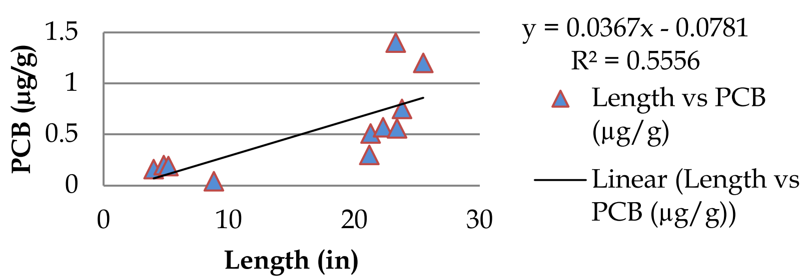
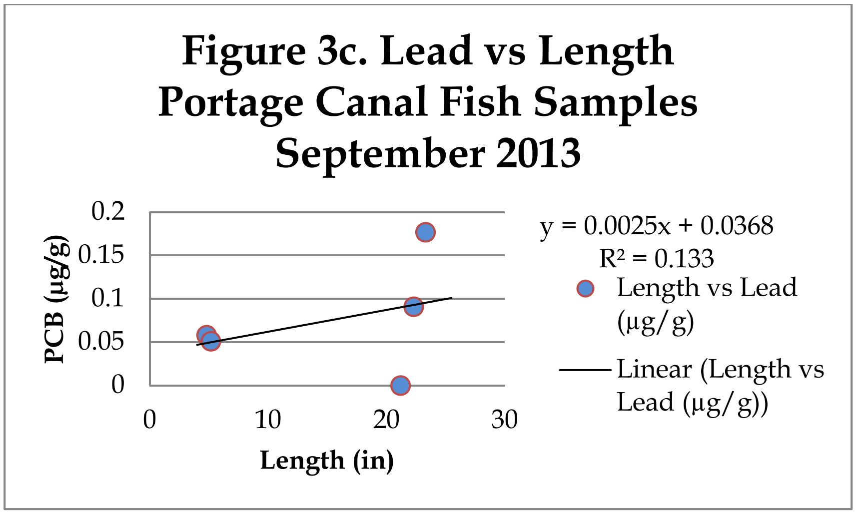


Figure 2b. PCB vs Length Portage Canal Fish Samples September 2013





Exposure Pathway Assessment

To determine whether people are actually exposed to the contamination in the Canal, five elements were considered: the source of contamination, the movement of contaminants in air, soil and water, the point at which people come into contact with the contamination, the routes of exposure (such as eating contaminated fish), and the population that can be potentially exposed. All five elements of exposure must be present for an exposure pathway to be complete.

There are three exposure pathway classifications: completed pathway, potential pathway, or an incomplete pathway. A completed pathway is an exposure that likely occurred in the past, is currently occurring, or is likely to occur in the future. A potential pathway is an exposure that cannot be ruled out from having occurred, is occurring, or may yet occur. An incomplete or eliminated pathway is one in which one of the five elements is missing, and an exposure is not and will not occur. Several potential complete exposure pathways were identified (**Table 3)**, and are discussed below.

Table 3. Exposure Pathway Evaluation

Media	Exposure Pathways	Mercury	Lead	PCB
Surface Water	Ingestion	Incomplete pathway	Incomplete pathway	Incomplete pathway
	Dermal Absorption	Incomplete pathway	Incomplete pathway	Incomplete pathway
Sediment	Ingestion	**Potential Pathway**	**Potential Pathway**	Incomplete pathway
	Dermal Absorption	**Potential Pathway**	Incomplete pathway	Incomplete pathway
	Inhalation	**Potential Pathway**	Incomplete pathway	Incomplete pathway
Fish Consumption	Ingestion	**Potential Pathway**	**Potential Pathway**	**Potential Pathway**

Surface Water. Exposure via surface water, both through ingestion and dermal absorption, are ruled out as routes of exposure. Less than 1% of lead in soil is soluble in water, as the majority is sorbed to suspended solids and sediments (ATSDR 2007; EPA 1982). In addition, residents and others using the public spaces bordering the Canal only infrequently come into direct contact with the Canal's water.

While volatile forms of mercury (e.g., metallic mercury and dimethylmercury) are expected to evaporate to the atmosphere, nonvolatile forms will partition to particulates in the water column and migrate downward to the sediments (Hurley et al. 1991; ATSDR 1999), where they are sorbed to sediment particulates. Research has shown little re-suspension from the sediments back into the water column (Bryan and Langston 1992; ATSDR 1999). Based on this information, and the usage patterns of the Canal, it can be concluded that mercury exposure via contact with water is limited, and does not constitute a human health concern.

Very low levels of PCBs are expected to exist in the surface water. However, data has shown that concentrations in the water column are expected to be lower that the sediment and suspended matter (ATSDR 2000). In addition, the more highly chlorinated PCBs, which are in general the more toxic PCBs are generally more hydrophobic compounds, meaning they are less likely to be found in the water column. Once in the sediment, PCBs may be immobilized for long periods of time (ATSDR 2000). Based on this information, and the low levels of PCBs found in the sediment, PCBs in the surface water does not constitute a human health concern.

Sediment

The potential uptake of lead in sediments via contact with skin is unlikely at the Portage Canal. Inorganic lead is generally considered to have much lower absorption via the dermal route than via inhalation or oral routes of exposure (ATSDR 2007). As inorganic lead is the predominant form of lead in the environment and at hazardous waste sites, lead exposure via the dermal route is not considered a significant route of exposure at Portage Canal.

Similarly, potential inhalation exposure to lead in sediments is not expected due to lack of volatilization to air. Per the EPA, the compound tetramethyl lead is volatile, and can form from organic and inorganic lead compounds via microbial conversion in anaerobic sediments. However, volatilization of tetramethyl lead is insignificant if the water over the sediment is aerobic, as the compound will be oxidized (Callahan 1979; ATSDR 2007). Furthermore, the majority of lead compounds are assumed to be associated with suspended solids and sediments in aquatic systems (ATSDR 2007). Some inhalation exposure via particulate dust may also hypothetically occur, but due to the moist nature of sediments and the observed vegetative cover in the Canal aerosolization is unlikely, and it can be concluded that lead exposure via inhalation is minimal and does not constitute a human health concern.

Of the potential pathways for exposure to lead in sediment, incidental ingestion of those sediments is the most plausible. Based on this exposure assessment, exposure to lead-contaminated sediment is a potential pathway. While interviews and observations indicate that most people are not in contact with the contaminated sediment, we cannot rule out that some children (especially those living adjacent to the Canal) are wading in the Canal, climbing, or

playing on the banks and coming into contact with Canal sediment. As such, exposure due to incidental (hand to mouth) ingestion with the contaminated sediment may occur.
As with lead, some incidental (hand to mouth) ingestion of mercury may be occurring. In addition, while minimal, mercury exposure from sediment contamination may occur via inhalation of vapors and dermal absorption. However, total mercury levels in the Canal are below EPA sediment screening values. As such, there is a low risk of mercury exposure from direct contact with sediment, and mercury contamination concentrations are below levels that constitute a health hazard from direct exposure to sediments.

Similarly to lead and mercury, low levels of incidental (hand to mouth) ingestion of PBCs, as well as inhalation of PCB vapors and dermal absorption may be occurring. Out of 8 sediment samples taken during a 2003 Phase II investigation, 6 samples were non-detect for PCBs above the laboratory detection limit. PCBs were detected in the other two samples at concentrations of 0.50 mg/kg of Aroclor 1254/1242 mixed, and 0.83 mg/kg of Aroclor 1254. EPA residential soil screening value for Aroclor 1242 and 1254 are both 0.24 mg/kg. While eight samples does not constitute exhaustive sampling, at the levels detected with 75% of samples non-detect for PCBs, and the knowledge of usage patterns of the canal, PCB exposure from sediment is not considered a health hazard.

Fish Consumption
Two species of fish were collected from the Canal: grass pickerel and common carp. Other species are known to exist in the canal, but were not observed or captured in this investigation. Carp are not widely consumed by Wisconsin anglers, though it is edible and reportedly consumed by some people. Pickerel (related to the Northern Pike) is not a legal fish to possess or consume in Wisconsin. However, pickerel can be used as an indication of potential concentrations of other gamefish in the Canal. While the Canal is not ideal for fishing, 1st and 2nd hand observations demonstrate that people do fish the Canal. It is unknown whether people consume these fish. However, for the purpose of risk assessment and protection of human health, we assume that the fish from the Canal are being consumed, regardless of popularity or legal status. Given this assumption, and due to the levels of chemicals observed in the Canal fish, ingestion of fish is a potential pathway for exposure to methylmercury (MeHg), PCBs, and lead.

Risk Assessment

Sediment
As shown in **Table 1**, maximum lead and mercury concentrations are above human health-based screening values, while average concentrations are below these screening values. ATSDRs Environmental Media Evaluation Guides (EMEGs) represent concentrations of substances in an environmental media during a specified period of time to which individuals will not experience adverse health effects (ATSDR 2005). EPAs Residential Screening Values are risk-based values based on default exposure parameters that EPA determines represent "Reasonable Maximum Exposure" conditions over a long term (chronic) exposure (EPA RST 2013). In other words, the screening values are calculated to represent a level of contamination in soil that is protective of human health over a long period of exposure in a residential (non-industrial) exposure setting.

Any contaminant concentrations below these screening values are considered protective of human health, including sensitive subpopulations.

Based on this screening, we rule out mercury contamination as a public health hazard via Canal sediment exposures. While maximum concentrations of mercury from the sampling events do exceed screening values, health concerns at the levels observed do not stem from the risk of any one exposure, but from many exposures to the contamination over a lifetime. It is unlikely that these “hot spots” of maximum concentrations represent the exposure that an individual would receive over a lifetime. This unlikelihood, in addition to the limited evidence of actual and frequent exposure (i.e. limited access and entry into the Canal, even among children), and at exposure frequencies well under the frequency assumptions built into the screening value equations (350 days/yr of exposure) indicate that the average contamination concentrations are a more appropriate value for assessing a long term/chronic exposure scenario. As these average concentrations for mercury are below soil screening values, DHS concludes that the mercury contamination does not constitute a public health hazard via Canal sediment exposures.

The same basic logic holds true for lead. We are concerned with the risk that results from many exposures to lead over a lifetime (or over a childhood) of exposure (i.e. chronic exposure). However, the difference when assessing risks for lead is that per current scientific guidance, the Centers for Disease Control (CDC) states that no safe blood lead level in children has been identified (CDC 2012). ATSDR notes there is no clear threshold for some of the more sensitive health effects associated with lead exposures. Furthermore, as lead bioaccumulates in the body, primarily in the skeleton (EPA IRIS), every exposure potentially adds to the total lead burden in the body. CDC and ATSDR recommend reducing lead exposure wherever possible.

Lead is a well-established developmental neurotoxin, and also affects the kidneys, blood formation, reproduction, humoral immunity, and the peripheral nervous system. Due to variation in lead uptake among individuals and among the various chemical forms of lead, the toxicity of lead exposure is usually expressed in terms of its resulting concentration in blood, and the toxic endpoints corresponding to those blood concentrations. Until recently, ten micrograms of lead per deciliter of blood (10 µg/dL) was used as the level of concern in children. In 2012, the Centers for Disease Control lowered the blood lead action level to 5 µg/dL, in response to numerous studies that have reported subtle biochemical, kidney, neuromotor, and cognitive effects in children (and in some studies, adults) chronically exposed to lead at very low levels (ATSDR 2012).

Although there is limited evidence of individuals entering the Canal and being exposed to contaminated soil, and while the exposure frequencies are below assumption levels built into the current EPA screening value, because every lead exposure potentially adds to the total body burden, DHS cannot rule out that lead exposure does not occur or will not occur in the future via the Canal sediments. For this reason, DHS concludes that the lead contamination in the Canal sediment is an indeterminate public health hazard.

Fish Consumption

Methylmercury is a highly toxic, common organic form of mercury that rapidly enters the food chain (ATSDR 1999). Methylmercury is formed from inorganic mercury via a number of physical, chemical, and biological processes, called methylation. Once converted to MeHg, the compound is accumulated by aquatic organisms due to its lipophilic and protein-binding properties in a process called bioaccumulation (Ullrich 2001).

The MeHg concentration in aquatic organisms increases with size and position on the food chain. In reported examples (Callahan 1979; ATSDR 1999), fish at the top of the food chain contain concentrations 10,000- 100,000 fold higher than in surrounding waters. These mercury concentrations in fish can remain high for many years after contaminated sediments have been dredged (Ullrich 2001).

MeHg is highly toxic to adults, children and fetuses. According to the ATSDR toxicological profile, about 95% of methylmercury is absorbed through the gastrointestinal tract (ATSDR 1999) and may then enter the brain where it is converted to inorganic mercury, and causes neurotoxicity. Neurodevelopmental effects include mental retardation, cerebral palsy, deafness, blindness, and dysarthria for in-utero exposure, and sensory and motor impairment in exposed adults (NRC 2000).

Chronic, low-dose prenatal MeHg exposure from fish consumption has been associated with less severe effects such as diminished attention, fine-motor function, language, visual-spatial abilities, and verbal memory in children. Animal studies, including primate studies, corroborate these results. Evidence also suggests that exposure to MeHg adversely effects the cardiovascular system, possibly at exposure levels below concentrations associated with neurodevelopmental effects. Furthermore, immune and reproductive systems may also be affected (NRC 2000).

PCBs (polychlorinated biphenyls) are a group of structurally related, highly stable synthetic molecules that are highly soluble in oil and insoluble in water. PCBs are man-made chemicals that were used industrially for their fire resistance and insulating qualities. Many PCBs were sold commercially in mixtures known as Aroclors. However, manufacturing of PCBs in the United states ended in 1977 due to evidence of harmful effects of the chemicals, and recognition that PCBs persist for very long times in the environment (ATSDR 2000).

Due to their insolubility in water, PCBs tend to accumulate in soils and sediments. In addition, PCBs bioaccumulate in body fats and within the food chain. PCBs have various toxicological effects in the body related to physiological development including low birth weight and learning disabilities, cell cycle regulation, and tumorigenesis. Several epidemiological studies have shown a link between prenatal and perinatal exposure to PCBs and to low birth weight and learning problems. Some evidence exists that some PCBs are human carcinogens, but it has not been demonstrated indisputably, and thus PCBs are considered *probable* carcinogens. Some exposure to PCBs is unavoidable due to their ubiquity in the environment (ATSDR 2000, 2011).

The EPA has a reference dose (RfD) of 0.1 microgram of methylmercury per kilogram of bodyweight per day (µg MeHg/kg bw/day), and a RfD of 0.02 µg PCBs/kg bw/day for Aroclor 1254, the PCB mixture with the highest levels measured in the Canal. This RfD represents an estimate of the daily exposure to the human population, including sensitive subgroups, that is likely to be without an appreciable risk of health effects over the course of an individual's lifetime (EPA IRIS 2013).

The Great Lakes Consortium published a protocol in 1993 for evaluating exposure doses and producing fish consumption advice in order to promote consistency in methods between the Great Lakes states, and published an addendum in 2007 to address mercury-based fish consumption advice (Great Lakes 1993, 2007). The protocols recommend using a Health Protection Value (HPV) approach, and use a RfD of 0.05 µg PCB/kg/day for total PCB residue in fish (based on a review of the toxicological data), and 0.1 µg Hg/kg/day for mercury (based on the current EPA RfD for mercury). The Protocol also gives standard meal frequency categories as a way of presenting easy to remember fish consumption advice to the public. This approach was adopted in this public health assessment. The Protocol's meal frequency categories versus PCB and mercury concentrations protective of health are reproduced in **Table 3** below. The Protocol does not currently include meal frequency categories for Pb concentrations protective of health.

Table 3. Recommended meal frequency based on mercury and PCB concentrations in fish.

Fish Meals	Fish Mercury Concentration Sensitive Populations (ppm)	Fish Mercury Concentration Other Populations (ppm)	Fish PCB Concentration All Populations (ppm)
Unrestricted	< 0.05	<0.16	<0.05
1 meal/ week	0.05 – 0.22	0.16 – 0.65	0.05 – 0.22
1 meal/ month	0.22 – 0.95	>0.65	0.22 – 1.0
6 meals/year	N/A	N/A	1.0 – 1.9
No Consumption	>0.95	N/A	>=2

N/A= Not applicable

The following calculation for estimating dose was used, derived from Appendix G of the ATSDR Public Health Assessment Guidance Manual, Fish Ingestion Exposure Dose Equation (ATSDR 2005). A number of assumptions were used in calculating PCB and mercury concentrations, based on Protocol guidance, that correspond to meal frequency groups. Assumptions are listed in **Appendix B**.

$$D = (C \times IR \times AF \times EF \times CF) / BW$$

Where, D = Exposure Dose (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated fish (mg/day)
AF = bioavailability factor (unitless)

EF = exposure factor (unitless)
CF = conversion factor (10^{-6} kg/mg)
BW = Body Weight (kg)

Chemical concentrations in fish are variable, and dependent on species and individual fish length/age, as well as the location and quality of the water body (Great Lakes 2007). Advisory determinations are based on the limited fish data available from Portage Canal (presented in this public health assessment). While both average and maximum concentrations of PCBs and mercury in the carp and pickerel samples were reviewed to estimate exposure risks, ultimately average concentrations of skin-on-fillet samples (See **Table 2**) were used to develop the advisory determinations in **Table 4** (using existing state of Wisconsin advisory protocols). Separate advisories for PCB and mercury were determined, and in each instance, the more stringent of the two was chosen. While pickerel is not a legal fish to possess or consume in Wisconsin, it is assumed that pickerel data is representative of other gamefish that potentially exist and are consumed from the Canal.

A bioavailability value of 1 (indicating 100% bioavailability of PCBs or MeHg) was used, based on ATSDR guidance (ATSDR 2005). Scientific literature reviews that indicate nearly 100% of MeHg in the gastrointestinal tract is absorbed (Gochfeld 2003). Evidence shows that absorption of PCBs approaches similar rates (ATSDR 2000). Evaluation results are summarized below in **Table 4.** Reproductions of the complete calculations are provided in **Appendix B**.

The presence of lead in the fish samples indicates that a completed exposure pathway exists for consumption of lead-contaminated fish. The issue of lead in food is not new. Lead solder in canned foods and lead leachate from ceramics were addressed beginning in the 1970s. At that time, the Food and Drug Administration (FDA) indicated its intent to reduce lead levels in food to the lowest levels practicably obtained (FDA 2006). Unfortunately, no one standard for acceptable amounts of lead in food exists. The FDA currently has action levels for lead in ceramicware and silver-plated hollowware (FDA 2000), candy and wrappers, bottled water, wine, food additives and food cans (FDA 2006). FDA previously had guidance levels for crustacean of 1.5ppm of lead, and for clams, oysters and mussels of 1.7 ppm of lead (see FDA Seafood HACCP 3rd ed.), but these guidances are no longer listed (FDA 2011).

Due to the variety of sources of lead, and the differences in lead uptake among individuals and the between the various chemical forms, lead risk is assessed based on blood lead levels. The Centers for Disease Control and Prevention (CDC) currently lists a reference value blood level in children of 5 micrograms per deciliter of blood (5 µg/dL). The reference level is based on the highest 2.5% of the U.S. population of children ages 1-5 years. That level is currently 5 µg/dL and based on the 2009-2010 National Health and Nutrition Examination Survey (NHANES). The current (2011-2012) geometric mean level for that group is 0.97 µg/dL. CDC will periodically update the reference level (CDC 2012).

To date, no sampling of blood lead among fish consumers has been performed in Wisconsin. Therefore, in order to predict blood lead levels that may occur from the observed lead levels in Canal fish, the EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) (EPA 2010) was used to calculate the increase in blood lead levels due to consumption of Canal fish. A table presenting these calculations in included in **Appendix B5** below.

Based on this modeling, Canal fish consumption does increase blood lead levels. However, even when using the maximum detected lead concentrations in fish, and allowing for unrestricted fish meals, the modeled child blood lead levels are below the reference value of 5 µg/dL. In addition, elevated blood lead has not been confirmed among consumers of Pb contaminated fish in Wisconsin and the measured Pb levels in the Portage fish samples vary greatly. However, because every lead exposure potentially adds to the total body burden, DHS cannot rule out that lead exposure from Canal fish does not constitute a health hazard, and thus concludes that lead is an *indeterminate public health* hazard from fish consumption in Portage Canal.

Table 4. Advisory Table for consumption of fish in Portage Canal

	Children under 15, and women of childbearing years	**Women beyond childbearing years, and men**
Carp	1 meal/month	1 meal/month
Gamefish (based on pickerel data)	1 meal/month	1 meal/week

Limitations

The following are limitations of this health assessment:

- Access to the Canal is limited in areas, and sampling in some instances occurred by boat or marsh buggy, making sampling a difficult activity. Errors could have occurred in sampling, and more rounds of data would demonstrate the accuracy of the results.
- Fish data was limited, as DNR was unable to catch and analyze a large number individual fish or wide variety of species. More fish data would give us a better sense if the data we have is accurate and representative of actual levels.
- Canal use patterns were based on limited observations and interviews with limited individuals. While these are reputable sources, more observations, interviews, or surveys of a canal users and Portage residents would give us more confidence in the accuracy of the use patterns.
- The comparison values used were designed for comparison to soil data, not sediment data. While we believe that the comparison values used are a sufficient surrogate, there are differences in soil and sediment that potentially could result in different conclusions if accurate sediment specific comparison values existed.

Child Health Considerations

Due to their unique physical and behavioral attributes, children are often at greater risk than adults from exposure to hazardous substances in communities with known contamination issues. Children are more likely to engage in exploration and play behaviors in and around contaminated sites, such as the Portage Canal. In addition, in the case of the Portage Canal, children are more likely than adults to fish in the Canal due to its convenience and location, and thus more likely to consume fish from the Canal. In addition to these increased exposure potentials, a child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. Furthermore, as children are in the midst of critical growth stages, toxic exposure can lead to permanent life-long damage to body systems if exposure levels are high enough during critical growth stages.

DHS evaluated the likelihood that children living near the Portage Canal may be exposed to contaminants at levels of health concern. DHS concluded that children may be exposed to harmful levels of chemical contaminants attributed to the Canal via mercury and PCB contaminated fish.

Conclusions

Results of this assessment indicate that contamination in the Portage Canal constitutes a public health hazard from consumption of fish in the Portage Canal. Based on an analysis of the conditions in the Portage Canal, DHS makes the following conclusions:

- **DHS concludes that consuming carp and gamefish within the Portage Canal could harm people's health.** The levels of mercury and PCBs in carp and gamefish samples recently taken from the Canal are elevated such that consuming fish from the Canal is a public health hazard.

- **DHS cannot currently conclude whether lead contamination in the Canal sediment could harm people's health.** No safe blood lead level in children has been identified. While the levels are below current EPA residential advisory levels, we expect those levels to be revised downward in the future, and any lead exposure from the Canal sediment contributes to cumulative lead exposures and blood lead burdens.

- **DHS concludes that mercury and PCB contamination in the Canal sediment is not expected to harm people's health.** Evidence indicates that the public has limited direct contact with the contaminated sediment, and that the contamination concentrations are below levels that constitute a health hazard from direct exposure to sediments.

- **DHS concludes that exposure to surface waters within the Portage Canal is not expected to harm people's health.** Evidence indicates that the water does not contain contaminant concentrations that would constitute a health risk, and that the public does not have direct contact with the surface waters frequently enough to constitute a health risk.

Recommendations

To ensure that the health of the public is protected, DHS recommends:

- Avoid contact with the Portage Canal sediments.

- Enact the following fish consumption advisories:
  - All individuals – do not consume more than 1 meal per month of carp from the Canal.
  - Children and women of childbearing age – do not consume more than 1 meal per month of gamefish from the canal.
  - Adult men and adult women past childbearing age – do not consume more than 1 meal per week of gamefish from the Canal.

- The appropriate state and local agencies communicate the risks of direct contact of Canal sediment and consuming Canal fish. While Wisconsin's general, statewide fish consumption advice applies to all waters of the state, including the Portage Canal, additional, more stringent advisories may be issued for the Canal, as delineated in this public health assessment.

- Mercury and PCB contamination of fish is likely due to sediment contamination. DHS recommends that regulatory agencies consider steps to remove, remediate or otherwise mitigate this source of fish contamination.

- Continued monitoring of fish contamination in Portage Canal be performed, even after sediment contamination mitigation, as fish may be contaminated long after the source of contamination has been removed.

- Additional fish surveys may be warranted to confirm the occurrence of fish species in the canal, and the frequency of use by anglers.

Public Health Action Plan

- DHS will continue to respond to and address health questions and concerns raised by the public regarding contamination of the Portage Canal.
- DHS will continue to assist DNR as necessary to assess and mitigate the human health implications of sediment contamination in the Portage Canal.
- DHS will work with DNR to clarify and communicate the health risks of using the Canal by posting warning signs, and other available channels such as public meetings and news media.

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Appendix A

Site Photos

Site Location:
Portage Canal, City of Portage, WI

Date:	**Photo #**
07/15/2013	1

Description:

View of revitalized canal between Wisconsin River Levee and Wisconsin Street (facing east)

Residential apartment building on right.

Site Location:
Portage Canal, City of Portage, WI

Date:	**Photo #**
7/17/2013	2

Description:

View of revitalized canal between Wisconsin Street and Adams Street (facing west)

Site Location:
Portage Canal, City of Portage, WI

Date:	**Photo #**
07/15/2013	3

Description:

View of school of carp in revitalized canal between Wisconsin Street and Adams Street.

Site Location:
Portage Canal, City of Portage, WI

Date:	**Photo #**
07/15/2013	4

Description:

View of 1033 W Atkinson Avenue

View of school of panfish in revitalized canal between Wisconsin River Levee and Wisconsin Street.

Site Location: Portage Canal, City of Portage, WI		
Date: 07/15/2013	**Photo #** 5	
Description: View of revitalized canal between Wisconsin Street and Adams Street (facing north) Residences back yards on north bank of canal.		

Site Location: Portage Canal, City of Portage, WI		
Date: 07/15/2013	**Photo #** 6	
Description: View of weir in culvert that crosses beneath Adams St. Weir is approximately 12-18" vertical height. (facing northeast)		

Site Location:
Portage Canal, City of Portage, WI

Date:	**Photo #**
07/15/2013	7

Description:

View of overgrown, silted canal between Adams St and railroad bridge. Taken from Adam St. culvert (facing east)

Site Location:
Portage Canal, City of Portage, WI

Date:	**Photo #**
07/15/2013	8

Description:

View of overgrown, silted canal between Adams St and railroad bridge. Taken from southern bank of canal (facing north)

Residences back yards on north bank of canal in center of photo.

Site Location: Portage Canal, City of Portage, WI	
Date: 07/15/2013 **Photo #** 9 **Description:** View of commercial facility along southern bank of canal Adams St and railroad bridge. (facing north) Several similar commercial properties were observed along south bank in this section of the canal.	

Site Location: Portage Canal, City of Portage, WI	
Date: 07/15/2013 **Photo #** 10 **Description:** View of canal between railroad bridge and Agency House. Taken from railroad bridge (facing northeast)	

Site Location: Portage Canal, City of Portage, WI		
Date: 07/15/2013	**Photo #** 11	
Description: View of Ice Age Trail along southern bank of canal between railroad bridge and Agency House. (facing east southeast)		

Site Location: Portage Canal, City of Portage, WI		
Date: 07/15/2013	**Photo #** 12	
Description: View of northern bank of canal and lowland area (on right) at approximate site of high contaminant concentrations in canal, between railroad bridge and Agency House. (looking south)		

Site Location:
Portage Canal, City of Portage, WI

Date:	**Photo #**
07/15/2013	13

Description:

View of recreational area at Agency House. (looking east)

Site Location:
Portage Canal, City of Portage, WI

Date:	**Photo #**
07/15/2013	14

Description:

View of weir at Agency House beneath foot bridge. Weir is approximately 3-4' vertical height. (facing south (upstream))

Appendix B

Calculations

Calculation Assumptions

The following assumptions were used in calculating PCB and mercury concentrations that correspond to meal frequency groups, based on Protocol guidance (Great Lakes 1993, 2007):

PCBs

- The Health Protection Value equals 0.05 µg PCB/kg/day (for PCBs);
- Calculations were based on an adult with bodyweight of 70kg or a child with bodyweight of 16 kg (based on the 50th percentile of children ages 1-6 years) per ATSDR Guidance (ATSDR 2005);
- A constant ratio of 227g uncooked fish per 70 kg body weight is assumed for the quantity of fish consumed per meal;
- It is assumed that PCB residue is reduced 50% during preparation and cooking of the fish, as PCBs accumulate in the fatty tissue, portions of which will melt off during cooking; and,
- Great Lakes Protocols advisory goal for a 70 kg individual is 0.05µg PCB/Kg/day and assumes a meal size of 227 grams of uncooked fish (filet). Scaling this to a 70 kg person, the advisory goal of 0.05 µg PCB/kg/day X 70kg = **3.5 µg PCB/day** for a 70kg individual;

Mercury

- The Health Protection Value equals 0.1 µg Hg/kg/day (for mercury);
- Calculations were based on an adult with bodyweight of 70kg or a child with bodyweight of 16 kg (based on the 50th percentile of children ages 1-6 years) per ATSDR Guidance (ATSDR 2005);
- A constant ratio of 227g uncooked fish per 70 kg body weight is assumed for the quantity of fish consumed per meal;
- It is assumed that mercury accumulates in the muscle tissue; cooking and cleaning the fillet are not expected to reduce mercury concentrations; and,
- It is assumed that MeHg concentrations equal total mercury concentration in fish tissue.
- Great Lakes Protocols advisory goal for a 70 kg female or child is 0.1µg Hg/Kg/day and assumes a meal size of 227 grams of uncooked fish (filet). Scaling this to a 16 kg child would equate to a meal size of 52 grams of uncooked fish. The advisory goal of 0.1 µg Hg/kg/day X 16kg = **1.6 µg Hg/day** for a 16kg child;

**

Table B1. Child Mercury Exposure Calculations from Portage Canal Fish Consumption

Meal Frequencies	Consumption	Child (16 kg) Consumption	IR (Child)
	meals/yr	g fish/day	mg fish/day
Unrestricted	225	31.98	31,984
2 meals/wk	104	14.78	14,784
1 meal /wk	52	7.39	7,392
1 meal /mo	12	1.71	1,706
no consumption	0	0.00	-

Exposure Dose calculations[1]

D= (C X IR X AF X EF X CF) / BW

		Value	Units
D =	Exposure Dose	See Results	(mg/kg/day)
Cc.max =	Contaminant concentration (Max-Carp)[2]	0.299	mg/kg = µg Hg/g = ppm
Cc.avg =	Contaminant concentration (Avg-Carp)[2]	0.227	mg/kg = µg Hg/g = ppm
Cp.max =	Contaminant concentration (Max-Pickerel)[2]	0.297	mg/kg = µg Hg/g = ppm
Cp.avg =	Contaminant concentration (Avg-Pickerel)[2]	0.297	mg/kg = µg Hg/g = ppm
IR =	intake rate of contaminated fish	varies-see table	(mg/day)
AF=	bioavailability factor (conservative)	1	(unitless)
EF=	exposure factor	1	(unitless)
CF=	conversion factor (10^{-6} kg/mg)	1.0E-06	(kg/mg)
BW =	Body Weight	16	kg

Child (16kg) Panfish Consumption Risk Assessment [3]

		Dose of Methylmercury				Daily Intake (16kg child)[4]	
	Meal Frequencies	Max	Avg	Max	Avg	Max	Avg
		mg/kg/day	mg/kg/day	µg/kg/day	µg/kg/day	µg Hg/day	µg Hg/day
Carp	Unrestricted	0.00060	0.00045	0.598	0.454	**9.563**	**7.260**
	2 meals/wk	0.00028	0.00021	0.276	0.210	**4.420**	**3.356**
	1 meal /wk	0.00014	0.00010	0.138	0.105	**2.210**	**1.678**
	1 meal /mo	0.00003	0.00002	0.032	0.024	0.510	0.387
Pickerel	Unrestricted	0.00059	0.00059	0.594	0.594	**9.499**	**9.499**
	2 meals/wk	0.00027	0.00027	0.274	0.274	**4.391**	**4.391**
	1 meal /wk	0.00014	0.00014	0.137	0.137	**2.195**	**2.195**
	1 meal /mo	0.00003	0.00003	0.032	0.032	0.507	0.507

Assumptions

1. Methylmercury concentration = total mercury measured in fish tissue (MeHg = 100% Hg)
2. Child BW = 16 kg (ATSDR children 1 -6 y.o., 50th percentile- ATSDR PHA Guidance Manual, App G)
3. RfD of MethylMercury = 0.1 µg/kg bw/day = 0.0001 mg/kg of bw/day
4. Fish Consumed/ Meal (g/kg) = 227 g fish each meal for a 70kg adult
   = 52 g fish each meal for a 16kg child

Notes:

Exceed GLP advisory goal of 1.6 µg Hg/Day

[1] Based on guidance from ATSDR Public Health Assessment Guidance Manual (http://www.atsdr.cdc.gov/hac/phamanual/appg.html)

[2] Average and maximum concentration from skin on fillet fish sampling data obtained by WDNR on 9/29/2013.

[3] Per ATSDR PHA Guidance Manual, App G- The bioavailability factor represents, as a percent, the total amount of a substance ingested, inhaled, or contacted that actually enters the bloodstream and is available to possibly harm a person. Typically, the bioavailability factor is assumed to be 1 (100%) for screening purposes—that is, all of a substance to which a person is exposed is assumed to be absorbed. The bioavailability factor may be revisited if you conduct a more refined analysis of exposures and substance toxicology, as described in Chapter 8.

[4] Great Lakes Protocols (GLP) advisory goal: Child Max Daily Hg Ingestion = 0.1 µg Hg/kg/day X 16kg (bodyweight) = 1.6 µg Hg/day

Table B2. Adult Mercury Exposure Calculations from Portage Canal Fish Consumption

Meal Frequencies	Consumption	Adult (70 kg) Consumption	IR (Adult)
	meals/yr	g fish/day	mg fish/day
Unrestricted	225	140	139,932
2 meals/wk	104	65	64,679
1 meal /wk	52	32	32,340
1 meal /mo	12	7	7,463
no consumption	0	0	-

Exposure Dose calculations[1]

D= (C X IR X AF X EF X CF) / BW

		Value	Units
D =	Exposure Dose	See Results	(mg/kg/day)
Cc.max =	Contaminant concentration (Max-Carp)[2]	0.299	mg/kg = µg Hg/g = ppm
Cc.avg =	Contaminant concentration (Avg-Carp)[2]	0.227	mg/kg = µg Hg/g = ppm
Cp.max =	Contaminant concentration (Max-Pickerel)[2]	0.297	mg/kg = µg Hg/g = ppm
Cp.avg =	Contaminant concentration (Avg-Pickerel)[2]	0.297	mg/kg = µg Hg/g = ppm
IR =	intake rate of contaminated fish	varies-see table	(mg/day)
AF =	bioavailability factor (conservative)	1	(unitless)
EF =	exposure factor	1	(unitless)
CF =	conversion factor (10^{-6} kg/mg)	1.0E-06	(kg/mg)
BW =	Body Weight	70	kg

Adult (70kg) Fish Consumption Risk Assessment [3]

		Dose of Methylmercury				Daily Intake (70kg adult)[4]	
	Meal Frequencies	Max	Avg	Max	Avg	Max	Avg
		mg/kg/day	mg/kg/day	µg/kg/day	µg/kg/day	µg Hg/day	µg Hg/day
Carp	Unrestricted	0.00060	0.00045	0.598	0.454	**41.840**	**31.764**
	2 meals/wk	0.00028	0.00021	0.276	0.210	**19.339**	**14.682**
	1 meal /wk	0.00014	0.00010	0.138	0.105	**9.670**	**7.341**
	1 meal /mo	0.00003	0.00002	0.032	0.024	2.231	1.694
Pickerel	Unrestricted	0.00059	0.00059	0.594	0.594	**41.560**	**41.560**
	2 meals/wk	0.00027	0.00027	0.274	0.274	**19.210**	**19.210**
	1 meal /wk	0.00014	0.00014	0.137	0.137	**9.605**	**9.605**
	1 meal /mo	0.00003	0.00003	0.032	0.032	2.217	2.217

Assumptions

1. Methylmercury concentration = total mercury measured in fish tissue (MeHg = 100% Hg)
2. Adult BW = 70 kg (adult, approximate average- ATSDR PHA Guidance Manual, App G)
3. RfD of MethylMercury = 0.1 µg/kg bw/day = 0.0001 mg/kg of bw/day
4. Fish Consumed/ Meal (g/kg) = 227 g fish each meal for a 70kg adult

Notes:

Exceed GLP advisory goal of 7.0 µg Hg/Day

[1] Based on guidance from ATSDR Public Health Assessment Guidance Manual (http://www.atsdr.cdc.gov/hac/phamanual/appg.html)

[2] Average and maximum concentration from skin on fillet fish sampling data obtained by WDNR on 9/29/2013.

[3] Per ATSDR PHA Guidance Manual, App G- The bioavailability factor represents, as a percent, the total amount of a substance ingested, inhaled, or contacted that actually enters the bloodstream and is available to possibly harm a person. Typically, the bioavailability factor is assumed to be 1 (100%) for screening purposes—that is, all of a substance to which a person is exposed is assumed to be absorbed. The bioavailability factor may be revisited if you conduct a more refined analysis of exposures and substance toxicology, as described in Chapter 8.

[4] Great Lakes Protocols (GLP) advisory goal: Child Max Daily Hg Ingestion = 0.1 µg Hg/kg/day X 70kg (bodyweight) = 7.0 µg Hg/day

Table B3. Child PCB Exposure Calculations from Portage Canal Fish Consumption

Meal Frequencies	Consumption	Child (16 kg) Consumption	IR (Child)
	meals/yr	g fish/day	mg fish/day
Unrestricted	225	31.98	31,984
2 meals/wk	104	14.78	14,784
1 meal /wk	52	7.39	7,392
1 meal /mo	12	1.71	1,706
no consumption	0	0.00	-

Exposure Dose calculations[1]

D= (C X IR X AF X EF X CF) / BW

		Value	Units
D =	Exposure Dose	See Results	(mg/kg/day)
Cc.max =	Contaminant concentration (Max-Carp)[2]	1.200	mg/kg = µg PCB/g = ppm
Cc.avg =	Contaminant concentration (Avg-Carp)[2]	0.664	mg/kg = µg PCB/g = ppm
Cp.max =	Contaminant concentration (Max-Pickerel)[2]	0.041	mg/kg = µg PCB/g = ppm
Cp.avg =	Contaminant concentration (Avg-Pickerel)[2]	0.041	mg/kg = µg PCB/g = ppm
IR =	intake rate of contaminated fish	varies-see table	(mg/day)
AF =	bioavailability factor (conservative)	1	(unitless)
EF =	exposure factor[5]	0.5	(unitless)
CF =	conversion factor (10^{-6} kg/mg)	1.0E-06	(kg/mg)
BW =	Body Weight	16	kg

Child (16kg) Fish Consumption Risk Assessment [3]

	Meal Frequencies	Dose of PCBs Max mg/kg/day	Avg mg/kg/day	Max µg/kg/day	Avg µg/kg/day	Daily Intake (16kg child)[4] Max µg PCB/day	Avg µg PCB/day
Carp	Unrestricted	0.00120	0.00066	1.199	0.664	19.191	10.619
	2 meals/wk	0.00055	0.00031	0.554	0.307	8.870	4.908
	1 meal /wk	0.00028	0.00015	0.277	0.153	4.435	2.454
	1 meal /mo	0.00006	0.00004	0.064	0.035	1.023	0.566
Pickerel	Unrestricted	0.00004	0.00004	0.041	0.041	0.656	0.656
	2 meals/wk	0.00002	0.00002	0.019	0.019	0.303	0.303
	1 meal /wk	0.00001	0.00001	0.009	0.009	0.152	0.152
	1 meal /mo	0.00000	0.00000	0.002	0.002	0.035	0.035

Assumptions
1. Skinning/trimming/cooking reduced PCB concentration 50% from raw, skin-on filet levels.[5]
2. Child BW = 16 kg (ATSDR children 1 -6 y.o., 50^{th} percentile- ATSDR PHA Guidance Manual, App G)
3. Health Protection Reference value of 0.05 µg PCB/kg bw/day = 0.00005 mg/kg of bw/day
4. Fish Consumed/ Meal (g/kg) = 227 g fish each meal for a 70kg adult
= 52 g fish each meal for a 16kg child

Notes:
Exceed GLP advisory goal of 0.8 µg PCB/Day

[1] Based on guidance from ATSDR Public Health Assessment Guidance Manual (http://www.atsdr.cdc.gov/hac/phamanual/appg.html)
[2] Average and maximum concentration from skin on fillet fish sampling data obtained by WDNR on 9/29/2013.

[3] Per ATSDR PHA Guidance Manual, App G- The bioavailability factor represents, as a percent, the total amount of a substance ingested, inhaled, or contacted that actually enters the bloodstream and is available to possibly harm a person. Typically, the bioavailability factor is assumed to be 1 (100%) for screening purposes—that is, all of a substance to which a person is exposed is assumed to be absorbed. The bioavailability factor may be revisited if you conduct a more refined analysis of exposures and substance toxicology, as described in Chapter 8.

[4] Great Lakes Protocols (GLP) advisory goal: Child Max Daily PCB Ingestion = 0.05 µg PCB/kg/day X 16kg (bodyweight) = 0.8 µg PCB/day
[5] Per Great Lakes Protocols, a 50% reduction factor is to be used in calculating the PCB residue from raw, skin-on filet fish consumption.

Table B4. Adult PCB Exposure Calculations from Portage Canal Fish Consumption

Meal Frequencies	Consumption	Adult (70 kg) Consumption	IR (Adult)
	meals/yr	g fish/day	mg fish/day
Unrestricted	225	140	139,932
2 meals/wk	104	65	64,679
1 meal /wk	52	32	32,340
1 meal /mo	12	7	7,463
no consumption	0	0	-

Exposure Dose calculations[1]

D= (C X IR X AF X EF X CF) / BW

		Value	Units
D =	Exposure Dose	See Results	(mg/kg/day)
Cc.max =	Contaminant concentration (Max-Carp)[2]	1.200	mg/kg = µg PCB/g = ppm
Cc.avg =	Contaminant concentration (Avg-Carp)[2]	0.664	mg/kg = µg PCB/g = ppm
Cp.max =	Contaminant concentration (Max-Pickerel)[2]	0.041	mg/kg = µg PCB/g = ppm
Cp.avg =	Contaminant concentration (Avg-Pickerel)[2]	0.041	mg/kg = µg PCB/g = ppm
IR =	intake rate of contaminated fish	varies-see table	(mg/day)
AF =	bioavailability factor (conservative)	1	(unitless)
EF =	exposure factor[5]	0.5	(unitless)
CF =	conversion factor (10^{-6} kg/mg)	1.0E-06	(kg/mg)
BW =	Body Weight	70	kg

Adult (70kg) Fish Consumption Risk Assessment [3]

		Dose of PCBs				Daily Intake (70kg adult)[4]	
	Meal Frequencies	Max	Avg	Max	Avg	Max	Avg
		mg/kg/day	mg/kg/day	µg/kg/day	µg/kg/day	µg PCB/day	µg PCB/day
Carp	Unrestricted	0.00120	0.00066	1.199	0.664	**83.959**	**46.457**
	2 meals/wk	0.00055	0.00031	0.554	0.307	**38.808**	**21.474**
	1 meal /wk	0.00028	0.00015	0.277	0.153	**19.404**	**10.737**
	1 meal /mo	0.00006	0.00004	0.064	0.035	**4.478**	2.478
Pickerel	Unrestricted	0.00004	0.00004	0.041	0.041	2.869	2.869
	2 meals/wk	0.00002	0.00002	0.019	0.019	1.326	1.326
	1 meal /wk	0.00001	0.00001	0.009	0.009	0.663	0.663
	1 meal /mo	0.00000	0.00000	0.002	0.002	0.153	0.153

Assumptions

1. Skinning/trimming/cooking reduced PCB concentration 50% from raw, skin-on filet levels.[5]
2. Adult BW = 70 kg (adult, approximate average- ATSDR PHA Guidance Manual, App G)
3. Health Protection Reference value of 0.05 µg PCB/kg bw/day = 0.00005 mg/kg of bw/day
4. Fish Consumed/ Meal (g/kg) = 227 g fish each meal for a 70kg adult

Notes:

Exceed GLP advisory goal of 3.5 µg PCB/Day

[1] Based on guidance from ATSDR Public Health Assessment Guidance Manual (http://www.atsdr.cdc.gov/hac/phamanual/appg.html)

[2] Average and maximum concentration from skin on fillet fish sampling data obtained by WDNR on 9/29/2013.

[3] Per ATSDR PHA Guidance Manual, App G- The bioavailability factor represents, as a percent, the total amount of a substance ingested, inhaled, or contacted that actually enters the bloodstream and is available to possibly harm a person. Typically, the bioavailability factor is assumed to be 1 (100%) for screening purposes—that is, all of a substance to which a person is exposed is assumed to be absorbed. The bioavailability factor may be revisited if you conduct a more refined analysis of exposures and substance toxicology, as described in Chapter 8.

[4] Great Lakes Protocols (GLP) advisory goal: Adult Max Daily PCB Ingestion = 0.05 µg PCB/kg/day X 70kg (bodyweight) = 3.5 µg PCB/day

[5] Per Great Lakes Protocols, a 50% reduction factor is to be used in calculating the PCB residue from raw, skin-on filet fish consumption.

Table B5. Child Lead Exposure Calculations from Portage Canal Fish Consumption

Meal Frequencies	Consumption	Child (16 kg) Consumption	IR (Child)	% of Avg Total Meat Consumed
	meals/yr	g fish/day	mg fish/day	%
Unrestricted	225	31.98	31,984	58%
2 meals/wk	104	14.78	14,784	27%
1 meal /wk	52	7.39	7,392	13%
1 meal /mo	12	1.71	1,706	3%
no consumption	0	0.00	-	0%

Fish Contaminant Concentrations

Maximum[2]	0.177	mg/kg = µg Pb/g = ppm
Average[2]	0.075	mg/kg = µg Pb/g = ppm

Consumer-Only Intake of Total Meat [3]

Age	Avg total meat consumed (g/kg-day)	Avg total meat consumed (g/day) for a 16kg child
0-1 yrs	2.7	43
1-2 yrs	4.1	66
3 yrs	3.9	62
4yrs	3.9	62
5yrs	3.9	62
6	2.8	45
7	2.8	45
Average	**3.44**	**55.1**

Child (16kg) Fish LeadConsumption Risk Assessment[4]

Exposure Scenario	Pb conc. In fish µg Pb/g	Meal Frequency (meals/ month)	Max Calculated Blood Lead Levels (µg/dL)	0.5-1yr (µg/dL)	1-2yr (µg/dL)	2-3yr (µg/dL)	3-4yr (µg/dL)	4-5yr (µg/dL)	5-6yr (µg/dL)	6-7yr (µg/dL)
maximum	0.177	1 meal/ month	3.5	3.0	3.5	3.2	3.1	2.6	2.2	1.9
average	0.075	1 meal/ month	3.5	3.0	3.5	3.2	3.1	2.5	2.2	1.9
maximum	0.177	1 meal/week	3.6	3.1	3.6	3.3	3.2	2.7	2.3	2.1
average	0.075	1 meal/week	3.5	3.1	3.5	3.3	3.1	2.6	2.2	2.0
maximum	0.177	Unrestricted	3.9	3.3	3.9	3.8	3.7	3.2	2.8	2.6
average	0.075	Unrestricted	3.7	3.1	3.7	3.5	3.3	2.8	2.4	2.2

Assumptions

1. Child BW = 16 kg (ATSDR children 1 -6 y.o., 50^{th} percentile- ATSDR PHA Guidance Manual, App G)
2. Fish Consumed/ Meal (g/kg) = 227 g fish each meal for a 70kg adult
= 52 g fish each meal for a 16kg child

Notes:

[1] Lead Health Protection Reference value of 5 µg/dL of Blood for children, based on curent CDC guidance.
[2] Average and maximum concentration from skin-on-fillet fish sampling data obtained by WDNR on 9/29/2013.
[3] EPA Exposure Factors Handbook, 2011 p.11-17; Table 11-4
[4] Prediction modeling from EPA's Integrated Exposure Uptake Biokinetic Model v1.1.

Greetings,

You are receiving a document from the Agency for Toxic Substances and Disease Registry (ATSDR). We are very interested in your opinions about the document you received. We ask that you please take a moment now to complete the following ten question survey. You can access the survey by clicking on the link below.

Completing the survey should take less than 5 minutes of your time. If possible, please provide your responses within the next two weeks. All information that you provide will remain confidential.

The responses to the survey will help ATSDR determine if we are providing useful and meaningful information to you. ATSDR greatly appreciates your assistance as it is vital to our ability to provide optimal public health information.

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