

## Response to comments received from NOAA on September 9, 2009

*September 9, 2009*

The NewFields 2009 report does *not* suggest that Hg concentrations present in Douglas Harbor represent native levels. The report does indicate on page 41 that the concentrations reported in the NewFields 2009 report are “similar to those reported in the sediment samples collected in 2007...”

With regard to the comment regarding the use of SEM and AVS concentrations, the SEM and AVS analyses for the sediment samples were added to the program based on a discussion with the regulatory agencies (pro and con) during one of the phone conversations to discuss the project SAP. The actual bioavailability of Hg was measured during the bioaccumulation test.

The SEM/AVS was examined in case there was a need to describe the presence or lack of relationship between the simultaneously extracted materials and the presence or absence of bioaccumulation. The relationship of SEM and AVS has been controversial because the biological availability of Hg is based on the occurrence of a bacterially mediated production of methyl Hg which occurs most readily in the dissolved Hg form under optimum Eh conditions in aerobic environments. Other easily extracted materials also influence Hg availability. For example, Hg sulfide is a highly favored reaction based on its low solubility as a sulfide complex. Sulfides are primarily present under anaerobic conditions and the relationship of dissolved sulfides on a molar basis to the dissolved Hg concentrations on a molar basis after the extraction process is only the first part of determining potentially ‘bioavailable’ Hg. There are other compounds that react with soluble Hg that are not a part of the AVS. These compounds may be extracted during the same process resulting in an over-prediction of the amount of available Hg. More importantly, the methylation process that is bacterially mediated under aerobic conditions can be enhanced or decreased based on other factors (Eh, pH, oxygen content of sediment, porewater content, bioturbation, etc.). Many of the controlling factors mentioned affect the ability to accurately predict the potential bioaccumulation of Hg.

Therefore, the effects based testing of measuring the actual bioaccumulation responses of test organisms under similar testing conditions has been the primary means of establishing potential risk of Hg to organisms and ultimately humans. The effects based testing concentrations are the primary data for this evaluation not the SEM/AVS ratios. This was agreed upon during development and review of the SAP by the applicable regulatory agencies.

Specific responses to questions 1 – 4 follow.

1. What are the chronic effects of Hg exposure and bioaccumulation in the aquatic food web? Marine organisms will be exposed to Hg from the fill material for decades, if not longer. While the NewFields report focuses on acute effects, juvenile salmon experience sublethal chronic effects at Hg levels much lower than 0.2 mg/kg .

The comments from NOAA refer to Beckvar et al. (2005) when discussing low Hg concentrations and potential chronic impacts to salmonids and other aquatic species.

Table 2 (Beckvar et al. 2005) provides no effects residue data (NER) and low-effect residue (LER) data collected from ten different peer reviewed papers. For all but one paper, (Birge et al 1979), the LER values are equal to or greater than the highest Hg tissue concentration of 0.2 mg/kg reported for clams exposed to the lower composite from Douglas Harbor. In other words 9 of the 10 papers had Hg residue effects based values *greater* than the highest tissue concentration of 0.2 ppm reported in *M. nasuta* exposed to sediment from Douglas Harbor (NewFields 2009).

In reviewing Beckvar et al. 2005 we found a discrepancy between the NER shown for rainbow trout eggs reported at 0.02 ppm and the NER value of 0.04 ppm shown in Birge et al. 1979. Apparently the tissue residue from a control sample was used as the NER; we feel this is an inappropriate use of the control sample. Birge et al. 1979 does not summarize data relative to an NER or LER, rather the only statistical evaluation conducted for this study was Probit analysis to calculate lethal concentrations relative to 1% of the population or LC<sub>1</sub>.

Beckvar et al. 2005 states “deriving protective tissue residues is hampered by a lack of consensus in the scientific community regarding the treatment and analysis of published residue-effect information.” We would agree with this statement as reflected in the difference we have pointed out in calculating NER data from Birge et al. 1979. **We do agree with the final conclusion in Beckvar et al. 2005 “...the following tissue residues are deemed protective of fish. For Hg, we recommend 0.2 mg/kg whole body as protective for juvenile and adult fish.”**

We believe a more robust comparison of Hg tissue data would be to use the Effects Residue database (ERED; USACE/USEPA 2008). This database contains data from 2180 studies published between 1964 and 2007. From these studies, 13,981 distinct observations have been included for 404 analytes, 446 species, 15 effect classes, and 74 endpoints. The database was developed to reduce the level of uncertainty associated with interpreting bioaccumulation data for the purpose of making regulatory decisions, contains approximately 14,000 pairs of chemical specific tissue burdens to adverse effects extracted from the scientific literature. The use of the large ERED database prevents the possibility of interpreting data based on only a small number of scientific studies.

ERED was queried to examine effects based body burdens for Hg and the results comprised 37 different species and included acute and chronic endpoints. Figure 1 (Figure 4-4 of the NewFields 2009 report) summarizes this data and shows the *95% protection levels for all of the LOED - lowest observable responses is 0.2 ppm*. This effects based level corresponds with the conclusions of Beckvar et al. 2005. **The highest tissue level of 0.2 ppm reported in NewFields 2009 would *not* be predicted to elicit adverse impacts as supported by Beckvar et al. 2005 and the ERED (USACE/USEPA 2008).**

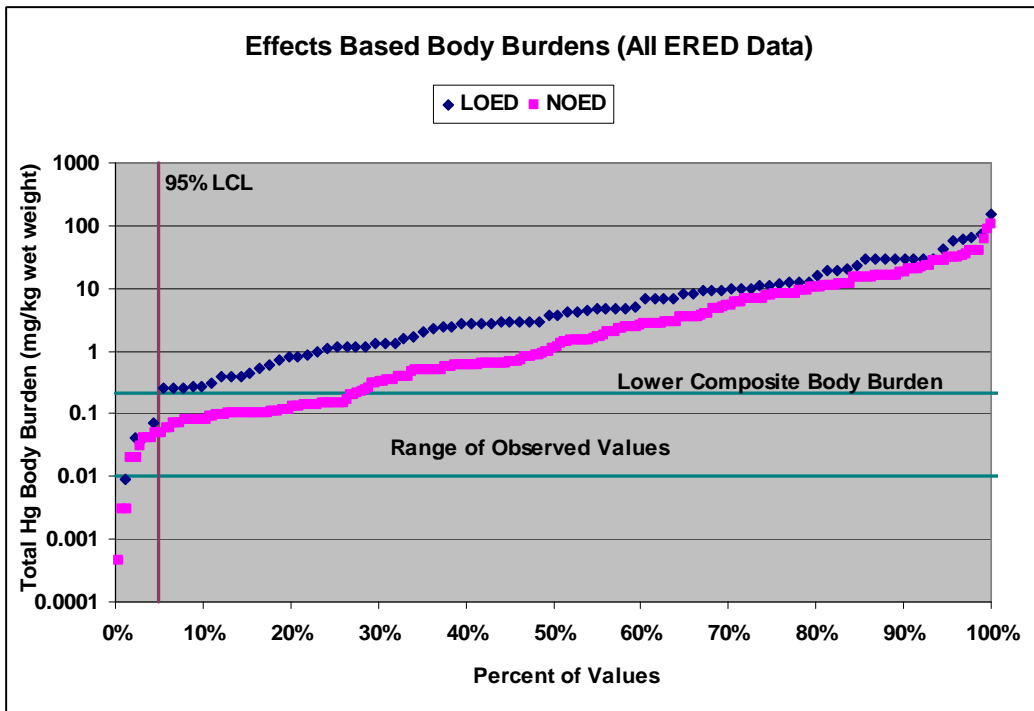


Figure 1 95% Lower Confidence Limit of Tissue Residue Effects for Mercury

2. What are the effects on Hg bioaccumulation at higher trophic levels in the food web? The NewFields tests evaluated clams and worms, not organisms such as forage fish, or commercial or sport caught fish intended for human consumption.

Response to question #2 – The effects of Hg at *higher* trophic levels in the food web, was addressed in the Supplemental Evaluation for Bioaccumulation Data from the Dredged Material Evaluation for the Douglas Harbor Marina-Juneau Alaska March 2009 and has been addressed in response to US Army Corp of Engineers Comments (Question #13) dated June 9, 2009, and in the response to question #9 sent by Carrie Bohan on January 7, 2010. Please see these documents for a detailed discussion of bioaccumulation at higher trophic levels.

3. What are the effects of Hg methylation by microbial action on marine organisms? Hg moved from the anaerobic to aerobic conditions is more easily methylated by microbial action, the sediment dredged from the Douglas Harbor basin will be exposed to aerobic conditions.

Response to question #3 – methylation of Hg was discussed in the Supplemental Evaluation for Bioaccumulation Data from the Dredged Material Evaluation for the Douglas Harbor Marina-Juneau Alaska March 2009, specifically pages 1 and 2 and in the responses to the US Army Corp of Engineer Comments. A brief summary follows.

Exposure of newly uncovered anaerobic sediments to seawater creates a potential for increased aerobic conditions and biogenic processes. This change results in the production of aerobic microbial communities that enhance the production of methyl Hg. Dissolved Hg appears to have two primary responses under aerobic and anaerobic conditions. A simple approach to these responses is that dissolved Hg can be bound to sulfides under anaerobic conditions while becoming methylated and more available for biological uptake under aerobic conditions (Sadiq, 1992).

The Lower Comp sample represents sediments that would be newly exposed after dredging within the harbor. This sediment was found to have elevated sulfides, low total organic carbon, and high sand content and was well consolidated with small amounts of water. The concern with the Lower Comp samples in the bioaccumulation test was that the more deeply buried and non-biogenically active sediments would not provide sufficient conditions for the test organisms to survive and grow throughout the testing period without addressing other contributing factors.

NewFields suggested a microbial acclimation process for the lower composite sediment by layering the sediment into testing containers, covering with natural seawater, and allowing the sediment to acclimate until ammonia concentrations were stabilized by the development of a natural microbial community. This process occurred over a 30 day period prior to the introduction of test organisms. In this process, we simulated what would happen to the newly exposed sediments in the harbor and at the disposal site. *Macoma nasuta* and *Nephtys caecoides* exposed to the Lower Comp had higher concentrations of total Hg in their tissues than those exposed to the upper composite (more aerobic and biogenically active) sediments; both the upper and lower composite had similar sediment Hg concentrations, indicating that this acclimation procedure may have made more Hg available. The acclimation of sediments in the benthic amphipod test also provides information that can be applied to what might be expected from the newly exposed harbor surface. Sediments were acclimated for the Lower Comp in the benthic amphipod test. The results of the amphipod test, where both unacclimated (representing newly exposed material) and acclimated (representing material exposed to seawater for one week) sediments demonstrate that the sediments are not toxic to benthic organisms according to ITM criteria immediately after exposure. After one week of exposure to seawater, the Lower Comp had higher survival than the reference sediment and the control sediment.

4. Acclimation of the Lower composite sediment prior to testing provides a realistic assessment of the potential for mercury to become methylated during the dredging and disposal operation. The results showed the acclimated sediment did not cause lethality to test organisms and did not cause accumulation of mercury above the project screening levels. What is the appropriate Hg threshold for bioaccumulation effects? This level should be determined through collaboration with EPA, Alaska Department of Environmental Conservation (ADEC) and other appropriate specialists.

Response to question #4 – The appropriate project tissue screening of 0.32 ppm wet weight was provided by the Alaska Department of Environmental Conservation. This project screening level was the culmination of project meetings, phone conversations and submittal and approval of the project sampling and analysis plan (SAP). The actual number of 0.32 ppm came from a Bulletin prepared by the Section of Epidemiology Division of Public Health Department of Health and Social Services. Dr. Lori Vebrugge led the study team which included members from the Alaska Scientific Committee for fish consumption.

Participants of project meeting and recipients of the SAP included Environmental Protection Agency, the Army Corp of Engineers, ADEC, U.S. Fish and Wildlife Service, and NOAA. The memo from ADEC describing the project specific action level is provided for informational purposes.

*Hi,*

*We've had some discussion back and forth, with a response to comments about ADEC & COE earlier comments. Here is ADEC response to the response to our earlier comment about tissue concentrations for Hg.*

*In the Inland Testing Manual on page 6-7 the paragraph at the bottom of the page says the following: “(t)he above comparisons to FDA values address human health concerns, and follow from EPA/USACE (1991). Other approaches which should be considered in addition to the use of the FDA values include comparisons to **state fish advisories**, cancer and non-cancer risk models, existing ambient fish concentration data.” (Emphasis added)*

*In 2007 the State of Alaska Division of Public Health published the Epidemiology Bulletin Volume 11, Number 4 entitled, “Fish Consumption Advice for Alaskans: A Risk Management Strategy to Optimize the Public's Health.” This Bulletin includes information about Hg in fish in Alaska and gives recommended consumption allowances. The Bulletin describes an EPA screening value for unlimited consumption defined as over 16 meals per month (p.5). In Table 8 of the Bulletin it lists for 16 meals per month a monthly consumption allowance for fish of 0.32 ppm wet weight of total Hg (assumed that all Hg is methylHg)(p.31). ADEC considers the 0.32 ppm as the tissue concentration number to use based on the Alaska fish advisory.*

*We look forward to reviewing the results of the testing.*

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**Response to comments from Fish and Wildlife Service dated January 6, 2009.**

**Comment:** “Of major concern is that disposal of Hg-contaminated harbor sediments will result in uptake of Hg by marine invertebrates (Dungeness and king crab, spotted and coonstripe shrimp) and bottom-feeding fish (Pacific halibut) that are used for human consumption?”

Other Hg bioaccumulation research has reported additional Hg uptake over time periods longer than the 28-day bioassay period. Because Dungeness crabs have an estimated life span of 8 to 13 years, ([www.adfg.state.ak.us/pubs/notebook/shellfish/dungie.php](http://www.adfg.state.ak.us/pubs/notebook/shellfish/dungie.php)), Hg uptake could exceed bioassay result concentrations reported in NewFields 2009. We request the applicant provide additional information for Hg uptake rate by crabs over longer periods than the 28-day bioassay.

*Summary of Comment: Length of time for conducting the 28-day bioaccumulation test may be inappropriate?*

**Response:** The length of the 28-day bioaccumulation test is based on the federal guidance for testing of dredged material evaluation programs (USEPA 1998). There was consensus discussion with the agencies (USACE, EPA, ADEC) based on a teleconference held on 12/17/2008 regarding the overall duration of the 28 day test. It was agreed that the 28 day test period would be followed for this project. A summary of the test duration is described on pages 72 and 73 of the NewFields 2009 report. Further, communications with USACE in the form of response to comments further discussed the duration of the bioaccumulation test were provided.

Earlier comments from the USACE related to “Recent studies indicate that steady state condition for Hg is not accurately predicted by the 28-day test and that a conversion factor should be applied to the data prior to comparing tissue results to screening levels. “ ...Considering the available data on Hg bioaccumulation in benthic invertebrates exposed to sediment (Best 2005; Best 2007..) the Hg body residue reported for *Macoma* exposed to Douglas Harbor sediment for 28 days are unlikely to represent steady state concentrations of clams residing in that sediment.....

In attempting to apply the information from the Douglas Harbor data to the study conducted by Best (2005) and McFarland et al (2002), it appears that the line attributed to the field-collected concentrations on the graph presented from Best et al. (2005) and obtained from MacFarland et al. (2002) is in dry weight units and therefore cannot be directly compared to the laboratory uptake of wet weight concentrations. Data provided in McFarland et al. (2002) show wet weight mean tissue concentrations at SM-1 to be 0.020 mg/kg and at SM-10 to be 0.017 mg/kg. Converting these concentrations to dry weight using the 85% moisture content reported in the document yields 0.13 mg/kg and 0.11 mg/kg dw. These field collected tissue samples were assumed to be at steady state and were used to provide an evaluation of whether steady state had been attained in the laboratory study. We have reproduced the figure below showing the line we believe is dry weight (0.12 mg/kg) and with an even distribution of the days of uptake on the x-axis. The appropriate wet weight concentration to use for *Modiolus sp.* body burden is 0.02 mg/kg (also shown in Figure 2). In this case, either the

laboratory exposure overestimates the uptake of Hg or comparison to *Modiolus* uptake is inappropriate. Based on this analysis we also decided not to apply a correction factor

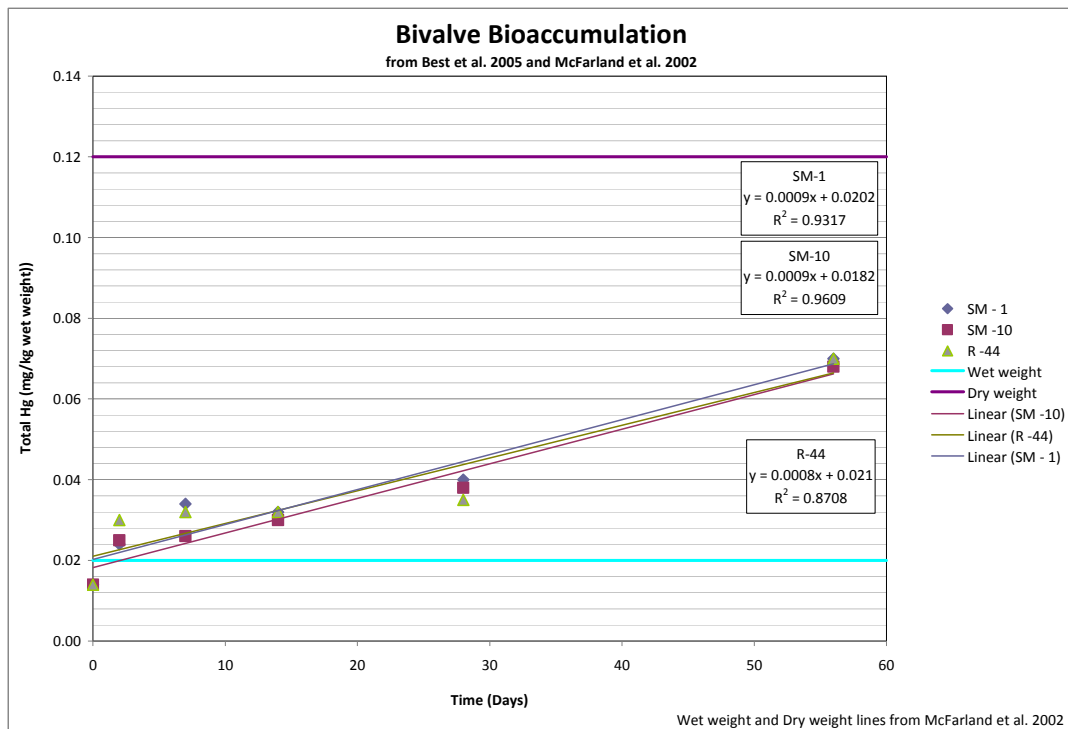


Figure 2 Adapted from Best et al. 2005 and McFarland et al 2002 (field collected data).

to these data because the 28-day exposure tests exceeded the tissue levels that had been collected at the comparison site which were assumed to be at the steady state for those exposures to Hg in the field.

Also, in examining the data presented the uptake and depuration of Hg into the tissues of this experimental clam does show rapid depuration for a fraction of the Hg. In this case, the uptake to 28-days and the depuration for 2 days after exposure the concentrations of Hg were essentially the same and these concentrations remained at these levels for more than 30 days after the original exposure. This indicates that both depuration processes and the length of exposure time used for these tests provide a reasonable estimate of the body burden steady state for these trophic level 2 organisms.

However, the conclusion of an outside reviewer (Dr. Lutufo) of this information at the request of US Army Corps of Engineers is that even with the use of his recommended estimate of 0.5 µg/g for steady state concentration of total Hg and applying a factor of 44% to estimate methyl Hg at 0.22 µg/g in the tissues; this value is less than the 0.32 µg/g guidance value developed for the protection of human health (ADEC and the Alaska Division of Public Health - ADPH).

While we disagree with some of the observations reported in Best et al. (2005 and 2007) relative to attainment of steady state concentrations within 28 days it does appear that the conclusion of no predicted adverse effect due to the concentrations of Hg in the Douglas Harbor sediment is still a reasonable conclusion from the existing knowledge on Hg bioaccumulation. Because of the wet weight

and dry weight comparisons and the laboratory uptake data that shows higher concentrations than the field steady state values we have also decided not to apply a correction factor for steady state to these data. In other words, the available data does not support a correction factor for the 28 day test. If a conversion factor were to become a standardized accepted practice, we would encourage the Army Corps and the US EPA to revise guidance documents relative to dredged material testing.

#### *Hg accumulation in crab and other shellfish*

**Comment:** It is important to note that bioaccumulated methyl Hg is tightly bound to tissue and thus is not likely to be depurated or released by aquatic species. Several recent studies have found elevated concentrations of Hg in muscle tissue of blue crabs (Karouna-Reiner et al, 2007 and Sastre et al. 1999) and green crabs (Coelho et al., 2008), indicating bioaccumulation by these species. A study of blue crabs (Reichmuth et al., 2009 on-line citation date) found higher Hg concentrations occurred in the muscle than in the hepatopancreas. This was unexpected as the hepatopancreas is one of the main storage sites for other toxins (Brouwer and Lee, 2007). In Reichmuth et al., (2009) on-line citation data) crabs fed clean food or transplanted into clean environment did not show a significant decrease in Hg which indicates that Hg may be harder or slower to depurate than to accumulate. Similar findings were seen in the estuarine fish mummichogs (Smith and Weis 1997). Once marine organisms' bioaccumulate Hg, they are unlikely to lose Hg back to the environment.

**Response:** The information provided by USFWS represents recent and historical assessments of uptake of Hg into the tissues of various crab species. The concern expressed in their letters of January 6, 2009 and February 2, 2010 revolves around the longer term/life cycle uptake of Hg into the tissues of long lived organisms (crab species). Additionally the letters also indicated a potential uptake to concentrations that might exceed those observed in clams and worms directly exposed to sediment from Douglas Harbor, Alaska. Four technical papers were provided by USFWS and required additional response.

A summary of these papers and the appropriate application to interpretation of the Douglas Harbor analyses follows:

**Jessica M. Reichmuth, Peddrick Weis, Judith S. Weis. 2010. Bioaccumulation and depuration of metals in blue crabs (*Callinectes sapidus*) from a contaminated and clean estuary. *Environmental Pollution* 158 (2010) 361-368.**

In this paper, two different experimental procedures were employed. In the first, lab exposures of 8 weeks duration were performed in artificial seawater with adult male crabs being fed fish three times a week for 8 weeks (trophic transfer study). The other experimental procedure was a field exposure for periods of 8 weeks at a time for three years. These studies were conducted in exclusion cages within the Hackensack Meadowlands (salinity of ~15‰) and in an area surrounded by a National Estuarine Research Center, Tuckerton (salinity of ~30‰), one of the cleanest estuaries on the Atlantic Coast. Male crabs were placed in exclusion cages and fed fish from the transplant site and then moved to the alternate site and fed fish from that site (transplant studies). All of the tissue data analyses provided in this document was based on dry weight determinations of total Hg. The fresh weight/dry weight relationship of these tissues was not provided in this paper so comparisons to fresh weight values in the other papers was derived by using a dry weight conversion based on other crab species where the dry



weight mass of tissues was ~15% of the wet weight or the water content was 85% for fresh weight determinations - ). The background tissue concentrations ranged from an average of 0.2 µg Hg/g of dry weight tissue to an average of 0.4 µg Hg/g of dry weight. These are equivalent to fresh or wet weight concentrations of 0.03 to 0.06 µg Hg/g of tissue.

The maximum concentration of Hg in various tissues was found in the muscle tissue for the transplant study. This maximum tissue concentration averaged ~1.0 µg Hg/g of dry weight muscle tissue from Tuckerton crabs transplanted to Hackensack Meadows and fed fish from Hackensack Meadows. This concentration is equivalent to a maximum fresh weight concentration of 0.15 µg Hg/g of tissue. All other tissues for the trophic transfer or the transplant studies were lower than these values (ranging from an average of 0.1 to 0.6 µg Hg/g of dry weight or 0.015 to 0.09 µg Hg/g of fresh weight tissue with none of them significantly different from baseline prior to test initiation. Since these are tissue values obtained by fish feeding crabs the Hg concentrations at this trophic level (Step 3) are likely to be methyl Hg.

Conclusion from this study in comparison to the Douglas Harbor assessment:

1. The concentrations of methyl Hg in crabs, exposed for 8 week periods over their 3 year life span are equal to or less than the levels observed in the tissues of the clams exposed to sediment from the lower composite sample of Douglas Harbor sediment. In contrast to the suggestion that crab exposed to Douglas Harbor sediment over their life time would have higher concentrations than the clams directly exposed to Douglas Harbor sediment is not supported by this paper. The time frame for the experimental testing of Douglas Harbor demonstrates uptake equivalent to these longer periods of time.

**J.P. Celho, A.T. Reis, S. Ventura, M.E. Pereira, A.C. Duarte, M.S. Pardal. 2008. Pattern and pathways for Hg lifespan bioaccumulation in *Carcinus maenas*. Marine Pollution Bulletin 56: 1104-1110.**

This study was a field evaluation of the change in concentration of Hg in the tissues of a crab whose life span is 3-4 years. The pattern of uptake and change through time in various tissues was compared to the sediment and water concentrations of Hg. There were three groups of data, one having very high concentrations of Hg in sediment and overlying waters, a moderate level of Hg contamination and a group with very low Hg contamination. The following table extracted from the paper contains values that can be compared to the Douglas Harbor values.

Station	Sediment (mg/kg)	Reactive Hg (ng/L)	Total Dissolved (ng/L)	Suspended (mg/kg)
<b>A1</b>	51.7	60.5	275.4	25.8
<b>High</b>				
A2	6.8	15.8	73.2	20.1
A3	5.2	24.0	97.8	9.0
A5	6.2	9.0	34.4	8.9
<b>Moderate</b>	>5	>9	>34.4	>8.9
A6	0.4	2.9	10.0	1.1
A7	0.1	4.0	6.8	0.7
A8	0.2	2.6	4.4	0.8
A13	0.2	0.6	1.0	0.6
A15	0.1	1.5	4.6	1.2
<b>Low</b>	<0.4	<4.0	<10.0	<1.2
<b>Maximum Douglas Harbor Values</b>	2.56		29.2 (total Hg) 0.979 (methyl Hg)	

The maximum sediment concentrations reported for Douglas Harbor are intermediate in concentration between the moderate and low group of Hg concentrations. The maximum total dissolved Hg concentrations in Douglas Harbor pore waters is less than the concentration of dissolved Hg observed above the moderately contaminated sediments from this estuary. Comparisons of the tissue burdens and uptake rates from Douglas Harbor exposures should be compared with the moderate and low groups not the highest contamination group.

The tissue concentrations adjacent to very high sediment contamination levels (red highlight) showed significant annual accumulation rates (especially in the gill and muscle tissue of female crab), representing an increase of ~25% per year. Other tissues and male crab showed different responses ranging from slower increases to decreases through time. The tissues of crabs adjacent to moderate and low sediment contamination levels had tissue values ranging from 0.1 to 0.5 mg/kg fresh weight and showed little inter-annual change in the concentrations observed in various tissues.

Conclusions from this study indicate that there is little likelihood for longer term crab species to demonstrate increased concentrations through their life span when exposed to sediment with concentrations of Hg similar to those in Douglas Harbor.

**J.M. Laporte, J.P. Truchot, F. Ribeyere and A. Boudou. 1997. Combined effects of water pH and salinity on the bioaccumulation of inorganic Hg and methylHg in the shore crab *Carcinus maenas*. Marine Pollution Bulletin Vol 34, no 11, pp. 880-893.**

This study was a short term exposure (3-15 days) to very high concentrations of methyl Hg (1 µg/L) that were 1,000 fold higher than the highest pore water concentrations in any of the Douglas Harbor treatments. Additionally this concentration is maintained by daily static renewal with artificial seawater containing no suspended particles. This means that the test organisms are exposed to freshly prepared methyl Hg on a daily basis, there are no particles in the water to adsorb Hg and that after 15 days of maximized exposure the crabs can increase their tissue concentrations for the whole crab from ~40 ng/g to ~110 ng/g or 0.11 µg/g, equivalent to those values observed in the tissues of the crabs from the previous two studies for sediment with low levels of Hg contamination.

**Natalie K. Karouna-Reiner, Richard A. Snyder, Jeffrey G. Allison, Matthew G. Wagner, K. Ranga Rao. 2007. Accumulation of organic and inorganic contaminants in shellfish collected in estuarine waters near Pensacola, Florida: Contamination profiles and risks to human consumers. ScienceDirect. Environmental Pollution 145 (2007) 474-488.**

This study examined the potential human health risks associated with eating Blue crabs (*Callinectes sapidus*) and oysters (*Crassostrea virginica*) that exceeded the Florida Specific Consumption advisories using the following: Consumption rates of 46 g/day, every day for a lifetime of 70 years. The tissue screening level that would be protective is 0.15 mg/kg with these parameters. With USEPA guidelines for consumption rates of 17.5 g/day, every day for a lifetime of 70 years the screening tissue value is 0.4 mg Hg/kg of tissue. Florida also has a DO NOT EAT VALUE for any concentration above 0.85 mg/kg for sensitive populations which include children and women of child-bearing age.

Based on this report the comparisons for human health should be made at these levels. Because Alaska Department of Health has developed separate criteria for Alaska consumption rates and subsistence

fishers these values were used to compare the tissue burdens obtained by modeling uptake from the trophic level 2 values obtained during the sediment testing to trophic level 4 (e.g., halibut) and people.

The following data was used to compare test results with additional papers provided by USFWS in their letters of January 6, 2009 and February 2, 2010.

NewFields 2009 - Dredged material evaluation for the Douglas Harbor Marina, Juneau, Alaska.

Sediment and Pore Water Measurements of total and methyl Hg (extracted from Tables 3.5 and 3.7 of NewFields 2009)

Station ID	Total Hg in sediment (µg/g dry weight)	Methyl Hg in sediment (µg/g dry weight)	Total Hg in pore water (ng/L)	Methyl Hg in pore water (ng/L)
Area 4A Lower Comp	2.56	0.00333	29.2	0.979
Ref -01	0.178	0.000294	5.1	0.405
Ref -02	0.195	0.000308	10.3	1.36
Ref - 03	0.199	0.000314	10.7	0.582
Ref - 04	0.268	0.000445	19.4	1.9
Ref - 05	0.303	0.000350	4.11	0.147
Ref Comp	0.226	0.000277	8.83/8.09	0.433/0.393

Mean tissue concentrations in clams and worms (total Hg µg/g wet weight) abstracted from Table 4-9 (NewFields 2009) and methyl Hg calculation from supplemental report

Station ID	<i>Macoma nasuta</i>		<i>Nephtys caecoides</i>	
	Total Hg (µg/g wet)	Methyl Hg (µg/g wet)	Total Hg (µg/g wet)	Methyl Hg (µg/g wet)
Lower Comp	0.213	0.094	0.027	0.012

**Response to comments from Fish and Wildlife Service dated February 2, 2010.**

Comments directed toward accumulation and transfer of Hg within the marine food web were addressed in response to comments from September 9, 2009

Comments regarding length of time for conducting the bioaccumulation study were addressed in response to comments from September 9, 2009.

The use of the Sediment Evaluation Framework (SEF) for the Pacific Northwest (May 2009) for interpretation of data is not recommended as it represents a significant departure from work generally conducted in the Northwest. The following statement in the document provides some context for the present status of this effort.

*The RSET (Regional Sediment Evaluation Team) agencies are committed to continuing work with regional and national experts and stakeholders to further develop and evaluate approaches to assessing bioaccumulation impacts to meet our legal responsibilities in a manner that is scientifically defensible yet does not present an undue hardship on the regulated community. However, until these approaches are more fully reviewed, the existing approaches as described*

*by DMMP or the Oregon Department of Environmental Quality (ODEQ) will be considered as viable options and available to applicants to assess bioaccumulation until the approaches outlined in this chapter (Chapter 8: Bioaccumulation Evaluation) is fully developed and reviewed for its regulatory applicability, reliability, and impacts.”*

The SEF document provides several guidance values that can be used to determine potential risk from Hg. These guidance values were cited in the comments provided by Fish and Wildlife Service. A discussion of these values is summarized here. While not specifically stated, the bioavailable Hg concentrations which provide the basis for interpretation framework are based on *methyl Hg and not total Hg*. This is in line with guidance issued by other regulatory agencies (USEPA, SAB, and OHHEA).

- The Toxicity Threshold Level (TTL) developed for protection of aquatic life is 0.11 mg/kg wet weight. The TTL is derived from Beckvar et al. 2005 and is protective for mortality, growth, reproductive and behavioral endpoints represented by the data summarized in this document. Most of the test species were fish dosed with methyl Hg resulting in methyl Hg in tissue body burden.
- The literature discussed by Beckvar et al. 2005 provides the highest no observable effect dose (NOED) as 0.23 mg/kg and the lowest observable effects dose (LOED) as 0.25 mg/kg with an extrapolation to 0.2 mg/kg wet weight as being protective of the effects with this assessment. Therefore, the cited value of 0.11 mg Hg/kg tissue for the protection of aquatic life in the RSET document is inconsistent with this information, and does not appear to base the guidance value on methyl Hg. While the specification of total or methyl Hg is not a major concern for fish species, it is a significant factor when evaluating lower trophic levels.
- Regarding Hg concentration in the tissues of wildlife consuming aquatic resources, distinctions are made between deep water and nearshore environments and endangered or threatened species and other wildlife species (referred to as “population”). The concentrations protective for these environments (deep or shallow) and types of organisms (ESA or population) range from 0.02 to 0.12 mg Hg/kg tissue wet weight. For application to Gastineau Channel we selected the population value for deep water as the appropriate assessment endpoint (0.12 mg Hg/kg tissue) for the following reasons.
  - The aquatic-dependent wildlife values for the shallow and endangered or threatened species are predominantly represented by shorebirds and are not appropriate for the deeper water disposal site within Gastineau Channel (>120 ft). The two species that are appropriate for deep water that are likely to dive to deep waters of the Gastineau Channel disposal site include the Harbor seal and the Orca Whale and with reported TTL values of 2.67 and 0.42 mg Hg/kg wet weight, respectively.
  - Because these values are higher than the guidance for the aquatic life (0.11 mg Hg/kg wet weight) they will not influence or control decisions for protection of ecological receptors.
- The human health guidance value provided in the document is the EPA reference dose value of 0.0001 mg methyl Hg/kg body mass-day. Assuming a person is either 63 kg (Asian or Pacific Islander), 70 kg for the general population and 79-82 kg for tribal populations the consumption of methyl Hg that would still be protective on a daily basis would range from ~0.006 to 0.0082 mg methyl Hg/day. Based on the concentration of total Hg in the test organisms from the lower composite exposure (0.2 mg total Hg/kg \* 0.44 = 0.092 mg methyl Hg/kg tissue wet weight) a

consumption of between 68 and 100 g of shellfish per day would need to be consumed to exceed this guidance value, assuming all shellfish consumed were at this equivalent concentration.