Letter Health Consultation

Burley Lagoon - Review of Sediment and Shellfish Data
Pierce/Kitsap County, Washington

March 14, 2013

Prepared by

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

Washington State Department of Health

DOH 334-322 March 2013

Foreword

The Washington State Department of Health (DOH) has prepared this letter 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 principal federal public health agency responsible for health issues related to hazardous substances. 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.

The purpose of a letter health consultation is to assess the health threat posed by hazardous substances in the environment and if needed, recommend steps or actions to protect public health. Letter health consultations are initiated in response to health concerns raised by residents or agencies about exposure to hazardous substances.

This letter health consultation was prepared in accordance with ATSDR methodologies and guidelines. However, the report has not been reviewed and cleared by ATSDR. The findings in this report are relevant to conditions at the site during the time of this letter health consultation and should not be relied upon if site conditions or land use changes in the future.

Use of trade names is for identification only and does not imply endorsement by DOH, the Centers for Disease Control and Prevention, ATSDR, the Public Health Service, or the U.S. Department of Health and Human Services.

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For people with disabilities, this document is available on request in other formats. To submit a request, please call 1-800-525-0127 (TTY/TDD call 711).

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March 14, 2013

Alexander Callender
Washington State Department of Ecology
P.O. Box 47600
Lacey, Washington 98504

Re: Review of Burley Lagoon shellfish data for human consumption

Dear Mr. Callender:

At the request of Washington State Department of Ecology (Ecology), the Washington Department of Health (DOH) prepared this letter health consultation to evaluate polychlorinated biphenyls (PCBs) found in sediment and shellfish samples to determine if they were a health threat to people.

Background

On November 27, 2012, Ecology contacted DOH Office of Shellfish and Water Protection (OSWP) with a citizen concern about shellfish contamination in Burley Lagoon from the Strandley/Manning site. In December 2012, OSWP asked DOH's Site Assessments and Toxicology Program to review the available historical biota and sediment data.

Strandley/Manning is a former National Priority Listed site by the Environmental Protection Agency's (EPA). In 1984 the site was first sampled by EPA and PCBs were detected in the sediments [1]. From 1984-1991, EPA completed actions to remove and stabilize contaminated soils from migrating off the site [1].

Starting in 1984, sediment and biota monitoring samples were collected in Burley Lagoon. Sediment and biota monitoring continued through 1992, for a total of six monitoring events [1]. Additionally, three supplemental sediment sampling studies were completed in 1984, 1991 and 1994. Because none of the sediment results exceeded the Washington State Sediment Management Standards, monitoring of marine sediments and organisms was discontinued. A series of phased removal actions continued on the site. Site monitoring was completed in 2001, and EPA determined no further action was needed at the site [1].

Results and Discussion

Contaminants of concern (COCs) in shellfish were determined by employing a screening process. Screening values (SVs) were developed according to EPA guidance and are used to narrow the focus of evaluation to contaminants that are present at potential levels of public health concern (Attachment A) [2]. In general, if a contaminant's maximum concentration is greater than its SV, then the contaminant is evaluated further. The range of PCBs concentration found in shellfish in Burley Lagoon growing areas post site cleanup (1988 – 1992) is presented in Table 1. Shellfish samples exceeded screening level and will be evaluated further.

Table 1. Post cleanup (1988 -1992) polychlorinated biphenyls (PCBs) concentrations range detected in shellfish from the Burley Lagoon, Washington.

Shellfish	Concentration Range (ppm)	Screening Values (ppm)		EPA Cancer Class	(MRL) (mg/kg/day)	Contaminant of Concern
		General Population +	Subsistence Consumer ++			
Littleneck clam	<0.003 - **0.03**	0.08	0.0098	B2	0.00002	**Yes**
Pacific oyster	<0.003 - **0.098**					
Bent nosed macoma clam	<0.03 - **0.037**					

B2 - EPA: Probable human carcinogen (inadequate human, sufficient animal studies)
MRL- ATSDR's Minimal Risk Level
ppm – parts per million
mg/kg/day - milligrams per kilogram body-weight per day
PCBs – polychlorinated biphenyls
Bold – chemical is a contaminant of concern and the value exceed screening values (Attachment A) [19]

+ Derived from EPA Guidance for Assessing Chemical Contaminant Data (recreational fishers). Based on fish consumption rate of 17.5 g/day, 70 kg body weight for noncarcinogens exposure [2].

++ Derived from EPA Guidance for Assessing Chemical Contaminant Data (subsistence fishers). Based on fish consumption rate of 142 g/day, 70 kg body weight for noncarcinogens exposure [2].

PCBs present at concentrations less than comparison values (CVs) are unlikely to pose a health threat. DOH selected the Agency for Toxic Substances and Disease Registry (ATSDR) soil health CV (Cancer Risk Evaluation Guide (CREG)) of 0.35 parts per million (ppm) for exposure to PCB in sediment. The range of PCBs detected in sediments in Burley Lagoon shellfish growing areas (1988 – 1992) is shown in Table 2. None of the PCBs in the sediment samples exceeded the method detection limit, ATSDR or state residential soil standards for everyday exposure. Therefore, sediment will not be evaluated any further.

Table 2. Post cleanup (1988 -1992) polychlorinated biphenyls (PCBs) concentrations range detected in marine sediment from Burley Lagoon, Washington.

Compounds	Concentration Range (ppm)	Comparison Value (ppm)	Comparison Value Reference	Contaminant of Concern (COC)
Total PCB	<0.03 - < 0.06	0.35	CREG	No

CREG - ATSDR's Cancer Risk Evaluation Guide (child)
PPM – parts per million
< - value below detection limit

Polychlorinated Biphenyls (PCBs)
PCBs are a mixture of man-made organic chemicals. There are no known natural sources of PCBs in the environment. The manufacture of PCBs stopped in the U.S. in 1977 because of evidence that it builds up in the environment and causes toxic health effects. Although no longer manufactured, PCBs can still be found in certain products such as caulk, old fluorescent lighting fixtures, old hydraulic oil or appliances containing capacitors made before PCB use was banned. Prior to 1977, PCBs entered the environment (soil, water, and air) during the manufacture and use of PCBs. Today, PCBs still enter the environment from poorly maintained hazardous waste sites, illegal dumping of PCB wastes, and leaks or spills from electrical transformers that contain PCB oils [3].

PCBs enter the environment as mixtures of individual components known as congeners. There are 209 structural variations of PCB congeners, which differ in the number and location of chlorine atoms on the chemical structure. Most PCBs produced commercially in the U.S. were sold under the trade name Aroclor. The name Aroclor 1254, for example, means that the molecule contains 12 carbon atoms (the first 2 digits) and about 54% chlorine by weight (second 2 digits). No Aroclor mixture contains all 209 congeners.

PCBs do not easily breakdown and are found worldwide because of their persistence. Small amounts of PCBs can be found in almost all outdoor and indoor air, soil, sediments, surface water, and animals. PCBs bioaccumulate in the food chain and are stored in fat cells. The major dietary source of PCBs is fish. PCBs are also found in meats and dairy products [3].

PCBs can get into people's bodies by ingestion, inhalation, and dermal (skin) contact. Some of the PCBs that enter the body are metabolized and excreted from the body within a few days; others stay in the body fat and liver for months and even years. PCBs collect in milk fat and can enter the bodies of infants through breastfeeding [3]. Skin irritation, vomiting, nausea, diarrhea, abdominal pain, eye irritation, and liver damage can occur in people acutely exposed to high levels of PCBs in occupational settings [3]. However, health effects relevant to low-level environmental exposures are immunological effects in monkeys (Aroclor 1254 - EPA's oral reference dose (RfD) of 0.00002 mg/kg/day) and developmental effects in children exposed to PCBs in the womb because mothers ate PCB contaminated fish [3].

Evaluating Exposure to PCBs in Shellfish
For this evaluation, the consumption rate used is the mean Suquamish Tribal Ingestion rate for littleneck clams, oysters, and clams (unspecified) [4]. These rates reflect only a portion of the total shellfish eaten. To reflect a full range of possible consumption rates for this area, we also evaluated the average US adult shellfish consumption rate and the median Tulalip adult, shellfish consumption rate [5].

The maximum levels of PCBs detected in shellfish from Burley Lagoon were used in health impacts evaluation. The exposure duration we used was 6 years for a child and 30 years for an adult. Please note, this approach is very conservative since the maximum levels of PCBs were only detected during one sampling event (1 year exposure).

The estimated exposure doses, exposure assumptions, and hazard quotients for PCBs in shellfish are presented in Attachment B. Based on these exposure estimates, people eating shellfish from the study area are not likely to experience adverse non-cancer health effects. Additionally,

exposure to the maximum levels of PCBs found in Burley Lagoon shellfish did not exceed the ATSDR minimum risk level (MRL).

The total estimated cancer risk from exposure to PCBs in shellfish ranged from very low to insignificant: 1 estimated excess cancer per 100,000 people exposed to 3 estimated excess cancers per 10,000,000 people exposed, respectively (see Attachment B, Table B3).

Summary of polychlorinated biphenyls (PCB) evaluation

- ATSDR's soil health comparison value Cancer Risk Evaluation Guide = 0.35 ppm.
- State residential soil standard = 1ppm.
- Maximum PCB level found in sediment < 0.06 ppm.
- Acceptable non cancer hazard quotient = 1.
- Hazard quotient range from eating Burley Lagoon shellfish = 0.05 to 0.7.
- EPA acceptable cancer risk range = $1x10^{-4}$ to $1x10^{-6}$.
- Cancer risk range from eating Burley Lagoon shellfish =$1x10^{-5}$ to $3x10^{-7}$.

Conclusion

1. DOH concludes that touching, breathing, or accidentally eating sediment from Burley Lagoon shellfish growing areas is not expected to harm people's health. Levels of PCBs in sediments are below level of concern.

2. DOH concludes that eating shellfish from Burley Lagoon shellfish growing areas is not expected to harm people's health. Exposure scenarios were evaluated using the maximum detected levels of PCBs. The results were below levels known to cause harmful non-cancer health effects. The results are also within the EPA acceptable estimated cancer risk range of 1 excess cancer risk per 10,000 people exposed to 1 excess cancer risk per 1,000,000 people exposed ($1x10^{-4}$ to $1x10^{-6}$).

Recommendations

DOH does not have any recommendations at this time.

DOH appreciates this opportunity to review the historical sampling data and help with these technical issues. If you have any questions regarding this letter please feel free to contact me at 360-236-3376 or 1-877-485-7316 or by email at Lenford.O'Garro@doh.wa.gov.

Sincerely,

Lenford O'Garro
Toxicologist
Site Assessment and Toxicology Section

Enclosure

cc: Joanne Snarski, Department of Health

References

1. Strandley/Manning Superfund Site. Summary of marine sediment, marine biota and near shore/intertidal sampling.

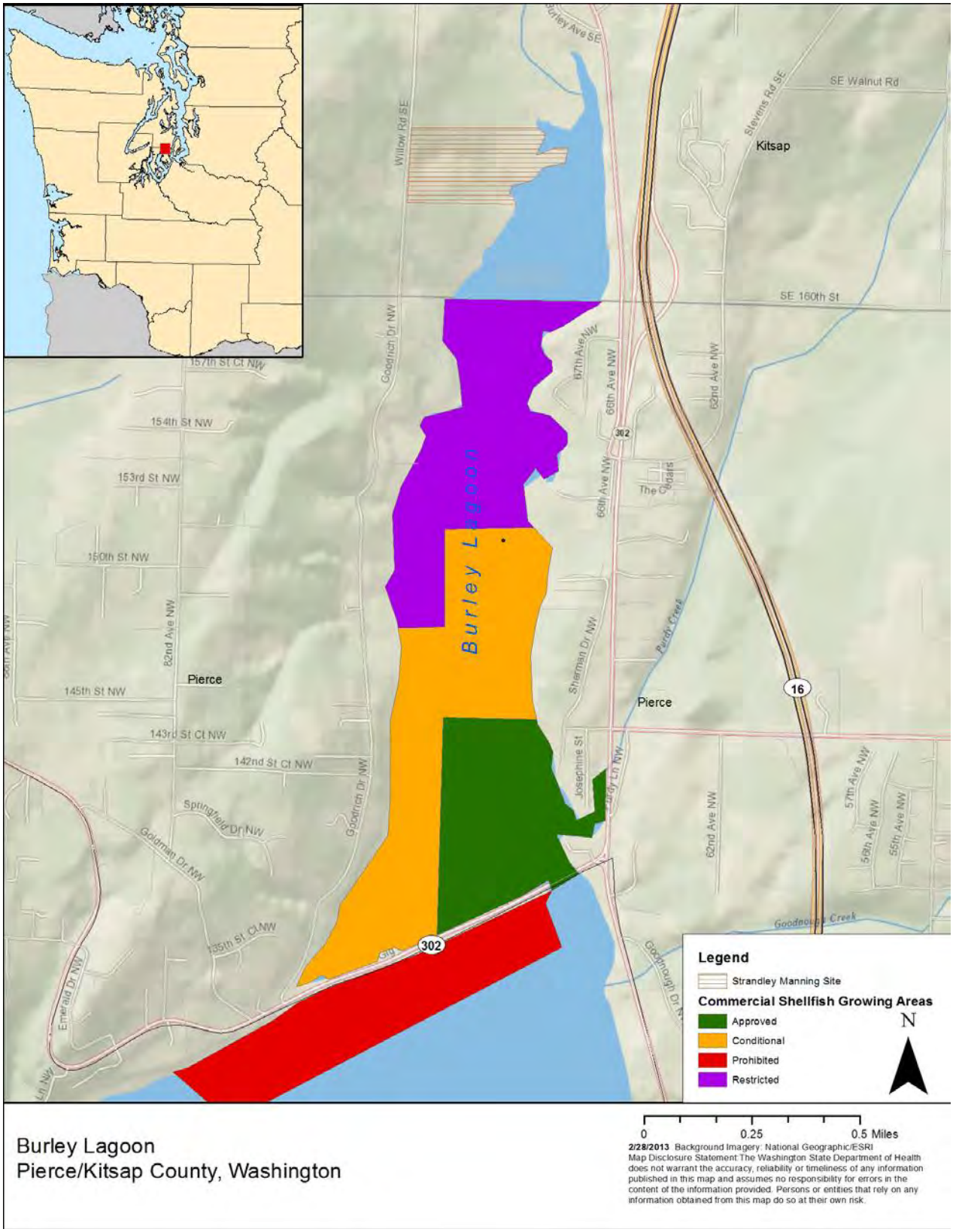
2. U.S. Environmental Protection Agency. Guidance for assessing chemical contaminant data for use in fish advisories: volume 2, risk assessment and fish consumption limits, third edition. Office of Water, Washington, DC. EPA 823-B-00-008; 2000b.

3. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for Polychlorinated Biphenyls (PCBs) (update) PB/2000/108027. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. November 2000. Available at: http://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=142&tid=26

4. The Suquamish Tribe. 2000. Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region.

5. Toy KA, Polissar NL, Liao S and Gawne-Mittelstaedt GD. A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region. 1996.

Figure 1: Puget Sound and Western Washington map showing location of Burley Lagoon in Pierce/Kitsap County, Washington.



Attachment A Screening Value Calculations

For Non-cancer Health Effects
SV = [MRL*BW]/CR [2]

SV = Screening value (mg/kg or ppm)
MRL = Minimal risk level (mg/kg/day)
BW = Mean body weight (kg)
CR = Mean daily consumption rate (kg/day)

BW (adult) = 70 kg
General population CR = 17.5 g/day = 0.0175 kg/day
Subsistence Consumer CR = 142.4 g/day = 0.1424 kg/day

If maximum concentration is greater than screening value, further evaluation is required.

For Cancer Health Effects
SV_{cancer} = [(RL / CSF) * BW]/ CR [2]

SV_{cancer} = Cancer screening value (mg/kg or ppm)
RL = Risk level (life time cancer risk)
BW = Mean body weight (kg)
CR = Mean daily consumption rate (kg/day)
CSF = Oral cancer slope factor (mg/kg/day)

BW (adult) = 70 kg
General population CR = 17.5 g/day = 0.0175 kg/day
Subsistence Consumer CR = 142.4 g/day = 0.1424 kg/day
RL = $1x10^{-5}$
CSF = contaminants specific
If maximum concentration is greater than screening value, further evaluation is required.

Estimated Cancer Risk

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

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

Attachment B Exposure Assumptions

Exposure scenarios were evaluated for consumption of shellfish from Burley Lagoon. Exposure assumptions given in Table C1 below were used with the following equations to estimate polychlorinated biphenyls (PCBs) doses associated with shellfish consumption.

$$\text{Dose}_{(\text{non-cancer (mg/kg-day)})} = \frac{C \times CF_1 \times IR \times CF_2 \times EF \times ED}{AT_{\text{non-cancer}}}$$

$$\text{Cancer Risk} = \frac{C \times CF_1 \times IR \times CF_2 \times EF \times ED \times CPF}{AT_{\text{cancer}}}$$

Table B1. Exposure Assumptions

Parameter	Value	Unit	Comments
Concentration (C)	Variable	ug/kg	Maximum value.
Conversion Factor$_1$ (CF_1)	0.001	mg/ug	Converts contaminant concentration from micrograms (ug) to milligrams (mg)
Ingestion Rate (IR) – mean Suquamish children (includes non-consumers) [4]	0.095	g/kg/day	Littleneck clams/clams
	0.019		Oysters
Ingestion Rate (IR) – U.S. average adults	0.03		all shellfish
Ingestion Rate (IR) – median Tulalip adults [5]	0.11		all shellfish
Ingestion Rate (IR) – mean adults Suquamish – (includes non-consumers) [4]	0.439		Littleneck clams
	0.107		Oysters
	0.047		Clams unspecified
Body Weight (BW) - child	16	kg	0-5 year-old child average body weight
Body Weight (BW) - adult	70		Adult mean body weight
Body Weight (BW) – adult tribal	79		Adult mean body weight (Suquamish)
Conversion Factor$_2$ (CF_2)	0.001	kg/g	Converts mass of fish from grams (g) to kilograms (kg)
Exposure Frequency (EF)	365	days/year	Assumes daily exposure consistent with units of ingestion rate given in g/day
Exposure Duration (ED)	6	years	Number of years eating shellfish (child)
	30		Number of years eating shellfish (adult)
Averaging Time$_{\text{non-cancer}}$ (AT)	2190	days	6 years (child)
	10950		30 years (adult)
Averaging Time$_{\text{cancer}}$ (AT)	25550	days	70 years
Minimal Risk Level (MRL)	0.00002	mg/kg/day	Source: ATSDR
Cancer Slope Factor (CSF)	2	mg/kg-day^{-1}	Source: EPA

Abbreviations not defined in the table:

ATSDR Agency for Toxic Substances and Disease Registry
EPA U.S. Environmental Protection Agency
mg/kg milligrams chemical per kilogram dry weight (same as parts per million, ppm)
mg/kg/day Daily dose in milligrams chemical per kilograms bodyweight per day

Table B2. Non-cancer hazards associated with exposure to polychlorinated biphenyls (PCBs) in shellfish from Burley Lagoon, Pierce/Kitsap County, Washington

Shellfish	Maximum Concentration (ppm)	MRL (mg/kg/day)	Child Dose	Adult Dose		
			Mean Suquamish (includes non-consumers)	Average U.S	Median Tulalip (All Shellfish)	Mean Suquamish (includes non-consumers)
Littleneck clam	0.03	0.00002	2.85E-6	9.00E-7	3.30E-6	1.32E-5
Pacific oyster	0.098		1.86E-6	2.94E-6	1.08E-5	1.05E-5
Bent nosed macoma clam	0.037		3.52E-6	1.11E-6	4.07E-6	1.74E-6
Hazard Quotient Littleneck clam			0.1	0.05	0.2	0.7
Hazard Quotient Pacific oyster			0.09	0.15	0.5	0.5
Hazard Quotient Bent nosed macoma clam			0.2	0.06	0.2	0.09

MRL- ATSDR's Minimal Risk Level
mg/kg/day - milligrams per kilogram body-weight per day
ppm - parts per million

Hazard Quotient (HQ) formula:

$$HQ = \frac{\text{Estimated Dose (mg/kg-day)}}{\text{MRL (mg/kg-day)}}$$

Table B3. Estimated cancer risk associated with exposure to maximum polychlorinated biphenyls (PCBs) in shellfish from Burley Lagoon, Pierce/Kitsap County, Washington.

Shellfish	Maximum PCBs Concentration (ppm)	CSF (mg/kg/day)	Child Cancer Risk [a]	Adult Cancer Risk [a]		
			Mean Suquamish (includes non-consumers)	Average U.S	Median Tulalip (All Shellfish)	Mean Suquamish (includes non-consumers)
Littleneck clam	0.03	2	4.89E-7	7.71E-7	2.83E-6	1.13E-5
Pacific oyster	0.098		3.19E-7	2.52E-6	9.24E-6	8.98E-6
Bent nosed macoma clam	0.037		6.03E-7	9.51E-7	3.49E-6	1.49E-6

[a]- Cancer risks do not represent cumulative lifetime exposure from childhood to adulthood due to lack of consumption data from 7 to 15 year old children.
ATSDR Minimal Risk Level
ppm – parts per million
mg/kg/day - milligrams per kilogram body-weight per day
CSF- cancer slope factor