U.S. Army Corps of Engineers
Seattle District

WASHINGTON STATE DEPARTMENT OF Natural Resources

SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING

MEETING MINUTES

SEPTEMBER 2009

Prepared for DMMP Agencies

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EPA United States Environmental Protection Agency REGION 10

Department of Ecology

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LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA Comprehensive Environmental Response Compensation and Liability Act
COC chemical of concern
CSL cleanup screening level
CSMP Cooperative Sediment Management Program (Washington State)
DMMO Dredged Material Management Office
DMMP Dredged Material Management Program
DNR Washington State Department of Natural Resources
EIS environmental impact statement
EPA U.S. Environmental Protection Agency
FOE Friends of the Earth
MTCA Model Toxics Control Act
NAVFAC Naval Facilities Engineering Command
NOAA National Oceanic and Atmospheric Association
NRC National Research Council
OSV ocean survey vessel
PAH polycyclic aromatic hydrocarbon
PCB polychlorinated biphenyl
ppb parts per billion
ppt parts per trillion
PSDDA Puget Sound Dredged Disposal Analysis
PSI Puget Sound Initiative
PSP Puget Sound Partnership
QA/QC quality assurance/quality control
RSET Regional Sediment Evaluation Team
SAIC Science Applications International Corporation
SEF Sediment Evaluation Framework
SEIS supplemental environmental impact statement
SIZ sediment impact zone
SMARM Sediment Management Annual Review Meeting
SMS Sediment Management Standards
SPI Sediment Profile Imagery
SQS Sediment Quality Standards
SRM standard reference materials
SVOC semi-volatile organic compounds
TEQ toxic equivalence
TMDL total maximum daily limit
TOC total organic carbon
TPAH tota l PAH
USACE United States Army Corps of Engineers
UTL upper tolerance limit
WDOE Washington State Department of Ecology
WPPA Washington Public Ports Association

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SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING MINUTES

The Cooperative Sediment Management Program (CSMP) held its annual review of dredging, disposal, and sediment management issues on May 6, 2009. Region 10 of the United States Environmental Protection Agency (EPA) hosted the 2009 Sediment Management Annual Review Meeting (SMARM), and the U.S. Army Corps of Engineers (USACE) facilitated. The meeting was held at USACE Federal Center South location in Seattle, Washington. The Dredged Material Management Program (DMMP) is an interagency cooperative program that includes USACE, Seattle District, the Environmental Protection Agency (EPA), Region 10, the Washington Department of Natural Resources (DNR), and the Washington Department of Ecology (WDOE). The public issues summary, meeting agenda, list of attendees, and the speakers' PowerPoint presentations are included as Appendices 1, 2, 3, and 4, respectively.

WELCOME AND OPENING REMARKS

Stephanie Stirling, USACE, Dredged Material Management Office (DMMO), served as the moderator for the annual review meeting. She welcomed everyone to the 21st annual SMARM meeting and requested that everyone sign in. After ensuring that everyone was seated, she introduced the first speaker, ***Stuart Cook, USACE Chief, Operations Division***.

Stuart Cook welcomed everyone to the annual review meeting and thanked all involved for setting up this conference. Mr. Cook stated that he has only been at this job since last July, having come from the Omaha District. He emphasized the importance of the DMMP within Puget Sound and stated that dredging and disposal is an important issue with far-reaching impacts. He was impressed at the size of the crowd despite a Puget Sound Partnership (PSP) meeting planned for the same day.

Stephanie Stirling returned to the podium to deal with some housekeeping issues. She thanked WDOE for providing snacks, and reminded the attendees to turn off all cell phones. She reminded everyone that the conference is being recorded to assist in recording the minutes and that everyone should state their name and affiliation when asking a question. She then introduced the panel seated at the front table:

Wayne Wagner, USACE
Jim Pendowski, WDOE
Rick Parkin, EPA
Rich Doenges, DNR
Stuart Cook, USACE

Stephanie Stirling

PP0.1 21th Sediment Management Annual Review Meeting
PP0.2 Cartoon

Rick Parkin, EPA, Office of Ecosystems, Tribal, and Public Affairs began by welcoming everyone to the meeting. He stated that it takes a lot of commitment from a lot of people to run the DMMP.

Mr. Parkin said that the DMMP has been very active since the last meeting. During the meeting today, the USACE will provide summary statistics about the year's dredging activities. The EPA will summarize cleanup activities. WDOE will summarize Puget Sound Initiative work and MTCA cleanup progress. The DNR will discuss site use authorization and fee updates. Mr. Parkin was pleased that the environmental impact statement (EIS) for the Commencement Bay disposal site had recently been released and will be available for public comment until June 8th. The Sediment Evaluation Framework, which has been in the works since 2002, is already out for public comment, and is expected to be finalized this month. He stated the last big issue to discuss today is the DMMP dioxin framework.

The DMMP dioxin/furan approach has been two years in the making. It seeks to strike a balance between maintaining a viable open water disposal program, supporting the waterfront economy, and upholding the goals of the region in protecting the health of the Puget Sound. The present proposal will be presented this afternoon with opportunities for comments.

Mr. Parkin said the DMMP has endeavored to keep the process open for the last 2 years, and although some may say this hasn't been the case, EPA continues to be committed to a process that encourages and considers stakeholder input. SMARM has always been a good place to present proposals. In the past, proposals were presented with 60 days available for public comment. This time, the DMMP will wait a couple months before the comment period to allow for a series of three dioxin meetings to occur. Each of the meetings will allow for further evaluation of the dioxin proposal.

Mr. Parkin said that he has put a lot of his own time into the DMMP dioxin/furan proposal, and knows that others have as well. Overall, he is proud of the work the staff of the DMMP agencies has done and very pleased with the progress On the dioxin guidelines.

Additionally, he pointed to the Puget Sound dioxin survey conducted last summer (2008) using the EPA's ocean survey vessel (OSV) *Bold* as a particularly successful component of the dioxin project. Not only was the dioxin/furan data collected by the Bold used in formulating the DMMP's dioxin proposal, but all of the additional chemicals of concern analyzed will be of use for other programs.

Stephanie Stirling introduced the next speaker and briefly summarized the first session of speakers.

AGENCY SUMMARY REPORTS, PART I

1. EPA—Summary of Regional CERCLA Activities, Shiela Eckman

Sheila Eckman, EPA, began by giving an update of the regional CERCLA cleanup program and a description of what happens at each site post construction/post cleanup. Her unit focuses on managing cleanup sites in Washington and Oregon. She discussed the eight current cleanup sites, which include the following: Wyckoff Eagle Harbor; Puget Sound Naval Shipyard; Old Navy Dump in Manchester, Elliott Bay, and Harbor Island; Pacific Sound Resources; Lockheed West; the Lower Duwamish; and Commencement Bay cleanup projects.

The most recent cleanup activities include Thea Foss Waterway in Commencement Bay in 2006, Lockheed Shipyard on Harbor Island in 2006, and Todd Shipyard on Harbor Island in 2007, and

Pier 24/25 of the Hylebos Problem Area in Commencement Bay in 2008. No in-water work was done in 2009, but a lot of work was done in the early part of the decade. Projects are expected to pick up again for in-water cleanup in 2011 and 2012.

Ms. Eckman gave a summary of completed cleanups and went through a list of ongoing investigations. The first draft of the feasibility study for the Lower Duwamish Waterway is available on the web. Drafts of the Portland Harbor remedial investigation and risk assessment are due this summer. Other projects are in various stages of design.

She moved on to a discussion of post-construction activities. Performance measures are a check on whether cleanup goals have been met. Monitoring is important to determine the effectiveness of the design. The construction design has to be maintained from an engineering perspective. Institutional controls on the construction/cleanup are an important part of post-monitoring. They include non-engineering controls established to protect the cap integrity. They may include navigational restrictions such as no anchoring or fish advisories if dictated by chemistry from monitoring events. Ongoing source control is also an integral part of post-monitoring, but rarely done.

The National Research Council (NRC) did a survey of monitoring at cleanup sites around the country and found that monitoring at many sites was inadequate to determine the success of a cleanup. The key to long-term monitoring is to make sure the remedy for a given site is sustainable. It should include activities such as cap maintenance, physical integrity, chemical monitoring, and modeling. Chemical monitoring for in-water cleanups should be expanded to the analysis of porewater data as well as sediment. Benthic monitoring should be conducted to make sure healthy benthic communities are being reestablished. Even sediment disposal at confined disposal sites needs to undergo post-construction monitoring.

There is a statutory requirement to do a 5-year review at any site where contaminants have been left in place.

Questions and Comments:

Question: Fred Felleman, Friends of the Earth (FOE), asked if the 5-year reviews are made available, and what sort of notice is given when they are to be conducted. He also asked if there was a comment period.

Response: Notice of the 5-year reviews are put in the paper, and sent out to the mailing list for the specific site. Comments are accepted before the review is completed. The review itself doesn't go through a public comment period because it is not a decision document.

Question: Anne Fitzpatrick, AECOM; How are you doing on the 5-year reviews?

Response: Results have varied. Some areas have been monitored for 5 to 10 years with no problems. Other areas have been found to be recontaminated right away, prior to the 5-year review. The more thorough we become with our 5-year reviews, the more we need to revisit the assumptions and management approach for some of these sites, particularly areas with groundwater contamination issues. Some institutional controls are not in place. For sediments, the largest issue revealed by the 5-year reviews is recontamination, not engineering failures.

Question: Fred Felleman, FOE; If reviews reveal inadequate cleanup, who is responsible for further work? Is lack of financial resources a factor?

Response: PRP funded sites have reopening standards if sites don't meet long-term criteria, so it is less of a problem for these areas. If there are no PRPs, the federally funded sites get put back in the line up for further investigation. Both of these routes have been carried out at sites.

Shiela Eckman

PP1.1 EPA Region 10 Superfund Sediment Cleanup Update
PP1.2 EPA Sediment Cleanup Project Updates
PP1.3 Update on Sediment Cleanup Projects continued
PP1.4 Puget Sound Superfund Sites
PP1.5 EPA Superfund Cleanup Progress in Puget Sound to Date
PP1.6 Most Recent in Water Cleanup Actions
PP1.7 Pier 24-25 Subtidal and Intertidal Capping
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PP1.22 Institutional Controls
PP1.23 Mitigation Site Monitoring and Maintenance
PP1.24 Ongoing Source Control
PP1.25 Five Year Reviews
PP1.26 Post Construction Resources
PP1.27 EPA Contacts

2. WDOE—Summary of Cleanup Activities and Proposed Changes to MTCA/SMS—Chance Asher

Chance Asher, WDOE, gave updates on cleanup work and issues identified with the Puget Sound Initiative (PSI), Bay Wide Characterizations, and rule initiatives. She began with an overview of the seven PSI sites: Port Gardner and the Snohomish River estuary, Fidalgo and Padilla Bays, Port Gamble, Budd Inlet, Port Angeles, Oakland Bay, and Dumas Bay. Each of these bays was selected for characterization because they contained critical habitat and portions of six of the bays were already undergoing cleanup work.

Ms. Asher then summarized some PSI accomplishments from the 2007 to 2009 biennium including an interim action plan at Port Gamble, and the completion of several bay-wide studies.

Over the last 3 years, WDOE received and used a lot of the money from the legislature. During 2007 through 2009, WDOE was able to add staff and fund characterizations. No additional staff or characterization funding is expected for 2009 through 2011. However, WDOE is not losing existing funds.

Ms. Asher next gave a summary of two bay-wide characterizations. Each characterization was conducted to provide a "baseline" overview of the sediment quality in each bay with the ultimate goal of setting cleanup priorities. The first bay discussed was Port Gamble. The site started small with two sites, an old mill site, and a site formerly leased from DNR for log storage. Selected dredging has occurred, resulting in removal of approximately 17,000 cubic yards of sediment containing woodwaste for beneficial upland reuse. A larger, baywide study is in process for Port Gamble that encompasses important sand lance, smelt, and herring habitat, and eelgrass and geoduck beds. The primary environmental concern at Port Gamble is historic wood waste.

The second bay-wide study discussed was Port Gardner. The study focused on the Everett area and Snohomish River estuary where several sites were identified for cleanup. For the sediment characterization, the bay was broken down into four areas, with sediment profile imaging (SPI), chemistry, and toxicity testing conducted in each. There were relatively few SMS exceedances for chemistry. Mercury, zinc, and 4-methylphenol exceeded criteria in the East Waterway. Much of the sediment sampled in the East Waterway contained wood waste and was believed to represent recent sedimentation. More contamination is suspected in deeper sediments. Dioxin was analyzed in fifteen samples, with highest levels in the East Waterway and the southern shore. Thirteen of 17 stations tested for bioassays had cleanup screening level (CSL) hits.

Ms. Asher described some updates to SMS. EPA approved the 303(d) list for sediments. The freshwater criteria under Regional Sediment Evaluation Team (RSET) are still a work in progress. WDOE is developing issue papers for SMS rule revisions with options identified for how to fix the issues. These should be publicly available later in the month. Six main issues were identified:

- **Integration**: Working on more integration between SMS and MTCA and how the rules could be harmonized. Similarities and differences between the two are a source of confusion.
- **Freshwater Criteria**: So far, there is a lack of chemical or biological criteria for freshwater sediments. There is no promulgated standard, only site specific narrative standards.
- **Other Deleterious Substances**: Chemical analysis can't catch all possible contaminants. That is why the "other deleterious substances" mentioned by SMS are an issue. For the other deleterious substances list (non standard contaminants), MTCA defers to SMS for cleanup. That connection needs to be tightened up.
- **Bioaccumulation – Human Health**: For human health, SMS has only a narrative standard. This still needs to be addressed. .
- **Bioaccumulation – Ecological Risk**: SMS criteria were promulgated to protect the benthic community from acute and chronic toxicity. They were not derived to protect higher trophic levels from the effects of bioacculative chemicals.

- **Background**: There remains an issue of how to define background concentrations. How should background be considered for cleanup sites? SMS does not address background concentrations when evaluating cleanup sites, while MTCA does.
- There is a series of technical feasibility issues that must be discussed.

WDOE hopes to have pertinent issue summaries on the web this month. Be sure to sign up for the listserv for updates.

Comments and Questions

Question: Fred Felleman, FOE; Did you sample herring or any other forage fish at Port Gamble?

Response: No

Comment: Russ McMillan, WDOE; We did collect geoduck, crab, oyster, and clam samples for tissue analysis.

Question: Fred Felleman, FOE; The most polluted orcas in the world (PCBs and other bioaccumulating chemicals) are found in the Puget Sound. Based on current bioaccumulation guidelines, orcas won't meet healthy levels for PCBs until 2063. Does this lend some public and political support towards creating bioaccumulation criteria?

Response: Yes, bioaccumulation is an issue with Puget Sound orcas. Any additional science on bioaccumulation of contaminants is helpful. However, it will take more than sediment criteria to prevent bioaccumulation in orcas, because continuing sources other than sediment are still contributing factors. These other source control issues contribute more to the problem than contaminated sediment based on bioaccumulation criteria.

Question: Lyndal Johnson, National Oceanic and Atmospheric Association (NOAA); Is there coordination between the RSET process and WDOE's work toward revised SMS criteria?

Response: We are very supportive of the RSET process, WDOE would consider the RSET numbers for promulgation if they are ready.

Question: Anne Fitzpatrick, AECOM; Using the SMS criteria to protect benthic infauna may not be protective of human health risks. Currently, we have to revert to MTCA to evaluate human health risks, and MTCA represents a comparison to background concentrations. This is a problem with urban sediment cleanups.

Response: Human risk levels may be below background concentrations. This sets up a paradigm that WDOE is working to address under the Human Health topic.

Question: Sherry Rone, Naval Facilities Engineering Command (NAVFAC) NW; How do TMDLs play into standards once sediments are listed for cleanup? Do sediment cleanups need to be evaluated for TMDLs?

Response: TMDLs are not typically evaluated for sediments, with the exception of Bellingham Bay. Sediment cleanups are often due to several contaminants present in a complex matrix. TMDLs are usually calculations for individual contaminants from point sources. Calculating TMDLs in sediment would require a lot of resources, which we do not have.

Question: Sherry Rone, NAVFAC NW; If dioxin/furan concentrations are a main issue, why not address them first when evaluating a site using the TMDLs?

Response: It would be difficult to calculate a total maximum daily limit (TMDL) for dioxin/furan congeners during a cleanup because of the multiple sources for this contaminant (such as atmospheric deposition). TMDLs are more focused on point sources such as water discharges.

Chance Asher

PP2.1 Washington State Dept. of Ecology Toxics Cleanup Program
PP2.2 Updates
PP2.3 Puget Sound Initiative
PP2.4 PSI Accomplishments
PP2.5 Aquatic and Upland PSI Resources
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PP2.7 Port Gamble Site Overview
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PP2.17 SMS Rule Revisions
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PP2.20 Examples: Setting Site Specific Criteria
PP2.21 Example: Decision making Process for Remedial Alternatives
PP2.22 Freshwater Standards Issue
PP2.23 Freshwater Standards Issue
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PP2.26 SPI Images: Vertical Profile and Plan View\
PP2.27 Bioaccumulatives: Human Health Issue
PP2.28 Bioaccumulatives: Human Health Issue
PP2.29 Bioaccumulatives Eco Risk Issue
PP2.30 Bioaccumulatives Eco Risk Issue
PP2.31 Background Issue
PP2.32 Background Issue
PP2.33 Next Steps
PP2.34 Questions?

MORNING BREAK

3. National Marine Fisheries Service—PAH Update—Lyndal Johnson

Lyndal Johnson, NOAA, discussed polycyclic aromatic hydrocarbon (PAH) sediment screening for the protection of fish. Within the sediment evaluation framework there are different ways of protecting organisms for benthic infauna, fish, wildlife, and human health.

PAHs don't fit under the bioaccumulation framework within the Sediment Evaluation Framework (SEF). Fish metabolize PAH, so you can't determine exposure. Her goal was to correlate sediment PAH concentration levels in sediments with biological effects in fish, mainly English sole. A sediment PAH concentration of 2,000 parts per billion (ppb) is considered a threshold value for where effects begin with English sole. Using similar methods, effects thresholds at concentrations of 1,950 ppb and 300 ppb were noted for starry flounder and winter flounder, respectively. Most sediment concentrations in the Puget Sound are below 2,000 ppb. Approximately 21 percent are above this 2,000 ppb, 11 percent above 5,000 ppb, and 5 percent above 10,000 ppb.

In addition to flatfish, sediment PAH levels were compared to effects on salmon eggs and embryos, though the specific PAH compounds may not match those most common in Puget Sound. Total PAHs (TPAH) have impacts on herring eggs, with evidence that the eggs take up PAH from the sediment. Lower sediment concentrations may also have impacts. Several English sole nurseries are in areas of low but measurable PAH concentrations. Ms. Johnson and NOAA are also investigating metabolites of PAH in fish bile to determine effects, rather than just correlating effects to sediment concentrations.

Doses of 2 to 6 µg/g per fish per day had impacts on juvenile salmon. Juvenile salmon consume 12-20 percent of body weight per day. What sort of PAH load might they be getting? This dietary uptake is closely associated with PAH metabolites in bile. They are investigating PAH metabolites in bile versus number of lesions on fish. PAH in the water column can also contribute to total fish loads, so diet alone isn't an indicator of fish exposure.

At most sites in Puget Sound, PAH levels are below effects levels, but some have concentrations high enough to potentially cause severe effects. All of this raises the question of how PAH should be dealt with, particularly if sediment concentrations are above the SMS criteria. It is possible to do a risk assessment of PAH at each site of concern. This is expensive to do, but may be appropriate for cleanup sites.

Some next steps are to outline a proposed framework in a white paper and to go through an internal NOAA review. The paper will be presented to RSET and hopefully reach a consensus for incorporating into SEF.

No questions were entertained due to time constraints.

Lyndal Johnson

PP3.1 PAH Sediment Screening for the Protection of Fish: A Draft Framework
PP3.2 Sediment Evaluation Framework
PP3.3 PAH SLs & TRVs for Fish: Problems and Limitations
PP3.4 Exposure Pathway/Assessment

PP3.5 SEF Sediment Evaluation Framework
PP3.6 Sediment PAH Concentration vs. Biological Effects in English Sole
PP3.7 Liver Lesions in Other Species
PP3.8 Additional Studies of PAH Concentration in Sediments vs. Biological Effects
PP3.9 Distribution of PAH Concentrations in Puget Sound Sediments
PP3.10 TPAH in Spawned Herring Eggs
PP3.11 Impacts of PAH-contaminated Sediment on Flatfish Metamorphosis
PP3.12 Exposure Pathway/Assessment
PP3.13 SEF Sediment Evaluation Framework
PP3.14 PAHs Affect Growth and Metabolism
PP3.15 Concentration in Prey?
PP3.16 PAHs in Salmon Stomach Contents (wet wt)
PP3.17 Salmon Bile Metabolism vs. PAHs in Diet
PP3.18 Dose, PHN FACs and Toxicity
PP3.19 Bile Metabolite Concentrations in Juvenile Salmon
PP3.20 PAHs in Sole Stomach Contents vs. Lesions
PP3.21 PAHs in Bile vs. Lesions
PP3.22 RSET Sediment Evaluation Framework
PP3.23 RSET Sediment Evaluation Framework
PP3.24 Next Steps

4. DNR—DNR Disposal Fee Proposal—Courtney Wasson

Courtney Wasson, DNR, stated that DNR has authority under Washington Administrative Code for fee increases to cover monitoring. The last fee increase was in 1994. DNR has tried to avoid additional increases in fees. As time went on, monitoring prices increased, making it more difficult to avoid fee increases for sediment disposal.

Around 2015, DNR disposal-site-related expenditures will exceed revenues. DNR has already tried to use cost-saving methods to avoid fee increases. In the past, 150,000 cubic yards of dredged material disposal at a site triggered a monitoring event; this amount was increased to 300,000 cubic yards. A year of monitoring was skipped at Commencement Bay due to disposal of native sediment. Taking advantage of tiered monitoring can result in a reduced need for bioaccumulation testing.

There are options to create extra funding at the disposal sites. As an example, higher fees may apply for unexpected problems such as missing the target site during disposal. Such ideas will increase fees on individual dredgers for unique situations rather than applying higher fees to the dredging community as a whole.

Still, after evaluating all options, there will be a fee increase added to the current prices of $0.45 per cubic yard within Puget Sound, and $0.10 per cubic yard at Willapa Bay. DNR has not determined the extent of the fee increase. There will be a public forum to discuss these fee increases.

Comments and Questions

Question: Brian Ross, EPA Region 9; You assumed a flat level of expenditures [in the PowerPoint slides]. How did you estimate this?

Response: Revenue was calculated by averaging disposal volumes for the last 20 years and applying that average to the current fee. There were no expenditures this summer due to the OSV *Bold* survey. Expenditures for the next few years are already planned. Future monitoring will be full monitoring events with dioxin/furan analysis.

Comment: Eric Johnson, Washington Public Ports Association (WPPA); Disposal volumes on an annual basis are variable and susceptible to large projects. I encourage DNR to sit with dredgers to get better future disposal volume estimates for more accurate revenue projections.

Comment: Courtney Wasson, DNR; We understand how variable disposal volumes are. In calculating the revenues, we did not include disposal from Commencement Bay's Blair project. If you have any disposal estimates, please share them with the DNR.

Comment: Mark Larsen, Anchor; As standards/criteria for disposal become more strict, past estimates for open water disposal may not match future disposal volumes.

Courtney Wasson

PP4.1 DMMP Disposal Fees
PP4.2 DMMP Fund Balance Projection
PP4.3 Proposed Options
PP4.4 Rulem aking

LUNCH

5. WDOE—The Bold Survey—Laura Inouye

Laura Inouye, WDOE, gave a summary of the six objectives of the OSV *Bold* survey.

Samples were collected from 70 locations throughout Puget Sound. Locations were equally distributed, excluding urban bays. A subset of 20 of these samples was collected from reference areas. The remaining 50 samples were considered main basin samples. Sampling depth had to be greater than 35 feet due to the size of the OSV *Bold*.

The first objective was the correlation of sediment chemistry to total organic carbon (TOC) and grain size. There were significant correlations between TOC and fines for some metals. None of the organic compounds were correlated to TOC or fines, possibly due to the low concentrations of organics present.

Objectives two and three were to characterize the concentrations in both the reference and main basins. Objective four was to determine if the concentrations in the two basins were significantly different. No differences between these two populations were found, even when the outliers were removed. Overall, total toxicity equivalencies (TEQ) were calculated for both dioxin/furan and polychlorinated biphenyl (PCB) congeners. PCB congener TEQs did not contribute much to the total TEQ. Dioxin/furan TEQs ranged from 0.01 to 11.6 ppt. PCB TEQs ranged from 0 to 0.168 ppt.

Objective five involved looking at other chemical of concern (COC) concentrations. These concentrations were evaluated against the SMS criteria. All metals were below Sediment Quality Standards (SQS) values. Arsenic, chromium, lead, and zinc were detected in all samples. Semi-volatile organic compounds (SVOC) concentrations were generally low. Phenol

was detected in 63 percent of samples, with ten locations above SQS. One sample was above the CSL. 4-methylphenol was detected in 50 percent of samples, with one location above the CSL. No pesticides were detected.

Objective six was the comparison of dioxin/furan assays to chemistry results. Three assays were conducted towards this purpose. More data needs to be considered across a wider range of TEQs before a final determination can be made as to whether assays are a substitute for chemistry. USACE is currently funding a study incorporating sediments from other projects.

Data summaries are currently on the DMMP website. A draft of the report is in progress.

Comments and Questions

Question: Ted Benson, WDOE; At one of the sites I worked on, there was a great deal of intrasample variability. Was intrasample variability factored in when comparing dioxin/furan concentration results?

Response: Yes it was. Five field duplicates were collected. Three were comparable for dioxin/furan concentrations. Two of them were not. Mandy Michalsen, John Wakeman, and I are working on a further evaluation of intrasample variability.

Laura Inouye

PP5.1 OSV Bold Survey: 07/31/2008 - 08/05/2008
PP5.2 OSV Bold Survey: Objectives
PP5.3 Survey Design
PP5.4 Images of Field Work
PP5.5 Objective 1: Correlations between TOC, fines and Chemical Concentrations
PP5.6 Objectives 2 & 3: Characterize Reference and Main Basin Concentrations
PP5.7 Objective 5: Other COCs
PP5.8 Objective 6: Dioxin Assays
PP5.9 For More Information…

DIOXIN ISSUE PAPER

6. Floyd/Snider—Kate Snider

Kate Snider, Floyd/Snider, gave an overview of the recent DMMP proposed revision for dioxin/furan guidelines (**Appendix 6**). The proposal was released on the web about a week ago. The proposal is not a final decision. There are still several public meetings planned for May and June to allow for comments on this process.

Her goals for the afternoon are to discuss the basis of the agencies proposal, the implementation of that proposal and its estimated impacts, and then talk about next steps and public input. The agencies have been working for 2 years to collect public input and additional data prior to developing this proposal.

This proposal only impacts Puget Sound disposal sites. There are currently five non-dispersive and three dispersive disposal sites in the Puget Sound. The non-dispersive sites are carefully monitored, and the dispersive sites are monitored by bathymetry.

The previous guidelines for dioxin stated that there should be no disposal for sediments with 2,3,7,8-TCDD exceeding 5 ppt or total TEQ exceeding 15 ppt. The DMMP developed interim guidelines in 2006, but soon decided updated guidelines were needed. The process of creating updated guidelines started with input at public meetings. The collection of the OSV *Bold* data was part of the information needed to establishing these guidelines.

Kate Snider – Includes Slides for Dave Bradley and Dave Fox

PP6.1 DMMP Proposed Revision to the Open-water Disposal Guidelines for Dioxins
PP6.2 Presentation Overview
PP6.3 Intro and Dioxin Proposal
PP6.4 Puget Sound Disposal Sites Map
PP6.5 Two Types of Disposal Sites
PP6.6 Problem Statement
PP6.7 DMMP Dioxin Project
PP6.8 Work to Date
PP6.9 DMMP Agency Proposal Development
PP6.10 Regulatory Framework
PP6.11 Open Water Disposal Sites Two-Tier Decision-making Framework
PP6.12 Risk Management Choices that Shaped the Proposal
PP6.13 Risk Considerations
PP6.14 Consideration of Background Levels
PP6.15 Sediment Impact Zones
PP6.16 What Concentrations Represent Background?
PP6.17 Background Stations Map
PP6.18 Derivation of Background Concentration
PP6.19 The DMMP Agency Proposal
PP6.20 The DMMP Agency Proposal
PP6.21 Existing Dioxin Sediment Concentrations in Puget Sound
PP6.22 Evaluation Relative to Other Options
PP6.23 Benefits of Proposed Dioxin Guidelines
PP6.24 Implementation of Proposal
PP6.25 Comparisons of Suitability Guidelines – Pass/Fail Impact
PP6.26 Comparisons of Suitability Guidelines – Number of Projects Impacted
PP6.27 Increased Testing for Dioxins
PP6.28 Increased Cost Associated with Disposal
PP6.29 Geographic Limitations and Applicability to other COCs
PP6.30 Next Steps and Opportunities for Additional Input
PP6.31 Next Steps and Opportunity for Additional Input

7. WDOE—Dave Bradley

Dave Bradley, WDOE, gave a brief history of his role in the dioxin/furan proposal with emphasis on his role in regulatory and risk management. In terms of the regulatory framework, the Puget Sound Dredged Disposal Analysis (PSDDA) and DMMP guidelines are integral. PSDDA/DMMP guidelines were developed in 1988 and have undergone several updates since. The SMS rule was created in 1991 and has not been updated. The DMMP guidelines have fairly detailed information applying to benthic toxicity. There is less information in terms of human

health. The SMS rule has a narrative standard in terms of human health risk. The proposal is centered on the interpretation of that narrative standard.

The SMS criteria are based on a two tiered system, with the lowest tier (SQS) based on no adverse effects for benthic toxicity and no significant human health risks. The upper tier (CSL or sediment impact zone (SIZ) maximum) is based on minor biological effects and no significant human health risks.

Several risk management considerations have shaped the new dioxin/furan proposal. Two important considerations were: 1) Who are we trying to protect? 2) What is an acceptable level of exposure? There are risks for the general population as well as for people who consume large amounts of fish. Another question is: What level of protection should be provided? A one-in-a-million cancer risk level is consistent with federally approved water quality standards, as well as state cleanup and other programs.

Determining the background level was an important part of the proposal. The risk based value determined was below background concentrations, so background was used for the dioxin/furan guideline.

In creating the new proposal, the agencies did not pursue an action requiring a sediment impact zone (SIZ) out of concern that the benefits of using an SIZ would not be greater than the concerns of implementing an SIZ.

8. USACE—David Fox

David Fox, USACE, began by defining what constitutes background concentrations. Data from other sediment surveys were combined with data collected during the OSV *Bold* survey, including 13 locations from the Anderson Ketron disposal site, and 14 reference locations from other surveys. All stations were combined into one dataset since no significant differences were found between the reference and main basin stations. The upper tolerance limit (UTL) of this data set was used to determine background. The UTL is the upper 90 percent confidence interval on the 90th percentile. For the combined data set, the TEQ for the UTL is 4 ppt. Anything less than this would result in failures for several stations at background concentrations. A technical memo on the DMMO website shows the derivations of this UTL.

The DMMP agency proposals are based on insuring disposed sediment levels will not be greater than existing levels throughout the main basin and reference areas of Puget Sound. The goal was to establish a target disposal concentration for all sites at a level equal to the UTL. For dispersive sites, no DMMU can have a concentration greater than 4 ppt. For non-dispersive sites, the volume weighted average concentration between all DMMUs cannot exceed 4 ppt, while concentrations in individual DMMUs can range upward to 10 ppt. This 10 ppt guideline was based on dioxin data from large urban bay surveys.

The proposal was evaluated relative to other options and represented a balancing of objectives. Some of the benefits are that the new proposal is more protective of subsistence consumers, it would improve the health of Puget Sound, and it would maintain the viability of open water disposal. The proposal was developed to ensure regulatory guidance, consistency, and optimizing the protection of human health and waterfront economies.

Along with the proposal, updated reason-to-believe guidelines for the presence of dioxin/furan contamination will result in increased testing of dioxin/furan congeners in DMMUs in urban

areas. Since the March meeting, several people have asked for a test-out option using bioaccumulation testing. Agencies are evaluating whether to include a test-out option.

To estimate the impact from the implementation of the proposal, the proposed guidelines were compared against dioxin/furan data collected for previous sampling efforts. Under the former guidelines of 15 ppt, 18 percent of DMMUs would fail. Under the proposed guidelines, 22 percent of these DMMUs would have failed. Small projects and those that rely on dispersive sites would be more heavily impacted. More details can be found in the issue paper. The reason to believe guidelines will result in more testing. Over the past 21 years, 10 percent of DMMUs were tested for dioxins. In the past 3 years, 38 percent of DMMU's were tested. In the future, 55 percent are expected to be tested for dioxins.

There is likely to be an increased cost associated with disposal. The cost range for upland disposal is $30 to $122 per cubic yard. If an additional 12 percent of volume would have to be disposed of upland, this could result in extra costs of $5,000,000 to $20,000,000.

Though the current proposal is limited to dioxin, it could have implications for PCBs as well. The proposed guidelines are limited to Puget Sound. Other areas will have to be addressed separately.

Kate Snider returned to recap the Dioxin Issue Paper. The agencies feel as though the interim guidelines need to be superseded with a new framework. She reminded everyone that this is a proposal, not a decision. Stakeholder input and dialog is encouraged. Public meetings are scheduled for May 18, May 28, and June 3, 2009. After the meetings, the agencies will decide how to proceed and will presumably submit an updated proposal. All updates to the proposal can be found on the dioxin project website under DMMO. She then asked for input from attendees on how to organize the May and June meeting agendas.

Comments and Questions

Question: Tad Deshler, Windward; At the March meeting, risk estimates specific to each disposal site were discussed as a possibility for developing the proposal. Today, only background risk estimates were discussed. Why?

Response: Erika Hoffman, EPA; We could only implement guidelines based on site specific risks if the disposal sites were identified as Sediment Impact Zones (SIZs). The current agency proposal does not include SIZ designation and thus work on site-specific risks is on the back burner. The concept didn't go away, just the priority of getting the site specific risks calculated.

Comment: Dave Bradley, WDOE; SMS standards are not site-specific either. There is still value in discussing the risk frameworks at the upcoming meetings.

Question: Carl Kassebaum, AECOM; A risk of 10^{-6} is assumed for salmon and nearshore fish. Is the fishery over the disposal site different? Have depth considerations been taken into account at the disposal sites? Are there different fish out there? If less dredging is done if this proposal is instituted, will nearshore risk increase?

Response: Dave Bradley, WDOE; There is a risk tradeoff, and these issues have only been looked at qualitatively. A quantitative risk assessment has not been done taking these factors into consideration. Any information is welcome.

Comment: Erika Hoffman, EPA; For the Puget Sound wide background risk calculations that we are presenting here, it was appropriate to use different kinds of seafood found throughout Puget Sound (rather than species specific to any given disposal site). This was a forward risk calculation for several different consumer groups. Also, regarding the question of whether leaving nearshore sediment in place would increase risk, it's important to remember that dioxin is a largely a legacy contaminant brought to the surface by dredging. Thus, dredging and disposal would likely make dioxins more bioavailable in both the nearshore environment and at the disposal site.

Comment: Kate Snider, Floyd/Snider; This is a great set of issues to discuss at the public meetings, but we need to move on today.

Comment: Wayne Wagner, USACE; When presenting the proposal, append it to explain the work that went into it and how it was done, rather than just focusing on the numbers themselves.

Comment: Fred Felleman, FOE; Try to get a broader section of the public at these meetings to provide input. Perhaps this could be done by expanding the mailing list.

PUBLIC ISSUE PAPERS, PART I

9. Anchor QEA, Puget Sound Dioxin Data Review and Implications for DMMP Policy—Mark Larsen

Mark Larsen presented some of the history of dioxin/furan and PCB contamination in Puget Sound. Both dioxins and PCB congeners were discussed on the assumption that the proposal may be expanded to include both. Both are legacy contaminants, and we are mostly dealing with residual non-point source effects. His goal is to discuss three main topics; the first is net effects, the second is biota use, and the third is site management.

Concentrations of both contaminants are declining in sediments and the food chain. Deposition rates and loadings of PCBs and dioxins peaked in the 1960s through the 1980s, and have been in decline since then. EPA estimates that between 1987 and 2000, source loadings dropped about 89 percent. Declines in sediments are matched by declines in the food chain as seen in data for Dungeness crabs, seals, and herons. This decrease in loadings is due to a decrease in point source effects.

In deeper portions of Puget Sound, deposition of clean sediment has led to lower surface concentrations over time. Further improvements to this declining trend in nearshore sediments require source control from multiple sources. Currents, upland erosion, nearshore development, and vessel activities can all be responsible for resuspending dioxin and PCB contaminated sediments. In short, nearshore systems are more complex compared to the simpler deep water systems. Proper sediment disposal can result in a net environmental benefit.

Mr. Larsen then moved on to discuss the types of fish using the disposal sites. These sites were chosen because of the depth, and because they are infrequently used by seafood species such as English sole and Dungeness crab. The disposal sites are frequented by dogfish and ratfish. Even seafood species that might use the site have a much larger home range, of which the disposal sites only make up a small percentage. The disposal target zone would only take up about 2.5 percent of the 10 square kilometer home range of a Dungeness crab. The infrequent usage by

crabs indicates dredged material placed at the disposal site would have little potential for uptake into crab tissue. The human health risk due to nearshore sediment disposal at these sites is reduced due to infrequent usage by biota.

Lastly, the TEQs measured by monitoring events indicate fairly low average TEQs at the disposal sites. In the past, sediments with much higher TEQs would have been disposed of at the sites. We are underestimating the degree at which limited amounts of higher concentration sediment can be homogenized on site.

Comments and Questions

Question: Teresa Michelsen, Avocet; When you show average dioxin/furan concentrations for the disposal sites, do you realize that they just include the perimeter and not the onsite data?

Comment: Erika Hoffman, EPA; (Agrees) The data shown here is from off-site/perimeter.

Comment: Erika Hoffman, EPA; Disposal sites would be a larger percentage of the crab's home range (up to 12 percent) if the full disposal site area were used instead of just the target zone area.

Response: Mark Larson, Yes, the numbers I used are for the presentation. I encourage you to run the calculations yourself.

Question: Dave Bradley, WDOE; Are you suggesting that 10 ppt may be too conservative of a standard to use as a maximum DMMU concentration for sediment disposal?

Response: It is worthy of further investigation.

Mark Larsen

PP9.1 Dioxin/Furan Data Review & Implications for DMMP Policy Update
PP9.2 Overview
PP9.3 Overview
PP9.4 Dioxin Status
PP9.5 Status of Source Control in U.S.
PP9.6 Source Control – B.C. Pulp Mills
PP9.7 Source Control – EU Monitoring
PP9.8 Reductions in Human Exposure
PP9.9 Puget Sound Monitoring Data
PP9.10 Declines Observed in Puget Sound Crab Tissue Monitoring
PP9.11 Marine Bird Monitoring – Georgia Straits
PP9.12 Puget Sound Seal Monitoring - PCBs
PP9.13 Puget Sound Seal Monitoring - Dioxins
PP9.14 Puget Sound Orca Monitoring
PP9.15 Restoration of Deep-Water Sediments in Puget Sound
PP9.16 Natural Sedimentation in Deep Basins
PP9.17 Natural Recovery of Sediment Quality
PP9.18 Further Improvement Requires Continued Reductions in Nearshore Environments
PP9.19 1. The Original DMMP Helps Reduce Puget Sound Food Chain Exposures
PP9.20 Safety Factors Were Incorporated Into the Design of DMMP
PP9.21 Site Locations

PP9.22 Site Locations
PP9.23 Sites Are Small Relative to Home Range
PP9.24 Sites Are Small Relative to Home Range
PP9.25 Sites Located in Deep Water Further Isolated from Food Chain
PP9.26 Limited Crab Use of Deep-Water Areas
PP9.27 Limited Crab Use of Deep-Water Areas
PP9.28 Deep-Water Locations Minimize Potential Food Chain Exposures
PP9.29 Biological Factors Isolate DMMP Sites & Enhance Program Safety
PP9.30 Biological Factors (Cont'd)
PP9.31 Biological Factors (Cont'd)
PP9.32 Biological Factors - Corollary
PP9.33 3. Physical Factors Provide Additional Protection
PP9.34 Active Site Management
PP9.35 Recent Monitoring: 20 Years of Use Managing Urban Bay Sediments
PP9.36 Implications for Poly Update Based on the Data
PP9.37 Concerns if Data are Ignored
PP9.38 References Cited
PP9.39 References Cited (Cont'd)
PP9.40 References Cited (Cont'd)
PP9.41 References Cited (Cont'd)
PP9.42 References Cited (Cont'd)

10. WPPA—Proposal to Reconsider Proposed Changes to the Open-Water Disposal Guidelines for Dioxins in Dredged Material—Eric Johnson

Eric Johnson started by saying the WPPA is not happy with the proposed guidelines. He believes they represent a deviation from the original goals of the DMMP which were to create predictable and cost effective means of sediment disposal. The DMMP was also designed to be environmentally protective and stand up to external criticism. The current dioxin/furan proposal is a shift away from disposal for navigational dredging and a move toward environmental cleanup. We need to better define the goals, because the proposal represents a significant change in policy that was established over the last 20 years.

Mr. Johnson said we backed into the interim policy too fast without fully evaluating it. The guidelines result in a policy of dealing with sediment differently in areas being dredged versus those not being dredged. So much of the work leading up to the proposal seemed to occur without adequate policy discussions. For example, when did we decide to treat open water disposal sites like they were reference sites?

When this program was set up 20 years ago, there were three basic questions asked in reference to dredged material: Is the material clean? Where will you dispose of it? How will it be managed over time? There was a workgroup set up for each of these questions, and parts of these questions are still being worked out. This meeting is part of an annual process dealing with question number three. Altogether, the DMMP has solved many issues dealing with sediment disposal by discussing problems in a transparent manner. Mr. Johnson does not believe that is the case today with the dioxin proposal.

Even though this process has been going on for a while, more time is needed to evaluate the dioxin/furan proposal. A few workshops in the summer will not solve this and associated issues. The cost to move this material upland is so high, up to ten times higher. This is coming at a time when the state legislature has taken money away from support of these projects. The source of revenue that local governments could use to fund these projects is gone.

In short, the DMMP has been a successful program, but the ports believe we need to slow down.

Questions and Comments

Question: John Wakeman, USACE; You say this is a major programmatic change, but what should be done with the background risk is above acceptable levels? That case arose with arsenic as well. In that instance, instead of having a threshold level, the reference standard was referenced to a reference bay.

Response: Correct. One of the advantages with arsenic is that we had the opportunity to do biological testing to ensure the standard would be protective.

Question: Jim Pendowski, WDOE; What do you propose to do to bring the process back to what it was 20 years ago? What do you propose to use for a dioxin/furan standard in the interim time period if you want the current proposal timeline extended?

Response: We need confidence that all issues are dealt with. I'm not trying to drag this out for no reason. Washington has cleanup and sediment standards that don't agree with each other very well; measuring human health versus ecological health. When DMMP was set up, these two standards had to be combined in a way that would allow for open water disposal.

In short, I hope the process doesn't take too long. In the meantime, we should use the interim dioxin/furan standard.

It was announced that Jeff Davis of the International Longshore and Warehouse Union couldn't make it. He will submit an issue paper later.

AFTERNOON BREAK

PUBLIC ISSUE PAPERS, PART II

11. Working Waterfront Coalition—Waterfront Business Perspective—Patrick Jones

Patrick Jones represents small businesses along the waterfront that require dredging and use of the disposal sites. These businesses do believe that there is an environmental benefit to disposal at open-water sites. They also believe there are community and economic benefits to open-water disposal, and a negative economic burden to upland disposal.

Previous presentations have stated that only a few projects in the future will be prevented from open-water disposal by the new proposal. A similar study sponsored by the waterfront

businesses found the opposite result; that a significant amount of material would have to go upland for disposal.

Mr. Jones gave some examples of projects in Bellingham that would be impacted by this proposal. These projects will not be able to afford the additional costs of upland disposal, and will not be able to remain in business as the waterways silt up. The difference in cost between open water disposal and upland disposal for one project is more than the entirety of stimulus funding received for Whatcom County. Those businesses, without some sort of assistance for dredging projects, will be put out of work. Loss of these businesses is a loss to the community in terms of lost jobs and recreational opportunities.

This proposal is coming at a really bad time in terms of economic impacts.

Mr. Jones wants to make clear that this is an economic development policy in addition to an environmental and dredging policy. Please don't create new rules that don't have an economically feasible alternative.

12. Stoel-Rives—Waterfront Business Perspective—Tom Newlon

Tom Newlon expanded on what Patrick Jones said in his presentation. He also echoed a previous question wondering why each site cannot be evaluated independently as SIZs. He asked: Are these dredging projects a benefit to the environment? This issue is reminiscent of the brownfields debate. At that time there was significant debate on how to initiate that program. The choice was to work closely with economic development to assist in cleanup. With MTCA, more brownfields have been cleaned up as a result of economic redevelopment at the site rather than for the sake of cleanup.

13. Port of Bellingham—Recommendations for a Dioxin Pilot Study—Mike Stoner

Mike Stoner praised the work done by the DMMP to date, and wants to make sure the program is viable into the future. The program cannot be easily stopped for policy development. For this reason, he proposed carrying out a pilot study on the disposal of dioxins prior to implementing the new dioxin/furan guidelines. A pilot program would give license to experiment and do some creative thinking in terms of the proposed guideline without disrupting all of the DMMP processes.

Mr. Stoner explained the DMMP in terms of its regulatory beauty, and how sound science within the DMMP is key to regulatory decisions.

Science is a crucial part of developing public policy such as this proposal. The OSV *Bold* survey has provided a look at dioxin concentrations in non-impacted areas of Puget Sound. As useful as this data is, more is still needed to evaluate the science of the proposal. We need a better idea of what the uptake from the sediment to the biota really is, rather than relying on assumptions. This is especially true when dealing with trace levels of dioxin. Also, what sort of fishing occurs at these sites? We can't apply the same answer for each site because each one is uniquely located. A one-size-fits-all program cannot be applied for disposal when so much work went into making sure these locations were uniquely located.

The pilot proposal involves setting up a technical working group and looking at historical data sets. We know that the dioxin/furan concentrations that originally were disposed of at these sites were much higher than the Puget Sound background, yet current concentrations at the sites are not that much above background. We also need to evaluate who is actually using these sites.

As part of the pilot study, different sites (test and control) could be set up for different interim usages and disposal criteria. Some sites would receive sediment that has higher concentrations of dioxin/furan concentration relative to the other sites. Disposal concentrations would vary between all sites and monitoring efforts would evaluate the state of these disposal sites relative to background.

If the existing proposal were initiated, a lot of projects in Bellingham wouldn't happen. Dioxins would be left in nearshore areas and we would lose some of the environmental and human health benefits of the dredged material disposal program.

A pilot study of this sort would have to happen over a period of time, perhaps two to three dredging seasons. In the meantime, dredging shouldn't stop. Interim guidelines would have to be implemented through the duration of the pilot study.

Mike Stoner

PP10.1 DMMP Pilot Program Proposal
PP10.2 Importance of DMMP Program
PP10.3 DMMP Guiding Principles
PP10.4 Regulatory Beauty
PP10.5 Sound Science
PP10.6 Pilot Proposal Framework
PP10.7 Technical Data Approach
PP10.8 Pilot Program Tasks
PP10.9 Moving Forward

Questions and Comments

Questions: Teresa Michelsen, Avocet; What would we learn from a pilot study over a span of 2 to 3 years? There is already so much variability in dredging disposal. When you propose the pilot study, address exactly what we would learn. Would it be better to look at less variable factors like crab usage of disposal sites?

Response: There has been a lot of usage of the disposal sites without obvious changes to the site. We could set up the program to only allow for dioxin/furan sediment disposal at certain sites, using some sites as a control. This would create a higher degree of variability at the sites, allowing us to better see a difference in site management.

Comment: Tad Deshler, Windward Environmental; These seafood risks are 70 year risks for cancer. If this pilot study were carried out and concentrations did increase, there would still be plenty of time to correct for the higher concentrations and set a better policy within the 70 year timeframe.

Comment: Erika Hoffman, EPA; While the DMMP's guidelines for other COC were based on best available information, these are heavily weighted towards effects on benthic communities, and not on higher trophic level communities and health health. We don't know how disposed

sediment interacts with the food chain. This proposal is getting at something that has not been well studied.

Comment: Mike Stoner, Port of Bellingham; We need to look at the new dioxin level and evaluate it with current studies. We need to tell the community what the risks are and how to respond to it.

Comment: Dave Bradley, WDOE; We've driven numbers down so low; how do we deal with uncertainty? It seems that we've addressed this uncertainty with conservative assumptions. Perhaps with time we need to make sure this assumption works out.

Comment: Mike Stoner, Port of Bellingham; We need standards that assure we are protective, but not unreliable. This is difficult to do with human health risk assessments.

Comment: Larry Dunn, Lower Elwha Klallam Tribe; Some people have no choice other than to eat fish directly from Bellingham Bay, especially for subsistence fishers. You can't just tell people not to eat fish; there needs to be a better solution.

Mr. Dunn has heard a lot of talk about how this proposal represents a partnership between all parties, but it isn't. The DMMP are the regulators, the rest are the users being regulated, and these groups are not necessarily going to work together.

All of the government agencies that manage these sites have responsibilities to the welfare of the public, and are also responsible for treaties signed in the 1850s. Much of the focus on the pilot study from the port seems to be about economics. The port also has responsibilities towards the public, and should not just discuss economics.

Comment: Mike Stoner, Port of Bellingham; You are correct, and it is not our intent to only discuss economic issues. We need more information to address human health risks. How much fishing occurs in 300 feet of water at the disposal sites as opposed to the nearshore locations?

Comment: Larry Dunn, LEKT; Crabs wander in and out of nearshore and disposal sites without knowledge of disposal site boundaries. EPA, USACE, and WDOE are trying to come up with a reasonable proposal, and I think the ports have some responsibility in this as well.

14. EcoChem—Clarification of SRM Analysis and Validation Requirements—Ann Bailey

Ann Bailey covered some of the quality assurance/quality control criteria necessary for analyzing dioxin/furan congeners. She reminded everyone about the trace nature of the dioxin furan analysis, and how this whole discussion is based on parts per trillion levels.

For quality assurance/quality control (QA/QC) checks, dioxins have ongoing precision and recovery standards, and each congener is spiked with isotopically labeled standard spiked. Field duplicates are optional, and represent a measure of precision. Standard reference materials (SRM) represent an extra check of laboratory accuracy. An excellent choice for an SRM is NIST SRM 1944 from New Jersey. This sample contains several analytes in addition to dioxin/furan congeners.

The current DMMP guidance states that SRM are optional. If an SRM is not analyzed, a full validation (QA2 or Stage 4) of the data is required. If analyzed, it is assumed that if the SRM is within all control limits, then full validation is not necessary. However, if the SRM fails, no

amount of validation will improve the quality of the data. It is very important to talk with the analytical laboratory prior to analysis to make sure they have the proper criteria and expertise to evaluate the SRM. If the criteria are not met by the laboratory, they should reanalyze the SRM and associated samples to ensure data quality.

An SRM should not serve as a substitute for full validation, and all data should undergo more than a QA1 validation to make sure EMPC (estimated maximum potential concentration) qualified data are treated correctly. EMPC data are reported at an estimated concentration, but did not meet all of the quantitative requirements. These data are frequently qualified as non-detects in a full validation. Inconsistent treatment of these EMPC values between projects will result in inconsistent calculations for TEQ.

Ann Bailey

PP11.1 Dioxin Data - Clarification of SRM Analysis and Validation Requirements
PP11.2 Batch Quality Control
PP11.3 Reference Material
PP11.4 Reference Material
PP11.5 Recommend
PP11.6 Important All Dioxin Data be Validated
PP11.7 All Dioxin Data Receive QA2 Validation
PP11.8 Measurament results can only be credible as some degree of consistency is attained.

Questions and Comments

Question: John Hicks, USACE; Is there an advantage to using an SRM for analysis other than dioxins?

Response: Yes. There is an extra cost associate with running an SRM, but having them run as an extra check on QA/QC can save the money and time that would be lost by moving forward with bad data.

AGENCY SUMMARY REPORTS, PART II

15. USACE—Summary of DMMP Testing Activities—Lauran Warner

Lauran Warner gave a brief summary of the big themes of 2009 and the activities of the DMMP. The DMMP evaluates the suitability of dredged material for open water disposal. In doing so, they complete suitability determinations, recency extensions, exclusion from testing, volume revisions, and anti-degradation determinations. Ms. Warner presented the volumes of dredged material sent to disposal sites in 2009. Nearly 4 million cubic yards of material have been disposed of, with around 4.4 percent going upland. Most of the sediment deemed unsuitable for open water disposal came from Blair Waterway in Tacoma. Biological testing was conducted on two projects, and only one DMMU failed. O&M projects are in the pipeline for the Duwamish, the Snohomish River, and Grays Harbor as well as some projects near Anacortes.

Ms. Warner then reviewed some of the information that is available on the USACE website, and where to find it.

Lauran Warner

PP12.1 Dredging Year 2009 DMMP Activity Summary
PP12.2 Big Themes of 2009
PP12.3 What DMMP Does
PP12.4 DMMP Actions
PP12.5 Dredging Year 2009 June 16, 2008 – June 15, 2009 Completed Projects
PP12.6 Dredging Year 2009
PP12.7 Project Volumes
PP12.8 Suitability Determinations in DY09
PP12.9 Total Volumes by Project Location
PP12.10 Unsuitable Volumes by Project Location
PP12.11 Biological Testing
PP12.12 In The Pipeline
PP12.13 Image of USACE Homepage
PP12.14 For More DMMP Information

16. USACE Portland District—RSET Summary of Activities—Marci Cook

Marci Cook gave an update on RSET. The SEF update has received 15 comment letters from several stakeholders. A review of the comments was presented in the slides and should be available on the Portland District website by the end of the month. Some of the major comments included concerns that SEF is replacing PSDDA (it is not), questions about the bioaccumulation section, and concerns about transparency, accountability, and predictability.

Ms. Cook discussed the status of the freshwater criteria. Oregon DEQ and WDOE are currently working on them and anticipate having public meetings this summer. If RSET accepts the numbers, the SEF will be updated via the website.

RSET will continue to work with stakeholders on SEF improvements, and will hold an annual meeting, similar to SMARM, in Portland, OR.

Marci Cook

PP13.1 Regional Sediment Evaluation Team and Sediment Evaluation Framework Update for SMARM 2009
PP13.2 RSET Update
PP13.3 SEF Update
PP13.4 SEF Update Overall Concerns from Comment Letters
PP13.5 SEF Update Freshwater Sediment Quality Guidelines
PP13.6 What's Next for RSET and SEF?
PP13.7 Questions?

17. USACE—Commencement Bay Site NEPA/SEPA Review Status—David Kendall

David Kendall gave updates on the Commencement Bay disposal site supplemental environmental impact statement (SEIS). The draft SEIS is available for comment. A copy is available on the website or through Steve Martin, USACE, or Courtney Wasson, DNR.

The disposal site is approaching its 9 million cubic yard capacity, and is one of the most monitored sites in the country, and is the most heavily used DMMP site in Puget Sound. Future development in Commencement Bay indicates strong continued need for disposal at the site. The SEIS evaluates cumulative site volumes up to 23 million cubic yards (mcy). Three alternatives for continued disposal were evaluated in the SEIS, with the preferred alternative increasing disposal up to a cumulative volume of 23 million cubic yeards, and implementing coordinate shifts within the existing target area every 5 mcy (e.g., DMMP implemented a provisional coordinate shift in 2007 565 ft SE of the site center coordinates at ~8 mcy, and will shift coordinates 565 ft to SW after ~13 mcy, and 565 ft to NE after ~18 mcy) to effectively manage mound height growth. The DMMP agencies used Multi-Dump-Fate Modeling forecasts to evaluate future mound height relative to the two action alternatives evaluated in the SEIS. This evaluation predicts a greatly flattened disposal mound with regular coordinate shifts.

Postscript: The Final SEIS availability was filed in the Federal Register on August 17, 2009. The 30 day "Wait Period" was concluded on September 14, 2009, with one additional public comment letter from EPA. The Corps and EPA are preparing a Record of Decision Amendment which will be signed by the Corps and EPA. The SEPA process will then commence and is expected to be concluded by the end of 2009. The Final SEIS is available on the Corps website: http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=DMMO&pagename=CB_SEIS

David Kendall

PP14.1 Commencement Bay Draft Supplemental Environmental Impact Statement
PP14.2 Purpose of the Update
PP14.3 SEIS Schedule
PP14.4 SEIS Schedule (Cont'd)
PP14.5 Docum ent Availability
PP14.6 Key Draft SEIS Content
PP14.7 Need
PP14.8 Cum ulative Disposal Volume
PP14.9 Selected Alternatives (analyzed in depth)
PP14.10 Mound Height Management
PP14.11 Mound Height Management Relative to Alternatives
PP14.12 Disposal Mound Images
PP14.13 DMMP's Management of the Site

Questions and Comments

Comment: Courtney Wasson, DNR; The SEIS is only available in CD form, not hard copy, but can also be accessed from Corps website (see website address above).

SUMMARY AND CLOSING

Stephanie Stirling ended the meeting by making a request for all issue papers, and stating that the public comment period for these papers has been extended to 60 days.

PP15.1 Public Comment Period for SMARM (30 days); Public Comment Period for Dioxin Issue Paper Evaluation (60 days)

MEETING ADJOURNED

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APPENDIX 1
MEETING AGENDA

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2009 SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING
AGENDA
May 6, 2009
Federal Center South, Seattle
Hosted by the US Environmental Protection Agency

8:30 Registration and Coffee

9:00 Welcome - Stuart Cook, Chief, Operations Division, Seattle District

9:10 Meeting Road Map - Stephanie Stirling, Moderator

9:15 Opening Remarks - Rick Parkin, Acting Office Director, Environmental, Tribal and Public Affairs, US Environmental Protection Agency

9:30 Agency Summary Reports, Part I

- EPA, Summary of Regional CERCLA Activities, Sheila Eckman
- Ecology, Summary of Clean-up Activities and Proposed Changes to MTCA/SMS - Chance Asher

10:30 BREAK

10:50 PAH Update - Lyndal Johnson, National Marine Fisheries Service

11:10 Issue Paper - DNR Disposal Fee Proposal - Courtney Wasson, DNR

11:30 LUNCH

12:15 Dioxin Update

- The BOLD Survey - Laura Inouye, Ecology
- Dioxin Issue Paper - Dave Bradley, Ecology; Dave Fox, Corps; Kate Snider, Floyd|Snider

1:30 Public Issue Papers, Part I

- Puget Sound Dioxin Data Review and Implications for DMMP Policy - Mark Larsen, Anchor QEA
- Proposal to Reconsider Proposed Changes to the Open-Water Disposal Guidelines for Dioxins in Dredged Material - Eric Johnson, Washington Public Ports Association
- The Impact of the Dioxin Proposal on Maritime Trade - Jeff Davis, International Longshore and Warehouse Union

SMARM agenda (continued)

2:10 BREAK

2:20 Public Issue Papers, Part II

- Waterfront Business Perspective - Patrick Jones, Working Waterfront Coalition; Tom Newlon, Stoel-Rives
- Recommendations for a Dioxin Pilot Study - Mike Stoner, Port of Bellingham
- Dioxin Data - Clarification of SRM Analysis and Validation Requirements - Ann Bailey, EcoChem

3:00 Agency Summary Reports, Part II

- Corps, Summary of DMMP Testing Activities, Lauran Warner
- RSET Summary of Activities, Marci Cook, Portland District

3:30 Commencement Bay Site NEPA/SEPA Review Status - David Kendall and Courtney Wasson

3:50 Summary and Closing

APPENDIX 2

LIST OF ATTENDEES

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APPENDIX 3

POWERPOINT SLIDES FOR EACH SPEAKER

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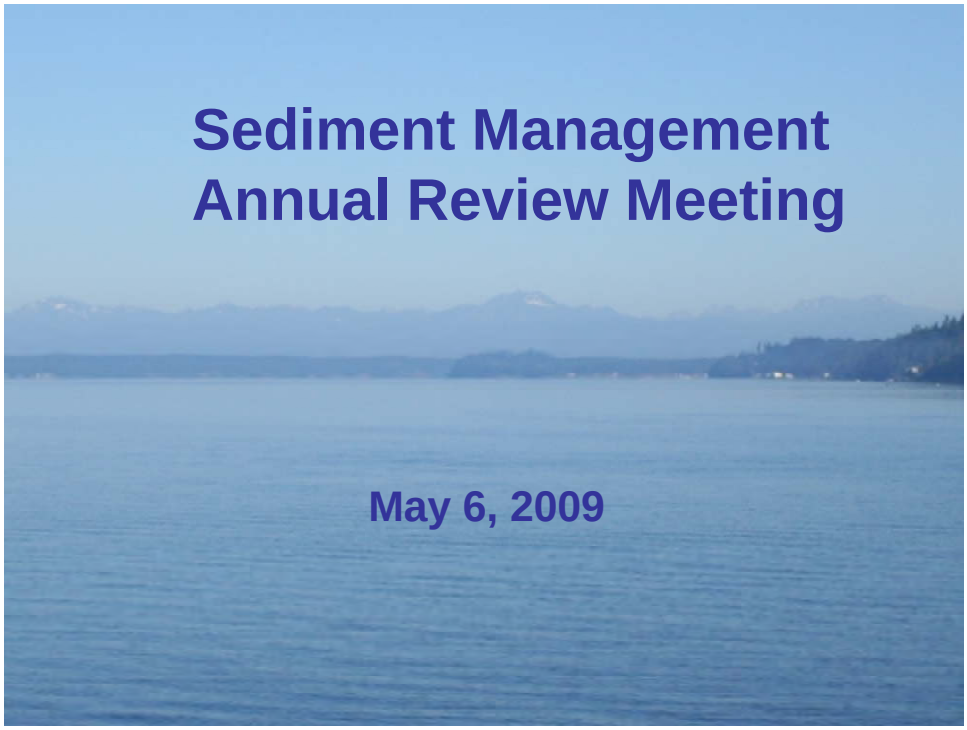

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EPA Region 10 Superfund Sediment Cleanup Update

Sediment Management Annual Review Meeting
May 6, 2009

Sheila Eckman, Unit Manager
Office of Environmental Cleanup
EPA Region 10

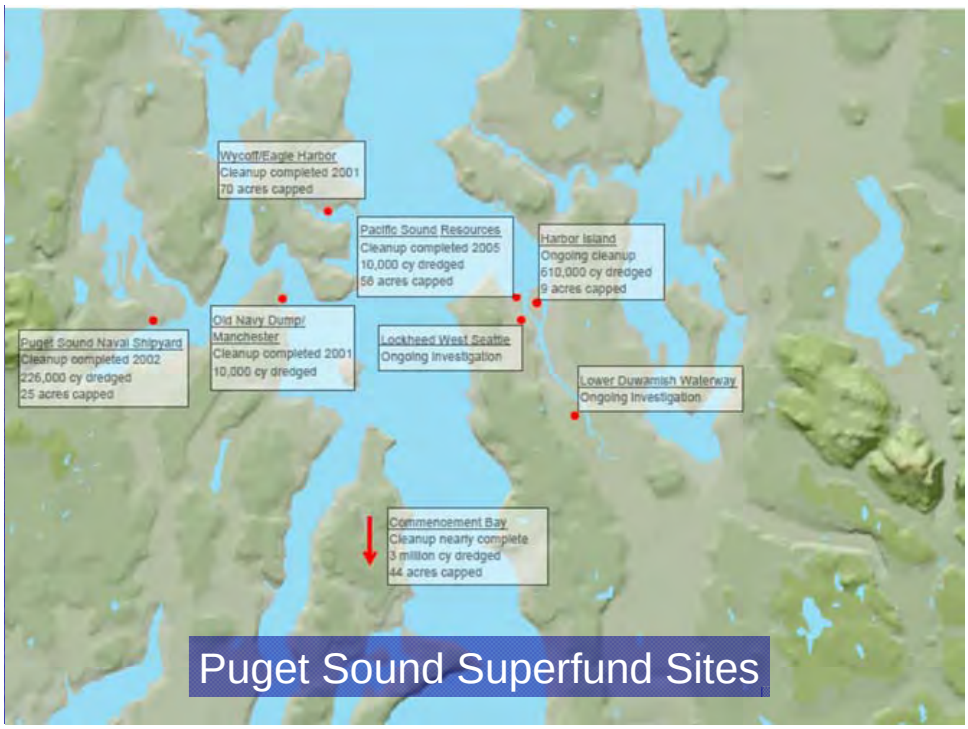
1.1

- EPA Sediment Cleanup Project Updates
- Life after Dredging and Capping

1.2

Update on Sediment Cleanup Projects

1.3



1.4

EPA Superfund Cleanup Progress in Puget Sound to Date

- 728 acres of contaminated sediment cleanup.
- 3.8 million cubic yards of contaminated sediment removed.
- 11,315+ pilings removed.
- 28,260 tons of debris removed.
- 223 acres capped.
- 22 acres of enhanced natural recovery.
- 77+ acres of habitat mitigation.

1.5

Most Recent In Water Cleanup Actions

- 2006: Thea Foss Waterway (Commencement Bay) and Lockheed Shipyard (Harbor Island)
- 2007: Todd Shipyard (Harbor Island)

1.6

- 2008: Pier 24-25 subtidal and intertidal capping (Hylebos Problem Area, Commencement Bay)

1.7

Ongoing Investigation/Design Work

- Hylebos/Occidental (Commencement Bay) – Site Characterization completion and evaluation of alternatives.
- East Waterway (Harbor Island) – Supplemental Investigation.
- Lockheed West Seattle – Remedial Investigation/Feasibility Study.
- T-117 Early Action (Lower Duwamish) – cleanup decision in 2009.

1.8

Ongoing Investigation and Design Work

- Lower Duwamish Waterway – first draft Feasibility Study completed.
- Portland Harbor – draft Remedial Investigation and Risk Assessments early summer.
- Upper Columbia River
- Boeing Plant 2
- Jorgensen Forge
- Rhone Poulenc

1.9

Estimated Dates for In-Water Sediment Remediaton

- 2010-2011: T-117
- 2012: Hylebos/Occidental, Boeing Plant 2, Jorgensen Forge, Rhone Poulenc
- 2013-2014: East Waterway
- ??: Slip 4, ASARCO
- After 2013-14: Lower Duwamish Waterway, Portland Harbor

1.10

Post Construction Activities at Sediment Sites

1.11

Post-Construction Activities

- General Performance Objectives
- Monitoring
- Maintenance
- Institutional Controls
- Source Control
- Five-Year Reviews

1.12

General Performance Measures

- Have short term sediment cleanup levels been achieved?
- Were cap and other engineering controls constructed as designed?
- Is natural recovery taking place as predicted?
- Short-term risk reduction?
- Long-term risk reduction?
- On-going source control to prevent recontamination?

1.13

"Environmental Monitoring is the only way to evaluate remedial success, but monitoring at most Superfund sites has been inadequate to determine whether dredging has been effective in achieving remedial objectives..."

- National Research Council 2007

1.14

Monitoring

- During construction.
- Immediately post construction.
- Long-term post construction.

1.15

Long-Term Monitoring Plan

- Monitoring directly related to remedial action objectives and cleanup levels.
- Sufficient period of time and frequency.
- Comparison to baseline data.
- Comparison with model predictions.

1.16

Long-Term Monitoring May Include:

- Sediment chemistry
- Benthic community structure and toxicity.
- Porewater chemistry.
- Surface water chemistry.
- Tissue chemistry – fish and shellfish.

1.17

Monitoring for Natural Recovery

- Monitored Natural Recovery (MNR) a component of many remedies.
- Higher bar for monitoring to make sure that recovery predictions are accurate and remedy is effective.
- Necessary to adjust over time as site conceptual model is calibrated.

1.18

Cap Maintenance and Monitoring

- Physical Integrity – geophysical properties, cap thickness.
- Chemical Monitoring – contaminants in sediments and pore water.
- Benthic monitoring – community structure and toxicity.

1.19

Maintenance and Monitoring of Confined Disposal Facilities

- Physical integrity
- Groundwater/surface water monitoring.

1.20

Institutional Controls

- Implementation and monitoring challenges.
- Protection of cap integrity
  - Regulated Navigation Area
  - Channel Deauthorization
  - Site-specific controls to protect the integrity of remedy.

1.21

Institutional Controls

- Protection of Human Health
  - Fish advisories
  - Land use restrictions

1.22

Mitigation Site Monitoring and Maintenance

- Physical and biological performance measurements.
- Related to performance objective of mitigation.
- Examples: water level, fish observation, vegetation monitoring, photo comparisons, waterfowl use.

1.23

Ongoing Source Control

- Surface water/stormwater inputs.
- Groundwater inputs.
- Regulatory controls in place?
- Monitoring of upland sources.
- NEVER COMPLETED.

1.24

Five Year Reviews

- CERCLA requirements for sites where hazardous substances remain on sites above unrestricted use levels.
- Review of monitoring data and remedial objectives.
- Determination if remedy remains protective of human health and the environment.

1.25

Post Construction Resources

- "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites", EPA, 2005
- "Sediment Dredging at Superfund Megasites: Assessing the Effectiveness", National Research Council, 2007
- http://www.epa.gov/superfund/cleanup/postconstruction/index.htm

1.26

EPA Contacts

- Sheila Eckman, Unit Manager, 206-553-0455
- Hylebos, Occidental - Jonathan Williams, 206-553-1369
- Lockheed West Seattle, T-117 - Piper Peterson Lee, 206-553-4951
- Middle Waterway, McCormick and Baxter - Nancy Harney, 206-553-6635
- Lockheed, Todd, Quendall Terminals - Lynda Priddy, 206-553-1987
- PSR, Harbor Island, East Waterway – Ravi Sanga, 206-553-4092
- Duwamish RI/FS - Allison Hiltner, 206-553-2140
- Slip 4, Sitcum, St Paul - Karen Keeley, 206-553-2141
- Portland Harbor RI/FS – Chip Humphrey, 503-326-2678
- Portland Harbor Early Actions – Sean Sheldrake, 206-553-1220
- Thea Foss – Kira Lynch, 206-553-2144
- ASARCO – Kevin Rochlin, 205-553-2106

Washington State Department of Ecology

Toxics Cleanup Program

May 6, 2009

2.1

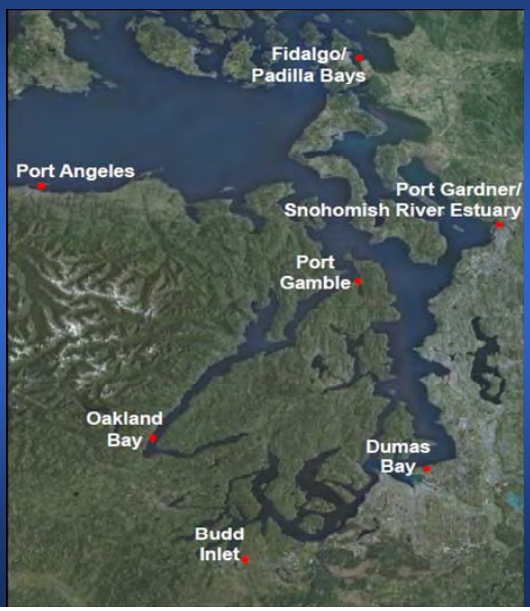
Updates

- Puget Sound Initiative sediment cleanup
- Baywide sediment characterizations
- SMS rule revisions

2.2

Puget Sound Initiative

- Critical habitat.
- Active cleanup work with engaged liable parties.
- Six embayments where bay-wide studies completed.
- Over 100 sediment sites around Puget Sound.



2.3

PSI - Accomplishments

- 2007:
  - Interim action
  - Baywide studies
- 2008:
  - Signed agreed orders
  - Baywide studies
  - Cleanup
- 2009:
  - Baywide studies
  - Cleanup
- Cleanup by 2020

2.4

Aquatic & Upland PSI Resources

- 2007 – 2009 biennium:
  - 8 new staff for cleanup
  - $5.9 million sediment
  - $4.7 million upland
- 2009- 2011 biennium:
  - No additional $ or staff
  - Remedial Action Grants: ~60% decrease

2.5

Baywide Sediment Studies

- Six of seven embayments completed
- Provide a sediment quality "baseline"
- Provide direction on cleanup priorities
- Inform where else to focus cleanup

2.6

Port Gamble - Site Overview

- Two sites:
  - Mill Site
  - Leased Area
- Interim Action completed ’07
- AO Signed May ‘08
- RI/FS’s started
- Baywide in process

2.7

Port Gamble –Critical Habitat

2.8

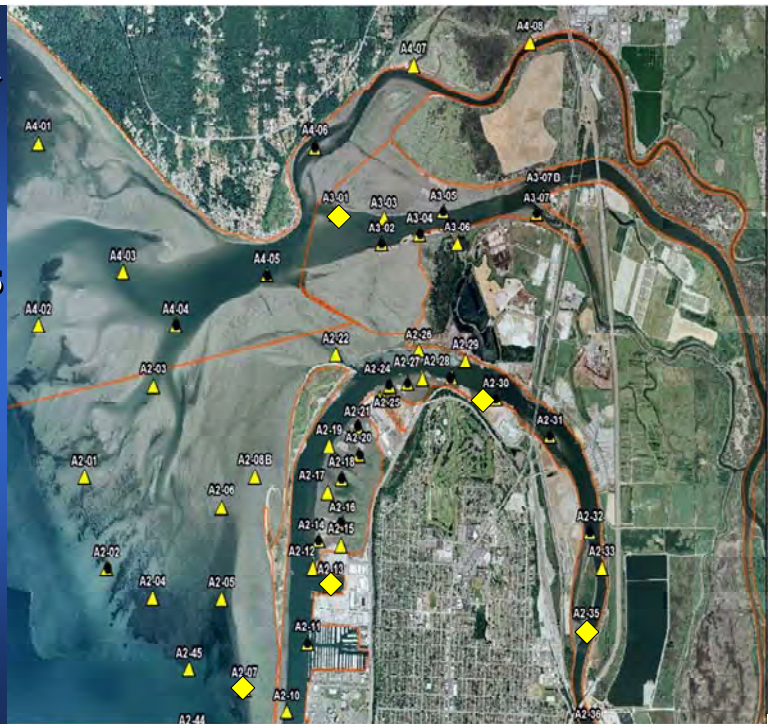
Port Gardner
Focus Area 4
Focus Area 3
Bay Wood
Jeld-Wen
Riverside Business Park
Focus Area 2
North Marina
5
East Waterway
ExxonMobil
2
Weyerhaeuser Mill A
Focus Area 1
Cleanup Sites

2.9

Port Gardner
SPI Locations

2.10

Estuary and River Stations



2.11

East Waterway Sampling Stations

2.12

Chemistry Results

Mercury:
- **CSL hit**

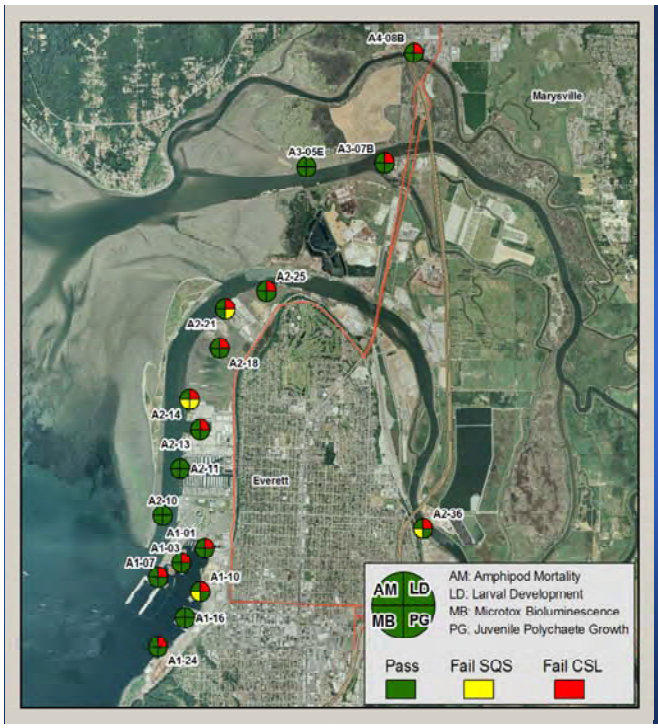
Zinc:
- **SQS hit**

4-Methyphenol:
- **1 Surface**
- **2 Subsurface**

2.13

Dioxin ppt TEQ

2.14



Biological Toxicity

- 13 CSL Hits out of 17 stations

2.15

SMS Updates

- 303(d) list for sediment approved
- Freshwater criteria development - RSET
- SMS rule revisions:
  - Issue paper development
  - Topics identified for further deliberation

2.16

SMS Rule Revisions

1. SMS/MTCA Integration:
   - Cleanup Decision Framework
   - Terms and Definitions
2. Freshwater Standards
3. Other Deleterious Substances
4. Bioaccumulatives: Human Health
5. Bioaccumulatives: Ecological Risk
6. Background - ubiquitous chemicals

2.17

SMS/MTCA Integration

How should Ecology harmonize the SMS and MTCA rules to provide clear processes, consistent language and decision framework for sediment cleanup?

2.18

Examples: Terms & Definitions

SMS

- Cleanup Objective
- Cleanup Standard
- SQS
- MCUL

MTCA

- Cleanup Level
- Cleanup Standard
- Remediation Level

2.19

Examples: Setting Site Specific Criteria

SMS

- Two phase structure for c/up levels:
  - Cleanup Screening Level
  - Sediment Quality Standard
  - Cost/feasibility/net benefit considered

MTCA

- One phase structure for c/up levels:
  - Protective of human health: 1 in a million
  - Cost/feasibility/net benefit not considered

2.20

Example: Decision Making Process for Remedial Alternatives

SMS

- Combines alternative & c/up level by using:
  - Cost
  - Net Benefit
  - Feasibility

MTCA

- Determines site specific c/up level first.
- Then considers:
  - Cost
  - Feasibility etc.
- Permanence

Freshwater Standards Issue

How can the SMS be revised to provide sediment cleanup standards in fresh water environments?

Freshwater Standards Issue

- Lack of freshwater chemical or biological criteria.
- Limited to a narrative standard.
- Limited to freshwater sediment quality values.
- Use of BPJ and BAS – site specific, no predictability for PLP.

2.23

Other Toxic, Radioactive, Biological or Deleterious Substances Issue

How can Ecology best clarify the connection between these provisions in the SMS and the definition of "hazardous substance" under MTCA?

2.24

Other Toxic, Radioactive, Biological or Deleterious Substances Issue

- MTCA defers to SMS for sediment cleanup.
- Biological criteria trumps chemistry in SMS.
- Confirmatory designation in SMS needs further clarification in MTCA.

2.25

Vertical Profile

Plan View

2.26

Bioaccumulatives: Human Health Issue

How should Ecology provide clear and predictable cleanup standards that protect human health at sediment cleanup sites?

2.27

Bioaccumulatives: Human Health Issue

- SMS has only a narrative standard for human health.
- 2 tiered SMS model – SQS/cost/feasibility.
- SMS numeric criteria do not specifically include bioaccumulative exposure pathway.
- MTCA has more specifics for human health for soil and water.

2.28

Bioaccumulatives Eco Risk Issue

How should Ecology provide clear and predictable clean up standards that protect biological resources from bioaccumulative effects?

2.29

Bioaccumulatives Eco Risk Issue

- SMS criteria promulgated to protect the benthic community.
- SMS numeric criteria do not specifically include bioaccumulative exposure pathway.
- MTCA has a terrestrial ecological evaluation process.

2.30

Background - Issue

How should Ecology consider background concentrations when making decisions on cleanup standards at sediment cleanup sites?

2.31

Background - Issue

- SMS rule doesn't address how background levels can/cannot be considered when establishing cleanup standards.
- Risk-based sediment levels may be below background.
- How to determine natural and area background levels in SMS.
- Technical feasibility issues.

2.32

Next Steps

- Distribute issue summaries for public feedback on issues and options.
- List serv: http://www.ecy.wa.gov/programs/tcp
- Develop draft rule language and background materials.
- External review/discussions (some type of external advisory group, other technical review).
- Ecology decision on rule scope and schedule.

2.33

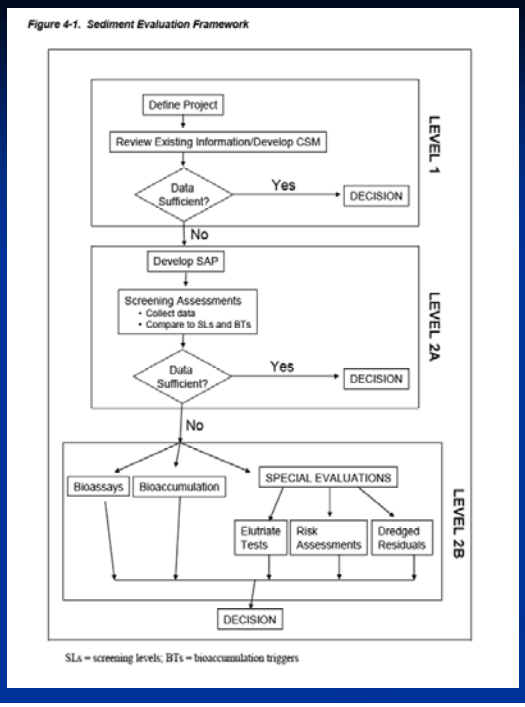
Questions?

2.34

PAH Sediment Screening for the Protection of Fish: A Draft Framework

Lyndal Johnson, Dan Lomax, and Sean Sol
NOAA Fisheries

3.1



Sediment Evaluation Framework (SEF 2009)

Protection of:

- Benthic organisms (SLs)
- Fish (TRVs/SLs)
- Wildlife (TTLs/BTs)
- Human Health (TTLs/BTs)

3.2

PAH SLs & TRVs for fish: Problems and limitations

- Current SLs are based on synoptic field data combining chemistry with invertebrate bioassay and/or benthic data
- May be protective of fish prey base, but not direct effects on fish
- TRV approach proposed as alternative for protection of fish for bioaccumulative compounds
- Fish metabolize PAHs, so TRV won't work; something different needed

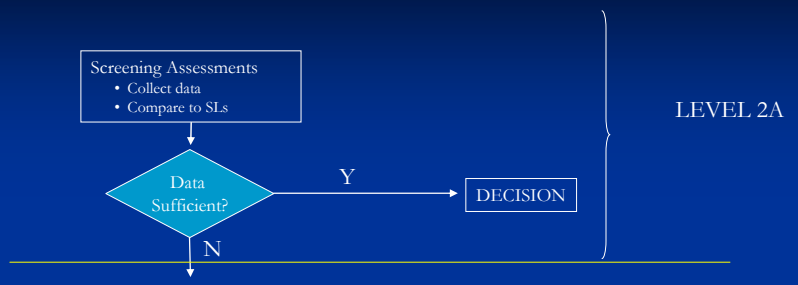
3.3

Exposure Pathway/Assessment

- Direct correlation of sediment PAH levels with biological effects
- Alternatives to TRVs
  - Metabolites of PAHs in bile of fish
  - Dietary effects thresholds

3.4

SEF Sediment Evaluation Framework



NWFSC Recommendation for this screening level:

Modified SL for fish based on

Direct correlation of sediment PAH levels with biological effects

--injury endpoints in benthic fish

Recommended Screening Level: 2000 ng/g dry wt total PAH

3.5

Sediment PAH concentration vs. biological effects in English sole

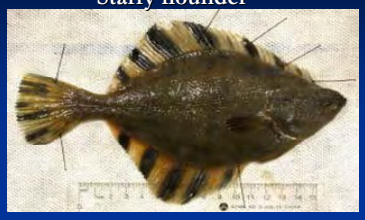
Biological Effect

PAH (ppb dry wt)	Liver Lesions (%)	Gonad Dev (%)	Inhib. spawn (%)	Infertile eggs (% eggs)	DNA damage (nmol adducts per mol bases)	Reduced Growth (%change in wt per day)
50	0	15	12	38	5	1.1-1.2
100	0	15	12	38	5	--
1000	9	15	17	42	25	--
2000	18	15	25	48	36	--
3000	24	15	30	51	43	--
5000	31	18	35	55	51	0.05-0.10
10000	40	27	43	61	63	--
100000	71	58	69	80	100	--

3.6

Liver Lesions In Other Species

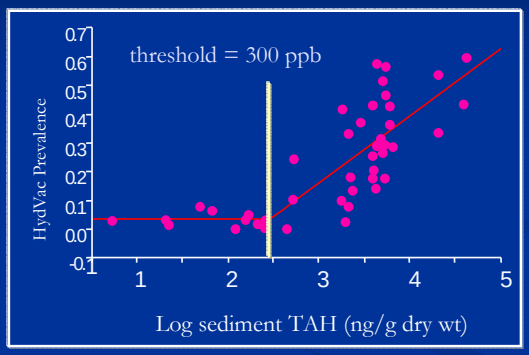
Starry flounder



Threshold for degenerative lesions
1950 ppb Total PAHs

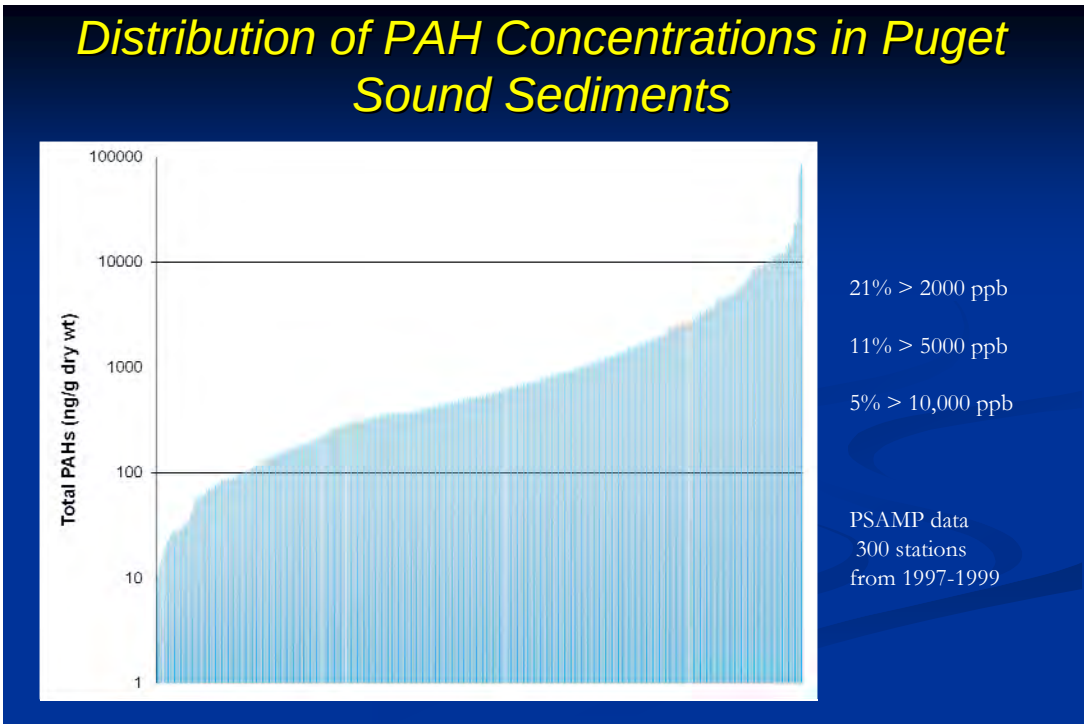
Winter flounder

Threshold for degenerative lesions
300 ppb total PAHs

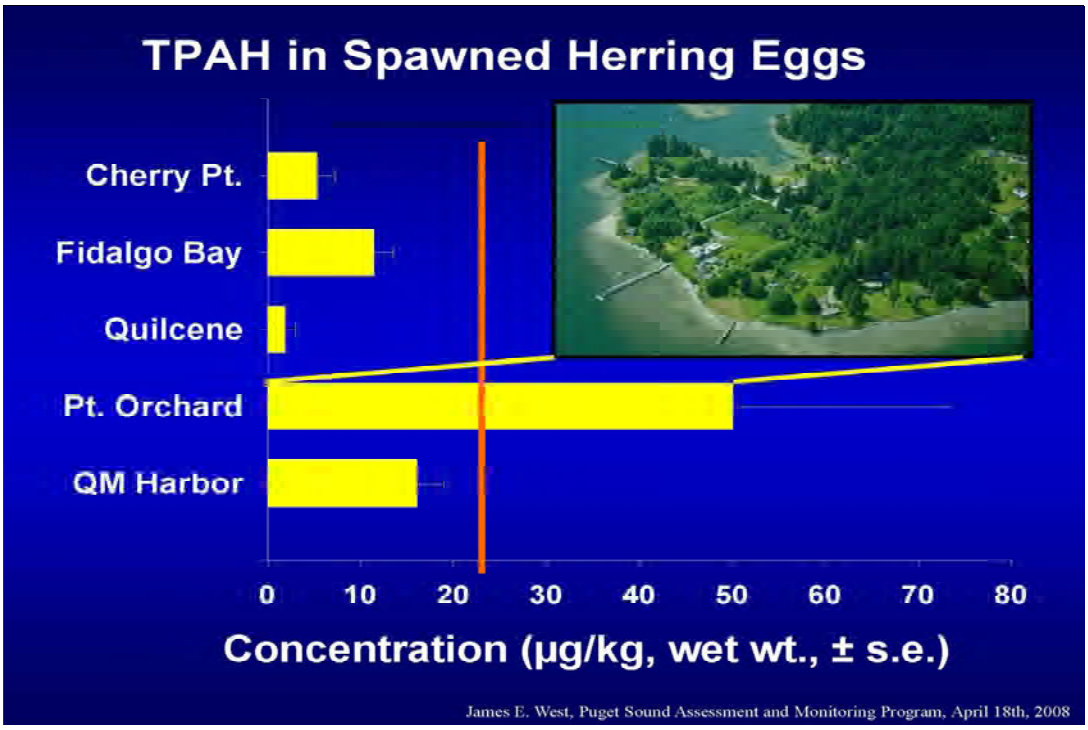


Additional Studies of PAH concentration in sediments vs. biological effects

Species	Compound	Endpoint	Concentration	Reference
Pink salmon eggs	PAHs in weathered oil	Embryo mortality	2.8 ug/g dry wt	Murphy et al. 1999
Pink salmon embryos	PAHs in weathered oil	Embryo mortlaity	3.8-4.6 ug/g dry wt	Heinz et al. 1999
Rainbow trout	PAHs in crankcase oil	EROD induction	3-21 ug/g dry wt	Upshall et al. 1992
Spot juveniles	PAH mixture	Altered feeding behavior	22 ug/g dry wt (NOEL)	Hinkle-Conn et al. 1998


Distribution of PAH Concentrations in Puget Sound Sediments
Total PAHs (ng/g dry wt)
100000
10000
1000
100
10
1
21% > 2000 ppb
11% > 5000 ppb
5% > 10,000 ppb
PSAMP data
300 stations
from 1997-1999

3.9


TPAH in Spawned Herring Eggs
Cherry Pt.
Fidalgo Bay
Quilcene
Pt. Orchard
QM Harbor
0
10
20
30
40
50
60
70
80
Concentration (µg/kg, wet wt., ± s.e.)
James E. West, Puget Sound Assessment and Monitoring Program, April 18th, 2008

3.10

Impacts of PAH-contaminated sediment on flatfish metamorphosis

March 2008	June 2008
15K yolk sac larvae	15K yolk sac larvae
120 metamorphosis	300 metamorphosis
16 fully settled juveniles	150 fully settled juveniles

Experimental plan Spring 2009

- Expose to Kitimat sediment at stage F-G (mohawk)
- Assess metamorphosis success or lethality
- Fix all larvae
- Subsamples for CYP1A induction and histopathology

Mark Tagal

3.11

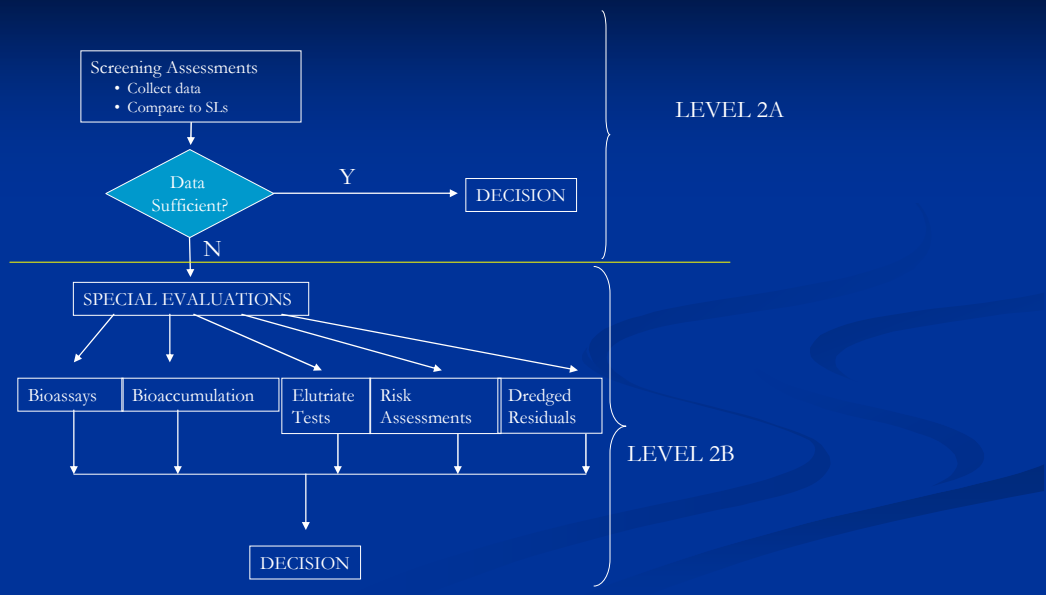
Exposure Pathway/Assessment

- Alternatives to TRVs
  - Metabolites of PAHs in bile of fish
  - Dietary effects thresholds

Might be used to derive sediment guidelines to support SLs; or used for Level 2B testing

3.12

SEF Sediment Evaluation Framework



3.13

PAHs affect growth and metabolism

Plasma lipids

Fish weight

Plasma lipase

Decline in whole body & plasma lipids
Changes in enzymes involved in energy metabolism
Changes in fish weight and weight distribution

Doses in the 2-6 ug/g fish/d range

Meador et al. 2006

3.14

Concentration in prey?

Depends on feeding rate of fish

Juvenile salmon may consume 12-20% of their body weight per day

$$\text{Concentration in prey (ug/g)} = \frac{\text{Dietary dose (ug/g fish /day)}}{\text{Dietary ingestion rate (g diet/g fish/day)}}$$

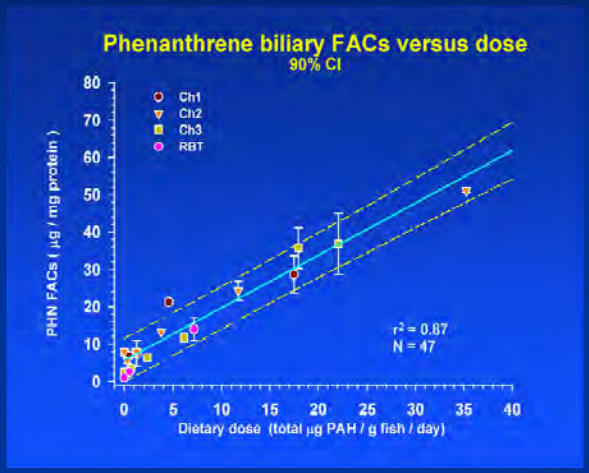
Dose (ug/g fish/day)	Feeding rate	PAHs in prey (ug/g dry wt)	PAHs in prey (ug/g wet wt)
2	12% body wt	16.7	3.3
2	16% body wt	12.5	2.5
2	20% body wt	10	2
6	12% body wt	50	10
6	16% body wt	37.5	7.5
6	20% body wt	30	6

3.15

PAHs in salmon stomach contents (wet wt)

3.16

Salmonid bile metabolites vs. PAHs in diet



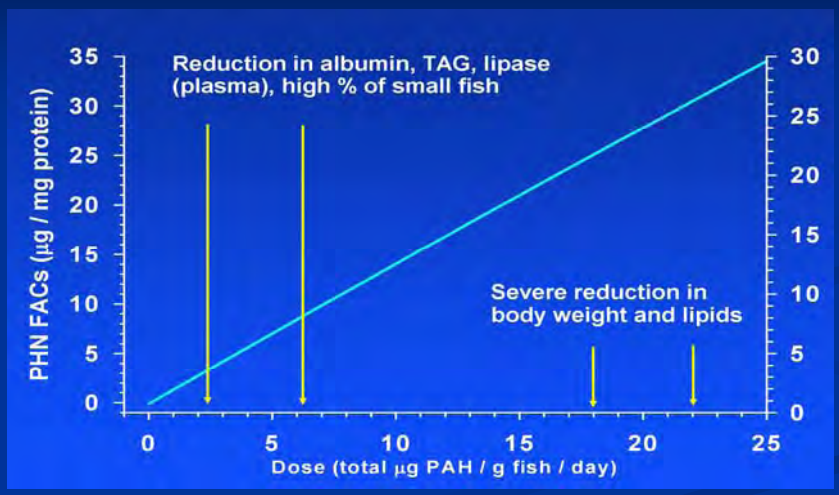
Strong correlation between bile metabolites and dietary dose

Dietary PAH concentrations of 2-6 ug/g fish/day correspond to bile metabolite levels of 3-8 ug PHN-FACs/mg bile protein

Dietary dose of 18-22 ug/g fish/day correspond to PHN FACs of 20-35 ug/mg bile protein

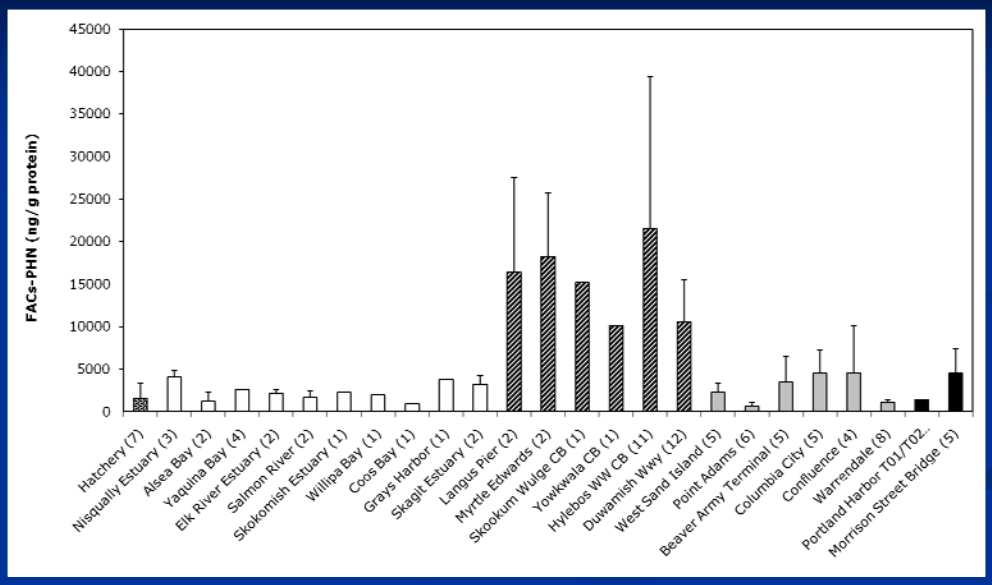
3.17

Dose, PHN FACs and Toxicity



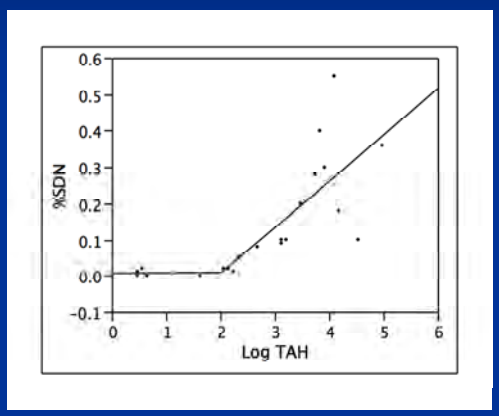
3.18

Bile metabolite concentrations in juvenile salmon



3.19

PAHs in sole stomach contents vs. lesions

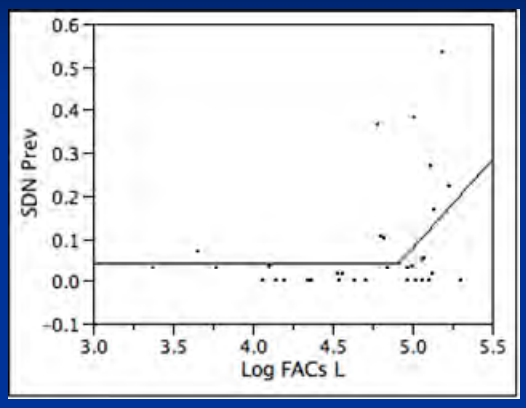


Threshold value of ~100 ppb dry wt (or 500 ppb wet wt) for total PAHs in stomach contents

Estimated sediment TAH concentration where these stomach contents concentrations are found are in the 1000-2000 ng/g dry wt range

3.20

PAHs in bile vs. lesions



Log FACs-NPH (ng/g bile)

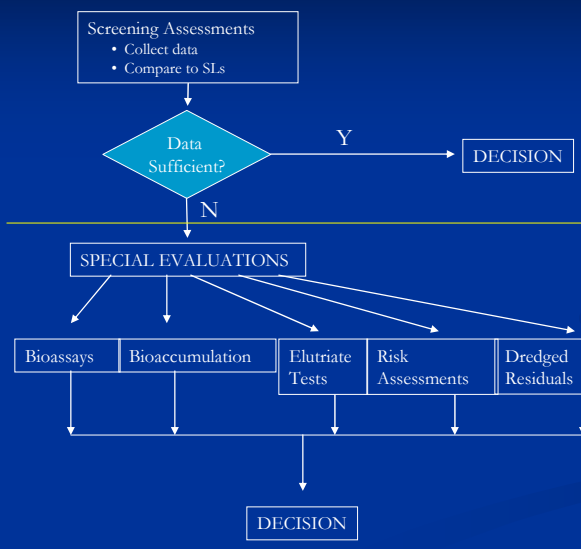
Threshold value of around

~100,000 ug/g bile for FACs-NPH

Equivalent to FACs-PHN concentration of ~3-3.5 ug/mg bile protein FACs-PHN bile protein

3.21

RSET Sediment Evaluation Framework



LEVEL 2A

Recommended SL1:
2000 ng/g dry wt total PAH

LEVEL 2B

FACs-PHN guideline of ~3 ug/mg protein for use in field assessments

Prey tissue concentrations of 2-3 ug/g wet wt total PAHs for in bioaccumulation testing

3.22

RSET Sediment Evaluation Framework

SPECIAL EVALUATIONS

Bioassays

Currently no bioassay for fish

Bioaccumulation

Compare PAH accumulation in prey species with dietary guideline; but test species not really suitable for salmonids

Elutriate Tests

Fathead minnow fish test available, but may not be sensitive enough

Bile metabolite levels?

Risk Assessments

Field assessment of exposure and risk in species of concern

Bile metabolite levels

Stomach contents PAHs

Surrogate species

Dredged Residuals

Compare PAH concentrations in exposed surface with 2000 ng/g dry wt guideline

Follow up with field assessment of exposure if SL guideline exceeded

Biological Testing Subcommittee White Paper addresses some issues related to bioassays and bioaccumulation testing for the protection of fish.

3.23

Next Steps

- Complete white paper outlining suggested screening guidelines and evaluation framework
- Internal NOAA review of white paper
- Present to white paper to RSET
- Come to consensus on how to apply and incorporate into the SEF

3.24

DMMP Disposal Fees

- 1988 account established in statute (RCW 79.105.510)
- Fee established by administrative rule (WAC 332-30-166)

In 1994 rate structure set at:

$0.45 per cubic yard:
- Anderson / Ketron Island
- Bellingham Bay
- Commencement Bay
- Elliott Bay
- Port Angeles
- Port Gardner Bay
- Port Townsend
- Rosario Strait

$0.10 per cubic yard at dispersive sites:
- Grays Harbor (4 sites)
- Willapa Bay (2 sites)

No fee for beneficial use of materials

4.1

DMMP Fund Balance Projection

Fiscal Year	Fund Balance	Expenditures	Revenue
FY04 (actual)	$458	$292	$403
FY05 (actual)	$902	$166	$610
FY06 (actual)	$1,180	$373	$651
FY07 (actual)	$1,206	$646	$672
FY08 (actual)	$815	$527	$137
FY09 (estimated)	$704	$210	$98
FY10 (projected)	$588	$530	$414
FY11	$471	$530	$414
FY12	$355	$530	$414
FY13	$238	$530	$414
FY14	$122	$530	$414
FY15	$6	$530	$414
FY16	($111)	$530	$414
FY17	($227)	$530	$414
FY18	($344)	$530	$414
FY19	($460)	$530	$414

4.2

Proposed Options

- Adjusting minimal fees.
- Establishing a tiered fee structure that more accurately reflects additional costs triggered by sediment quality thresholds, difficulties resulting from disposal activity, or complexity of the site to be dredged (such as proximity to contaminated sediments).
- Increasing the per cubic yard disposal fee to account for current and additional management and monitoring costs at some or all of the disposal sites.
- Varying the site management and monitoring costs associated with different disposal sites. This may include revising the volume amounts that trigger monitoring events.
- Accounting for the value of in-kind contributions from DMMP participating agencies and from disposal site users.

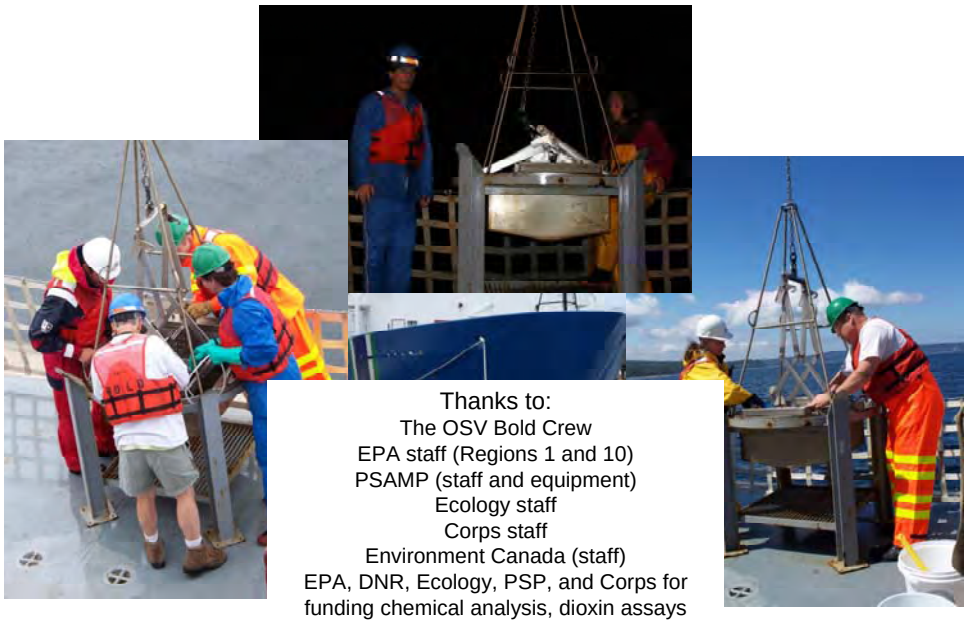
4.3

Rulemaking

- Provides an open public forum to address emerging site management considerations and associated costs.
- Will consider and address any concerns of project proponents that benefit from using the disposal sites and the regulatory management agencies charged with ensuring environmental compliance.
- Once the current state budget deliberations are completed, DNR will be finalizing a rulemaking proposal and schedule for public review.
- Rulemaking process may take up to one year to allow for:
  - public input on alternatives,
  - economic and small business impact analysis, and
  - formal consideration of any recommended changes by the Board of Natural Resources.

4.4

OSV BOLD SURVEY: 07/31/2008- 08/05/2008



Thanks to:
The OSV Bold Crew
EPA staff (Regions 1 and 10)
PSAMP (staff and equipment)
Ecology staff
Corps staff
Environment Canada (staff)
EPA, DNR, Ecology, PSP, and Corps for funding chemical analysis, dioxin assays analysis, data analysis, data reporting)

5.1

OSV BOLD SURVEY: Objectives

- **Objective 1.** Evaluate whether the concentration distributions of dioxin/furan/PCB congeners appear to be correlated with grain size or total organic carbon (TOC).
- **Objective 2.** Identify the concentration distributions of dioxin/furan/PCB congeners in the existing DMMP reference areas.
- **Objective 3.** Identify the concentration distributions of dioxin/furan/PCB congeners in Puget Sound generally, away from known sources and cleanup sites.
- **Objective 4.** Compare the concentration distributions in the existing reference areas to general concentrations in Puget Sound away from known sources and cleanup sites to determine whether they are statistically different.
- **Objective 5.** Determine the distribution of other chemicals of concern (metals, SVOCs, pesticides) in Puget Sound.
- **Objective 6.** Conduct corroborative testing of three dioxin/furan and PCB congener TEQ assays to determine whether they are well-correlated with standard methods, have low enough detection limits, and are cost-effective.

5.2

Survey Design

- Stratified random sampling of 4 reference areas (20 samples) and 10 main basin areas (50 samples).
- Urban bays excluded (Budd Inlet, Commencement Bay, Elliott Bay, Sinclair and Dyes Inlets, Eagle Harbor, Everett and Bellingham Bay)
- Between 35 and 600 ft water depth
- 500 m away from point sources*
- 250 m away from sediment samples (EIM database) that exceeded DMMP SLs
- 2500 meters away from other accepted samples where possible
- Grain size contingency stations to allow collection of range of grain size fro each area

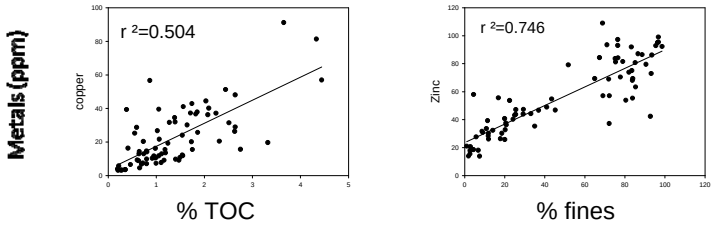
* Thanks to People for Puget Sound for providing GIS layers mapping outfalls!

5.3

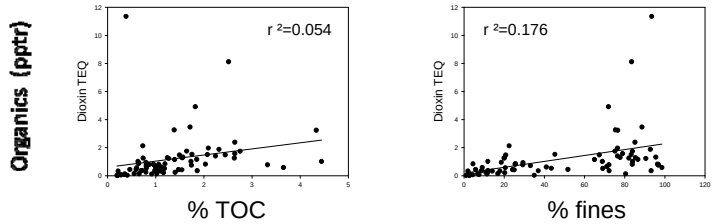
5.4

Objective 1: Correlations between TOC, fines, and chemical concentrations

Metals: % TOC, r^2 range from 0.504 to 0.177
% fines, r^2 range from 0.746 to 0.0400



Organics: %TOC, r^2 range from 0.054 to 0.008
%fines, r^2 range from 0.176 to 0.017



Objectives 2 and 3: Characterize Reference and Main Basin concentrations

Reference

	range (ppb)		mean (ppb)
PCB	188	2420	494
PCB TEQ	0	0.007	0.005
Dioxin TEQ	0.01	5.07	1.2

Main Basin

	range (ppb)		mean (ppb)
PCB	58.5	10600	940
PCB TEQ	0	0.188	0.004
Dioxin TEQ	0.047	11.8	0.774

Objective 4. Reference vs Main basin

- No statistically significant differences between Reference Bays and Main Basin for dioxin
- Outliers observed for dioxin in Carr Inlet R_CAR_5) and South Sound (SS_0, SS_9)
- Outliers observed for PCBs in Central Puget Sound (CPS_0, CPS_3), Hood Canal (HC_0), and Port Susan/Possession Sound (PSPS_1).

Objective 5: Other CoCs

All metals were below the SMS SQS values:

Analyte (mg/kg DW)	Percent Detected	SMS		Percentiles				
		SQS	CSL	25th	50th	75th	90th	95th
Antimony	0	--	--	DL	DL	DL	DL	DL
Arsenic	100	57	93	3.6	6.0	8.6	11.0	13.6
Cadmium	67	5.1	6.7	DL	DL	0.4	0.7	0.9
Chromium	100	260	270	18.9	26.2	38.5	54.6	67.6
Copper	100	390	390	9.4	15.7	31.2	40.3	49.9
Lead	100	450	530	5.0	7.7	13.3	17.6	21.6
Mercury	59	0.41	0.59	DL	DL	0.1	0.2	0.2
Nickel	100	--	--	19.4	25.2	30.7	49.6	55.2
Selenium	37	--	--	DL	DL	DL	1.0	1.2
Silver	74	6.1	6.1	DL	DL	0.2	0.2	0.3
Zinc	100	410	960	32.5	51.4	78.2	92.4	94.6

DL = Percentile value is under the value for the maximum reported detection limit.

SVOCs, except phenols, were low (many non-detects).

- Phenol was detected in 63 percent of the samples, with 10 of the 70 samples being above the SMS SQS. One station (HC_2) equaled the CSL.
- 4-methylphenol was detected in 50 percent of the samples, with one station (R_SAM_3) being above the SMS CSL (the SMS CSL is equal to the SMS SQS for 4-methylphenol).

No pesticides were detected in the samples.

Objective 6: Dioxin assays

- CALUX, 101L, and Procept® assays conducted on the Bold samples
- In order to evaluate the potential of the various assays for the evaluation of dredged sediments, more data is being considered which include a wider TEQ concentration range. *
- The determination of utility of these assays for evaluating dredged material is incomplete at this time but is in progress under a separate program funded by USACE and USEPA.
- The outcome of this analysis will be published in a separate report.

* Thanks to Port of Seattle, Port of Olympia, and the PSI Bay-wide studies for donating archived samples for this study!

For more information

http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=DMMO&pagename=Dioxin_Work_Group

Entire Bold dataset available at this site
(currently being input into the EIM database)

Coming soon, Bold final report

To be posted when available: Dioxin assay evaluation

Dredged Material Management Program (DMMP) Proposed Revision to the Open-water Disposal Guidelines for Dioxins in Dredged Material

SMARM - May 6, 2009

6.1

Presentation Overview

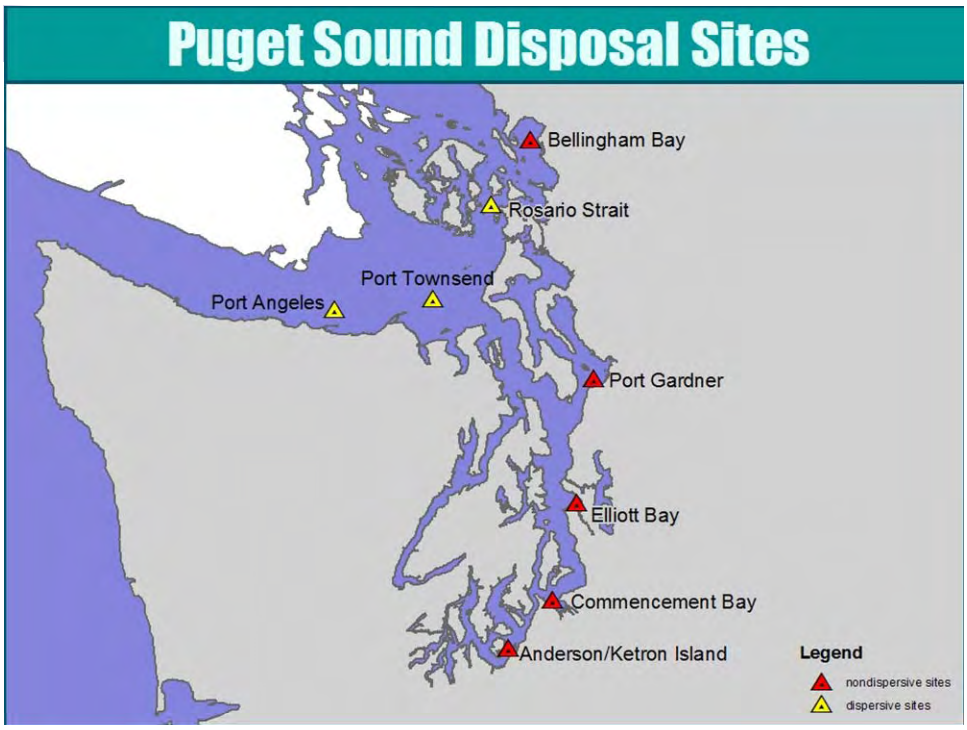
- Introduction
- Risk management basis
- Regulatory framework
- Background determination
- Agency proposal
- Implementation and impact analysis
- Next steps and public input

6.2

Introduction and Dioxin Proposal

- The DMMP agencies have been working during the past two years to collect public input and additional scientific data to develop updated guidelines for acceptable dioxin levels in sediments bound for open water disposal
- DMMP agencies have put forward a proposal for the revision to the dioxin guidelines
- The Issue Paper presents the proposal, basis, rationale, choices and proposed process forward
- The DMMP proposal is not final and your input is valuable

6.3



6.4

Two Types of Disposal Sites

- Nondispersive sites
  - Dredged material stays on site
  - Monitored using sediment profile imaging, chemistry, bioassays and tissue analysis
- Dispersive sites
  - Material is rapidly dispersed by strong currents
  - Monitored using bathymetry only

Problem Statement

- Former guidelines for disposal (5 pptr TCDD/15 pptr TEQ) were based on 1991 Grays Harbor risk assessment addressing consumption by recreational fishers
- Does not reflect current knowledge of exposure to & risk from dioxins in Puget Sound
- DMMP agencies developed interim guidelines in 2006, but recognized that a new dioxin framework was needed

DMMP Dioxin Project

- Staff-level workgroup
  - DMMP agencies: USACE, DNR, DOE, and EPA
- Regular review and direction provided by agency managers and directors
- Legal review by state and federal attorneys
- Facilitated by Floyd|Snider

Work to Date

- 2007 – option definition and public meetings
- SMARM 2008 – goals for updated framework, options under consideration, input from 2007 public meetings
- Summer 2008 – Puget Sound background sampling
- Fall 2008 – RSET statistical workshop
- Fall/Winter 2008/2009 – agency deliberations, revisions to options considered – **SEE OPTIONS ATTACHMENT TO ISSUE PAPER**
- March 2009 – dioxin framework proposal presented at public workshop and posted on web
- Issue Paper and SMARM 2009 – agency proposal to receive input – proposal *not* final

DMMP Agency Proposal Development

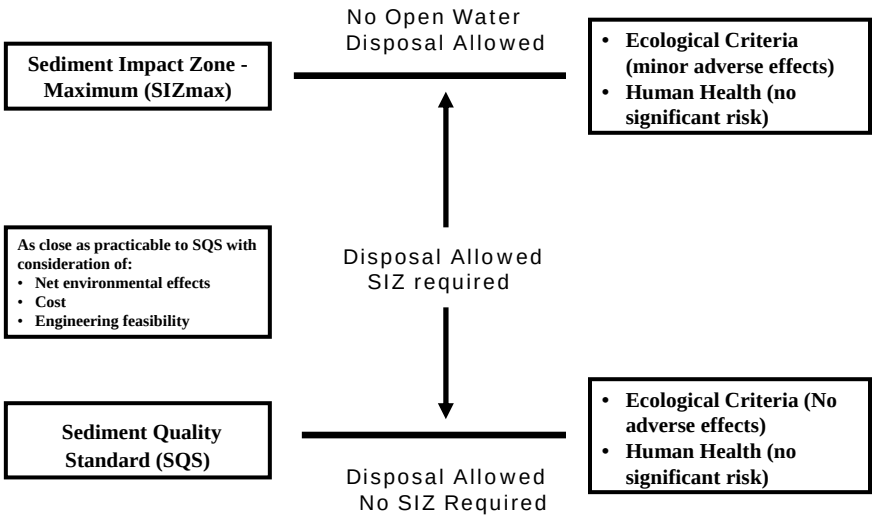
- DMMP Agencies have put forth a proposal that is based on background concentrations in Puget Sound
- Rationale for the proposal based on
  - Risk management
  - Regulatory framework
  - Updated knowledge of Puget Sound conditions
  - Policy decisions re: balancing of objectives
- We will present this rationale, details provided in the Issue Paper and attachments

Regulatory Framework

- Key regulatory provisions:
  - PSDDA/DMMP guidelines developed in 1988 - multiple updates
  - Sediment Management Standards (SMS) rule adopted in 1991
- The DMMP guidelines and SMS rule provide chemical and biological criteria based on benthic toxicity. Less detailed requirements for bioaccumulation and human health risks.
  - DMMP tissue screening levels based on cancer risk level of 10^{-5} or reference areas (option for bioaccumulation testing).
  - SMS rule narrative standard – concentrations must be "below levels which correspond to a significant risk to human health".
- Proposal required an interpretation of SMS narrative standard
  - Agencies have utilized benchmark cancer risk level of 10^{-6}
  - Set goals based on background levels if background risk $>10^{-6}$

SEE REGULATORY ATTACHMENT TO ISSUE PAPER

Open Water Disposal Sites
Two-Tier Decision-making Framework



Risk Management Choices That Shaped the Proposal

- Risk Considerations
- Agencies considered exposure for general population and people who eat large amounts of fish.
- Agencies used a target cancer risk of one-in-one million (10^{-6}) when evaluating compliance with the Sediment Quality Standards (SQS) narrative standard for human health protection.
- Consideration of Background Levels
- Agencies decided to base guidelines on background levels because background risk is greater than one-in-one million (10^{-6})
- Regulatory Flexibility
- Agencies decided not to pursue options that require a sediment impact zone (SIZ) authorization.

Risk Considerations

- Agencies considered health risks for general population and people who consume large amounts of local fish/shellfish
  - Disposal sites located within Usual and Accustomed (U&A) areas for one or more tribes
  - Consistent with federal and state guidance on water quality standards
  - Consistent with federal and state cleanup policies
- Agencies used a cancer risk level of one-in-one million (10^{-6}) when evaluating compliance with the Sediment Quality Standards (SQS) narrative standard for human health protection
  - Consistent with federally approved water quality standards
  - Consistent with state cleanup policies
  - Consistent with many other state programs

Consideration of Background Levels

- Tissue levels from background areas exceed benchmark risk level of one-in-one million cancer risk (10^{-6})
- Standard risk assessment methods
- Fish consumption rates based on surveys of recreational fishers and tribal members
- EPA cancer slope factor
- Agencies decided to base the guidelines on background levels because background risk is greater than 10^{-6}
- Conceptually similar to DMMP guidelines
- Conceptually similar to SMS rule framework
- Conceptually similar to state cleanup standards

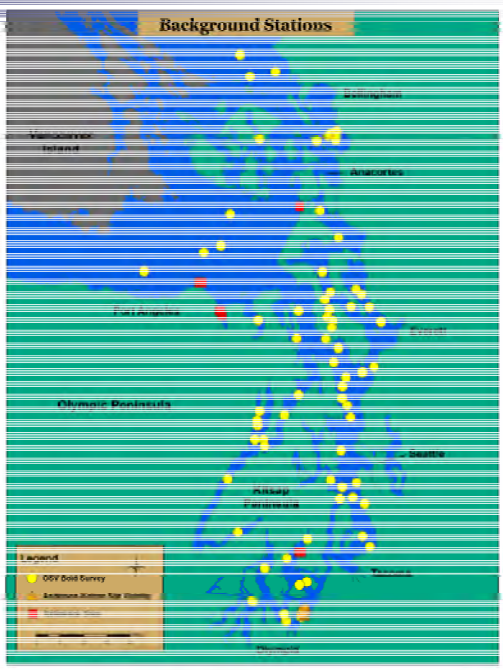
SEE RISK ATTACHMENT TO ISSUE PAPER

Sediment Impact Zones

- Agencies decided not to pursue options that require a sediment impact zone (SIZ) authorization
  - Ensure sites will not reach levels that trigger active cleanup
  - Agencies evaluation of past projects indicates that proposed guidelines will not significantly change the pass/fail percentages relative to previous guidelines
  - Benefits of SIZ designation unlikely to outweigh liabilities and added complexities:
    - Temporary solutions – SIZs need closure plans
    - Increased management during operation
    - Encumbrances on state-owned land
    - Measures needed to address potential cleanup liabilities
    - Uncertainties re: local permitting

What Concentrations Represent Background?

- In summer 2008, using the OSV Bold, the DMMP agencies collected sediment data from locations outside urban bays and distant from sources of contamination throughout Puget Sound
  - 50 main-basin samples
  - 20 samples from 4 reference bays
- Data from other surveys were added to the Bold data set:
  - 13 samples from vicinity of the A-K disposal site (main basin)
  - 14 reference samples
- Main-basin dioxin concentrations ranged from 0.04 to 11.6 pptr TEQ, with a mean of 1.6 pptr. Reference concentrations ranged from 0.04 to 5.1 pptr TEQ, with a mean of 1.1 pptr.
- No statistical difference between main basin and reference data, so combined into a single data set.



Derivation of Background Concentration

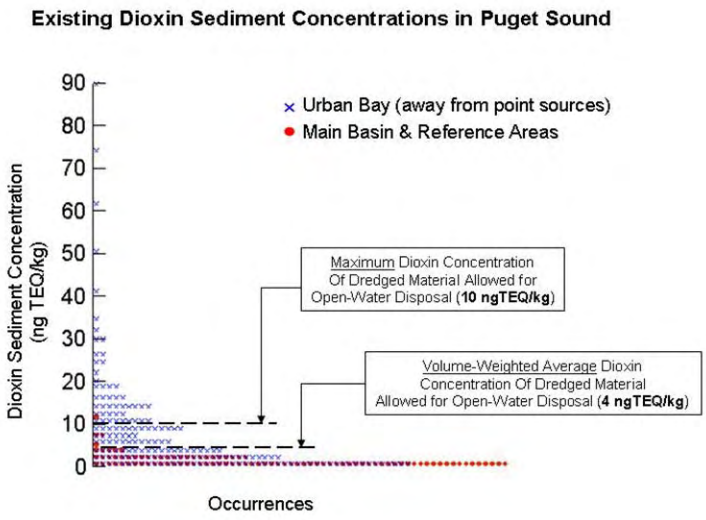
- Statistical Workshop recommended an upper tolerance limit (UTL) approach
- The UTL used for the proposed guideline is:
  - 90% upper confidence limit on the 90th percentile of the background observations
  - For the combined Main Basin and Reference Bays data set, this number is 4 pptr TEQ
- Use of anything less than the UTL would result in lots of sediment that is at background concentrations failing
- Technical Memorandum detailing derivation of the background concentration is posted on the DMMO website

The DMMP Agency Proposal

- Proposed guidelines are based on ensuring that disposal site sediment dioxin concentrations will not be greater than existing levels throughout the non-urban, main basin and reference areas of Puget Sound
- **Disposal Site Management Objective:** Establishment of a target disposal site concentration for all non-dispersive and dispersive disposal sites at a level equal to the UTL
  - Proposed Disposal Site Management Objective is **4 pptr TEQ**

The DMMP Agency Proposal

- **Dispersive Disposal Site Guidelines:** Dioxin concentrations could not exceed a maximum concentration of **4 pptr TEQ** in any DMMU
- **Non-Dispersive Disposal Site Guidelines:**
  - Volume-weighted average concentration of dioxin in material from each dredging project could not exceed the disposal site management objective (**4 pptr TEQ**)
  - Dioxin concentrations could also not exceed a maximum concentration of **10 pptr TEQ** in any DMMU
    - Dioxin data from 13 large urban-bay surveys were used to model urban concentrations. Applying a cutoff at 10 pptr resulted in a volume-weighted average of less than 4 pptr.



Evaluation Relative to Other Options

- Goal was pragmatic balancing of objectives – achieving measurable improvement for Puget Sound while maintaining the open-water disposal program
- The proposal was developed to:
  - Ensure regulatory compliance and consistency
  - Optimize the balance between:
    - Protection of human health and the environment
    - Waterfront economic impacts
- Other risk and background-based options were either not in regulatory compliance or did not provide a good balance between economic impacts and protection of human health and the environment.

Benefits of Proposed Dioxin Guidelines

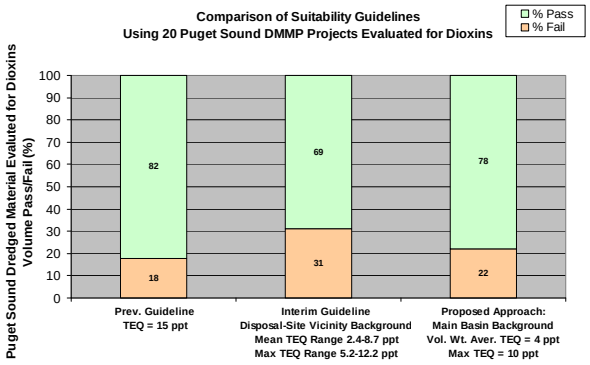
- More protective of subsistence consumers and everyone who eats local seafood
- Improves the overall health of Puget Sound, consistent with Puget Sound Partnership goals
- Consistent with federal and state regulations – Clean Water Act, SMS, MTCA and DMMP guidance
- Maintains viability of the open-water disposal program for the dredging community
- Addresses concerns regarding liability associated with use of state-owned aquatic lands

Implementation of Proposal

- Updated “Reason to Believe” guidelines – increased testing for dredging projects in urban areas
  - Deeper native sediment exempt from dioxin testing
- Potential bioaccumulation test-out option
- Continued use of BMPs for sequencing of disposal operations
- Added on-site disposal site monitoring stations
- Adaptive management based on monitoring data

Comparisons of Suitability Guidelines - Pass/Fail Impact

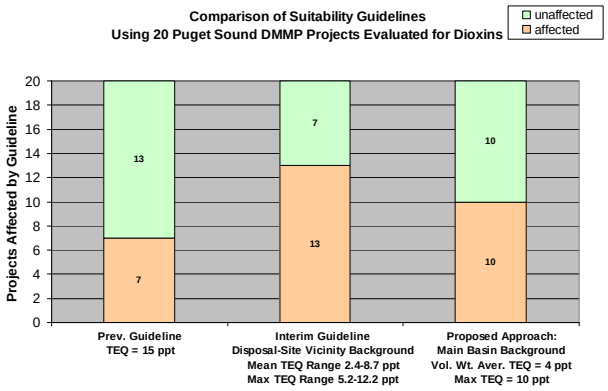
- SEE IMPACT ANALYSIS ATTACHMENT TO ISSUE PAPER
- All Puget Sound dredging projects over the last 21 yrs reviewed
- 20 of these projects tested for dioxins (~6% of total volume)
- The pass/fail impact was evaluated using these 20 projects
- The failure rate increased from **18%** (15 ppt TEQ guideline) to **22%** with the proposed guideline



Note: native material included only w here tested.

Comparisons of Suitability Guidelines – Number of Projects Impacted

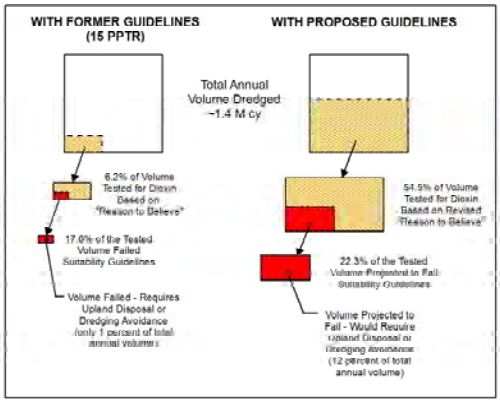
- The number of projects affected increases from **7** to **10** (out of 20) under the proposed guideline



Note: affected projects have one or more DMMUs that fail the dioxin guideline.

Increased Testing for Dioxins

- Over the past 21 years, 10% of projects tested for dioxins (6% of volume).
- In the last 3 years, 38% of projects tested for dioxins (33% of volume).



- With the revised framework **55%** of the annual project volume is estimated to require testing*.
- **12%** of the total annual dredging volume is estimated to be unsuitable for open water disposal with respect to dioxin.

* Most non-urban projects would not require testing, and deeper native material would not require testing.

Increased Cost Associated with Disposal

- Increased Disposal Cost of Unsuitable Material
  - Assuming that the increased volume of unsuitable material would still be dredged, but with upland disposal
  - Using a range of <u>incremental</u> cost for upland disposal of $30 to $122/c.y.
  - Using the annual dredge volume of 1.4 Million c.y. (21 yr history)
  - Estimating 11% of additional annual volume unsuitable for open-water disposal
  - Results in a range for annual <u>incremental</u> cost of $5 to $20 million
- The agencies acknowledge the fact that in lieu of upland disposal, projects could be cancelled with significant associated economic impact

Geographic Limitations and Applicability to Other COCs

- **Proposed guidelines applied to Puget Sound only**
  - Dioxin suitability guidelines for areas outside of Puget Sound (Grays Harbor, Willapa Bay, and the Columbia River) need to be revisited as well
  - However, those are significantly different systems and may have a different basis for defining an appropriate framework
  - The DMMP agencies have not yet evaluated a suitability framework outside of Puget Sound
- **Proposed guidelines are for dioxins/furans only**
  - The proposal is not for other bioaccumulative compounds
  - The adjusted framework for dioxin/furans also could have implications for other bioaccumulative compounds, especially dioxin-like polychlorinated biphenyls (PCBs)
  - This is also an issue that the DMMP Agencies have begun to discuss, but have not yet determined a recommended approach forward at this time

Next Steps and Opportunities for Additional Input

- The Agency proposal is a proposal, not a final decision
- Stakeholder input and dialog is encouraged
- The Agencies want to be as transparent as possible regarding rationale and deliberations
- DMMP Issue Paper available for review and comment
- Stakeholder meetings will be held after the SMARM as follows:
  - May 18: Regulatory context, project objectives, risk assessment (Lacey)
  - May 28: Pass/fail analysis, impacts to dredging (Seattle)
  - June 3: Implementation issues, additional discussion (Seattle)
  - *See the Dioxin Project Website for times, locations and agendas*

Next Steps and Opportunities for Additional Input

- The Agency proposal will be updated based on input received from the SMARM and the May/June stakeholder meetings
- An opportunity for formal comment will be provided following revisions (likely late summer)
- After formal public comment is completed, Agency directors will make a final decision

- Input can be provided by email to dioxin.project@floydsnider.com
- Updates on the project can be found at the Dioxin Project website, under DMMO at: http://www.nws.usace.army.mil

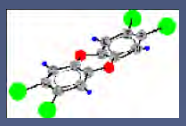
6.31

Dredged Material Management Program (DMMP) Proposed Revision to the Open-water Disposal Guidelines for Dioxins in Dredged Material

SMARM – May 6, 2009

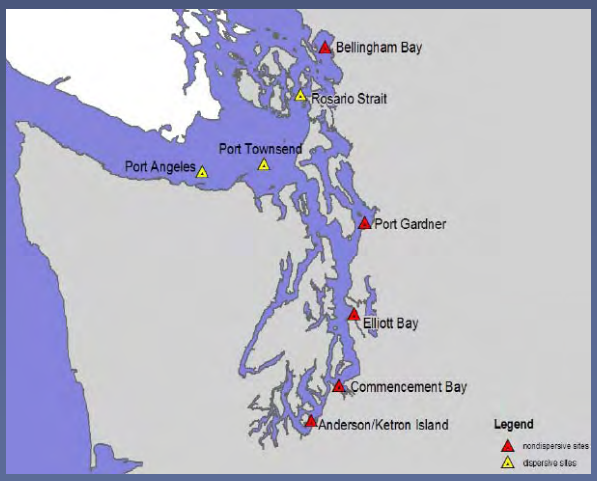
6.32

Dioxin/Furan Data Review & Implications for DMMP Policy Update



Mark Larsen
Anchor QEA

Presented to:
SMARM 2009
May 6th



9.1

Overview

1. Dioxin (and PCB) concentrations are declining in Puget Sound food chain
   - Shared Goal - Achieve Further Progress
   - Priority - Nearshore Environment
   - Original DMMP Helps Achieve This
2. Deep-Water DMMP sites are isolated from the food chain
   - Restricts linkage between DMMP sites and food chain quality
   - Important to setting goals for DMMP sites

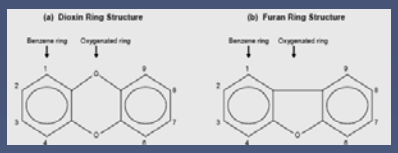
9.2

Overview

3. Physical factors limit exposure of sediments at DMMP sites
   - Need to consider these factors
   - Site goals ≠ DMMU criteria

9.3

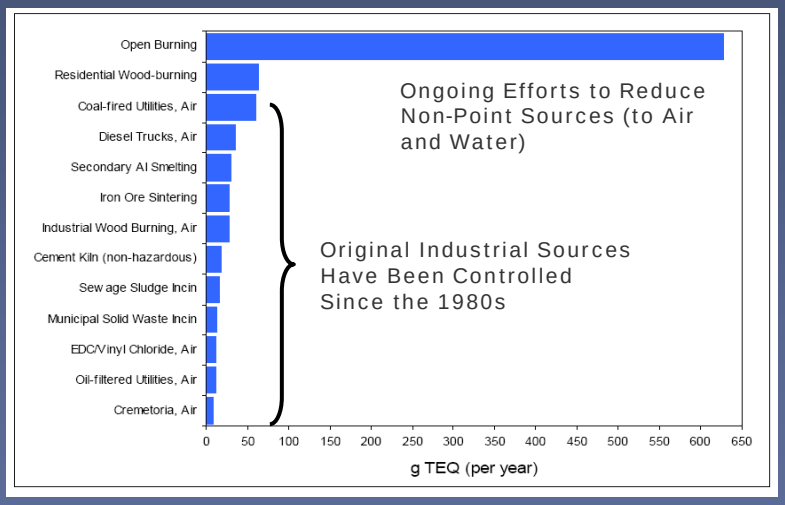
Dioxin Status



- Legacy Compounds
  - Natural, industrial, residential sources
- Sources are Declining
  - EPA estimates 89% reduction from reasonably estimable U.S. sources
    - Between 1987 & 2000 (EPA, 2005)
  - Similar declines in Canada and E.U.

9.4

Status of Source Control in U.S.

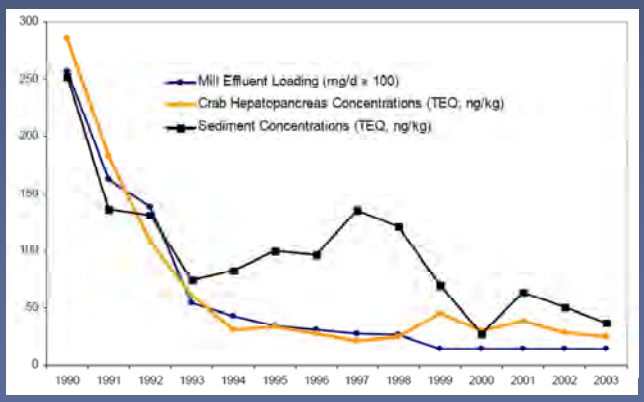


Data From U.S. EPA (2005)

9.5

Source Control – B.C. Pulp Mills

- Reductions in Loadings (9 B.C. Mills)
  - Reduced Sediment & Seafood Exposures

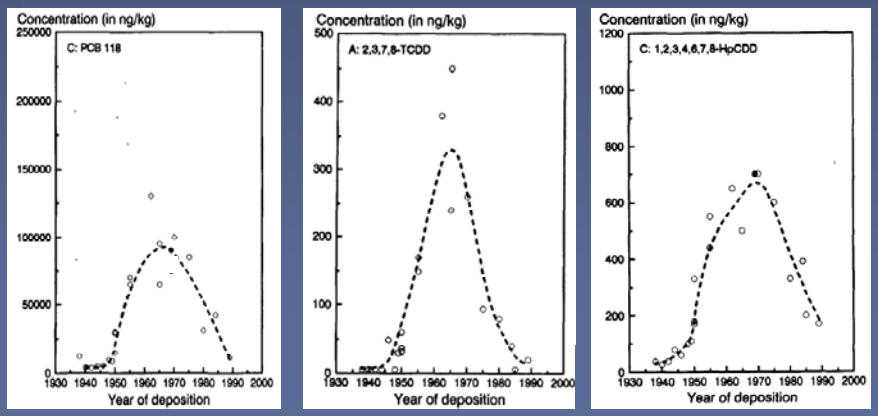


B.C. Ministry of Environment. 2005

9.6

Source Control – EU Monitoring

- Rhine River Monitoring
  - Reductions in PCBs, Dioxins, Other Pollutants



Beurskens et al. 1993.

9.7

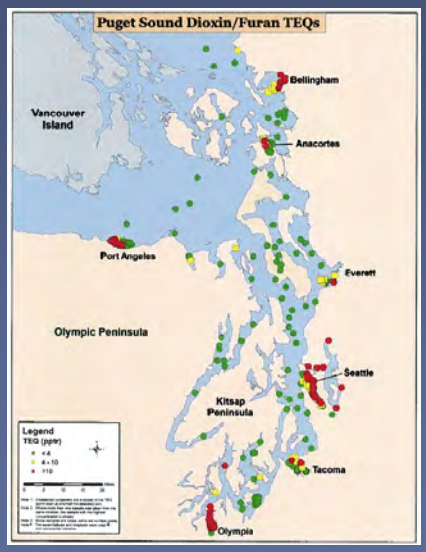
Reductions in Human Exposures

- Agency-Measured Declines
  - USDA Food Monitoring Program (USDA, 2009)
  - EPA Monitoring of Human Population
    - >50% Decline - 1980s to 1990s (EPA, 2003)
  - Similar Results - EU Monitoring Program

9.8

Puget Sound Monitoring Data

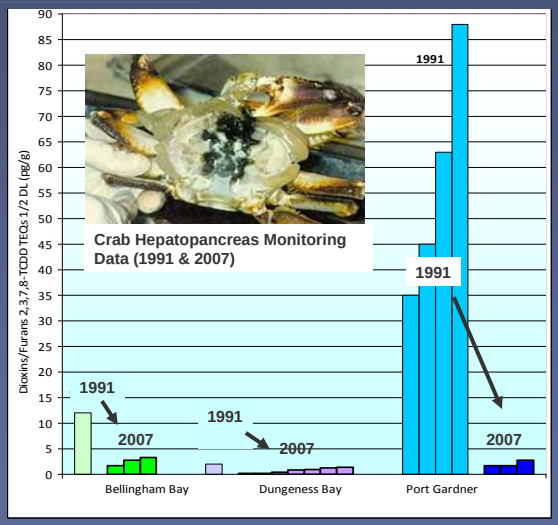
- Declining Food Chain Exposures
  - Shellfish (Crab)
  - Marine Birds (Heron)
  - Marine Mammals (Seals, Whales)



Seattle DMMO; 2009

9.9

Declines Observed in Puget Sound Crab Tissue Monitoring

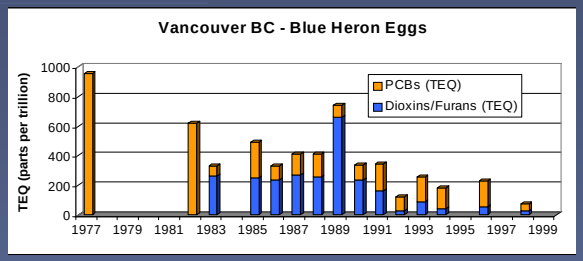


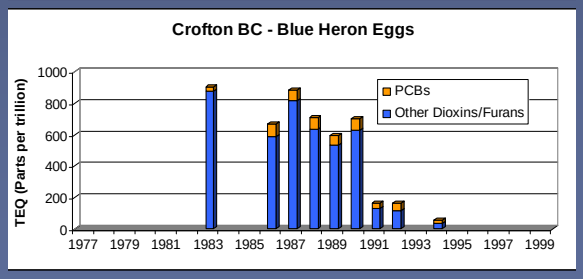
- Measured Declines
  - Urban Bays
  - Non-Urban Areas

Data From EPA, 1991; SAIC 2008 & Malcolm Pirnie, 2007

9.10

Marine Bird Monitoring – Georgia Straits





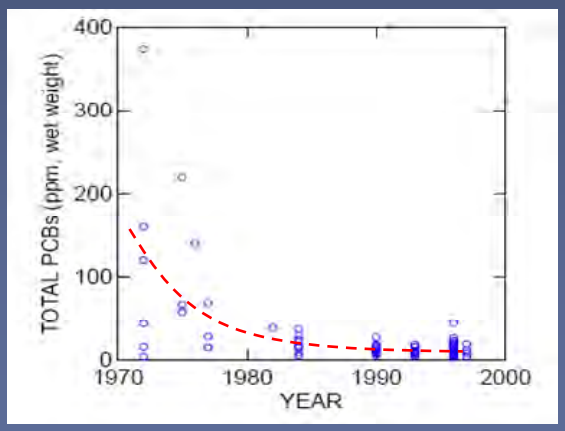
Data From Environment Canada, 2005b

- Measured Declines
  - PCBs
  - Dioxins

9.11

Puget Sound Seal Monitoring – PCBs

- Substantial Declines Since 1970s

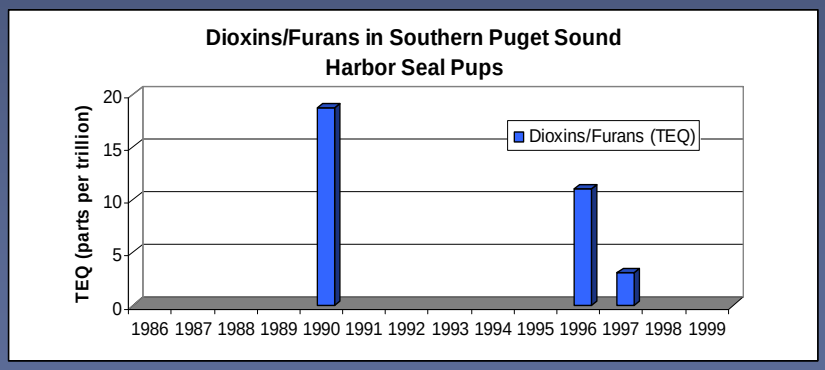


From Calambokidis et al, 1999 (Figure 2)

9.12

Puget Sound Seal Monitoring – Dioxins

- Substantial Declines Since 1980s



Neonate Data from Calambokidis et al, 1999 (Table 14)

9.13

Puget Sound Orca Monitoring

- Modeling & Monitoring of Declining PCB Concentrations in Orca Populations

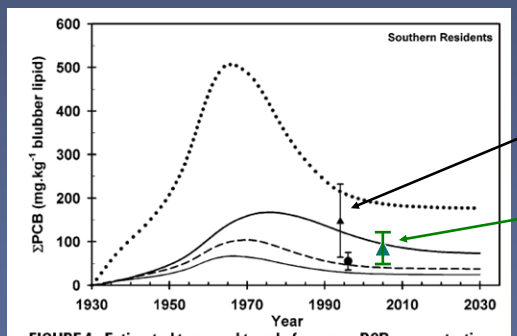


FIGURE 4. Estimated temporal trend of average PCB concentrations in four specific age classes (dotted line: 1-year-olds, dashed line: 11-year-old juveniles, thin solid line: 20-year-old females, thick solid line: 40-year-old males) for northern (upper) and southern residents (lower) using the dietary exposure profiles shown in Figure 2. Mean measured concentrations (±range) are also shown for males (▲) and females (●) as previously documented (*6*).

1996 Biopsy Data
(Avg. 146 +/- 33 mg/kg)
(n=4; mean age 44)

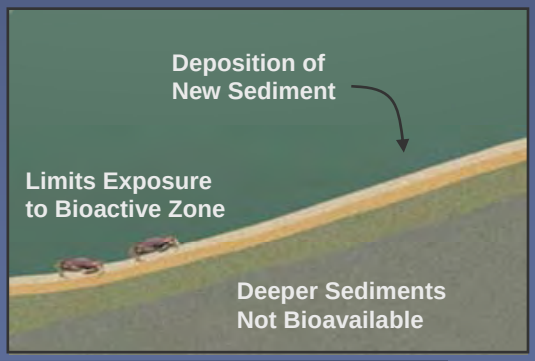
2004/2006 Biopsy Data
(Avg. 66 +/- 26 mg/kg)
(n=7; mean age 34)

Modeled Information From Hickie et al, 2007 (Figure 4); Updated Sampling Data from Krahn et al, 2007.

9.14

Restoration of Deep-Water Sediments in Puget Sound

- Natural Processes
  - Sedimentation at Depth
  - Safely Isolates Historic Sediments



9.15

Natural Sedimentation in Deep Basins

- Typically 1-3 cm/year Sedimentation Rates

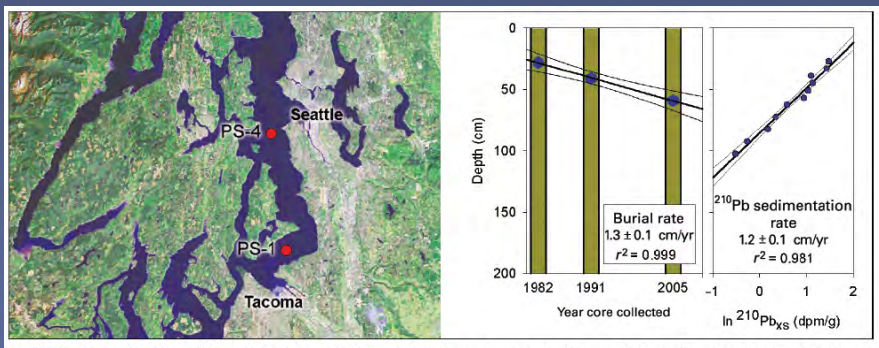


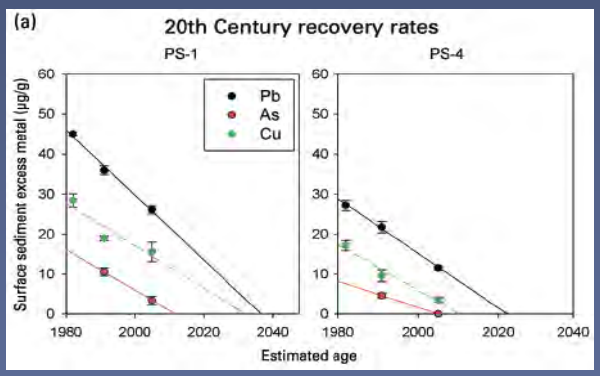
FIGURE 1. Coring locations PS-1 and PS-4 in central Puget Sound are located on the map (left). Sedimentation rates at PS-1 are calculated by burial rate as linear regression of peak in total Pb, with 95% confidence intervals, for cores collected in 1982, 1991, and 2005 (right: year core collected); and ^{210}Pb as linear regression, with 95% confidence intervals, of natural log excess ^{210}Pb activity versus accumulation in 2005 (right: ^{210}Pb sedimentation rate).

From Brandenberger et al., 2008

9.16

Natural Recovery of Sediment Quality

- Improving Sediment Quality Over Time

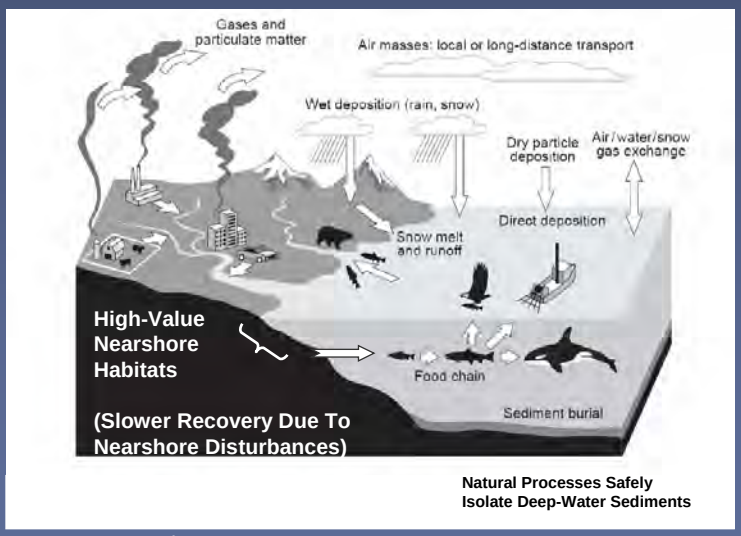


From Brandenberger et al., 2008

- Process Applies Equally for Dioxins

9.17

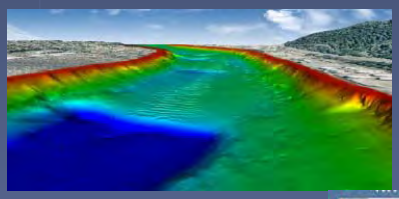
Further Improvement Requires Continued Reductions in Nearshore Environments



From Ross et al., 2004

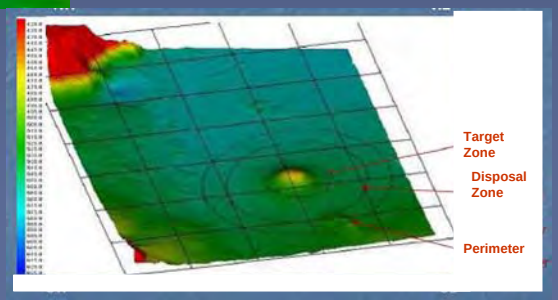
9.18

1. The Original DMMP Helps Reduce Puget Sound Food Chain Exposures



Program Isolates Nearshore Urban Sediments from Food Chain

20 Years of Safe Operation



ANCHOR QEA

9.19

Safety Factors Were Incorporated Into the Design of DMMP

2. Biological Factors
   - Locations of Sites
   - Size & Depths of Sites
3. Physical Factors
   - Natural Recovery Processes
   - Active Site Management

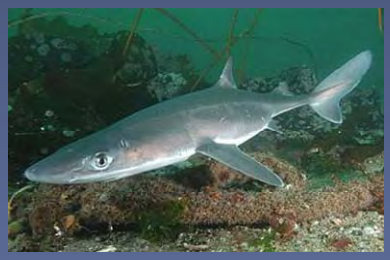
Important to Understand When Setting Goals and Criteria

ANCHOR QEA

9.20

Site Locations

- Most Sites in Deep Basins
  - Avoidance of Important Biota Use Areas



Dogfish & Six Gill Sharks
(Deep-Water Scavengers)

Ratfish
(Not Consumed)

9.21

Site Locations

- Limited Use by Seafood Species

English Sole
Ubiquitous in Puget Sound

Dungeness Crab
Infrequent at Depths
Of DMMP Sites

9.22

Sites Are Small Relative to Home Range

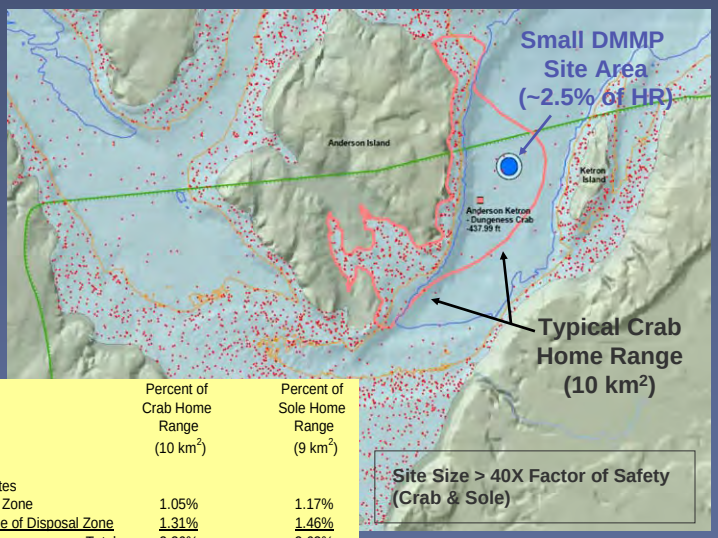
- Crab/Fish Movement
  - Tagging Studies; Telemetry Studies
  - Typical Crab HR Estimates ~ 10 km^2

Fig. 4. *Cancer magister*. Areas of distribution and movements of males fitted with ultrasonic transmitters. Arrows indicate large-scale movement. (A) Distribution from November 1989 through March 1990; (B) distribution from April through late July 1990; (C) distribution from late July through October 1990. Star symbols (n = 2) show where male crabs molted. Depth contours are in meters

From Stone et al., 2001.

9.23

Sites Are Small Relative to Home Range



	Percent of Crab Home Range (10 km^2)	Percent of Sole Home Range (9 km^2)
Non-Dispersive Sites		
Target Zone	1.05%	1.17%
Balance of Disposal Zone	1.31%	1.46%
Total	2.36%	2.63%

9.24

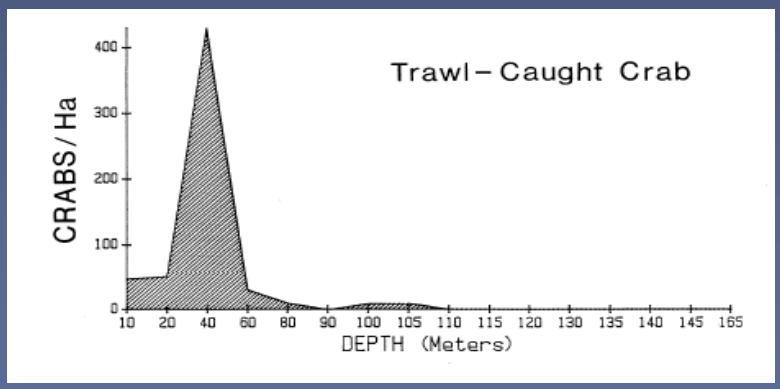
Sites Located in Deep Water Further Isolated from Food Chain

- Most Sites > 300 ft in Depth
  - Port Gardner (420 ft)
  - Elliott Bay (300-360 ft)
  - Commencement Bay (540-560 ft)
  - Anderson/Ketron (442 ft)

9.25

Limited Crab Use of Deep-Water Areas

- Port Gardner Trawl Studies (1986)
  - Additional Studies in Other Bays (1986-87)

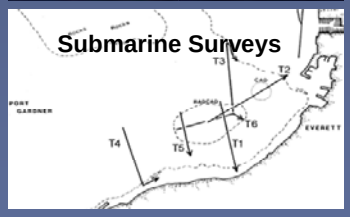


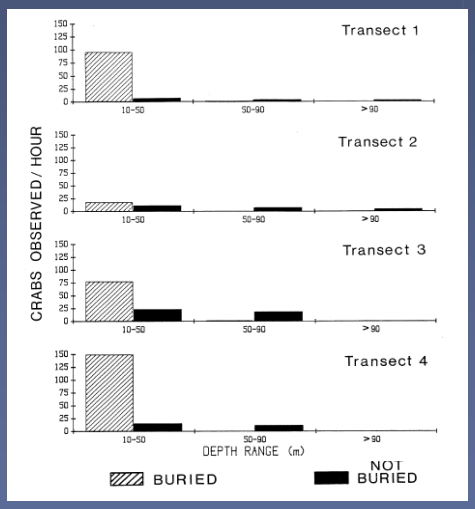
From Dinnel et al., 1987

9.26

Limited Crab Use of Deep-Water Areas

- Port Gardner 1987

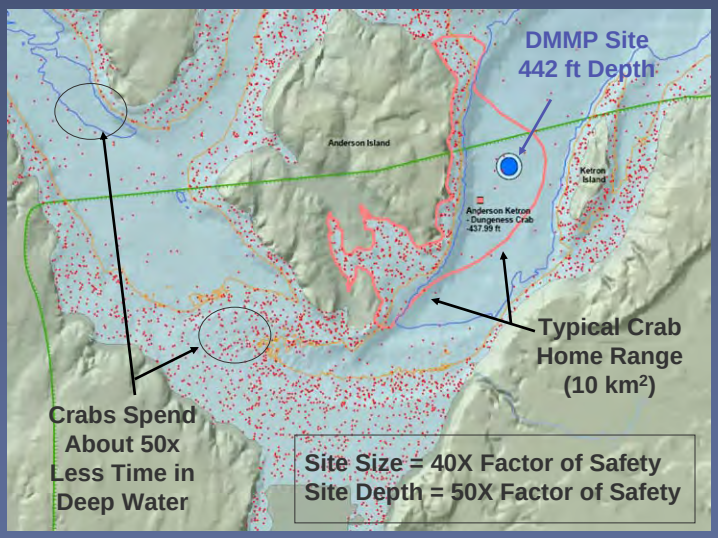




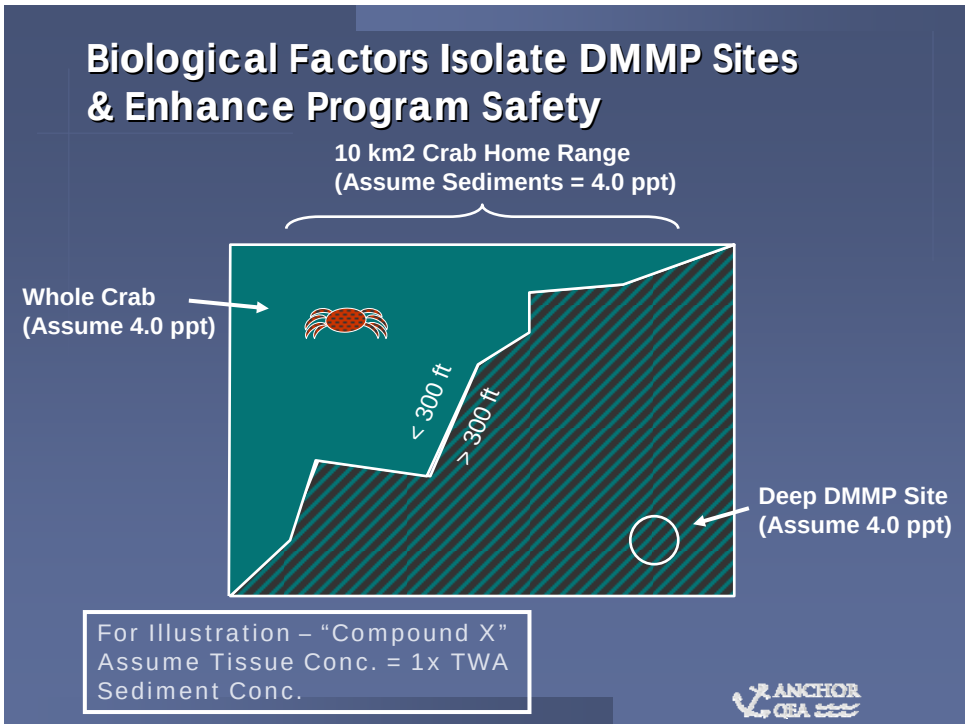
From Dinnel et al., 1987

9.27

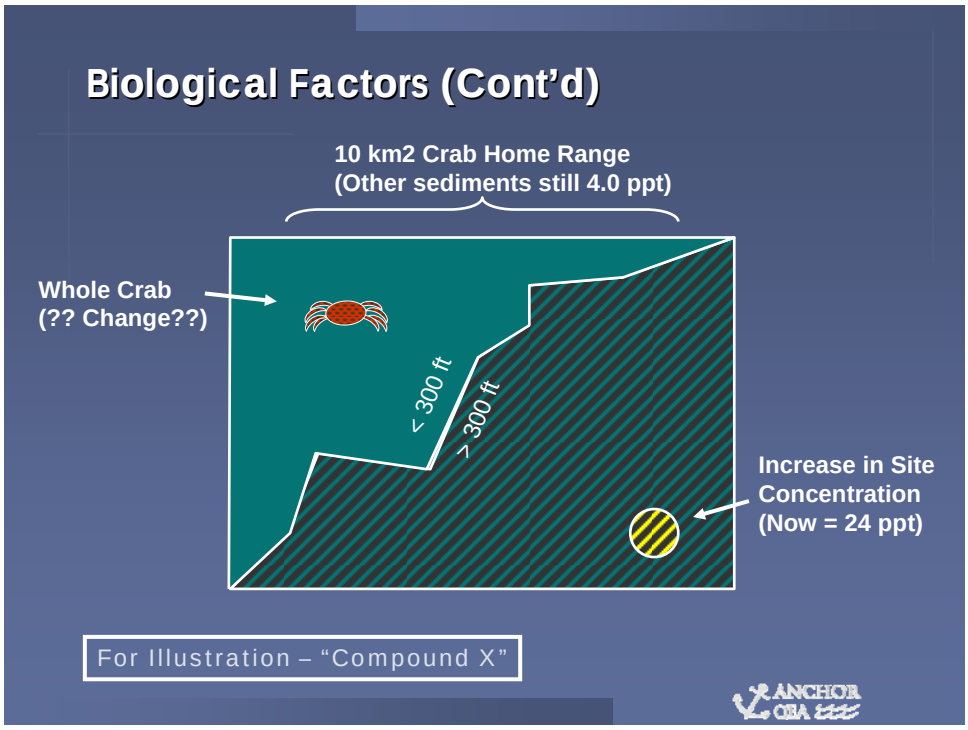
Deep-Water Locations Minimize Potential Food Chain Exposures



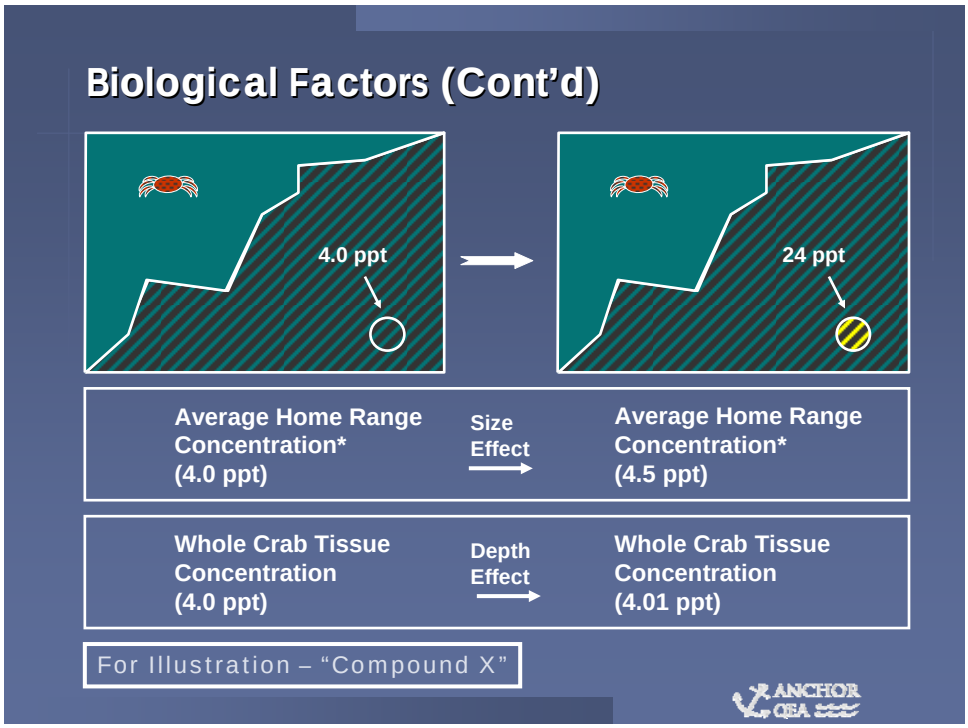
9.28


Biological Factors Isolate DMMP Sites & Enhance Program Safety
10 km2 Crab Home Range
(Assume Sediments = 4.0 ppt)
Whole Crab
(Assume 4.0 ppt)
< 300 ft
> 300 ft
Deep DMMP Site
(Assume 4.0 ppt)
For Illustration – "Compound X"
Assume Tissue Conc. = 1x TWA
Sediment Conc.
ANCHOR QEA

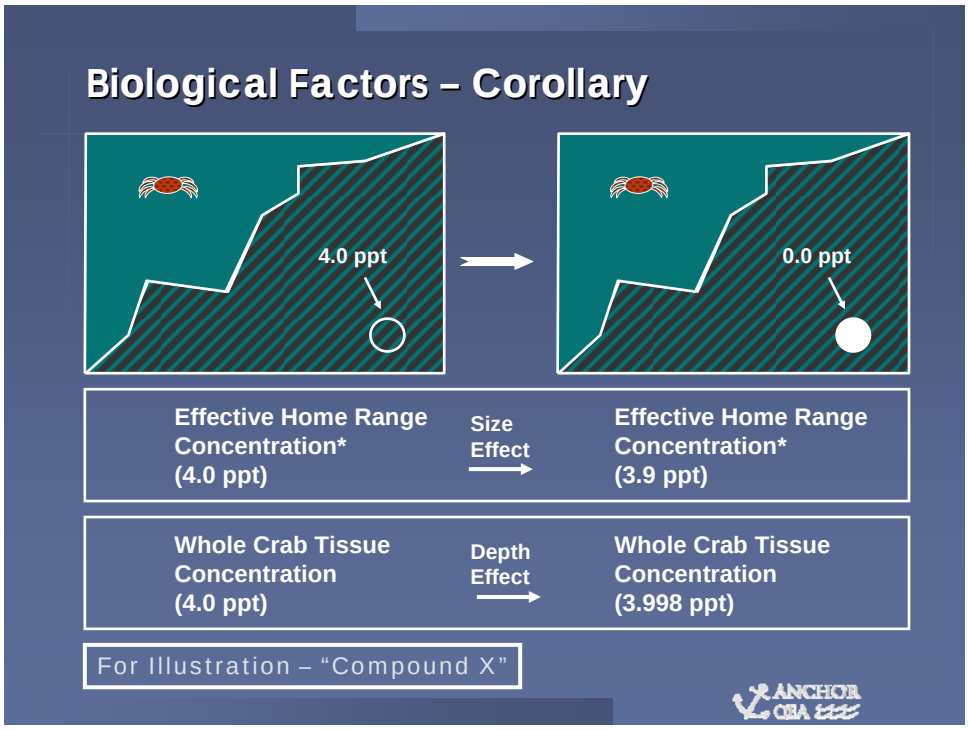
9.29


Biological Factors (Cont'd)
10 km2 Crab Home Range
(Other sediments still 4.0 ppt)
Whole Crab
(?? Change??)
< 300 ft
> 300 ft
Increase in Site
Concentration
(Now = 24 ppt)
For Illustration – "Compound X"
ANCHOR QEA

9.30


Biological Factors (Cont'd)
4.0 ppt
24 ppt
Average Home Range Concentration* (4.0 ppt)
Size Effect
Average Home Range Concentration* (4.5 ppt)
Whole Crab Tissue Concentration (4.0 ppt)
Depth Effect
Whole Crab Tissue Concentration (4.01 ppt)
For Illustration – "Compound X"
ANCHOR QEA

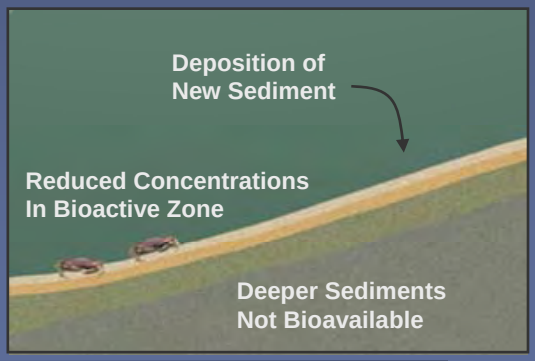
9.31


Biological Factors – Corollary
4.0 ppt
0.0 ppt
Effective Home Range Concentration* (4.0 ppt)
Size Effect
Effective Home Range Concentration* (3.9 ppt)
Whole Crab Tissue Concentration (4.0 ppt)
Depth Effect
Whole Crab Tissue Concentration (3.998 ppt)
For Illustration – "Compound X"
ANCHOR QEA

9.32

3. Physical Factors Provide Additional Protection

- Sediment Burial Limits Exposure
  - Natural Deposition
  - Active Site Management



9.33

Active Site Management

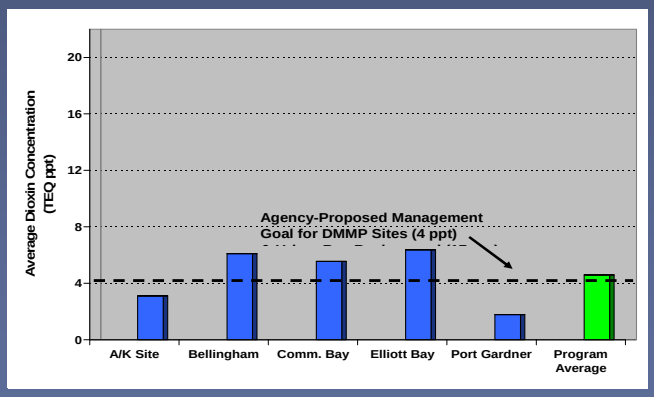
- Mixing & Burial of Placed Sediments
  - Urban Projects
  - Non-Urban Projects
  - Deep Native Projects
  - "Frequent-Flyer" Projects
- Volume Average Concentrations
  - 2006-2009: All Tested Projects ~ 4ppt

Site Concentration << Max. Disposed Materials

9.34

Recent Monitoring: 20 Years of Use Managing Urban Bay Sediments

- Well Below Urban Background Levels
  - Very Near Background-Based Goal



From SAIC, 2008 and Seattle DMMO, 2009.

9.35

Implications for Policy Update Based on the Data

1. Goal: Continue Progress of Last 20 Years
   - Improvements in Food Chain
   - Original DMMP is Part of this Progress
2. Set Appropriate DMMP Site Goals
   - Recognize Isolation of DMMP Sites from Food Chain when Setting Goals
3. Set Appropriate DMMU Criteria
   - Recognize Physical Factors
   - Site Avg. Goals << DMMU Max. Criteria

9.36

Concerns if Data are Ignored

1. Final Policy May Do More Harm than Good to the Food Chain
2. Economic Impacts May be Greater than Required to Meet a Specified Goal

9.37

References Cited

BC Ministry of Environment (2005). British Columbia Coast and Marine Environment Project: 2005. Industrial Contaminants. Strategic Policy Division. Ministry of Environment. Government of British Columbia.

Beurskins, Jacobus E.M., GE A.J. Mol, Hein L. Barreveld, Bert van Munster and Herman J. Winkels; 1993. Geochronology of Priority Pollutants in a Sedimentation Area Of the Rhine River. Environmental Toxicology and Chemistry, Vol. 12, pp. 1549-1566.

Brandenberger, Jill M., Eric A. Crecelius and Patrick Louchouarn; Historical Inputs And Natural Recovery Rates for Heavy Metals and Organic Biomarkers in Puget Sound During the 20th Century. Environ. Sci. Technol. 2008. Vol. 42 (18); 6786-6790.

Calambokidis, John; Steve Jeffries; Peter Ross and Michael Ikonomou, 1999. Final Report Temporal Trends in Contaminants in Puget Sound Harbor Seals. Prepared For EPA and Puget Sound Water Quality Action Team, 1999.

Dinnel, P.A.; D.A. Armstrong; B.S. Miller; R.R. Lauth. 1987. Use of the Pisces IV Submersible for determining the distributions of Dungeness Crab, Shrimp, and Bottomfish in Port Gardner Washington. Final Report October 1987. UW Fisheries Research Institute. FRI-UW-8709.

9.38

References Cited (Cont'd)

Environment Canada, 2005a. Dioxin/furan levels: An indicator of toxic contaminants In coastal BC. Environment Canada, Pacific and Yukon Region. Available: www.ecoinfo.ec.gc.ca.envind/region/dioxinfuran/dioxin_e.cfm.

Environment Canada, 2005b. Toxins in great blue heron eggs: An indicator of Contaminants in the Georgia Basin. Available: www.ecoinfo.ec.gc.ca/ Env_ind/region/gbhtoxin/gbhtoxin_e.cfm.

Hickie, Brendan E.; Peter S. Ross, Robie W. Macdonald, and John K. B. Ford; 2007. Killer whales (Orcinus orca) face protracted health risks associated with lifetime Exposure to PCBs. Environ. Sci. Technol. 41 (18), 6613-6619. August 2007.

Krahn, Margaret M.; M. Bradley Hanson; Robin W. Baird; Richard H. Boyer; Douglas G. Burrows; Candice K. Emmons; John K.B. Ford; Linda L. Jones; Dawn P. Noren; Peter S. Ross; Gregory S. Schorr; Tracy K. Collier; 2007. Persistent organic pollutants and stable isotopes in biopsy samples (2004/2006) From Southern Resident Killer whales. Marine Pollution Bulletin.

References Cited (Cont'd)

Malcolm Pirnie, 2007. Phase 2 Addendum Remedial Investigation for the Marine Environment Near the Former Rayonier Mill Site, Port Angeles. Washington. Prepared for Rayonier, Jacksonville, Florida. Agency Review Draft February, 2007.

Ross, P.S., S. Jeffries and J. Calambokides. 2004. Southern Resident Killer Whales At Risk: Contaminant-related health risks. Presentation at NMFS March 2004. Seattle, Washington.

EPA, 1991; Puget Sound Estuarine Studies: Dioxin and Furan Concentrations in Puget Sound Crabs. EPA 910/9-040.

Science Applications International Corporation (SAIC), 2008. Dioxin/furan concentrations At the non-dispersive open-water dredged material disposal sites in Puget Sound. Prepared for the Washington Department of Natural Resources. Available as part of the 2009. DMMP Issue Paper – SMARM 2009. Proposal to revise the Open-water disposal guidelines for dioxins in dredged material. http://www.nws.usace. army.mil/PublicMenu/Menu.cfm?sitename=DMMO&pagename=Dioxin_Work_Group.

References Cited (Cont'd)

Seattle DMMO. 2009. Presentation on the proposal to revise the open-water disposal Guidelines for dioxins in dredged material. Presented at the U.S. Corps of Engineers. March 11, 2009.

Stone, Robert P.; Charles E. O'Clair. 2001. Seasonal movements and distribution of Dungeness Crabs Cancer Magister in a glacial southeastern Alaska estuary. Marine Ecological Progress Series. Vol. 214: 167-176.

U.S. Department of Agriculture. 2009. Animal Plant Health Inspection Service. Centers for Epidemiology and Animal Health.Available:http://www.aphis.usda.gov/vs/ ceah/cei/taf/emerginganimalhealthissues_files/dioxins.htm#activities

U.S. EPA. 2003. Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds. Part III: Integrated Summary and Risk Characterization for 2,3,7,8TCDD and Related Compounds. NAS Review Draft. National Center for Environmental Assessment. Office of Research And Development. U.S. EPA. Washington D.C. December 2003. Available: http:// www.epa.gov/ncea/pdfs/dioxin/nasreview/#part3.

9.41

References Cited (Cont'd)

U.S. EPA. 2005. The Inventory of Sources and Environmental Releases of Dioxin Like Compounds in the United States: The Year 2000 Update. EPA/600/P-03/002A. National Center for Environmental Assessment. Washington. DC. Available: http:// www.epa.gov/ncea/pdfs/dioxin/2k-update.

9.42

DMMP Pilot Program Proposal

Mike Stoner

Environmental Director
Port of Bellingham

Presented to

SMARM 2009

May 6th

10.1

Importance of DMMP Program

- Water Dependent Commerce
  - *Thousands of Jobs in Whatcom County*
- Environmental Cleanup
  - *Projects currently on hold due to interim policy*
- Habitat Restoration
  - *Bellingham Bay Pilot*

Sustainable Ecosystem-based Program Management

10.2

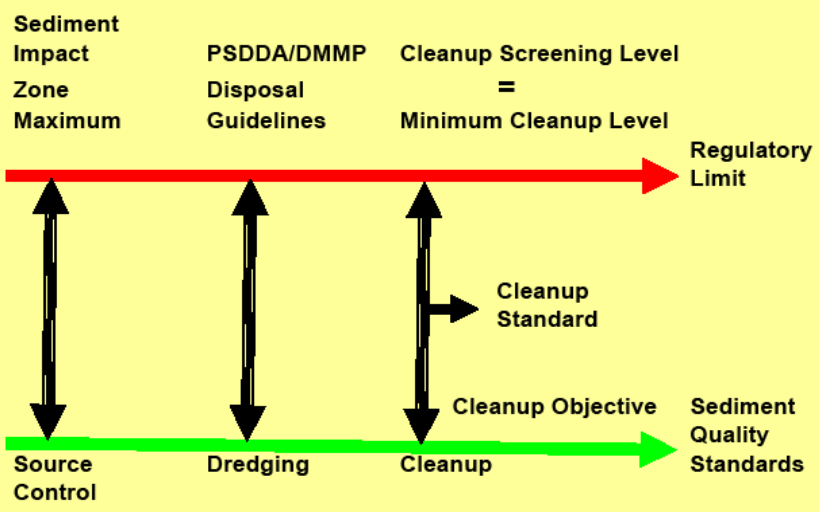
DMMP Guiding Principles

- Regulatory Beauty
- Sound Science
- Navigation & Commerce
- Adaptive Management

The Balance between Sensitivity and Reliability

10.3

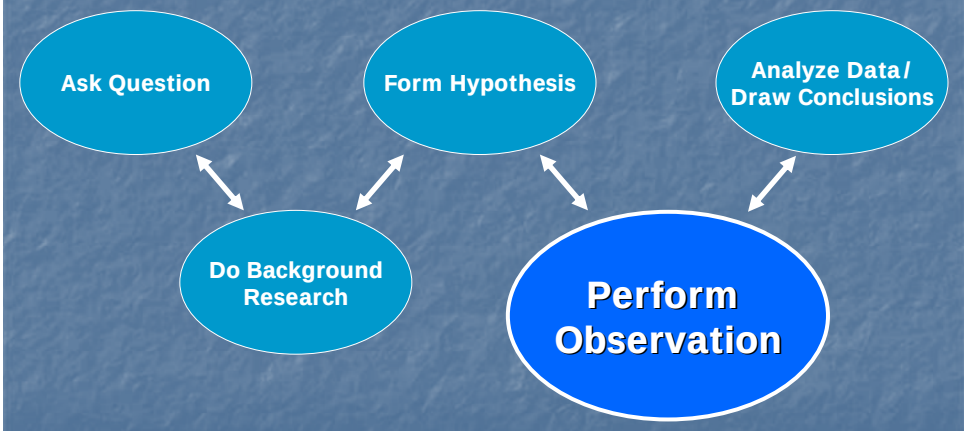
"Regulatory Beauty"



David Kendall USACE 2007 WPPA Conference

10.4

Sound Science



Ensure DMMP Changes are based on Sound Science

10.5

Pilot Proposal Framework

1. Establish Technical Working Group
2. Perform Historical Data Analysis
3. Develop & Implement Pilot Program
4. Monitor DMMP Sites & Dredging Activity
5. Recommend Dioxin Policy Adjustment

What is the incremental risk/benefit posed by DMMP?

10.6

Technical Data Approach

- Establish criteria for DMMP test sites & control sites
- Track volume/concentration of dredge material loading
- Monitor surface concentration at DMMP sites
- Monitor benthic & crab/fish tissue

How does management goal relate to seafood resources?

10.7

Pilot Program Tasks

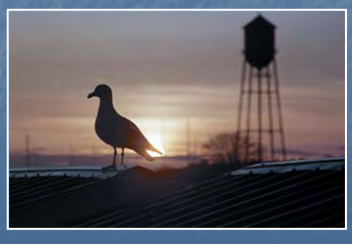
- Compare DMMP sites to PSAMP reference
- Measure fishing activity at DMMP sites
- Track use of DMMP sites
- Measure impact/benefit to nearshore
- Evaluate potential food chain impacts
- Recommend dioxin policy adjustment based on Pilot Program observations

Protect the DMMP as a National Model

10.8

Moving Forward

- DMMP Pilot Program
  - *Close remaining data gaps*
  - *Ensure DMMP adjustments are based on sound science*
  - *2-3 year program (shared funding)*
- Understand Impacts of DMMP Adjustments
  - *Water dependent commerce*
  - *Environmental/habitat restoration*



2009 SMARM Issue Paper:

Dioxin Data – Clarification of SRM Analysis and Validation Requirements

Ann K. Bailey
EcoChem, Inc., 710 Second Avenue, Suite 660, Seattle, WA 98104
abailey@ecochem.net

11.1

Batch Quality Control

Routine

- Method blank
- Laboratory control sample (LCS)
- Matrix spike (MS)
- Laboratory duplicate (or MS duplicate)

Dioxin Data for DMPP

- LCS replaced with Ongoing Precision and Recovery sample (OPR)
- No MS (because each sample spiked with labeled compounds)
- Field Duplicate (optional?)
- Reference Material analysis (NIST SRM 1944 recommended)

11.2

Reference Material

Advantages

- Homogenous
- Well-characterized
- Analyte incorporated into matrix
- Range of analyte concentrations
- Stability assessed

Disadvantages

- Limited matrices available
- Cost

11.3

Reference Material

NIST SRM 1944 (NY/NJ Waterway Sediment)

Well-characterized

Dioxin lab should have past experience with its analysis

DMMP Current Guidance:

If SRM performance poor,
then "raw data" validation is required.

However, validation cannot improve analytical performance!

11.4

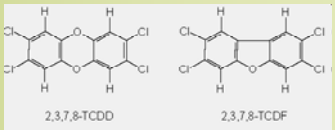
Recommend:

NIST SRM 1944 analysis required with each sample batch. (Currently analysis is optional and states one analysis per "project".)

Acceptance criteria for SRM results be specified in laboratory contract (based on 95% CI). If outside contract criteria, laboratory must determine analytical reason and perform re-analysis, as appropriate (currently raw data validation required rather than re-analysis).

Important all dioxin data be validated

- If QA1 validation , then evaluated and qualified based on:
  - Sample handling
  - Method blank
  - QC results recovery
- If QA2 (raw data) validation, then QA1 plus:
  - Peak identification
  - Calculation verification



During QA1 validation only, peak identification not evaluated, thus "K" flags not converted to "U" flags if interference

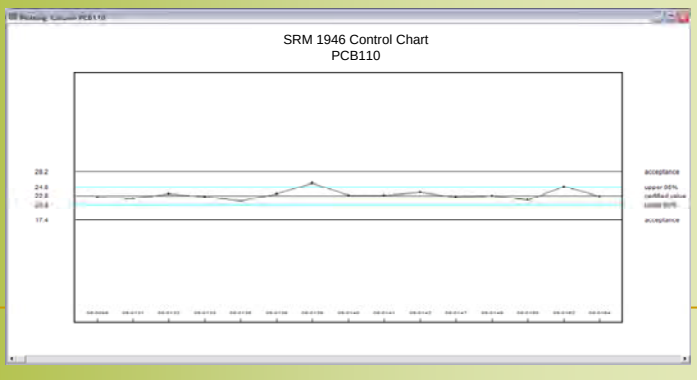
If application of qualifiers not consistent, then data may not be comparable

Recommend:
All dioxin data receive QA2 validation

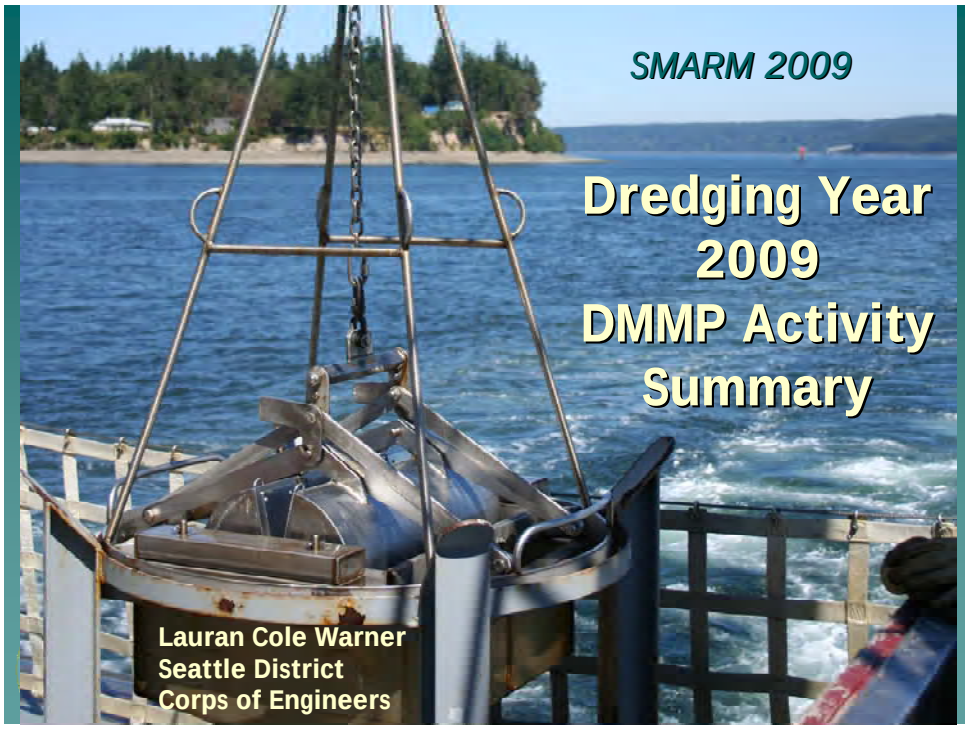
11.7

"Measurement results can only be credible as some degree of consistency is attained."

John K. Taylor
Quality Assurance of Chemical Measurements (1987)



11.8



12.1

Big Themes of 2009

- Bold survey
- Lots of projects
- RSET
- Dioxin

12.2

What DMMP Does

Based on existing regulations and current guidelines, we evaluate potential dredged material for suitability for open-water disposal.

12.3

DMMP Actions

- Suitability Determination
- Recency Extension
- Exclusion from Testing
- Volume Revision
- Anti-Degradation Determination

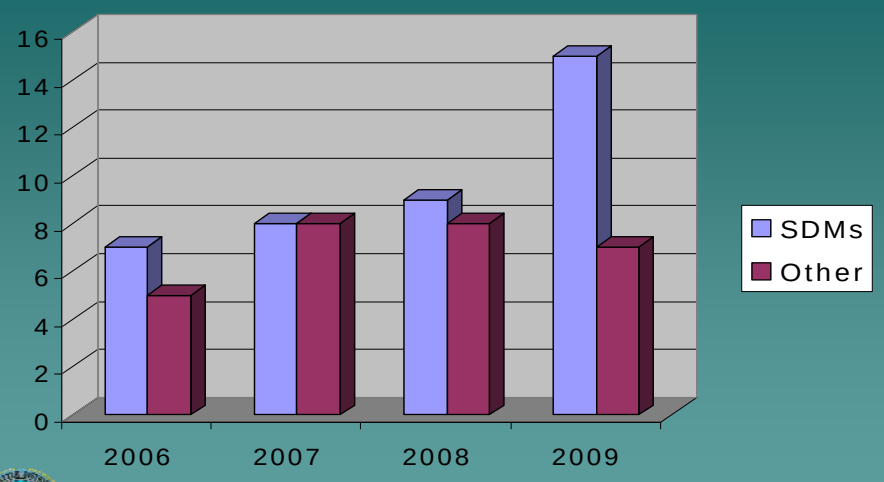
12.4

Dredging Year 2009
June 16, 2008 – June 15, 2009

- Completed Projects:
  - 15 Suitability Determinations
  - 3 Anti-degradation Determinations
  - 2 Volume Revisions
  - 1 Exclusionary Determination
  - 1 Water Quality Characterization

12.5

Dredging Year 2009



12.6

Project Volumes

Category	Volume Considered	Volume Suitable	% Unsuitable
Exclusionary	88,800	88,800	0
Volume Revision	8,978	8,978	0
SDM	3,879,584	3,703,357	4.5
Totals	**3,977,362**	**3,801,135**	**4.4**

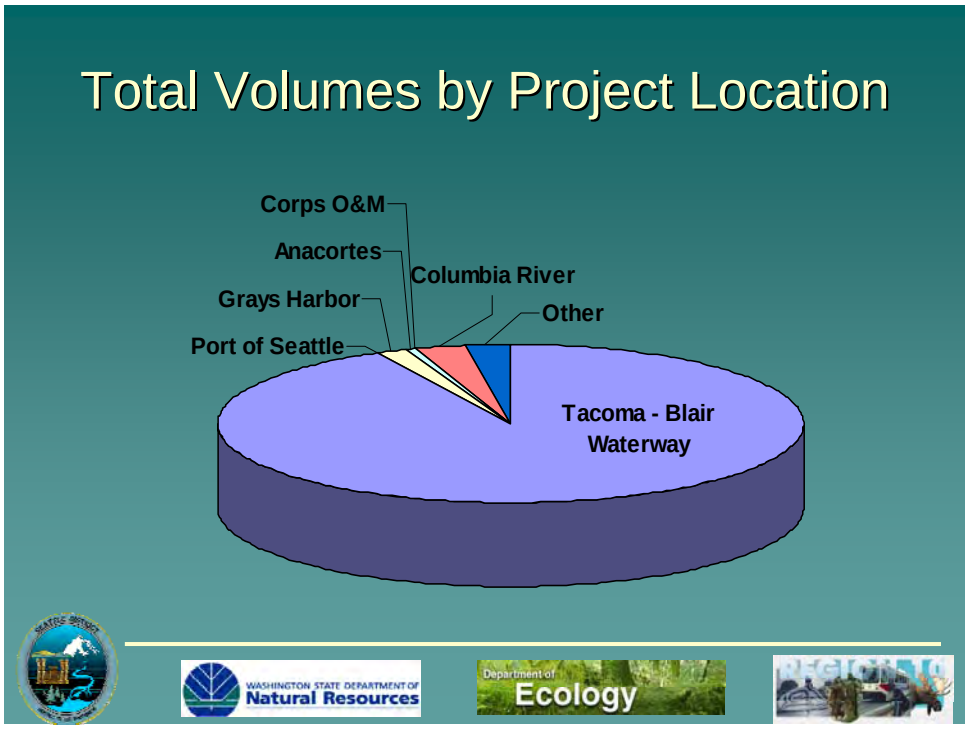
12.7

Suitability Determinations in DY09

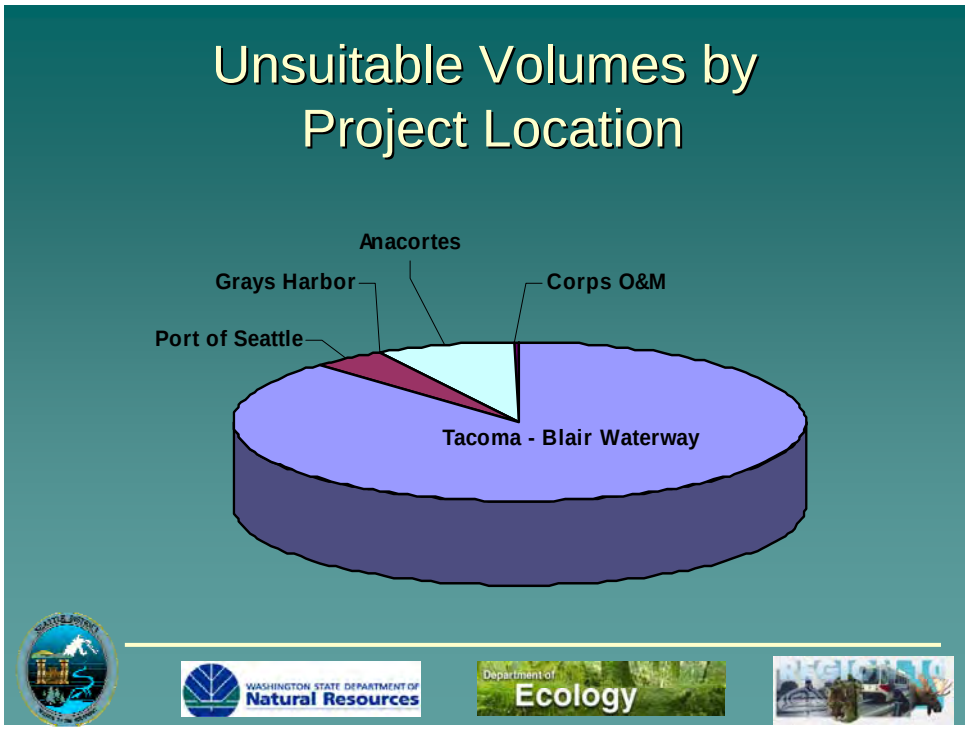
15 projects conducted testing

- 12 projects included dioxin testing
- 2 projects conducted bioassays
- No bioaccumulation testing
- 6 projects had unsuitable material

12.8


Total Volumes by Project Location
Corps O&M
Anacortes
Columbia River
Grays Harbor
Other
Port of Seattle
Tacoma - Blair Waterway
WASHINGTON STATE DEPARTMENT OF Natural Resources
Department of Ecology

12.9


Unsuitable Volumes by Project Location
Anacortes
Grays Harbor
Corps O&M
Port of Seattle
Tacoma - Blair Waterway
WASHINGTON STATE DEPARTMENT OF Natural Resources
Department of Ecology

12.10

Biological Testing

- Two completed projects with bioassay testing; one DMMU in 1 project failed due to larval hit

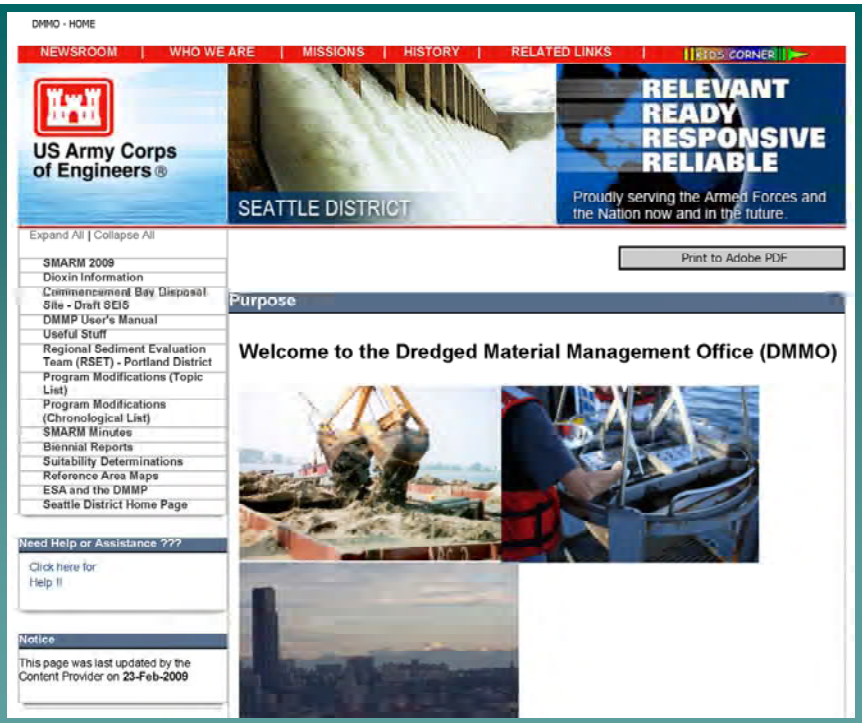
- Two O&M projects underwent bioassay testing; results still pending

12.11

In the Pipeline

- O&M: Grays Harbor, Duwamish, Snohomish
- Anacortes: Scott Paper Mill, Skyline Marina
- Projects at Port of Everett, Port of Grays Harbor, and Columbia River

12.12



12.13

For more DMMP information

http://www.nws.usace.army.mil

Click on “Dredged Material Management”

12.14

US Army Corps of Engineers
Portland District

Regional Sediment Evaluation Team and Sediment Evaluation Framework Update for SMARM 2009

Marci E. Cook
Project Manager, Regional Sediment Evaluation Team, Sediment Evaluation Framework and Portland Project Review Group
Portland District Corps of Engineers

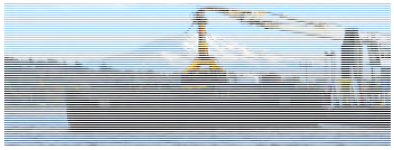
BUILDING STRONG℠

13.1

US Army Corps of Engineers
Portland District

RSET Update

- RSET considered all comments received on the 2009 Draft of the Final SEF
- Responses have been prepared and will be placed on the RSET webpage at the end of May 2009. Web address is: https://www.nwp.usace.army.mil/pm/e/rset.asp
- RSET hopes to meet with the Ports and other stakeholders to discuss theirs concerns during the summer of 2009
- Publication of the Final SEF is still projected for the end of May 2009



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13.2

US Army Corps of Engineers
Portland District

SEF Update

- Final Draft SEF public notice closed on March 25, 2009
- 15 comment letters received:
  1. EPA Region 10
  2. WA. Department of Natural Resources
  3. WA Public Ports Association
  4. Pacific Northwest Waterways Association
  5. Port of Skagit
  6. Port of Vancouver
  7. Port of Seattle
  8. Port of Tacoma
  9. Test America
  10. Friends of the Earth
  11. Tetra Tech
  12. NW Aquatic Resources
  13. Schwabe, Williamson & Wyatt
  14. 2 private citizens

BUILDING STRONG℠

13.3

US Army Corps of Engineers
Portland District

SEF Update

- **Overall Concerns from Comment Letters**
  1. **Transparency, accountability, predictability, consistency and equity**
     a. The goal of RSET is to ensure all of the above. We are constantly working to improve our processes and will continue to into the future.
  2. **SEF as a clean up document**
     a. Initially the SEF was going to be used as a guide for environmental clean up dredging in addition to routine dredging.
     b. The SEF currently does not address clean up dredging.
  3. **Bioaccumulation (Chapter 8)**
     a. RSET recognizes the issues associated with implementing Bioaccumulation testing and will continue to work on addressing those issues
  4. **That the SEF will be replacing PSDDA**
     a. The SEF approach was developed to cover the entire Pacific Northwest region and incorporates and expands much of the good science developed through DMMP.
     b. The SEF recognizes the need for local/regional differences in both science and process and provides that flexibility; the PSDDA program is consistent with this flexibility. The DMMP process will not change based on the guidance in the SEF

BUILDING STRONG℠

13.4

SEF Update

- **Freshwater Sediment Quality Guidelines (SQG)**
  - Oregon Dept of Environmental Quality and WDOE have been working with the subcommittee to develop the values
  - ODEQ anticipates having public meetings in the summer of 2009
  - If RSET adopts the numbers, the SEF will be updated via the website

US Army Corps of Engineers
Portland District

What's Next for RSET and SEF?

- RSET will continue to work with stakeholders on SEF improvements
- RSET will continue to have monthly meetings
- RSET will hold a yearly update meeting, similar to the SMARM, in Portland
- RSET will be working with Idaho regulatory agencies and the Walla Walla District to stand up their Project Review Group.
- As needed, any changes or modifications that are made to the SEF (e.g. , Freshwater SQG's) will be done via the RSET webpage.

Questions?

Commencement Bay Draft **Supplemental Environmental Impact Statement**

Reauthorization of the Dredged Material Disposal Site

May 2009

14.1

Purpose of this Update

- Inform Stakeholders on status and schedule of recently released draft Supplemental Environmental Impact Statement (SEIS) involving reauthorization of the Commencement Bay Dredged Material Disposal Site

14.2

SEIS Schedule

- Recently completed Draft SEIS prepared with DNR funding (through EPA / Corps Interagency Agreement) under Corps contract
- Draft SEIS distributed by hard copies/CD's to federal, state, local, and regional agencies for formal Public Interest Review on April 24, 2009, after filing with EPA and publishing Notice of Availability in Federal Register
- NEPA Public review and 45 day comment period ends on June 8, 2009
- This may be only time to comment under SEPA relative to SEIS meeting SEPA Guidelines

SEIS Schedule (continued)

- DMMP agencies will review and respond to all public comments, and amend SEIS as necessary, and add comment/response section to Final SEIS
- Final SEIS will be distributed for 30-day Wait Period, to allow last minute "significant" public comments
- A Record of Decision Amendment (ROD) will then be prepared and signed by the Corp's District Engineer and EPA Regional Administrator
- Washington State (DNR as SEPA lead) will determine, whether to adopt SEIS as their environmental checklist under SEPA

Document Availability

- Draft SEIS is available on Seattle District website: http://www.nws.usace.army.mil
  Click on Dredged Material Management, and then from webpage click on Commencement Bay SEIS to link to documents (11 mb)
- Limited CD copies are also available on request: Dr. Stephen Martin (206/764-3631) or Courtney Wasson (360/902-1083)

Key Draft **SEIS** Content

- Explanation of Purpose and Need
- Analysis and Impacts of selected alternatives
- Compliance with Federal, State, Tribal (U&A Trust responsibilities), and Local environmental regulations
- MDFATE (multi-disposal-fate) Analysis of the future disposal site capacity up to **23 mcy**
- Analysis to confirm the depositional environment and sediment transport Potential near the disposal site
- Technical Appendix (summary of environmental data collected near or at site and all monitoring conducted)
- Draft SEIS Concludes that alternatives evaluated will not result in significant impacts on Commencement Bay environmental resources

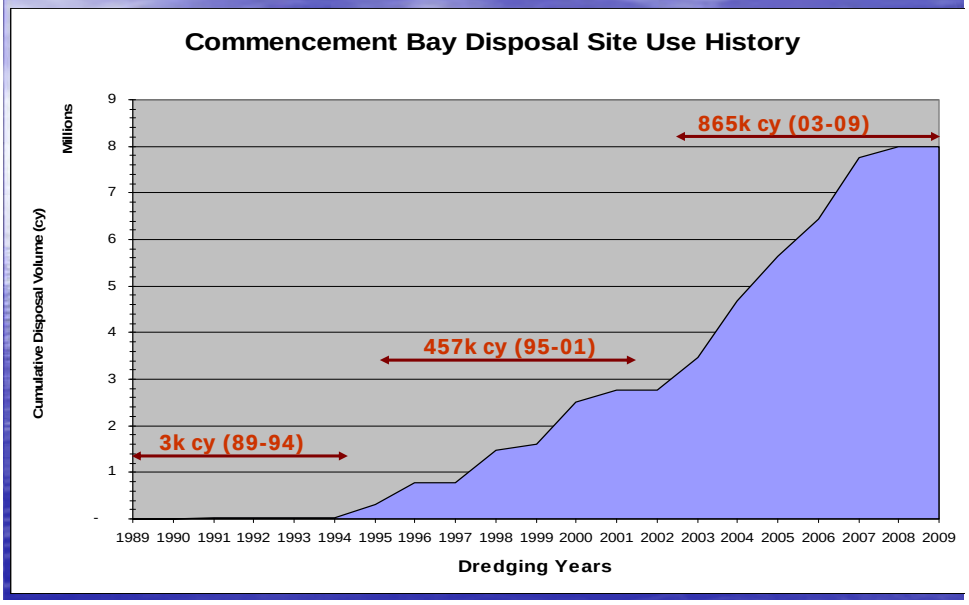
Need

- Site is approaching originally authorized Volume (9 mcy); currently at 8.0 mcy
- Continued need for disposal of suitable dredged material at reasonable cost
- Future development in Commencement Bay indicates continued strong stakeholder need for this disposal site
- SEIS evaluates cumulative site volumes up to 23 mcy

Commencement Bay Draft SEIS
Reauthorization of the Dredged Material Disposal Site

14.7

Cumulative Disposal Volume



14.8

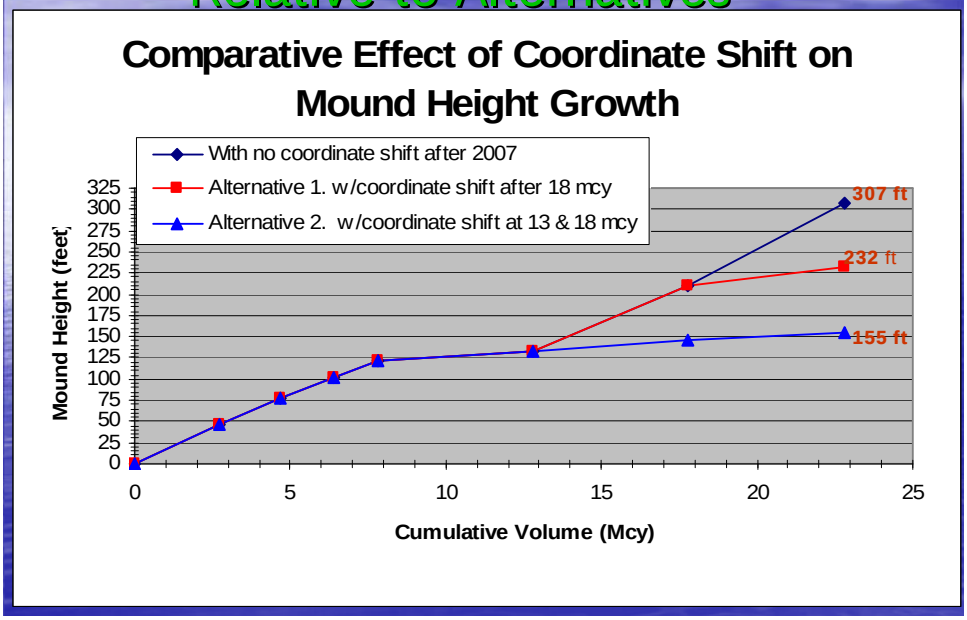
Selected Alternatives (analyzed in depth)

- **Alternative 1**: Establish new permit volume of 23 mcy with SW site coordinate shift within Target Area at 18 mcy
- **Alternative 2 (Preferred)** : Establish new permit volume of 23 mcy with site coordinate shifts within Target Area: SW at 13 mcy, and NE at 18 mcy
- **Alternative 3**: No Action (close site)

Mound Height Management

- Surveys show mound of disposal material has smaller diameter than predicted, largely remaining within target zone due to dredged material characteristics
- This resulted in a mound higher and narrower than the 1988 EIS prediction
- Water depth still in excess of 400 feet (at top of the mound = 121 ft, as measured in 2007)
- Disposal coordinates within Target were shifted in 2007 565 feet to southeast corner
- DMMP established site management goal: **Mound Height <250 ft**

Mound Height Management Relative to Alternatives



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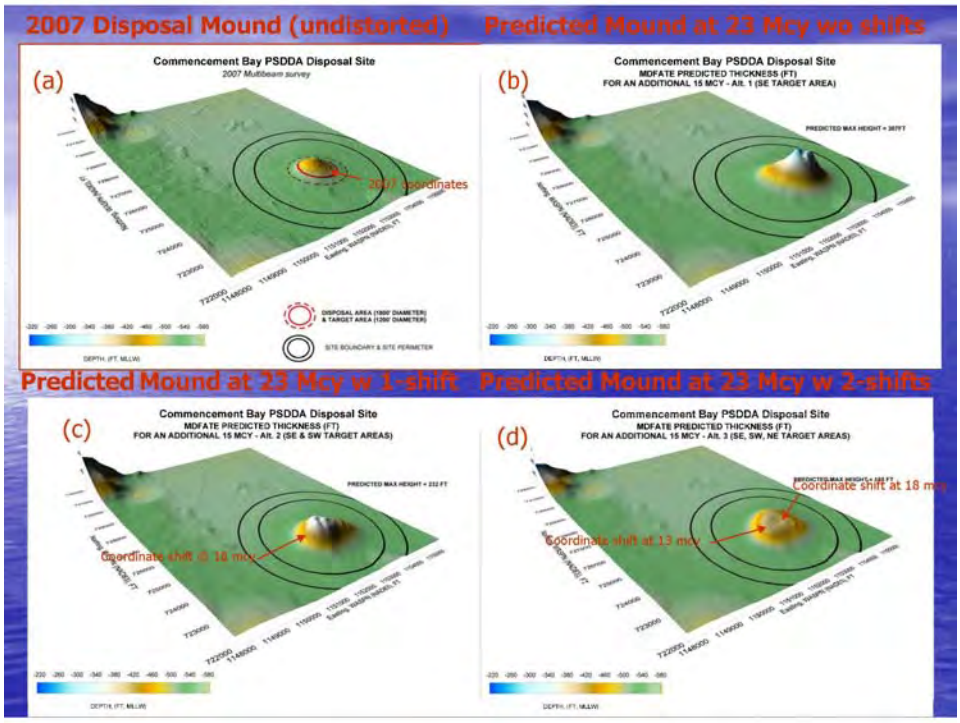

14.12

DMMP's Management of the Site

- One of the most intensively monitored disposal sites in the country
- Monitored 8 times since designation
- Results evaluated against **6 testable hypotheses** using updated Monitoring Plan
- With few exceptions the disposal site has performed within management criteria

Public comments must be submitted by July 6, 2009
Comments can be sent to David.R.Kendall@usace.army.mil
For dioxin, please send comments to
dioxinproject@floydsnider.com

APPENDIX 4

SMARM 2009 PUBLIC ISSUE PAPERS

1. Eric Johnson, Washington Public Ports Association. Proposal to Reconsider Proposed Changes to the Open-Water Disposal Guidelines for Dioxins in Dredged Material.
2. Patrick Jones, Director. Washington Working Waterfront Coalition: Comments to 2009 SMARM.
3. Mike Stoner, Port of Bellingham (Environmental Director). Pilot Project Proposal.
4. Jay Bornstein, Bornstein Seafoods. Letter in support of the Pilot Project Proposal.
5. Ann Bailey, President, EcoChem, Inc. Clarification regarding reference material analysis and Data Validation requirements for Dioxin data..

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1. PROPOSAL TO RECONSIDER PROPOSED CHANGES TO THE OPEN-WATER DISPOSAL GUIDELINES FOR DIOXINS IN DREDGED MATERIAL

Submitted by Eric Johnson, Washington Public Ports Association

INTRODUCTION

For more than 20 years, the Washington Public Ports Association ("Association") has worked cooperatively with government and industry to implement sensible policies for the responsible disposal of navigational dredging sediments with the goal of adopting policies that promote economic activity, environmental stewardship and the public health.

The Association was one of the key stakeholders that helped develop policy when the Puget Sound Dredged Disposal Analysis ("PSDDA") was initiated in the mid-1980s. Since the beginning, policy development was marked by a recognition that disposal in "relatively deep marine waters is expected to be a preferred option for environmental, as well as economic reasons" and "dredged material disposal at unconfined, open-water sites has very little potential for affecting the overall ecosystem of Puget Sound."[1]

Recognizing that dredge projects benefit both the environment and the economy, the Dredged Materials Management Program ("DMMP") worked diligently to create policies that provide a safe, economical and environmentally appropriate method for managing low-level contaminated dredge materials from our urban bays and waterways. This approach allowed for cost-effective disposal of dredge materials at specific deep water locations.

As a result, ship passage in our navigation channels improved and moorage facilities at our state's ship berths and small boat harbors were economically maintained. The Puget Sound ecosystem also benefited as low-level contaminants were moved from near shore environments (where they had the highest likelihood of being introduced into the food chain) to deep water sites selected specifically because of their isolation. This has been a successful approach for more than 20 years.

However, proposed policy shifts during the last two years seem to indicate a change in thinking among the government agencies that oversee dredged materials management. Recent changes by the DMMP agencies are problematic for two reasons:

1. the proposed changes represent a substantial shift away from a policy designed to regulate the responsible disposal of sediments from navigational dredging to one that would apply an environmental cleanup standard to materials dredged from urban waterways; and,

2. the agencies that have advanced these policy proposals have initiated a substantial policy shift by utilizing a process that, although it does not entirely disqualify public input, certainly does not follow the process traditionally associated with such a significant reconstruction of policy.

[1] PSSDA Reports, *Management Plan Report: Unconfined Open-Water Disposal of Dredged Material, Phase II*, September 1989, pgs. ES-3 and ES-7.

PROBLEM IDENTIFICATION

The policy changes put forward by the DMMP agencies represent a radical departure from the established policy as it has stood for more than two decades. More than mere "tweaks" to update the existing policy, the proposal represents a fundamental shift in the agencies' approach to the basic principles underlying navigational dredging policy.

This fundamental shift was initiated in July 2006 by a single navigational project without any meaningful public notification or input regarding its significant policy ramifications. Therefore, we urge the agencies to reconsider their proposal – beginning with an examination of the fundamental assumptions on which their proposal is based – and revisit them through a transparent, public process that includes the following:

1. Meaningful involvement in policy discussions – rather than soliciting public comment after the agencies have unilaterally made fundamental policy decisions, it is essential the Association and other partners be present from the beginning to ensure open deliberations and seamless sharing of information. Key data has been withheld from stakeholders and we are only beginning to see (one week prior to this SMARM) information that guided the agencies' decision-making. In order to ensure good faith, transparent decision-making, it is essential to reconsider the proposal at a fundamental level and rebuild it using an open, public process.

2. Thorough consideration of policy implications and alternatives – in addition to a lack of transparency, the process to date has been marked by an aggressive timeline that undermines a thorough and complete review of all the information available. Under the current timeline a final decision could be made in a matter of weeks, leaving little time to consider important policy issues that must be vetted, evaluated and discussed. For example, the "project tipping point" issue has been acknowledged, but time has not been allotted to evaluate this concern and its associated economic impacts. In fact, it has not been evaluated at all, which begs the following question: can a government process be considered fair or deliberative when issues are raised and acknowledged, but then dismissed as too complicated to address in the allotted time? Simply stated, no, it cannot.

3. Rational decision-making process – in order to achieve a thorough review of data, literature, stakeholder concerns, and policy options, the agencies must follow a thoughtful decision-making process. A one-day workshop does not sufficiently fulfill this requirement; neither does a series of ad hoc meetings extemporaneously organized over several months. Rather, a thoughtful decision-making process requires formal evaluation at multiple levels of the process, much like the original PSDDA work groups that developed our once successful system. Some matters (such as dioxin toxicity) require careful consideration of information that is being evaluated at the national level. Others can be evaluated directly through a pilot proposal. Although a rational, thoughtful process takes time, it is essential to creating the best policy based on sound science.

CONCLUSIONS

The proposed policy changes regarding the disposal of sediments from navigational dredging represent a radical departure from the established policy as it has stood for more than two decades. Furthermore, the agencies arrived at the fundamental assumptions that served as the basis for the proposal with little stakeholder input, transparency or public process. Therefore, the policy must be reconsidered beginning with a transparent, public process that includes stakeholder partnership from the very beginning. For these reasons, we urge you to not advance this DMMP dioxin proposal and, instead, renew the stakeholder discussion starting with an open dialogue about the fundamental principles that serve as the basis of navigational dredging policy.

2. Washington Working Waterfront Coalition: Comments to 2009 SMARM

Patrick Jones, Director

Introduction

The Washington Working Waterfront Coalition (WWWC) is an organization that has formed to maintain the viability of our working waterfronts and to promote environmental improvements with the Dredged Materials Management Program (DMMP) on technical and regulatory issues. The Coalition is committed to the complementary goals of improving environmental quality and preserving the function and vitality of our waterfront harbors.

Our members share a strong concern about the impact the current DMMP proposals will have on the commercial viability of the many water-dependent enterprises that are such a key component of Washington's environment, economy, and culture. Our broad-based coalition, representing small business, larger industrial and commercial users of waterfront facilities, shipyards, marinas, port districts with their many related water dependent jobs, and concerned citizens who have a strong working knowledge of the DMMP and its important role as a steward of the environmental and economic health of our waterways, asks that the agencies direct their efforts towards a solution that is consistent with the original goals of the program.

As you know, the DMMP rose out of a collaborative effort between agencies, ports and others that strove to provide a system for the management of dredged material that was environmentally prudent *and* allowed dredging projects to go forward in a cost-effective fashion. The agencies recognized that dredging projects benefit both the environment and the economy, and agency staff worked diligently to come up with a system that achieved the needed balance. This system was memorialized in two EIS documents, the state and federal permits for the DMMP disposal sites, and most importantly, a commitment of the four agencies to continue to work together at the staff and management level to preserve the program objectives as it adapts to new information. The program has performed exceptionally well for the better part of 20 years, and has provided a safe, economical and environmentally appropriate method for the management of dredged materials generated primarily from our urban bays and waterways.

The current proposal seems to have moved away from these objectives. As best we can tell from the agency documents published last week describing the underlying rationale for these very significant changes, the new standards will: (1) significantly increase costs for disposal, making dredging economically infeasible for many projects in urban harbors, and stopping many currently-planned projects; (2) result in continued sediment accumulation in our waterways, making them unsafe and unusable; (3) precipitate the loss of good paying, family-wage jobs; (4) continue the accumulation of low-level contaminated sediments in our harbors where they are more accessible to the food chain and more likely to be disturbed; and (5) fail to create environmental benefits, by eliminating the only viable option to remove large volumes of sediment from our urban bays and waterways.

These sweeping policy changes would undo two decades of progress which have been marked by steady improvements to both our waterfront economy and the environmental quality of Puget Sound. Without

practical or cost-effective options for safely managing and disposing of sediments from harbor maintenance, our waterfront economy and environment are at risk. Our members believe that through a collaborative, transparent approach, grounded firmly in science, we can all work together to improve the health of bays in Puget Sound.

The WWWC proposes that the agencies reconsider their proposal in order to develop good solutions that: are grounded firmly in science and best management practices; fulfill the original intent and focus of the program; ensure predictable and reasonable project approvals; preserve the safety of our working harbors; continue leveraging improvements to the health of Puget Sound; and build on 20 years of existing program success.

Discussion

The members of the WWWC have reviewed, in the very limited time available since the publication of the technical papers supporting this significant change to the open water disposal program, the DMMP staff proposed approach. We believe it necessary to restate the concerns originally communicated in our March 31 letter.

Melding MTCA risk evaluations and disposal site criteria is unnecessary and unwise.

MTCA cleanup criteria and risk evaluations are appropriately different from the criteria used for open water disposal suitability determinations. We have seen no rationalization from the DMMP for their "uniformity of analysis" approach. The DMMP agencies are not legally required to have the MTCA risk evaluations and DMMP suitability criteria match exactly, because the two sets of criteria are appropriately separate, and they address different issues. This has been the case for the 20-plus year life of the program that began as PSDDA. PSDDA was expressly designed to allow for the *managed* disposal of dredged sediments at appropriately located sites. The current DMMP proposal appears to be an attempt to change the purpose of the program. "Uniformity of analysis" is simply not legally required and, from a policy perspective, is a profoundly bad idea.

The approach favored by DMMP staff will seriously harm the economy.

This policy decision is <u>not</u> a case of jobs versus the environment. Both the environment and economy are presented with a "lose/lose proposition" if the proposed policy is implemented. We have not compiled a list of every project that has been made possible by the availability of open water disposal, but a full list would show:

- over 30 million cubic yards of sediments that have been relocated to deep water;
- tens of thousands of creosote piling that have been removed;
- hundreds of acres of relatively shallow sediments that were made significantly cleaner by dredging projects; and
- additional habitat enhancements that have gone along with the projects that included dredging.

These benefits have all been made possible without sacrificing sediment quality at the disposal sites, as monitoring at those sites has not detected any degradation or other notable problems.

We are very concerned that the DMMP agencies are dramatically underestimating the potential number of projects that will be affected and the economic harm that will follow. Further, we would like to raise the issue that the DMMP agencies are pursuing an environmental benefit that won't be achieved by the current policy, and are underestimating the harm to the environment that could be inadvertently caused by the current policy proposal.

The potential for underestimating the number of projects is significant because the current proposal is based on a concentration limit that is well below the current background concentrations in most of our urban bays, and on false cost assumptions. No new concentration information is required to make this point - it has been made in the data posted by the DMMP agencies on their own web site, in reports submitted to the DMMP as part of earlier comments, and in the agency presentation of March 11. Yet, somehow the agencies have concluded that only a small minority of projects will be affected (though most of the dredging projects using the DMMP originate in these same urban bays).

In summary, the economic harm of the policy proposal has been dramatically under-stated. The true economic impact will be great, and agency decision-makers should require good scientific and economic data so they can understand the policy choices in front of them.

The proposed policy will also harm the environment.

The driving presumption behind the current policy is that a more stringent criterion for dioxins/furans at the disposal sites will be better for public health and the environment. This assumption is flawed, and the opposite may occur. The current interim policy may actually reduce cleanup and harm Puget Sound and the people that live here.

The agencies' current policy analysis misses the linkage between the disposal sites and the Puget Sound food chain. The risk analysis performed to date artificially overestimates the potential risks associated with the disposal sites by lumping disposal site risks with the background risk estimates. This type of analysis does nothing to advise decision-makers regarding the level of incremental benefit/impact associated with their policy decision. Simply put, the implementation of the current policy, or even eliminating the disposal program entirely for that matter, would not significantly change seafood dioxin/furan concentrations.

Second, the analysis fails to consider other potential environmental effects of the policy. Regarding seafood quality, there are substantial benefits associated with the existing projects that relocate urban sediments from highly productive near-shore areas to isolated deep-water disposal site areas. The relocation reduces the biological availability of the low levels of contamination found in many urban area sediments. These benefits will not be achieved if dredging projects stop due to the heavy cost burden of upland disposal.

Finally, consistent with the intent of the Puget Sound Initiative, we need to think holistically in our environmental policy decisions. For this policy, there are a number of unintended consequences that may occur, including among other things the environmental resource costs of increasing our reliance on landfill disposal (e.g., additional greenhouse gas emissions created during train-haul of sediments to upland disposal sites) and the negative impact of the policy proposal on restoration projects involving beneficial reuse of dredged materials. More work is needed to understand the environmental benefits of the existing program and the potential costs of the proposed policy prior to making a policy decision.

Technical assumptions and approaches used are questionable.

Even assuming that a MTCA risk assessment is an appropriate way to evaluate whether managed open water disposal is appropriate for dredged material, the risk assessment assumptions and approaches used by the DMMP agencies in the dioxin evaluation process appear to be far more conservative than is necessary. We concur with and support the numerous comments you have received from the premier scientific and technical consultants on this issue.

The DMMP process has lacked transparency and openness.

Our coalition is very concerned about the delayed release of risk assessment and other basic supporting materials, which were made available to us little more than a week before the SMARM. The problems that ports and businesses have had getting information on the agencies' approach and the data that drives the proposed policy demonstrates that this policy exercise has not had the rigorous review required for such monumental policy changes.

We have only recently been provided information on issues associated with the DMMP agencies' risk assessment, their view of constraints inherent in the current regulatory framework. And we still have been given no clear explanation as to why the agencies changed direction from the approach on which PSDDA was founded. There has not been collaboration or joint efforts involving the entities that make use of the program, those that have experience disposing of dredged sediments, or those dramatically affected by the Work Group's efforts.

Real world impacts.

The consequence of the changes proposed by the DMMP agencies, and the multiple policy decisions made by agency staff without consultation with program stakeholders, is that many businesses will simply be unable to operate in the medium and long term. As best as we can assess, the proposal will increase the cost of dredged material disposal by factors ranging from 5 to 12 times the present cost. This would have a devastating impact on most operators. Marinas do not generate revenues close to being able to cover these costs. Our boatyards and commercial shipyards have aggressively invested in environmental practices and infrastructure, but simply will not have the resources to maintain access to their facilities. Similarly, waterfront seafood processors will not be able to operate over time. Bornstein Seafoods in Bellingham continues to have its channel silt up. The new costs associated with this proposal will not allow them to dredge, costing the community jobs, undermining their commercial viability, and causing the contaminants to remain in nearshore habitat. This story is repeated throughout the Sound. A successful, safe disposal alternative is being eliminated for both the public and private sector, with no alternative being proposed to address our communities' need.

Conclusion

The scheduled workshops and process over the next several months will be a good first step for allowing all stakeholders to fully understand and evaluate the impact of these policy proposals. We believe, however, that much more than that is needed before a final policy will be ready for adoption. In particular, the agencies need to work with stakeholders on the fundamental question of whether the 20+ year experience of allowing open water disposal of most urban area sediments was an environmental failure.

We believe strongly that DMMP has been a huge success for both the environment and the economy of this region, but that it is now crippled by the interim dioxin policy. We see no evidence that the DMMP agencies plan to meet their responsibility to provide for a system of dredged material management that facilitates the kind of environmentally and economically beneficial projects that benefit our communities, our state and our environment. Without a return to an open water disposal program that works for most urban sediments, our economy and environment will suffer.

3. NEAR-TERM ACTION ITEMS FOR FOCUSED ANALYSIS BY DMMP STAFF AND PILOT WORK GROUP

This list of near-term action items is provided at the request of DMMP agency management to identify particular Phase 1 Pilot action items that are the most important to assessing policy options and remaining information needs.

The items generally fall into three groups.

- Group A includes three work items that are critical for consideration of background-based site management goals and that can be completed within 3 months.
- Group B includes two work items that are critical to consideration of alternate site management goals that can be completed within 3 months. Some work items for Group A would also apply to Group B.
- Group C includes one additional work item that is considered a high-priority Phase 1 Pilot issue, but that will likely take longer than 3 months (likely 6 months) to complete. Initiation of this work item is recommended in parallel with the Group A and B items to ensure Phase 1 completion by the 2010 SMARM.

The estimated 3-month duration for Group A and B items considers only the technical work itself. Additional time would be required to establish work group framework or to incorporate the new information into a policy evaluation.

Group A: Items Supporting Background-Based Policy Evaluation

A-1: Background Goal TOC Normalization: Incorporate organic carbon normalization into background-based goal target

Activity Lead: DMMP staff with input from Pilot Work Group members

Duration: Initial analysis 3-4 weeks. Additional time for Pilot Work Group review and issue paper summary.

Methods:

a. Repeat statistical analysis of main basin background data (Bolt data set) and assess organic carbon normalized equivalent of 4ppt goal previously defined
b. Define dry weight equivalents at range of TOC concentrations to allow comparison to different sites/dredge materials
c. Compare to existing disposal site average concentrations.
d. Document results in short issue paper.

Policy Applications: Outputs are directly applicable to establishment of site goal(s) that are based on Main Basin and reference site background concentrations.

A-2: Evaluation of Sequential Disposal Effects at Non-Dispersive Sites: Use existing information to define relationship between DMMU concentrations and observed/expected surface concentrations at non-dispersive sites.

Activity Lead: Selected Pilot Work Group members

Duration: Estimated 3 months technical analysis time. Additional time for Work Group Review and issue paper development.

Methods:

a. Using historical PCB data-set, estimate maximum and volume-weighted concentrations of PCBs in materials disposed of at non-dispersive sites (PCBs as surrogate for dioxin/furans)
b. Compare disposed PCB materials to surface average PCB concentrations observed during site monitoring
c. Using dioxin/furan data from recent DMMP projects, evaluate relationship between volume-average and max concentrations
d. Assess information on sediment deposition and mobility at each of the disposal sites.
e. Develop issue paper summarizing findings

Policy Applications: The sequential disposal information will be useful in assessing the relationship between disposal criteria and site management goals established for the non-dispersive sites. Examples of these issues include the following:

a. Define project criteria and BMPs that may be appropriate to achieve defined long-term, surface-weighted average concentrations within the disposal sites. The BMPs could be tiered depending on project average and DMMU maximum concentrations.
b. Provide a basis for evaluating the appropriateness of the "4/4" policy for dispersive sites and the "4/10" policy for non-dispersive sites in achieving a site management goal of "4" (information would also be useful for evaluation of criteria necessary to achieve alternative site management goals).

A-3: Evaluation of Background Sedimentation Effects: Use existing background sediment data from urban bays, coupled with estimated sedimentation rates to assess potential impact of natural sedimentation on observed disposal site concentrations.

Activity Lead: Selected Pilot Work Group members

Duration: Estimated 3 months technical analysis time. Additional time for Work Group Review and issue paper development.

Methods:

a. Document range of background dioxin/furan concentrations in urban bays near the disposal sites using existing data.

b. Identify disposal sites where current background concentrations and natural sedimentation could result in exceedances of the "4" ppt site management goal.
c. Develop issue paper summarizing findings

Policy Applications: Natural sedimentation will over the longer term limit the ability to meet any management goal that is established below this value (because sedimentation will occur on top of the disposed materials). It is important to assess which disposal sites may be affected by this limiting factor.

Group B: Items Supporting Alternate Risk-Based Policy Evaluation

B-1: Evaluation of Incremental Risk Inputs/Outputs: Develop ranges of inputs/outputs from risk analysis in order to identify 1) the potential range in risk outputs and their significance to policy decision-making, and 2) prioritized issues for further evaluation.

Activity Lead: Selected Pilot Work Group Members. Alternately, information could be developed by dredger community for review by Pilot Work Group members.

Duration: Estimated 3 months technical analysis time. Additional time for Work Group Review and issue paper development.

Methods:
a. Develop "box score" summary of key risk assessment variables
b. Define potential inputs applicable to each non-dispersive site based on existing information (e.g., . difference CSF values; BSAF assumptions, site use factors).
c. As part of box score analysis, incorporate seafood abundance and resource use, using existing information, as part of site-use factor inputs.
d. Calculate outputs for 10^{-5} and 10^{-6} risk levels.
e. Illustrate outputs using graphical and tabular outputs showing effects of key variables.
f. Identify inputs that are subject to change based on additional information (regulatory analysis or collected data).
g. Develop issue paper summarizing ranges of inputs/outputs and uncertainties that could be addressed through further work or data collection.

Policy Applications: Results would provide information useful in evaluating 1) the range in potential risk-based outputs which may be significant to management goal selection, and 2) the adequacy of existing technical information to support such risk outputs.

B-2: Regulatory Issue Paper: Update regulatory issue paper as applicable to incorporate workshop outputs.

Activity Lead: Selected Pilot Work Group Members. Work likely to be led by Ecology and DNR AAGs with input from selected legal representatives of the dredging community.

Duration: Estimated 2 months analysis time. Additional time for Work Group Review and issue paper finalization.

Methods:

a. Conduct issue meetings to discuss updated information relevant to regulations and policy context.
b. Develop issue paper summarizing ranges of inputs/outputs and uncertainties that could be addressed through further work or data collection

Policy Applications: Results may influence the context for risk-based management goal development or the implementation of such a goal if selected.

Group C: Longer Lead-Time Action Items Recommended as Part of Phase 1

C-1. Evaluation of Background, Urban Bay and Disposal Site Tissue Levels: Assess relationship between tissue dioxin/furan concentrations near the disposal sites with tissue dioxin/furan concentrations from within the Puget Sound Main Basin.

Activity Lead: Selected Pilot Work Group members

Duration: Estimated 5 months technical analysis time. Additional time for Work Group Review and issue paper development.

Methods:

a. Compile available tissue data from EIM or other agency databases.
b. Issue "data call" to interested parties to develop other references outside of these databases.
c. Compile data, focusing on data from outside of urban bays, in areas consistent with Bolt sediment data locations within the Puget Sound main basin data set
d. Identify ranges of observed tissue concentrations for Main Basin, for disposal site vicinity samples and for other urban bay samples.
e. Develop issue paper summarizing findings

Policy Applications: Tissue concentration data provide an important metric for assessing the impacts (or lack thereof) of the disposal sites on seafood tissue concentrations. Baseline "background" tissue data for the Main Basin also provide important information on the potential contribution of non-sediment sources of dioxins/furans to measured seafood concentrations within Puget Sound.

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July 6, 2009

4. Dredged Material Management Program
c/o Floyd Snider
601 Union Street, Suite 600
Seattle, WA 98101
dioxin.project@floydsnider.com

Re: DMMP Dioxin Project

Dear DMMP Agencies:

This letter provides comments in support of the recent Port of Bellingham pilot proposal. By collecting field data and reviewing carefully dredged soil disposal locations, practices and biological effects, the Pilot Proposal would provide a sound basis for development of new testing and suitability criteria relating to dioxin/furans.

This law firm represents Bornstein Seafoods, Inc., which is a Washington business engaged in seafood processing and packaging. Bornstein Seafoods operates in a waterfront facility located in Bellingham, Washington, and currently provides living wage jobs to approximately sixty people in its community. Prior correspondence on this topic from Bornstein Seafoods is attached for ease of reference.

The Pilot Proposal is phased and allows for gathering of appropriate data with which to measure performance and effects. Data needs are identified with specificity; a field study plan is prepared, and then an extensive field studies are performed as part of phase three. This pilot proposal is a well considered and thoughtful approach.

The pilot study offers a substantial opportunity for development of disposal criteria and disposal sites that protect the environment and conserve both natural and financial resources.

Bornstein Seafoods supports the DMMP Agencies' careful consideration and adoption of this pilot proposal.

Very truly yours,

K&L GATES LLP

By
William H. Chapman

Cc: Jay Bornstein, Bornstein Seafoods
Dave Bradley, Ecology
WHC:mw

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BORNSTEIN
SEAFOODS

April, 8 2009

Dredged Material Management Program
c/o Floyd Snider
601 Union Street, Suite 600
Seattle, WA 98101

Re: DMMP Dioxin Project

Dear DMMP Agencies:

This letter provides preliminary comments regarding the Dredge Material Management Program (DMMP) proposal to establish new testing and suitability criteria relating to dioxin/furans.

Bornstein Seafoods, Inc. is a Washington business engaged in seafood processing and packaging. We operate a waterfront facility located in Bellingham, Washington and currently provide living wage jobs to approximately 60 people in our local community.

Our company has a long history on the working waterfront and is familiar with the DMMP and its importance to the success of our business. We support the DMMP's efforts in the past to harmonize environmental protection and the maritime business community's need for cost-effective dredging operations. However, we are extremely concerned that the disposal site dioxin concentration goal in the current DMMP proposal would, if implemented, effectively eliminate the open water disposal option for maintenance dredging projects in urban bays and waterways. Although we understand that no estimate of secondary economic impacts has been included in the development of the current proposal, it is clear to us that its implementation will severely affect our working waterfront business and ultimately places the jobs of our waterfront working employees in jeopardy.

In addition, the mere prospect that high disposal costs will prevent a dredge project from being performed is enough reason for us to forgo making capital improvements to our waterfront facilities such as dock repairs, upgrades, or new shipping facilities. In today's economy, our company cannot afford to make capital investments at waterfront facilities that we will not be able to use in five, ten, twenty, or even thirty years.

Frankly, we are surprised and disappointed that the current policy proposal makes no attempt to consider these economic impacts. It seems that the DMMP agencies did not thoroughly evaluate the potential economic impacts of the approach they are proposing before preparing to put it in place. Further, the proposal was made without any recognition of the *environmental* consequences of stopping maintenance dredging projects. Projects of the type that allow our business to continue operating have environmental benefits that will be foregone if the proposed policy is implemented. Radical changes to this type of policy need to be much more thoughtfully developed.

In conclusion, we support a clean and healthy Puget Sound, and have taken many measures to contribute to its protection and restoration. However, environmental standards that eliminate economically and environmentally beneficial projects hurt the Sound and cost our region jobs. The current DMMP dioxin proposal represents exactly that type of unwise approach to environmental protection. We strongly encourage the DMMP to conduct a better and more expansive evaluation so that the final policy is both protective of the environment and supportive of waterborne commerce. A new policy that strikes this balance will continue to bring environmental and economic success to our employees, our company, our community, our state, and our region.

Thank you for considering our comments as part of the current policy evaluation. Please include us on future information distributions.

Sincerely,

Myer Jay Bornstein, President
Bornstein Seafoods, Inc.

CC: Port of Bellingham

5. Please consider the following for discussion during the 2009 SMARM.

Clarification regarding reference material analysis and data validation requirements for dioxin data:

Reference - Users' Manual - DMMP - July 2008. Validation of dioxin data is discussed in Section 6.5.3.3, and in *Supplemental Information on Polychlorinated Dioxins and Furans (PCDD/F) for Use in Preparing a Quality Assurance Project Plan (QAPP)*:

> From Section 6.5.3.3: *If the applicant chooses not to validate the [dioxin] data, the primary method of data evaluation will consist of analysis of a traceable sediment reference material. Based upon review of precision, accuracy, representativeness, and completeness measures as well as the SRM, further validation of the dioxin raw data may be required. The DMMP will review the primary results against the Method 1613B acceptance limits or those in the QAPP, and against the sediment reference material.*
>
> The Supplemental Information recommends the use of NIST SRM 1944, but does not state performance criteria for the SRM. (Dioxin values in SRM 1944 are not "certified". Thus requiring agreement with 95% CI [as specified in Table 6-4 of the DMMP Users' Manual] may not be appropriate for all analytes.)

We believe it is important that all dioxin data be validated, as false positives could be reported if interferences and "blank" contamination are not considered. Because of the sensitivity of the method and for comparability purposes, we recommend that all dioxin should receive QA2 (full) validation.

We also agree with the recommendation for Reference Material analysis with each set of dioxin samples. However, we also recommend that Measurement Quality Objectives for the Reference Material be specified and agreed on with the laboratory prior to sample analysis. If criteria are not met – then analytical issues should be resolved by the laboratory, and reanalysis of the entire analytical batch performed. (Further validation of the data cannot improve analytical performance, if the results indicate problems with accuracy or precision.)

Ann Bailey
President
EcoChem, Inc
710 Second Ave Suite 660
Seattle, WA 98045

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APPENDIX 5

DMMP RESPONSE TO PUBLIC ISSUES

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DMMP Response to Public Issue Papers

1. Eric Johnson, Washington Public Ports Association. Proposal to Reconsider Proposed Changes to the Open-Water Disposal Guidelines for Dioxins in Dredged Material.

2. Patrick Jones, Director. Washington Working Waterfront Coalition: Comments to 2009 SMARM.

3. Mike Stoner, Port of Bellingham (Environmental Director). Pilot Project Proposal.

4. Jay Bernstein, Bernstein Seafoods. Letter in support of the Pilot Project Proposal.

DMMP Response. In response to the concerns and comments expressed by regional stakeholders at the SMARM regarding the proposed dioxin regulatory framework guidance, the DMMP agencies convened three post-SMARM public workshops (5/18/2009, 5/28/209, and 6/24/2009) to listen to stakeholder concerns and allow additional discussion and input for DMMP agency review and consideration about dioxin regulation and other bioaccumulative chemicals. Since the conclusion of these workshops, the DMMP agencies have been carefully considering the information provided by stakeholders, and are currently working on an updated proposal for implementing dioxin regulatory guidance for evaluating dredged material for open-water disposal at either non-dispersive or dispersive site sites, which they anticipate implementing in the near future, after DMMP Agency Director approval and Stakeholder coordination.

We are also considering the recommendations for additional review and stakeholder involvement in a longer term process to look at a comprehensive re-evaluation of sediment bioaccumulation guidelines

5. Ann Bailey, President, EcoChem, Inc. Clarification regarding reference material analysis and Data Validation requirements for Dioxin data.

DMMP Response. The DMMP agencies agree that insuring the accuracy and precision of chemical analysis results for DMMP characterizations, especially dioxin/furans through the use of Reference Material (SRM 1944) and Data Validation (QA2) is a worthwhile goal that the DMMP agencies strongly support and are working to implement. Federal projects currently undergoing DMMP characterizations are required to verify the accuracy of dioxin and COC analyses with Reference Material and Data Validation to insure accurate and precise analytical results. The DMMP agencies will prepare a Clarification Paper for the 2010 SMARM clarifying these requirements for all DMMP characterizations. The DMMP agencies are interested in establishing a regional reference sediment sample, that could be used to evaluate the accuracy of dioxin, PCB Aroclors and congeners and other COCs in

future sediment evaluations. They are looking into the potential funding sources and details in collecting and establishing a regional reference material, and will provide an update on the feasibility of accomplishing this at the 2010 SMARM.

APPENDIX 6

DMMP DIOXIN ISSUE PAPER

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May 2009

DMMP ISSUE PAPER – SMARM 2009

PROPOSAL TO REVISE THE OPEN-WATER DISPOSAL GUIDELINES FOR DIOXINS IN DREDGED MATERIAL

INTRODUCTION

The Dredged Material Management Program (DMMP) agencies require chemical testing for projects involving dredged material disposal at one of the eight open-water disposal sites in Puget Sound. Routine testing includes 62 chemicals of concern (COCs). In addition to the routinely tested COCs there are chemicals of concern for limited areas. Dioxins are in the latter category and have been tested on a case-by-case basis for dredging projects in Puget Sound.

The term "dioxins," in the context of the DMMP testing requirements, includes the group of 17 chlorinated dioxins and furans of known concern for health effects in fish, wildlife, and humans. Dioxin compounds are produced unintentionally from many industrial processes and persist in the environment where they tend to concentrate in fats, and magnify in the food web. These compounds are carcinogenic and toxic, although there is scientific controversy regarding how to estimate effects at low doses.

Historical discharges from industries such as chlorine pulp mills, wood treatment, and pesticide manufacturing provided sources for dioxins in sediments. Anthropogenic sources of dioxins are now largely controlled, but the compounds persist for a long time in the environment. Dioxins are also produced by natural events, including forest fires and volcanic activity. Dioxins are ubiquitous, due to global distribution of anthropogenic and natural sources. They are present throughout the world in aquatic and terrestrial environments, and in most foods that we eat.

Dioxin concentrations are typically presented as parts per trillion (pptr) TEQ, which is a measure of the toxic equivalence. The TEQ represents the combined toxicity of the 17 individual dioxins and furans for an environmental sample.

Until 2006, the maximum concentration of dioxins that could be present in dredged material being disposed at open-water disposal sites in Puget Sound was 15 pptr TEQ. This was based on a 1991 risk assessment that was done in Grays Harbor.

PROBLEM IDENTIFICATION

In the early years of DMMP implementation, the 15 pptr TEQ guideline was deemed adequate. Three Puget Sound projects were tested for dioxin, all in the vicinity of kraft pulp and paper mills in Everett. Concentrations of dioxin were relatively low, ranging from 0.6 to 8.7 pptr TEQ.

Then, in 2006, a proposal to dredge the navigation channel and berthing areas in Olympia Harbor triggered a requirement for dioxin testing due to the close proximity of the Cascade Pole Model Toxics Control Program (MTCA) cleanup site. High concentrations of dioxin were found. In light of the evolution of knowledge regarding the risks posed by dioxin, the DMMP agencies determined that the guidelines developed in 1991 needed to be re-evaluated.

The problem with using the 1991 Grays Harbor risk assessment is that it was based on seafood consumption by recreational fishers and did not reflect the risk to subsistence fishers in Puget Sound. Since its publication, much work had been done regarding tribal consumption rates in

Puget Sound. In addition, the U.S. Environmental Protection Agency (EPA) published a draft dioxin reassessment report in 2003, which underscored the risks from dioxin. Based on an evaluation of the latest data and risk assessment guidance, the DMMP agencies determined that the dioxin guidelines derived from the 1991 Grays Harbor risk assessment were no longer valid for Puget Sound.

For the Olympia Harbor project, a risk-based approach was attempted for the Anderson/Ketron open-water disposal site, but ultimately a background-based framework was adopted using concentrations of dioxin in the area surrounding the disposal site. This approach was expanded to include the other non-dispersive sites and is currently in effect, but the DMMP agencies acknowledged that this was an interim solution. A process was needed to develop longer term guidelines.

THE DIOXIN PROJECT

The DMMP agencies established a workgroup in the summer of 2007 with the purpose of developing a revised dioxin framework for dredged material. The effort came to be called the "Dioxin Project." The dioxin workgroup included staff-level employees from all four DMMP agencies, with periodic review and direction provided by agency managers and directors. Legal review was provided by state and federal attorneys. The Puget Sound Partnership became involved in the project in 2008. Work was facilitated by Floyd|Snider.

General approaches for development of revised guidelines were generated, including various background and risk-based options. In the fall of 2007 these options were presented, and input received, at seven regional public meetings and two technical workshops. Tribal input was received at a meeting with the Northwest Indian Fisheries Commission in March 2008. Public updates and formal comment opportunities were provided at the 2007 and 2008 Sediment Management Annual Review Meetings (SMARMs).

In the spring of 2008, the DMMP agencies recognized that insufficient data existed regarding background levels of dioxin in Puget Sound. Therefore, in the summer of 2008, the agencies collected sediment samples throughout the Sound using the EPA ocean research vessel Bold. The samples were analyzed for a suite of chemicals, including dioxins.

In the fall of 2008, a statistics workshop was convened by the Regional Sediment Evaluation Team (RSET). A panel of experts provided recommendations regarding assessment of dioxin data and development of guidelines based on background data.

In the winter of 2008/2009, the DMMP agencies refined the background and risk-based options based on input received from the public, the Puget Sound background data from the Bold survey, and recommendations from the statistics workshop. The other options considered in addition to the agency proposal are presented in Attachment 1.

The DMMP agencies' goal was to develop a framework for dioxin in light of the fact that unacceptable human health risk associated with seafood consumption exists at concentrations below Puget Sound background. The Regulatory and Policy Technical memorandum that is provided in Attachment 2 presents an overview of the state and federal regulatory requirements applicable to the disposal of dredged material at the open-water disposal sites managed by the DMMP agencies. The memorandum discusses the relationships between the Puget Sound Dredged Disposal Analysis (PSDDA) program guidelines and the Sediment Management Standards. The agencies made a number of choices and assumptions when preparing the

proposal. These choices reflect a combination of scientific and policy determinations. The technical and policy rationale for the decisions that were made in preparing the proposal are also presented in Attachment 2.

Calculations by the DMMP agencies determined that the incremental lifetime cancer risk (ILCR) for Puget Sound seafood consumers is greater than 10^{-6} and, for some populations, greater than 10^{-4}. In such a situation, the Sediment Management Standards allow adoption of a background-based approach. Attachment 3 documents the decisions made in performing a calculation of background risk, and shows the results by consumer group considered. Several stakeholders suggested evaluation of an alternative allowing an additional incremental risk above background. However, any approach above background would require the implementation of Sediment Impact Zones, which the agencies were not in favor of for many reasons, as described in Attachment 2.

The DMMP agencies evaluated the options in a deliberative manner, taking into account a variety of factors such as consistency with regulations (or modification of regulations to accommodate an alternative), benefits for the environment (reduction of dioxin concentrations at dredged material disposal sites), projected economic impacts, and administrative issues (site encumbrance, potential for inter-bay transfers, difficulty obtaining shoreline permits, and program funding). The original options that were considered either did not balance these factors well—for instance, they would cause undue economic hardship—or would require significant alteration of existing regulations that would need to go through additional public process and federal Clean Water Act review. Therefore, the DMMP agencies developed a hybrid option, which became the basis for the following proposal.

PROPOSED REVISIONS TO THE DIOXIN GUIDELINES

The DMMP agencies propose the following open-water disposal guidelines for dioxins in Puget Sound dredged material:

For Non-Dispersive Disposal Sites in Puget Sound:

<u>Volume-Weighted Background Approach Based on Comparison to Puget Sound Main Basin and Reference Area Concentrations:</u> The agencies propose to set volume-weighted *dredged material suitability guidelines* for all dredging projects so that material disposed at non-dispersive sites in Puget Sound would not result in disposal site surface concentrations that exceed a *disposal site management objective* that is based on background levels measured in the Puget Sound Main Basin and Reference Areas (not including urban bays, and away from point sources).

> *<u>Disposal Site Management Objective:</u>* The agencies propose to establish a target disposal site concentration for all non-dispersive disposal sites at a level based on the Puget Sound Main Basin and Reference Areas background concentrations. The value proposed for the Disposal Site Management Objective is 4 pptr TEQ, which is the nonparametric estimation of the 90% upper confidence limit for the 90th percentile of the distribution of the background data set.
>
> *<u>Dredged Material Suitability Guideline:</u>* The agencies propose to establish suitability guidelines (pass-fail criteria) that would be used to evaluate individual projects. The suitability guidelines would have two components: (1) The volume-weighted average concentration of dioxin/furan in material from each dredging project could not exceed the

disposal site management objective of 4 pptr TEQ, and (2) dioxin/furan concentrations could not exceed a maximum concentration of 10 pptr TEQ in any single Dredged Materials Management Unit (DMMU).

For Dispersive Disposal Sites in Puget Sound: The agencies propose that dioxin/furan concentrations could not exceed a maximum concentration of 4 pptr TEQ (the Disposal Site Management Objective) in any single DMMU.

Bioaccumulation Testing

The DMMP agencies are looking into the possibility of a test-out option involving bioaccumulation testing. The dredging proponent would have the option of pursuing bioaccumulation testing to determine whether or not the DMMUs could qualify for open-water disposal. It should be noted that a test-out option was available under the former guidelines.

A target tissue level (TTL) to be used in the bioaccumulation evaluation has not been determined for dioxins at this time. In the absence of a TTL, the dredging proponent would include a reference sediment in the bioaccumulation test. Concentrations in the project test-sediment tissue would be compared against concentrations in the reference-sediment tissue. The DMMP agencies are continuing to evaluate a bioaccumulation test-out option in the revised dioxin guidelines.

Revisions to Dioxin Testing Requirements

Testing for dioxins will continue to be required on a case-by-case basis in areas where there is reason to suspect presence of these chemicals. Factors which could trigger a “reason-to-believe” determination include the following:

- Located within an urban bay and having no historical information showing that dioxin is below levels of concern
- Proximity to current or historical point sources, such as outfalls
- Proximity to chlor-oxide bleach process pulp mills, chlor-alkali or chlorinated solvent manufacturing plants, former wood treatment sites, phenoxy herbicide manufacture and/or use and handling areas
- Proximity to areas with high polychlorinated biphenyl (PCB) concentrations
- Proximity to hog fuel burners/boilers and areas with previous fires or incineration sources
- Proximity to areas previously sampled that showed elevated levels of dioxin

Dioxin testing will be required for all projects meeting one or more of the reason-to-believe factors described above. Deeper underlying sediments, which are confirmed as “native,” will be exempt from testing, except as follows: the top 4 to 8 feet of a native sediment layer underlying sediments that are being tested for dioxins will also be required to be tested for dioxins.

These updated guidelines are consistent with the reason-to-believe requirements implemented in the last several years. Guidance for sampling density per project will remain unchanged.

The agencies recognize that dioxin analysis is expensive. The agencies are evaluating potential use of alternative assay-based testing methods, but those evaluations are still in progress.

Verification of Compliance with the Disposal Site Management Objective

The DMMP program would continue to implement best management practices (BMPs) for sequencing of disposal operations. Recent data from the Anderson-Ketron disposal site have shown that application of these BMPs has resulted in disposal site surface concentrations well below the current interim suitability guidelines for dioxins.

The agencies would increase the number of on-site monitoring samples collected at each disposal site from 3 to 10 to allow statistical comparisons to be made with Main Basin/Reference Areas concentrations. Otherwise, the site monitoring program would be very similar to the current program, with monitoring frequency based on site disposal volumes.

Monitoring results would be tracked over time to determine whether the disposal sites are coming into compliance with the new site management objective. If necessary, the suitability guideline will be adjusted to ensure the management objective is being met.

Impact on Open-Water Disposal Fees

A periodic disposal site fee increase due to inflation is being evaluated by the Department of Natural Resources in a separate process. The fee increase would also account for the increased program costs related to dioxins. It should be noted, however, that the increased program costs related to dioxins account for a very small portion of the overall disposal fee increase, and that the fee increase was scheduled to occur regardless of the revision to the dioxin guidelines.

The cost increases related to dioxins would include the following:

- Increased cost associated with the collection and analyses of additional samples for non-dispersive site monitoring as described above
- Potential increased cost for periodic re-evaluation of Puget Sound background concentrations

PROJECT-IMPACT AND CONCEPTUAL LEVEL ECONOMIC ANALYSIS

The DMMP agencies performed an analysis of potential project impacts under the proposed guidelines using data from all Puget Sound dredging projects since the inception of the DMMP, covering a period of 21 years. During this time well over 200 projects were evaluated for open-water disposal. Of these, 20 projects had at least some material that was tested for dioxins, the tested quantity consisting of approximately 1.8 million cubic yards, or 6.2 percent of the total volume.

The 20 projects that have had some level of dioxin testing were used as the basis for the evaluation of the pass/fail impact of the proposed dioxin guidelines. When the data from these 20 projects is compared, on a DMMU basis to the former dioxin guideline of 15 pptr, 82% of the material passes, and would be designated as suitable for open-water disposal. Under the proposed non-dispersive site guidelines, the pass rate is estimated to drop from 82% to 78% of the total tested volume. However, this compares to a pass rate of 69% under the current interim guidelines. In terms of number of projects, of the 20 projects, 7 projects would have been

impacted under the former guideline, while 10 and 13 projects would be affected under the proposed and interim guidelines, respectively. For those projects that would use the dispersive open-water disposal sites, the proposed (and interim) dispersive guidelines would impact 6 of the 7 projects, while under the former guideline only 2 projects would have been impacted. The impact analysis is presented in greater detail in Attachment 4.

The results from the impact analysis were also used to estimate a conceptual level economic impact that might occur from implementation of the proposed dioxin framework. The updated reason-to-believe guideline associated with the proposal will result in dioxin testing for the majority of dredging projects, particularly those located in urban bays. Therefore, there will be an increase in the cost of sediment characterization associated with the testing of dioxins and an increase in the total amount of material defined as unsuitable for open water disposal. Over the 21-year history of the DMMP program, approximately 6% of the project volume (10% of projects) has required dioxin testing. Over the last three years, with additional concern regarding dioxins, 33% of the project volume (38% of projects) has required dioxin testing. It is estimated that approximately 55% of the project volume would require dioxin testing under the proposed dioxin guidelines.

Under the proposed dioxin guidelines there will also be an increase in the volume of material that will be determined to be unsuitable for open-water disposal relative to the former 15 pptr guideline. Therefore, there will be additional costs associated with the alternative disposal of unsuitable material. Using the estimated failure rate of 22% under the proposed non-dispersive guideline and the annual average dredge volume over the last 21 years of 1.4 million cubic yards (CY), as described above and presented in Attachment 4, it is estimated that the annual average volume of material that would fail the proposed dioxin guideline is approximately 167,000 CY. The comparative costs of disposal for the predicted failed volume, relative to the cost of open-water disposal, includes the following:

- Annual average cost of open-water disposal at $8.40/CY = $1.4 Million
- Annual average low-end cost of upland disposal at $38/CY = $6.3 Million
- Annual average high-end cost of upland disposal at $130/CY = $21.7 Million

The agencies acknowledge the fact that in lieu of upland disposal, the predicted impacted projects with increased failed material could be cancelled, with significant associated economic impacts. These impacts are highly project-specific and the “tipping point” for project cancellation would likely be a lower threshold for smaller projects. The agencies have not attempted to calculate program-wide secondary impacts associated with this proposal vs. the previous or interim dioxin guidelines.

GEOGRAPHIC LIMITATIONS OF THE PROPOSAL

The Dioxin Project has focused on developing revised guidelines for Puget Sound only. Dioxin suitability guidelines for areas outside of Puget Sound (e.g., Grays Harbor and Columbia River) will need to be revisited as well. There are significant differences between other systems and Puget Sound that may require adjustments to the proposed framework.

OTHER BIOACCUMULATIVE COMPOUNDS

The adjusted framework for dioxin could have implications for other bioaccumulative compounds, especially dioxin-like PCBs. This is an issue that the agencies have begun to discuss, but have not yet determined a recommended path forward. The DMMP's long-term goal is to develop revised guidelines for all key bioaccumulative compounds.

NEXT STEPS

In the March Fact Sheet and March 11 public workshop, the DMMP agencies presented the proposal for advance review and input. Additional feedback was provided by several entities after the workshop, and this issue paper incorporates some of the comments received.

It is very important to recognize that the proposal presented in this issue paper does not represent the final decision by the agencies. Rather, it provides the basis for further discussion and evaluation. To that end, the DMMP agencies have set aside 3 meeting days in May and June to obtain additional input from stakeholders. Based on the comments received to date, the agencies think it would be productive to structure those meetings around the following topics:

May 18: Regulatory context, project objectives, and risk assessment

May 28: Material pass/fail analyses and impacts to dredging

June 3: Other implementation issues and additional discussions (if needed) on issues from earlier meetings

The May 18 meeting will be held at the Department of Ecology in Lacey in the ROA-36 Auditorium from 10:30am to 3:30pm. The May 28 and June 3 meetings will be held at the U.S. Army Corps of Engineers (USACE), Seattle District office on East Marginal Way South in Seattle in the Galaxy Room from 10:00am to 2:00pm. The meetings will be set up to stimulate dialogue and exchange information.

The DMMP would also like to receive written comments on the proposal. Written comments should be submitted to: dioxin.project@floydsnider.com.

The DMMP will review the meeting input and written public comments. The length of time needed to complete that review will depend on the types of comments and issues raised at the May meetings. Based on that review, the DMMP may modify its proposal based on the interactions and input. The DMMP will release an adjusted proposal for the dioxin guidance and implementation approach for formal public comment. Public comments on the revised proposal will be accepted for 60 days. After the public comment period, the agency Directors will make a final decision following consideration of public comments.

ATTACHMENTS

Attachment 1 – Options Considered in Addition to the Agency Proposal for Establishing Dioxin Suitability Guidelines for Open-Water Disposal

Attachment 2 – Dioxin Project Regulatory and Policy Technical Memorandum

Attachment 3 – Dioxin Project Risk Assessment Technical Memorandum

May 2009

Attachment 4 – Dioxin Project Impact Analysis Technical Memorandum

Proposal to Revise the Open-water Disposal Guidelines for Dioxins in Dredged Material

Attachment 1
Options Considered in Addition to the Agency Proposal for Establishing Dioxin Suitability Guidelines for Open-Water Disposal

Options Considered in Addition to the Agency Proposal for Establishing Dioxin Suitability Guidelines for Open-Water Disposal at Non-Dispersive Sites

In addition to the Agency proposal (described separately) the DMMP Agency group evaluated variations on the following options as methods for establishing suitability guidelines for open-water disposal of dredged material containing dioxin.

1. No Detectable Levels of Dioxins: Agencies would allow material to be disposed at open-water sites if there are no detectable levels of dioxin/furan compounds.

2. Background Approach Based on Comparison to Reference Area Concentrations: Agencies would allow material to be disposed at open-water sites if the levels of dioxin/furan compounds are less than or equal to existing concentrations in rural reference bays (approximately 2 ngTEQ/kg).

3. Background Approach Based on Comparison to Puget Sound Main Basin and Reference Area Concentrations: Agencies would allow material to be disposed at open-water sites if the levels of dioxin/furan compounds are less than or equal to existing concentrations in the Puget Sound Main Basin and Reference Areas, not including urban bays (approximately 4 ngTEQ/kg).

4. Background Approach Based on Comparison to Concentrations in the Puget Sound Main Basin and Urban Bays Away from Point Sources: Agencies would allow material to be disposed at open-water sites if the levels of dioxin/furan compounds are less than or equal to existing concentrations in the Puget Sound Main Basin and urban bay locations away from known point sources (between approximately 4 and 17 ngTEQ/kg depending upon the method selected for combining the non-urban and urban data sets).

5. Background Approach Based on Comparisons to Concentrations in Areas in the Vicinity of the Disposal Site (Current Interim Framework): Agencies would allow material to be disposed at open-water sites if the levels of dioxin/furan compounds are less than or equal to existing concentrations in the vicinity near, but not influenced by, existing disposal sites (individual site values vary between 4 and 12, with a geometric mean of 7 ngTEQ/kg). This option would result in different suitability criteria for the different disposal sites.

6. Incremental Risk Approach: Agencies would allow material to be disposed at open-water sites if the levels of dioxin/furan compounds do not pose an incremental risk greater than $1x10^{-6}$ above background concentrations calculated using "Puget Sound Main Basin" data. (Individual site values vary between 6 and 12, with a geometric mean of 7 ngTEQ/kg.) This option would result in different suitability criteria for the different disposal sites.

Note: Approximate suitability guidance values for Options 1, 2, 4, & 5 above were determined with statistical methods that calculated the 90th percentile of the background data sets. Approximate suitability guidance values for Option 3 and the Agency proposal (presented separately) were determined with updated statistical methods that calculated the 90th percentile of the distribution at the 90% upper confidence interval of the background data set.

Proposal to Revise the Open-water Disposal Guidelines for Dioxins in Dredged Material

Attachment 2
Dioxin Project Regulatory and Policy Technical Memorandum

Dioxin Project Regulatory and Policy Technical Memorandum

Dredged Material Management Program

April 29, 2009

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Introduction

Background

The Dredged Material Management Program (DMMP) agencies require chemical testing for projects involving dredged material disposal at eight open-water disposal sites in Puget Sound. Routine testing includes 62 chemicals of concerns. There are additional chemicals of concern where testing is required for limited areas. Dioxins have historically been in the latter category.

Until 2006, the maximum concentration of dioxins that could be present in dredged material being disposed at open-water disposal sites in Puget Sound was 15 pptr TEQ. This was based on a 1991 risk assessment that evaluated health risks to recreational fishers in the Grays Harbor area. Since 1991, there has been considerable research on tribal consumption rates in Puget Sound. In addition, EPA published a draft dioxin reassessment report in 2003, which underscored and revised the risk estimates for dioxin mixtures. In 2006, the DMMP agencies determined that the dioxin guidelines derived from the 1991 Grays Harbor risk assessment were no longer valid for Puget Sound. Over the last two years, the DMMP agencies have worked to update the suitability guidelines for dioxins and furans.

Risk Management Question

Dioxin and furans are widely recognized as hazardous substances that pose threats to human health and the environment. There is also widespread agreement among scientists, policy makers and the public that reasonable steps should be taken to reduce and/or prevent exposure to these substances. The dilemma facing the DMMP agencies revolves around how to make regulatory determinations in the face of the scientific uncertainties about the health risks at different levels of exposure.

Scientific information has guided the agencies' consideration of this issue. However, scientific information is only one of several factors considered by the agencies. In that sense, the agencies' deliberations have been focused on answering the following question:

How should the DMMP agencies revise the suitability guidelines for dioxins and furans, given:

- *Current statutory and regulatory framework for making decisions on the placement of dredged material at the open water disposal sites;*
- *Current scientific information on the threats to human health and the environment posed by dioxins and furans and the uncertainties surrounding those threats;*
- *Variability in exposures and susceptibility among individuals;*
- *Multiple sources and background concentrations and exposure levels; and*
- *Potential costs of different management options (e.g., open water, upland, etc.) and the uncertainties surrounding current cost estimates.*

Purpose of the Technical Memorandum

The DMMP agencies presented the proposal at a public workshop held on March 11, 2009. Attendees identified a wide range of concerns with the proposal. Based on the questions and concerns raised at the workshop, the agencies have decided to hold further meetings to discuss various risk assessment, economic impact and regulatory issues. This technical memorandum is designed to support review and discussion of the agencies proposal. It has been written to achieve three main purposes:

- Describe the regulatory and policy rationale for the agencies proposal;
- Describe key choices and assumptions underlying the agencies proposal; and
- Promote discussions with interested parties on key choices and assumptions.

Organization of the Technical Memorandum

This technical memo is organized into five main sections:

- Regulatory Framework for Open Water Disposal of Dredged Material: This section provides an overview of state and federal regulatory requirements applicable or relevant to agency decision-making on the disposal of dredged material at the open water disposal sites.
- Key Risk Management Choices and Assumptions: In preparing the proposal, the agencies needed to make a number of choices and assumptions. This section summarizes some of the key choices underlying the proposal and provides the technical and policy rationale for those choices.
- Description of the Proposal: This section summarizes the scope and key elements of the proposal.
- Rationale for the Proposal and the Site Management Objective: The agencies considered a wide range of factors when evaluating whether and how to revise the suitability guidelines for dioxins and furans. This section provides the technical and policy rationale for the agencies proposal.
- Rationale for the Proposed Suitability Guidelines: The agencies proposal includes revised suitability guidelines (pass-fail criteria) that would be used to evaluate individual projects. This section provides the technical and policy rationale for the proposed values.

Regulatory Framework for Open Water Disposal of Dredged Material

This section provides an overview of state and federal regulatory requirements applicable or relevant to agency decision-making on the disposal of dredged material at the open water sites. The DMMP believes it is important to understand current requirements including key constraints and areas of flexibility.

Puget Sound Dredged Disposal Analysis (PSDDA)/Dredged Material Management Program (DMMP)

The DMMP has established guidelines for unconfined, open water disposal sites for dredged material. These guidelines provide a comprehensive set of procedures for the sampling, testing, and evaluation of dredged material to ensure that such material is acceptable for unconfined, open-water disposal. The original evaluation procedures and the rationale for the procedures (*Evaluation Procedures Technical Appendix – Phase I (Central Puget Sound))* were published in June 1988 (PSDDA 1988a). Several times over the last 20 years, the DMMP agencies have updated the original guidelines based on new scientific information. The most current procedures are described in the *Dredged Material Evaluation and Disposal Procedures (Users Manual)* published in July 2008 (DMMP 2008). These evaluation procedures are used to assess projects conducted under Sections 401 and 404 of the Clean Water Act. Key features that are relevant to the current project include the following:

- Decision-Making Framework: Chemical disposal guidelines developed by the DMMP to evaluate dredged material established two chemical guideline values, the screening level (SL) and the maximum level (ML) for making decisions on dredged material suitability. The SL is defined for each chemical-of-concern (COC) as a guideline that establishes chemical concentrations[1] below which there is no reason-to-believe that dredged material disposal would result in unacceptable adverse effects to benthic organisms. ML guidelines established for DMMP chemicals corresponds to the concentration of a given chemical in dredged material, above which there is a reason-to-believe that the dredged material would be unacceptable for unconfined, open-water disposal. No bioassay testing is required when chemical levels are less than the SL. Above the SL and below the ML, routine toxicity testing is required. For a selected number of chemicals with bioaccumulative human health and/or ecological health concerns, the DMMP has established a bioaccumulation trigger (BT). Bioaccumulation testing is required if the BT is exceeded in dredged material. If a chemical exceeds the ML, biological testing is required. However, ML exceedances generally result in sediments that are found to be unsuitable for unconfined-open-water disposal. Most dredging applicants generally decline to conduct biological effects testing when one or more MLs are exceeded, and accept the material as unsuitable for open-water disposal at a DMMP site.
- Site Management Conditions: During the initial PSDDA studies, the agencies established management goals for the disposal sites. These goals are referred to as "site management conditions" or simply "site conditions."
    - Site Condition I (no adverse effects) applies to dispersive sites, and is defined as no benthic biological effects may exceed acute or chronic toxicity guidelines, and human health risks are not greater than 1 in 100,000 estimated incremental lifetime cancer risk.
    - Site Condition II (minor adverse effects) applies to non-dispersive sites, and is defined as some benthic biological effects may exceed acute or chronic toxicity guidelines (but limits the number

[1] The SLs are set at the Lowest Apparent Effects Levels (LAET) established for each chemical from a range of biological indicators, and the ML is established at the Highest Apparent Effects Threshold (HAET) level for each chemical expressed from a range of biological indicators (PSSDA, 1988, page II-208).

and intensity of these exceedances), and human health risks are not greater than 1 in 100,000 estimated incremental lifetime cancer risk.

- Evaluation Procedures for Human Health: The PSDDA agencies included human health screening methods and policies in the original technical protocols (PSDDA, 1988a). Specifically, a cancer risk of 1E-05 was selected for the derivation of risk-based tissue screening values that were used to evaluate the results from bioaccumulation tests. In developing the guidelines, the agencies noted that risk-based screening values may be lower than background concentrations. In these situations, the agencies recommended that decisions be based on a comparison to background concentrations. One chemical known to require such a comparison was arsenic:

  Arsenic is unique in that both reference and nonreference tissue levels in Puget Sound exceed the indicator value. Arsenic is high in reference tissues primarily because arsenic is naturally elevated in seawater in the north-eastern Pacific (including Puget Sound) and is bioaccumulated by organisms. This condition implies that the indicator value would not be useful in interpreting bioaccumulation tests on dredged material because control, reference and test tissues are likely to exceed the HI. Consequently, arsenic tissue concentrations should be interpreted by the use of statistically significant elevations above reference (EAR) concentrations as a measure of pollutant effects that are a concern for human health. This is, if tissue concentrations for test organisms are significantly above tissue concentrations for reference organisms, the dredged material would be considered unacceptable for unconfined, open-water disposal. (pp. II-127 & 128)

- Interim Guidelines for Dioxins and Furans: DMMP has not established a Screening Level (SL) and Maximum Level (ML) for dioxins and furans based on benthic toxicity. Consequently, reviews of dioxin data are done on a project-specific basis using interim guidelines. The interim guidelines were adopted by the Directors of the DMMP agencies in March 2007 to serve as a clear and consistent process for making suitability determinations until programmatic revisions are completed (DMMP 2008). Key features of the interim guidelines include:

  - Non-dispersive sites in Puget Sound: The evaluation approach is based on a comparison of dioxin in test sediments to disposal-site background. "Background" is defined using disposal-site sediment dioxin data generated as part of DMMP site monitoring. Under the interim approach, dioxin concentrations in any given dredged material management unit may not exceed the maximum of measured concentrations surrounding the site (off-site stations). In addition, the average dioxin concentrations (weighted to the volume of each dredged material management unit) cannot exceed the mean concentration surrounding the site (off-site locations). Bioaccumulation testing for dioxin is currently not used to determine suitability for nondispersive sites in Puget Sound.

  - Dispersive sites in Puget Sound: The evaluation approach is based on a comparison of dioxin in test sediments to reference background. "Background" is defined using sediment dioxin data from the nearest reference site. In the past, the available reference site dioxin data have been limited to Carr Inlet and Sequim Bay. Under the interim guidelines, it is the dredger's responsibility to sample the nearest reference site if data are not available. Bioaccumulation testing for dioxin is currently not used to determine suitability for dispersive sites in Puget Sound.

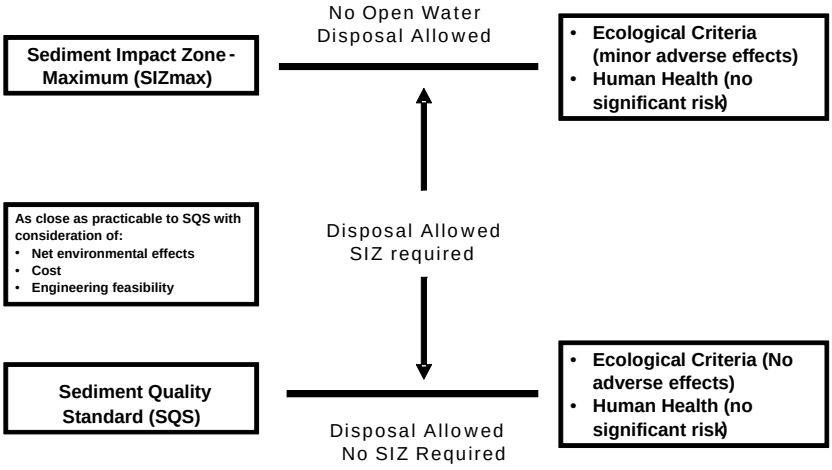
  - Dispersive sites in Grays Harbor: Under the interim guidelines, the DMMP uses a dioxin concern level of 5 ng/kg 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and a total toxic equivalency (TEQ) of 15 ng/kg as a trigger for requiring bioaccumulation testing. These concern levels were derived from a dioxin risk assessment performed by the COE (1991) for Grays Harbor in 1991. NOTE: The current proposal only applies to Puget Sound sites. The Grays Harbor guidelines will be updated at a future date.

Sediment Management Standards Requirements for DMMP Sites

The Sediment Management Standards (SMS) rule was published in 1991 to implement Ecology's responsibilities under the Water Pollution Control Act (90.48 RCW), the Model Toxics Control Act (70.105D RCW), and several other state laws.[2] EPA has approved the SMS rule as one part of Washington's water quality standards required under the Federal Clean Water Act. Part IV of the SMS rule establishes requirements that are applicable to the open water sites managed by the DMMP. The SMS rule incorporates the DMMP (formerly PSDDA) sediment characterization requirements by reference. Important features include:

- Decision-Making Framework: The SMS rule includes a two-tiered decision-making framework (Figure 1). The Sediment Quality Standards (SQS) represent the lower (more protective) tier in the SMS framework. SQS values are defined as sediment contamination that poses "no adverse effects" to sediment organisms and "no significant human health risk". The Sediment Impact Zone maximum (SIZmax) standards represent the higher (less protective) tier in the SMS framework. SIZ max values are defined as sediment contamination that pose "minor adverse effects" to benthic organisms and "no significant human health risk".

Figure 1: Open Water Disposal Sites
Two-Tier Decision-making Framework



Dredged material cannot be taken to open-water disposal sites if the material will cause site conditions that exceed the SIZmax. While the SMS rule authorizes Ecology to designate open-water disposal sites as Sediment Impact Zones if disposal activities result in sediment concentrations above the SQS, the results of monitoring over the last 20 years demonstrate that onsite chemistry and bioassay results are largely below SQS for benthic effects. Consequently, Ecology has concluded that it is not necessary to establish Sediment Impact Zones for the DMMP disposal sites based on benthic toxicity.

[2] Ecology has initiated a rulemaking process to amend the SMS rule and the Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 WAC). That rulemaking is focused on issues related to cleanup standards and actions. However, some of those issues are similar to issues that the DMMP agencies have considered during the current project.

- Chemical and Biological Criteria Based on Sediment Toxicity: The SMS rule includes chemical and biological tests that are used to identify sediments that pose "no adverse effects" and "minor adverse effects" to benthic organisms. The current chemical and biological tests focus on acute and sub-chronic effects in benthic organisms. Consequently, the current criteria and tests do not directly address risks to fish, wildlife and humans posed by the bioaccumulation in the food web.
- Human Health Narrative Standard: The SMS rule states that the SQS and SIZmax must both be established at levels that are "…below levels which correspond to a significant health risk to humans" (WAC 173-204-320(1)(a) and 173-204-420(1)(a), respectively). Determinations on what concentrations satisfy this narrative standard are made on a case-by-case basis when making suitability determinations for individual projects.
- Requirements for Open Water Disposal Sites: The SMS rule states that Ecology will establish requirements for dredging activities and disposal sites that include the testing and disposal requirements developed by the Puget Sound Dredged Disposal Analysis (PSDDA) program and cited in various PSDDA documents[3]. The SMS rule also states that (when necessary) Ecology may authorize sediment impact zones of PSDDA sites through administrative orders issued under Chapter 90.48 RCW.

Sediment Management Standards (SMS) Requirements for Sediment Cleanup

The Sediment Management Standards (SMS) rule also establishes requirements for identifying cleanup sites and selecting cleanup standards/cleanup actions. While these requirements are not immediately applicable to the DMMP sites, the agencies have considered the relationships between the various SMS provisions when making decisions on whether and how to revise the suitability guidelines for dioxins and furans. Key features of the SMS sediment cleanup provisions include:

- Decision-Making Framework: The SMS rule includes a two-tiered framework for establishing sediment cleanup standards that is conceptually identical to the two-tiered approach developed for open-water disposal sites. The lower (more protective) tier is the Sediment Quality Standard (SQS). This is defined as a sediment concentration that poses "no adverse effects" to sediment organisms and no significant risk to human health. The higher tier represents the regulatory limit. The SMS rule includes two types of regulatory limits applicable to sediment cleanup:
  - Cleanup Screening Levels: The CSL defines the maximum degree of sediment contamination allowed before a contaminated sediment site cleanup is required.
  - Minimum Cleanup Levels: The MCUL defines the maximum degree of sediment contamination allowed to be left in place after active cleanup.

  As with the SIZmax, MCULs and CSLs are set at sediment concentrations that pose "minor adverse effects" to benthic organisms and no significant risk to human health.
- Chemical and Biological Criteria Based on Sediment Toxicity: The SMS rule includes chemical and biological tests that are used to identify sediments that pose "no adverse effects" and "minor adverse effects" to benthic organisms. The current chemical and biological tests focus on acute and sub-chronic effects in benthic organisms. Consequently, the current criteria and tests do not directly address risks to fish, wildlife and humans posed by the bioaccumulation in the food web.

[3] WAC 173-204-410(7)(a) states that the SMS guidelines shall include testing and disposal guidelines cited in several PSDDA documents including (1) Management Plan Report – Unconfined Open Water Disposal of Dredged Material, Phase I, (Central Puget Sound), June 1988, or as amended; (2) Management Plan Report – Unconfined Open Water Disposal of Dredged Material, Phase II, (North and South Puget Sound), September 1989, or as amended; and (3) Users Manual for Dredged Material Management in Puget Sound, November 1990, or as amended.

- Human Health Narrative Standard: The SMS rule requires that sediment cleanup standards must be established at levels that are "…below levels which correspond to a significant health risk to humans" (WAC 173-204-320(1)(a) and 173-204-420(5), respectively). Determinations on what concentrations satisfy this narrative standard are made on a case-by-case basis when establishing sediment cleanup standards at individual sites.
- Cleanup Site Identification: The SMS rule includes a process for identifying sediment cleanup sites. Under this process, areas with sediment concentrations above the CSL are defined as cleanup sites. Ecology currently uses the SMS chemical and biological criteria to define cleanup sites.
- Cleanup Standards: Cleanup standards are established on a site-specific basis at levels that are as close as practicable to the SQS taking into account net environmental protection, feasibility and cleanup costs. The MCUL defines the upper constraint (least stringent) for site-specific cleanup standards. Ecology currently uses the SMS chemical and biological criteria to define cleanup sites. Ecology also performs site-specific interpretation of the human health narrative standard.

The Model Toxics Control Act (MTCA) provides the statutory basis for the majority of site cleanup actions conducted/overseen by Ecology. Consequently, sediment cleanup actions must comply with the general requirements in the MTCA Cleanup Regulation. This includes the requirement that cleanup standards for dioxin mixtures are based on a cancer risk level of one-in-one million (10^{-6}).

Relationships Between SMS Requirements Applicable to Dredging and Cleanup

Ecology evaluated the interrelationships between dredging and sediment cleanup when developing the SMS rule. When publishing the rule, the agency attempted to align the requirements for dredging, cleanup and source control. Ecology's overall goal was to create a regulatory framework that allows different programs to be implemented without conflict and in ways that complement each other. The Final Environmental Impact Statement for the SMS rule (Ecology 1991b) discussed key relationships between the regulatory limits applicable to dredging and sediment cleanup. In particular, Ecology stated that "…[t]he quality of dredged material that meets current disposal guidelines for unconfined, open-water disposal should not result in the need for future active cleanup. Therefore, the CSL should be established at or above the current PSDDA disposal guidelines." (p. 2-6). The DMMP has considered the relationships between dredging and sediment cleanup when evaluating options for updating the suitability guidelines for dioxin mixtures.

Key Risk Management Choices and Assumptions

The agencies made a number of choices and assumptions when preparing the proposal. These choices generally reflect a combination of scientific and policy determinations. The agencies recognize that there is not always a clear separation between scientific and regulatory policy determinations and that multiple interpretations are inevitable given the wide range of situations and fact patterns that arise at specific disposal sites and for specific dredging projects. Consequently, the agencies have tried to provide a clear rationale for the key scientific and policy choices that helped to shape the DMMP proposal. This section summarizes the technical and policy rationale for some of the more important choices.

Focus on High Exposure Populations

The DMMP agencies evaluated the cancer risks associated consuming seafood with background levels of dioxin (see the companion Dioxin Risk Assessment Technical Memorandum). To help guide that evaluation, the agencies developed a conceptual site model which was used to select the exposure pathways and population groups considered during the risk evaluation. Based on that site model, the agencies decided to characterize the health risks for a range of consumers, including the general population, recreational or medium-exposure groups and high-exposure population groups. With respect to the latter, the agencies evaluated the potential health risks to tribal populations[4] who catch and consume fish and shellfish from embayments in which the DMMP sites are located. The rationale for this choice includes:

- The DMMP sites are located in the Usual and Accustomed (U&A) fishing areas for one or more Puget Sound tribes. The PSDDA agencies described the site locations relative to U&A areas in the Phase I and Phase II Environmental Impact Statements (PSDDA 1988c; PSDDA 1989b). The information in the EIS documents is consistent with more recent information compiled by the Washington State Department of Transportation (WSDOT 2008).
- Available information on fish consumption rates indicates that many tribal members consume much larger amounts of local fish and shellfish than recreational fishers or the general public. Several researchers have completed surveys of tribal fish consumption habits and patterns. The agencies used the results from two surveys from Puget Sound tribes (Suquamish Tribe, 2000; and Toy et al. 1996) when preparing the risk evaluations for this project (see Table 1 in Dioxin Risk Assessment Technical Memorandum). The information from Puget Sound tribal surveys are consistent with studies summarized in the EPA guidance documents (EPA 1997; EPA, 2006). The fish consumption rates and other exposure parameters specified in these studies and guidance documents are much higher than rates for recreational fishers and the general public.
- Use of a tribal exposure scenario is consistent with federal guidance for water quality standards: EPA has approved the SMS rule as part of Washington's water quality standards. Consequently, EPA guidance (EPA 2000) for developing water quality standards is applicable to the interpretation of the SMS narrative standard. EPA recommends that states consider high exposure population groups when establishing state water quality standards.
- Use of a tribal exposure scenario is consistent with MTCA policies that are applicable to sediment cleanup actions: Under the Model Toxics Control Act (MTCA) Cleanup Regulation,

[4] When designing the risk evaluation, the agencies recognized that other population groups may also consume large amounts of fish and shellfish from Puget Sound. However, available studies indicate that tribal consumptions rates are similar to or higher than those for nontribal fishers (e.g., ethnic minority populations and recreational anglers). Consequently, the agencies concluded that use of tribal consumption rates is a health protective approach for evaluating health risks.

cleanup levels are based on estimates of the "reasonable maximum exposure" (RME).[5] The RME is designed to represent a high end (but not worst case) estimate of individual exposures and provides a conservative estimate that falls within a realistic range of exposures. This requirement applies to all environmental media including sediments. The MTCA rule also includes specific methods for establishing media-specific cleanup levels for ground water, surface water, soil and air. The methods for establishing surface water cleanup levels are conceptually similar to methods used to establish sediment cleanup levels because they are both based on preventing health risks associated with the consumption of contaminated fish and shellfish. The reasonable maximum exposure (RME) for MTCA surface water cleanup standards is generally based on a recreational angler exposure scenario.[6] However, Ecology has made site-specific determinations that a recreational angler exposure scenario is not appropriate at several sites located within one or more U&A areas (Ecology 2008). Ecology has based sediment cleanup requirements for these sites on a tribal exposure scenario.[7]

- Use of a tribal exposure scenario facilitates integration of policies for dredging and cleanup actions: The SMS rule requires Ecology to implement the SMS requirements for DMMP sites "…so as to prevent the creation of new contaminated sediment cleanup sites identified under WAC 173-340-530(4)…".[8] As noted above, MTCA cleanup standards are often based on a tribal exposure scenario. Ecology believes that using a tribal exposure scenario will promote integration of requirements for dredging and cleanup actions.
- Use of a tribal exposure scenario is consistent with EPA Region 10 guidance for Superfund cleanup actions: EPA Region 10 has published a decision-making framework for selecting and using tribal consumption data to establish cleanup requirements at federal Superfund sites (EPA 2007a). The framework identifies a four-tiered hierarchy of preferred data sources. Under the EPA Framework, exposure estimates for particular tribes can be based on fish consumption surveys from other tribes (Suquamish or Tulalip Tribes) with similar dietary habits.
- Use of a tribal exposure scenario is consistent with Title VI of the Civil Rights Act of 1964, federal trust responsibilities and tribal treaty rights. Title VI of the Civil Rights Act of 1964 and EPA's implementing regulations (40 CFR 7.25) state that federal grant recipients should not use criteria or methods that have the effect of inequitably treating members of a protected group. Under the federal rules, protected groups include "American Indians" and "Asian and Pacific Islanders".

Risk Assessment Methodology

The concept of risk can be very confusing and people often have different opinions on the best ways to measure and characterize risk. This was highlighted by Lyndon (1989) who observed that "…risk is a slippery concept; it has no simple meaning, but varies in content according to circumstances."

[5] MTCA defines the RME as the "…the highest exposure that can be reasonably expected to occur for a human or other living organisms at a site under current and potential future site use." CERCLA provides a similar definition "…the highest exposure that is reasonably expected to occur at a Superfund site…"

[6] WAC 173-340-730(1)(e) states that "…[t]he department may require more stringent cleanup levels than specified in this section where necessary to protect other beneficial uses or otherwise protect human health and the environment."

[7] Ecology has established (or in the process of establishing) sediment cleanup requirements for a wide range of sites located in usual and accustomed fishing areas of one or more tribes. In these situation, Ecology has used a tribal exposure scenario to establish cleanup standards. Sites include Bellingham Bay (Whatcom Waterway), Alcoa Vancouver and the former Rayonier mill site in Port Angeles.

[8] WAC 173-204-410(1)(c).

This observation is particularly relevant to the agency and public discussions on the dioxin suitability guidelines. A certain amount of confusion has been created on this topic because people have suggested several approaches for characterizing health risks. The agencies have reviewed these approaches and found that all of the approaches are based on the standard risk assessment methods. Indeed, the various assessments use many of the same exposure and toxicity parameters and assumptions.

Another common feature is that all of the approaches represent some form of "incremental" risk assessment. In other words, the assessments produce estimates of increased risks associated with sediment-related exposure relative to an underlying risk baseline. However, the approaches differ in terms of the risk baseline considered in the assessment. These distinctions are briefly described below.

- Background Risks: The DMMP agencies prepared a risk assessment to characterize the health risks posed by background levels of dioxins in fish and shellfish tissue (see the companion Dioxin Risk Assessment Technical Memorandum).[9] This background risk assessment is designed to answer the question "What are the estimated cancer risks associated with eating fish and shellfish with background levels of dioxins? " The background risk assessment involves estimating the risks over and above the risk due to non-Puget Sound fish/shellfish exposures (e.g. dairy products, meat, etc). The agencies decided that this background approach is appropriate when attempting to interpret the Sediment Quality Standard (SQS) human health narrative standard. This type of risk baseline is typically used by environmental agencies when establishing media-specific standards. For example, EPA uses this type of baseline when establishing water quality standards for carcinogenic substances (EPA 2000):

  > *The 2000 Human Health Methodology uses different approaches for addressing non-water exposure pathways in setting AWQC for the protection of human health depending on the toxicological endpoint of concern. With those substances for which the appropriate toxic endpoint is carcinogenicity based on a linear low-dose extrapolation, only two water sources (e.g. drinking water and fish ingestion) are considered in the derivation of the AWQC. Non-water sources are not considered explicitly. In the case of carcinogens based on linear low dose extrapolation, the AWQC is being determined with respect to the incremental lifetime risk posed by a substance's presence in water, and is not being set with regard to an individual's total risk from all sources of exposure. Thus, the AWQC represents the water concentration that would be expected to increase an individual's lifetime risk of carcinogenicity from exposure to the particular pollutant by no more than one chance in one million, regardless of the additional lifetime cancer risk due to exposure, if any, to that particular substance from other sources (pp. 4-3 and 4-4)*[10]

- Site-Specific Risks: Several people have suggested that the agencies establish dioxin guidelines at sediment concentrations where site-specific health risks do not exceed a target risk level. Under this approach, risk assessments would be designed to answer the question "What are the estimated cancer risks associated with eating fish that could be exposed to dredged material placed at the unconfined open-water disposal sites? With this question, the agencies would estimate the incremental risks posed by the disposal site relative to a baseline created by dioxin exposures created by other activities (including fish/shellfish exposures that are unrelated to the

[9] The agencies based the assessment of background risks on dioxin measured in fish and shellfish tissue collected from reference/non-urban locations in Puget Sound.

[10] Many other state and federal programs use this type of incremental risk assessment approach to establish regulatory requirements. For example, EPA (2007b, 2008b) recently elected to lower the primary National Ambient Air Quality Standard (NAAQS) for lead from 1.5 ug/m^3 to 0.15 μg/m^3. EPA acknowledged that there are multiple sources of lead exposure, but focused on the air-related impacts on neurological development. The underlying policies used to update the NAAQS for lead (e.g. focus on incremental air-related exposures) are conceptually similar to the human health methods for water quality standards.

DMMP sites)[11]. This approach is consistent with the Evaluation Procedures Technical Appendix (EPTA) published by the PSDDA agencies (PSDDA 1988a). The EPTA guidelines are designed to characterize health risks associated with eating fish "…that could have been exposed to dredged material placed at the unconfined, open water, disposal sites…" (p. II-125).[12] The agencies decided that this approach is not appropriate for evaluating compliance with the Sediment Quality Standard (SQS) human health narrative standard. However, this approach may be appropriate when establishing site-specific requirements within a sediment impact zone because of the similarities to the EPTA guidelines. The practical implications of using this type of approach are unclear in situations where background concentrations are associated with cancer risks that already exceed benchmark cancer risk levels.

- Background + Site-Specific Risks: Several individuals who provided comments in 2007 suggested that the agencies establish guidelines at sediment concentrations that represent the sum of background levels and site-specific levels corresponding to a target risk level. In some ways, this type of assessment combines elements of the background and site-specific assessments. This type of risk assessment is designed to answer the question "What site sediment concentrations will produce a small site-specific risk relative to the risks posed by background levels of sediment contamination?" As discussed below (Zero Increment above Background), the agencies have decided not to use an approach that involves adding a non-zero increment of risk to background levels that already exceed benchmark cancer risk levels.

Cancer Risk Levels- Sediment Quality Standards

When making decisions on carcinogenic substances, a key policy choice is the target or reference cancer risk level. When interpreting the human health narrative standard for the Sediment Quality Standards, the DMMP agencies chose to define "no significant health risk to humans" as an increased risk of one-in-one million (10^{-6}). The rationale for this choice includes:

- The use of a 10^{-6} cancer risk level is consistent with the cancer risk level used to establish Washington water quality standards: In December 1992, EPA completed a rulemaking (the National Toxics Rule) to establish chemical-specific numeric criteria based on human health protection applicable to 14 states (including Washington) (EPA 1992). The risk-based criteria for Washington are based on a cancer risk of one-in-one million (10^{-6}). Ecology subsequently completed a state rulemaking to reference the National Toxics Rule and specify that risk-based criteria for carcinogenic substances shall be based on a 10^{-6} cancer risk level (Chapter 173-201 WAC).
- The use of a 10^{-6} cancer risk level will promote integration of policies for dredging and cleanup actions: The MTCA rule establishes a target cancer risk level (10^{-6}) that is applicable to sediment cleanup actions. While the MTCA rule is not directly applicable to decisions on open-water disposal, using a target cancer risk level of 10^{-6} to implement the SQS narrative standard will promote integration of requirements for dredging and cleanup actions.
- The use of a 10^{-6} cancer risk level is consistent with approaches used by other state agencies: State and federal agencies use several target cancer risk levels when establishing regulatory requirements. One-in-one million is the most commonly used risk metric. For example, the Association of State and Territorial Solid Waste Management Officials (ATSWMO 2006) recently completed a survey of state action levels. They found that 20 of the thirty-four states

[11] Site-specific risks can be calculated using either sediment or tissue data.
[12] While not directly applicable to decisions at the DMMP open water sites, this approach is also consistent with risk assessment procedures specified in the MTCA rule.

completing the survey establish remedial action requirements using a 10^{-6} cancer risk level. Twelve of the thirty-four states use a one-in-one hundred thousand risk level (10^{-5}).

Default to Background Concentrations

The DMMP agencies are proposing to use a background-based approach for the updated dioxin suitability guidelines because the risks associated with consumption of seafood with background levels of dioxin are greater than the SQS narrative target level of 10^{-6} (see the companion Dioxin Risk Assessment Technical Memorandum). The rationale for this a background-based approach includes:

- This approach is consistent with the decision-making framework in the Evaluation Procedures Technical Appendix (EPTA). The PSDDA agencies included human health screening methods and policies in the original technical protocols. The protocols include risk-based tissue screening values that were used to evaluate the results from bioaccumulation tests. In developing the guidelines, the agencies noted that risk-based screening values may fall below reference concentrations. In these situations, the agencies recommended that decisions be based on a comparison to reference or background concentrations (See earlier discussion on DMMP requirements on pp. 7-8).[13]
- This approach is consistent with the case-by-case decision-making frameworks used to interpret the SMS narrative standards at sediment cleanup sites. Ecology has made case-by-case decisions interpreting the SMS narrative standards at many sites. The department has established background based standards in situations where the risk-based values are below reference area concentrations.
- This approach is consistent with the general MTCA requirements applicable to sediment cleanup actions. The MTCA rule establishes methods and policies for establishing risk-based cleanup levels. The MTCA rule states that site cleanup levels should be based on either the risk-based concentration or natural background levels, whichever is higher.[14]

Statistical Measure Used to Characterize Background Levels

Estimates of background levels in Puget Sound sediments are based on data from sediment investigation conducted in August 2008, monitoring results from areas surrounding the Anderson Ketron DMMP site and previously-collected data from Puget Sound reference areas. This combined dataset provides the most current and comprehensive information for characterizing background sediment concentrations in Puget Sound. The DMMP agencies have chosen to characterize background levels using an estimate of the upper end of the range of measurements from the main basin of Puget Sound and reference areas. Specifically, the agencies have chosen to use a number that corresponds to the 90 % upper confidence interval on the 90th percentile of the distribution of background measurements. The rationale for this choice includes:

[13] Note: The DMMP and MTCA approaches both include procedures for defaulting to background concentrations when the background risks exceed the applicable target risk concentrations. In both cases, background concentrations are used in lieu of the risk-based concentrations. Under those procedures, the risk-based concentrations are not added to the background concentrations.

[14] WAC 173-340-700(6)(d) states "…[i]n some cases, cleanup levels calculated using the methods specified in this chapter are less than natural background levels or levels that can be reliably measured. In those situations, the cleanup level shall be established at a concentration equal to the practical quantitation limit or natural background concentration, whichever is higher…"

- It is consistent with approaches that have been used to implement the SMS narrative provisions. Ecology and EPA have traditionally used the 90th percentile of reference area measurements to characterize background concentrations. (PSEP, 1991).
- It is consistent with MTCA requirements applicable to sediment cleanup actions. The MTCA rule defines methods and policies for establishing risk-based cleanup levels. The rule states that site cleanup levels should be based on either the risk-based concentration or natural background levels, whichever is higher. The MTCA rule generally uses the 90th percentile to characterize background concentrations.
- It minimizes the chance that DMMUs that fall within the background range of concentrations will be considered unsuitable for open-water disposal (reduces false positives).

Use of Sediment Impact Zones

The SMS rule states that Ecology may authorize sediment impact zones for PSDDA sites (WAC 173-204-410(7)(c) and (d)). SIZ authorizations provide the flexibility to establish disposal guidelines that take into account costs, net environmental protection and technical feasibility. However, the agencies did not pursue options that would require a SIZ authorization. The rationale for this choice includes:

- The proposed approach is designed to ensure that dredged material placed at the open water sites will not reach levels that trigger the need for cleanup site designation and active cleanup.
- The agencies evaluated the need for SIZs at the DMMP sites in the early 1990's and again in 2008. During those reviews, the agencies identified several implementation issues. These include the need for a closure plan, increased management of disposal sites during their operational life, potential encumberances on the use of state-owned land, need for a mechanism to address potential state liabilities and uncertainty on local permitting requirements.
- The agencies evaluated the impacts of the proposed guidelines relative to previous guidelines. That evaluation is currently being reviewed by the dredging community and the agencies intend to update the evaluation based on public comments. However, the initial impact analysis indicates that the volume of sediments passing the proposed guidelines is similar to the volume that would be acceptable for open water disposal using the previous guidelines (e.g., 15 pptr TEQ).
- Given the current impact analysis, the agencies concluded that the benefits of using a SIZ were unlikely to outweigh the liabilities and added complexities associated with establishing an SIZ at one or more DMMP sites. The agencies have not discussed whether or how an updated impact analysis would affect this conclusion.

If there are future discussions on options that include an SIZ authorization, Ecology believes that there are several important constraints/factors that will need to be considered:

- <u>SIZs cannot be used to authorize the disposal of material that would result in site concentrations that exceed the SIZmax standards in WAC 173-204-420.</u> The SIZmax standards include (1) chemical and biological criteria based on "minor adverse effects" and (2) a narrative standard for human health protection (i.e. no significant risk to human health).
- <u>SIZs for disposal sites cannot be used to authorize disposal of materials that would result in a site-specific cancer risk level greater than one-in-one hundred thousand (10^{-5}).</u> Ecology (1991) chose to establish the SMS regulatory limits (SIZmax, CSL, MCUL) at a level that is functionally equivalent to the guidelines established by the PSDDA program for unconfined, open water disposal of contaminated sediments (e.g. Site Condition II). WAC 173-204-410(7)(a) states that disposal guidelines must include testing and disposal requirements developed by PSDDA.

Consequently, the SMS rule appears to preclude SIZmax conditions that exceed the PSDDA guidelines for human health protection that are based on a site-specific cancer risk level of 10^{-5}.

- Sediment impact zones must be designed to achieve site sediment concentrations that are as close as practicable to the Sediment Quality Standards. The determination of what is "close as practicable" can take into account costs, net environmental protection and technical feasibility. As noted above, there are several implementation requirements (e.g. closure plan, management plan, etc.) that would need to be met when using this regulatory mechanism.

Managing Uncertainty in Toxicity Information

The DMMP agencies used the current EPA cancer slope factor (150,000 mg/kg/day^{-1}) when evaluating the cancer risks associated with dioxin-contaminated sediments. The rationale for this choice includes:

- The Environmental Protection Agency recommends that this value be used pending completion of the agency review and response to the National Research Council review of the EPA dioxin reassessment. EPA has initiated a process to review the National Research Council's (NRC 2006) recommendations on the cancer slope factor for dioxins. In the interim, EPA recommends that EPA risk assessors continue to use the cancer slope factor published in the Health Effects Assessment Summary Table (HEAST).
- The HEAST value falls within the range of values developed by credible scientific organizations. The HEAST value is less stringent than the cancer slope factor (1,000,000 mg/kg/day^{-1}) in the EPA Dioxin Reassessment (EPA 2003) and more stringent than the value calculated by the California Environmental Protection Agency (26,600 mg/kg/day^{-1}) (California EPA 2007).
- There are a range of scientific opinions on the practical significance of the NRC findings. The agencies recognize that a recent National Research Council (NRC, 2006) committee has concluded that the dose response relationship for low-level dioxin exposure is likely to be non-linear. Under the current EPA Cancer Guidelines (EPA 2005), a margin of exposure approach is typically used for carcinogens with a non-linear dose response relationship. The use of this methodology would generally produce a less-stringent toxicity value. However, the agencies are also aware that a more recent NRC (2008) committee charged with reviewing the EPA risk assessment policies and procedures has concluded that it may still be appropriate to use a linear extrapolation model for compounds like dioxin because of background exposures and variability in human susceptibility.

Managing Variability in Exposure

Exposure to hazardous substances is influenced by a wide range of factors and there are often wide ranges in exposures within a given population. Agencies may have some information on the range of values for a particular parameter (e.g. fish consumption rates). However, agencies must also decide which value within the range to use to characterize the range of values (e.g. average or upper end of exposure range). Choosing a summary measure to characterize population exposure reflects an explicit (or implicit) policy choice on the appropriate balance between over- or underestimating exposure levels for particular individuals within the population group. The DMMP agencies have chosen to estimate exposure levels using a combination of parameters that produce an estimate of the upper end of the exposure spectrum (although not worst case). The rationale for this choice includes:

- This approach is consistent with the laws that provide the underlying basis for the SMS rule and other implementing regulations.

- This approach is consistent with the policies and procedures for establishing water quality standards.
- This approach is consistent with the MTCA policies and procedures applicable to sediment cleanup activities.

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Description of the Agencies Proposal

Non-dispersive Disposal Sites in Puget Sound

The agencies are proposing to set volume-weighted (dioxin concentrations weighted to the volume of each Dredged Material Management Unit (DMMU)) *dredged material suitability guidelines* for all dredging projects so that material disposed at non-dispersive sites in Puget Sound would not result in disposal site surface concentrations that exceed a *disposal site management objective*.

> *Disposal Site Management Objective:* The agencies propose to establish a target disposal site concentration for all non-dispersive disposal sites at a level that is not significantly different than concentrations measured in the Puget Sound Main Basin and Reference Areas. The value proposed for the Disposal Site Management Objective is 4 pptr TEQ, which is the nonparametric estimation of the 90% upper confidence limit for the 90th percentile of the distribution of the background data set.
>
> *Dredged Material Suitability Guideline:* The agencies propose to establish suitability guidelines (pass-fail criteria) that would be used to evaluate individual projects. The suitability guidelines would have two components: 1) The volume-weighted average concentration of dioxin/furan in material from each dredging project could not exceed the disposal site management objective of 4 pptr TEQ; and 2) dioxin/furan concentrations could not exceed a maximum concentration of 10 pptr TEQ in any single DMMU.

Dispersive Disposal Sites in Puget Sound

The agencies are proposing that dioxin/furan concentrations should not exceed a maximum concentration of 4 pptr TEQ (the Disposal Site Management Objective) in any single DMMU.

Bioaccumulation Testing

The DMMP agencies are looking into the possibility of a test-out option involving bioaccumulation testing. The dredging proponent would have the option of pursuing bioaccumulation testing to determine whether or not the DMMUs could qualify for open-water disposal. It should be noted that a test-out option was available under the former guidelines.

A target tissue level (TTL) to be used in the bioaccumulation evaluation has not been determined for dioxins at this time. In the absence of a TTL, the dredging proponent would include a reference sediment in the bioaccumulation test. Concentrations in the project test- sediment tissue would be compared against concentrations in the reference-sediment tissue. The DMMP agencies are continuing to evaluate a bioaccumulation test-out option in the revised dioxin guidelines.

Revisions to Dioxin Testing Requirements

Testing for dioxins will continue to be required on a case-by-case basis in areas where there is reason to believe that dioxins and furans are present in the project sediments. Factors which could trigger a "reason-to-believe" determination include the following:

- Located within an urban bay and having no historical information showing that dioxin is below levels of concern
- Proximity to current or historical point sources, such as outfalls

- Proximity to chlor-oxide bleach process pulp mills; chlor-alkali or chlorinated solvent manufacturing plants, former wood treatment sites; phenoxy herbicide manufacture and/or use and handling areas
- Proximity to areas with high PCB concentrations
- Proximity to hog fuel burners/boilers, and areas with previous fires or incineration sources
- Proximity to areas previously sampled that showed elevated levels of dioxin

Dioxin testing will be required for all projects meeting one or more of the reason-to-believe factors described above. Deeper underlying sediments, which are confirmed as "native", will be exempt from testing, except as follows: the top 4 to 8 ft of a native sediment layer underlying sediments that are being tested for dioxins will also be required to be tested for dioxins.

These updated guidelines are consistent with the "reason to believe" requirements implemented in the last several years. Guidance for sampling density per project will remain unchanged.

The agencies recognize that dioxin analysis is expensive. The agencies are evaluating potential use of alternative assay-based testing methods, but those evaluations are still in progress.

Verification of Compliance with the Disposal Site Management Objective

The DMMP program would continue to implement best management practices (BMPs) for sequencing of disposal operations. This type of sequencing will help to ensure that site concentrations do not exceed the site management objective (4 pptr). Recent data from the Anderson-Ketron disposal site has shown that application of these types of BMPs has resulted in final site surface concentrations well below the current interim suitability guidelines for dioxins.

The agencies would increase the number of on-site monitoring samples collected at each disposal site from 3 to 10 to allow statistical comparisons to be made with Main Basin/Reference Areas concentrations. Otherwise, the site monitoring program would be very similar to the current program, with monitoring frequency based on site disposal volumes.

Monitoring results would be tracked over time to determine whether the disposal sites are coming into compliance with the new site management objective. If necessary, the suitability guideline will be adjusted to ensure the management objective is being met.

Geographic Limitations of the Proposal

The Dioxin Project has focused on developing revised guidelines for Puget Sound only. Dioxin suitability guidelines for areas outside of Puget Sound (e.g. Grays Harbor, Columbia River) will need to be revisited as well. There are significant differences between other systems and Puget Sound that may require adjustments to the proposed framework.

Other Bioaccumulative Compounds

The adjusted framework for dioxin could have implications for other bioaccumulative compounds, especially dioxin-like PCBs. This is an issue that the agencies have begun to discuss, but have not yet determined a recommended path forward. The DMMP's long-term goal is to develop revised guidelines for all key bioaccumulative compounds.

Rationale for the Agencies Proposal

Overview

The proposal represents that agencies' initial answer to the risk management question identified earlier in this document:

How should the DMMP agencies revise the suitability guidelines for dioxins and furans, given:

- *The current statutory and regulatory framework for making decisions on the placement of dredged material at the open water disposal sites;*
- *Current scientific information on the threats to human health and the environment posed by dioxins and furans and the uncertainties surrounding those threats;*
- *Variability in exposures and susceptibility among individuals;*
- *Multiple sources and background concentrations and exposure levels; and*
- *Potential costs of different management options (e.g. open water, upland) and the uncertainties surrounding current cost estimates.*

The agencies' rationale for the proposal rests on four main determinations:

- The agencies concluded that the proposed site management objective (in combination with other elements of the proposal) represents an environmentally protective approach and will support a healthier Puget Sound and safer seafood consumption when compared to the old guideline of 15 pptr. The agencies recognize that people have a wide range of opinions on health risk assessment issues. The agencies plan to meet with interested parties to discussed these issues during the public comment period following the annual review meeting on May 6th.
- The agencies concluded that the draft proposal is consistent with applicable environmental regulations and addresses state land ownership concerns. The agencies recognize that some of the SMS rule requirements should be clarified through rule amendments.
- The agencies' evaluation of past dredging projects indicates that the percentage of sediments passing the proposed guidelines is not significantly less than the percentage that would be acceptable for open water disposal using the previous guidelines (e.g. 15 ng/kg total TEQ). The agencies recognize that several dredging proponents have raised questions about whether use of data from past projects represents a reasonable approach for predicting future impacts. The agencies will be working with interested parties to update the agency impact analysis based on additional data and review of key assumptions.
- The agencies concluded that the proposal can be implemented within the existing DMMP structure.

These points are discussed in greater detail below.

Environmental Protection

A key feature of the agencies proposal is the site management objective (4 pptr). The proposed value is an estimate of the 90th percentile of the sediment concentrations measured in the main basin of Puget Sound and the reference areas traditionally used by the DMMP agencies. Agencies commonly use background concentrations to define regulatory requirements in situations where background or reference area risks exceed applicable regulatory benchmarks (see discussion on risk management choices). The agencies believe that the proposed site management objective (in combination with other elements of the proposal) represents an environmentally protective approach and will support a healthier Puget Sound and safer seafood consumption.

1. The agencies proposal will contribute to overall efforts to reduce levels of dioxins in Puget Sound. The proposal is one part of a broader strategy for dealing with bioaccumulative chemicals. In developing the proposal, the agencies have recognized the practical limitations posed by regional and global sources of dioxin compounds. Consequently, the long-term success of this approach depends on additional measures to deal with ongoing sources (point, non-point and global contributions) and cleanup of historic releases. The DMMP proposal includes review and adjustments to the site management objective as background levels decline.

2. The actual condition of the sites is expected to be better than what is allowed by the proposed guidelines. The agencies do not expect that all projects will have average concentrations of 4 pptr. It is likely that much of the dredged material will be cleaner than the proposed guideline and, consequently, the actual condition of the sites will be comparable to the background distribution, which is generally lower than 4 pptr.[15] This expectation is consistent with statements in the Environmental Impact Statements prepared to evaluate the potential impacts associated with the Phase I (Central Puget Sound) and Phase II (North and South Puget Sound) open water sites. It is also consistent with site monitoring performed by the Department of Natural Resources (DNR). Based on monitoring conducted between 2005 and 2007, DNR (2008) reported that concentrations at the DMMP sites were generally lower than the 15 pptr guideline that was used to evaluate projects prior to 2006.

3. The agencies have used the most current information on sediment background concentrations to prepare the proposal. Estimates of background levels in Puget Sound sediments are based on a sediment investigation conducted in August 2008 as well as earlier data from reference sites. The DMMP agencies have chosen to characterize background levels using an estimate of the upper end of the range of measurements from the main basin of Puget Sound and reference areas. Specifically, the agencies have chosen to use a number that corresponds to the 90% upper confidence interval on the 90th percentile of the range of background measurements.

4. The agencies proposal includes several implementation mechanisms that will help to ensure compliance and continued reductions in dioxin concentrations at open water sites. The proposal includes the following elements:

    - Short-term exceedances of the site management objective are unlikely, but would be confined to the disposal sites where they can be monitored and managed as necessary.
    - Increases testing requirements for dioxins
    - Adaptive Management process uses site monitoring data to validate that non-dispersive sites are meeting the goal and (if necessary) to make adjustments to suitability guidelines. This also allows the agencies the ability to review and (if necessary) modify the suitability guidelines based on improvements in Puget Sound background levels.

5. The proposal is consistent with regulatory guidelines being used in other parts of the United States. Other agencies have developed guidelines for open water sites. For example, the proposal is similar to a range for background used in San Francisco Bay. That range (2-4 pptr) is the median and mean of a data set (n=56) that was collected from background locations within San Francisco Bay (Brian Ross, pers. comm. February 2009).

[15] Ecology has evaluated the dioxin data from historic projects. Volume-weighted average concentrations for projects complying with the agencies proposal ranged from 1.8 to 3.4 ng/kg.

Regulatory Consistency

The DMMP guidelines and the Sediment Management Standards provide the primary regulatory foundation for the agencies proposal. These regulatory provisions include a clear set of criteria for regulatory decision-making based on benthic toxicity. However, the provisions have less detailed requirements applicable to the bioaccumulation pathway and human health risks. Consequently, much of the DMMP's evaluation focused on the SMS narrative standard that states that sediment quality standards must be set at or below "levels which correspond to a significant risk to human health". As discussed in Section 2 of this paper, the agencies used a two-step evaluation process when interpreting this provision. First, the agencies selected a benchmark cancer risk level (10^{-6}) that was used in evaluating the narrative standard. The agencies then determined that background levels of dioxin in Puget Sound main basin sediments exceed this risk benchmark (see Dioxin Risk Assessment Technical Memorandum). Given those results, the agencies chose to base the suitability guidelines on background concentrations. As discussed in Section 2, the agencies chose a background concentration that falls at the upper end of the distribution of dioxin in background samples.

The agencies believe that the proposal is consistent with applicable environmental regulations and addresses state land ownership concerns. In particular:

1. <u>The agencies believe the proposal complies with applicable requirements in the Sediment Management Standards (SMS) rule</u>. The draft Site Management Objective represents a case-by-case interpretation of the narrative Sediment Quality Standard (SQS) for human health protection. Compliance with the SMS rule requirements will not require Sediment Impact Zones (SIZs) because the draft Site Management Objective compiles with the SQS requirements.

2. <u>The agencies believe the proposal complies with the applicable provisions of the DMMP Users Manual</u>. The agencies recognize that the target cancer risk level used to interpret the SQS narrative standards for human health (10^{-6}) is more stringent than the cancer risk level used by PSDDA to define Site Conditions I and II (10^{-5}). However, as noted above, use of a 10-5 cancer risk level would lead to the same decision process and resulting proposal.

3. <u>The agencies believe the proposal will not create added state cleanup liabilities</u>. The SMS rule has a two-tiered sediment cleanup decision-making framework similar to the framework for open water disposal sites. The upper tier (less protective) is used to identify cleanup sites. The lower tier (more protective) defines the cleanup objective. Sediment cleanup standards are established on a site-specific basis at levels that are as close as practicable to the cleanup objective. The draft Site Management Objective is equivalent to the sediment cleanup objective. Compliance with the draft Site Management Objective will ensure that site concentrations remain below levels that would trigger cleanup site designation.

Economic Impacts

The agencies' evaluation of past dredging projects indicates that the percentage of sediments passing the proposed guidelines is not significantly less than the percentage that would be acceptable for open water disposal using the previous guidelines (e.g. 15 pptr total TEQ). Based on that evaluation, the agencies have concluded that the proposal will continue to provide dredged material disposal options similar to those available under the previous guidelines. In reaching that conclusion, the agencies recognize that several dredging proponents have raised questions about whether data from past projects represents a reasonable approach for predicting future impacts. The agencies will be working with interested parties to update the agency impact analysis based on additional data and review of key assumptions. However, the agencies conclusions regarding the proposal are based on the following factors:

1. <u>The agencies' evaluation of past dredging projects indicates that the volume of sediments passing the proposed guidelines is similar to the volume that would be acceptable for open water disposal</u>

using the previous guidelines (e.g., 15 pptr total TEQ).[16] The DMMP agencies reviewed the data from twenty past and current projects where dioxin testing has been performed. The twenty projects include 113 DMMUs with a cumulative total of 1,778,978 cubic yards of dredged material. The agencies compared the pass-fail rates for individual DMMUs using the previous guideline (15 pptr), the interim guidelines, and the proposal. Based on that evaluation, the agencies estimate that 78% of dredged material will pass under the proposal. The percentage of material passing under the proposal is similar to the percentage passing with the previous guidelines (82%) and is higher than the percentage of sediments with the current interim guideline (69%). The results of the agency evaluation are presented in a separate technical memorandum (Dioxin Project Impact Analysis Technical Memorandum).

2. The estimated pass/fail rates are also similar to projections made by the PSDDA agencies when establishing the original guidelines for unconfined open water disposal sites. The agencies recognize that there are many factors that influence whether the pass/fail rates should be considered reasonable. Pass/fail rates and cost impacts were considered by the PSDDA agencies when selecting Site Condition II as the management condition for unconfined, open-water disposal at the Central Puget Sound sites. Many things have changed in the last twenty years in terms of information on sediment concentrations, economic climate and information and attitudes on health risks. However, when evaluating the reasonableness of the proposal, it is instructive to compare the estimated passing rates in the table above with estimates considered by the PSDDA agencies when selecting Site Condition II. As shown in the table below, the estimated passing rates for the dioxin guidelines are somewhat higher than the passing rates considered reasonable by the PSDDA agencies when they selected Site Condition II for the non-dispersive sites in Central Puget Sound .

Summary of PSDDA Evaluations Considered During Selection of Site Management Condition II for Phase I Sites

	Total Forecasted Volume	Volume Passing	Volume Failing	% Passing
Commencement Bay	3,929,000	3,160,000	769,000	80.4%
Elliott Bay	10,525,000	3,374,000	7,151,000	32.1%
Port Gardner	4,943,000	4,684,000	259,000	94.8%
Total (all areas)	19,397,000	11,218,000	8,179,000	57.8%

3. The estimated volume-weighted passing rates fall slightly below the lower end of the yearly averages compiled by the Corp of Engineers. When evaluating reasonableness, it is also instructive to look at the overall experience over the last twenty-one years. Over that period, the percentage of tested sediment found to be acceptable for disposal at the DMMP sites has ranged from 81% to 100% (on a volume basis). Over the last 10 years, 93.7% of tested material has been found to be acceptable for disposal at the DMMP sites. For this ten-year interval, the passing rate falls to approximately 90% when native material is excluded from the evaluation.

4. The DMMP agencies recognize that reduction in state remedial action grants will increase local agency costs. The agencies recognize that many dredging projects have been conducted as part of sediment cleanup projects that have been partially funded through the Local Toxics Control Act. These grants cover 50-75% of remedial action costs. The Washington Legislature is currently

[16] The DMMP pass-fail evaluation has been posted on the DMMP website.

working to complete the state budget for 2009-2011. Current budgets being considered by the Legislature have significantly less monies for remedial action grants.

5. The agencies proposal reflects recent changes in applying the "reason to believe" criteria that are used to determine when dioxin testing is required. Over the last few years, the DMMP agencies have required more projects to conduct dioxin testing. In general, the decision to require more frequent testing is applicable to all of the options being considered by the agencies.
6. The agencies proposal is based on a volume weighted average. This provides additional flexibility for dredging proponents and should result in lower overall project costs.

Program Implementation

The agencies have concluded that the proposal is workable and can be implemented within the existing DMMP structure. It provides clear, predictable and equitable criteria for all disposal sites. It incorporates current procedures and best management practices (i.e., thoughtful and controlled sequencing of project DMMU disposal). In addition, site management objective and suitability guidelines are above the analytical range of uncertainty where analytical variability and accuracy impact data analyses.

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Rationale for the Proposed Suitability Guideline

The DMMP agencies are proposing to establish suitability guidelines (pass-fail criteria) that would be used evaluate individual projects. The proposed suitability guidelines have two main components:

- The volume weighted average concentration of material from each dredging project could not exceed the disposal site standard (4 pptr TEQ); and
- No single DMMU concentrations could exceed 10 pptr TEQ.

The DMMP agencies are proposing a sediment concentration of 10 pptr TEQ as a pass-fail guideline that would be used to evaluate the suitability of individual DMMUs for disposal at the DMMP open water sites in Puget Sound. This choice is based on several lines of reasoning:

1. Site monitoring data (SAIC, 2008) indicates that historic practices using a 15 pptr suitability guideline have resulted in average site concentrations similar to 4 pptr at several of the non-dispersive sites managed by the DMMP agencies. However, it is important to recognize that a relatively small number of on-site samples have been analyzed.

DMMP Site Monitoring Data (pptr) (based on target zone (Z) or site samples (S))		
DMMP Site	Year Sampled	Average (+/- SD)
Anderson/Ketron Island	2005	3.11 (n=1)
Bellingham Bay	2007	6.1 (n=1)
Commencement Bay	2007	5.56 (+/- 7.61)
Elliott Bay	2005/2007	6.37 (+/- 6.24)
Elliott Bay (site samples)	2005	2.99 (+/- 3.25)
Elliott Bay (site samples)	2007	9.74 (+/- 7.25)
Port Gardner	2006	1.78 (+/- 0.95)

2. The DMMP agencies have evaluated the potential impacts of using the10 pptr suitability guideline. Specifically, the agencies evaluated past projects and other available sediment data in order to estimate the cumulative effect of multiple projects. This analysis took into account projects that include native material that has been minimally impacted by current regional and global releases. The agencies' analysis indicates that a pass-fail criterion of 10 pptr could be expected to result in average site concentrations that are below the proposed site management objective (4 pptr).
3. The proposed maximum value (10 pptr) is within the range of values found in the Main Basin and Reference Areas data set. In the recent sampling, the maximum concentration detected in the Main Basin of Puget Sound was 11.6 pptr (with undetected values assigned a value of ½ the detection limit).
4. Use of the 10 pptr guideline will provide additional project flexibility that will enable completion of projects that provide nearshore environmental benefits.
5. Agencies will increase testing requirements and continue to implement BMPs (e.g. sequencing) to reduce chances that site concentrations will exceed 4 pptr.

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References

Association of State Territorial Solid Waste Management Officials (ASTSWMO). 2006. Report of State Action Levels. Prepared by CERCLA Training and Technology Transfer (T3) Focus Group.

California Environmental Protection Agency. 2007. Public Health Goal for TCDD in Water (DRAFT for Public Review). Prepared by the Pesticide and Environmental Toxicology Branch, Office of Environmental Health Hazard Assessment. June 2007.

Dredged Material Management Program. 2008. Dredged Material Evaluation and Disposal Procedures (Users' Manual). Prepared by Dredged Material Management Office. U.S. Army Corps of Engineers. Seattle District. July 2008.

Lyndon, M. L. 1989. Risk Assessment, Risk Communication and Legitimacy: An Introduction to the Symposium. Columbia Journal of Environmental Law 14:289.

National Research Council. 2006. Health Risks from Dioxin and Related Compounds: Evaluation of the EPA Reassessment. Committee on EPA's Exposure and Human Health Reassessment of TCDD and Related Compounds. National Academy of Sciences. National Academy Press. Washington DC.

National Research Council. 2008. Science and Decisions: Advancing Risk Assessment. Committee on Improving Risk Analysis Approaches Used by the U.S. EPA. National Academy of Sciences. National Academy Press. Washington DC.

Puget Sound Dredged Disposal Analysis (PSDDA). 1988a. Evaluation Procedures Technical Appendix – Phase I (Central Puget Sound), June 1988,

Puget Sound Dredged Disposal Analysis (PSDDA). 1988b. Management Plan Report – Unconfined Open Water Disposal of Dredged Material, Phase I, (Central Puget Sound), June 1988.

Puget Sound Dredged Disposal Analysis (PSDDA). 1988c. Final Environmental Impact Statement. Unconfined Open Water Disposal for Dredged Material, Phase I (Central Puget Sound), June 1988.

Puget Sound Dredged Disposal Analysis (PSDDA). 1989a. Management Plan Report – Unconfined Open Water Disposal of Dredged Material, Phase II, (North and South Puget Sound), September 1989.

Puget Sound Dredged Disposal Analysis (PSDDA). 1989b. Final Environmental Impact Statement. Unconfined Open Water Disposal for Dredged Material, Phase II (North and South Puget Sound), September 1989.

Puget Sound Dredged Disposal Analysis (PSDDA). 1990. Users Manual for Dredged Material Management in Puget Sound, November 1990.

Puget Sound Estuary Program (PSEP). 1991. Reference Area Performance Standards for Puget Sound. Prepared by PTI for USEPA and Washington Department of Ecology. September 1991.

Science Applications International Corporation. 2008. Dioxin/Furan Concentrations at the Non-Dispersive Open-Water Dredged Material Disposal Sites in Puget Sound. Prepared for the Washington Department of Natural Resources

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

Toy, K, N.L. Polissar, S. Liao, G. Mittelstadt. 1996. A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region.

U.S. Army Corps of Engineers. 1991. Human Health Risk Assessment of Seafood Consumption Related to Disposal of Federal Channel Maintenance Dredged Material at South Jetty/Point Chehalis –

Grays Harbor, Washington (Final Draft). Seattle District. Prepared by BCI under contract to Shapiro and Associates, Inc. April, 1991.

U.S. Environmental Protection Agency. 1992. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; State's Compliance. 40 CFR 131. Published December 22, 1992 (57 FR 60848)

U.S. Environmental Protection Agency. 1997. Exposure Factors Handbook. National Center for Environmental Assessment. Office of Research and Development. August 1997. Available at: http://www.epa.gov/ncea/efh/.

U.S. Environmental Protection Agency, Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000), EPA-822-B-00-004, EPA. 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health.

U.S. Environmental Protection Agency. 2003. Exposure and Human Health Reassessment of 2,3,7,8 Tetrachlorodibenzo-p-dioxin (TCDD) and Related Compounds. NAS Review Draft. National Center for Environmental Assessment. EPA/600/P-00/001Cb.

U.S. Environmental Protection Agency. 2004. An Examination of EPA Risk Assessment Principles and Practices. EPA/100/B-04/0001.

U.S. Environmental Protection Agency. 2005. Guidelines for Carcinogen Risk Assessment. Risk Assessment Forum. EPA/630/P-03/001F.

U.S. Environmental Protection Agency. 2006. Child-Specific Exposure Factors Handbook (External Review Draft). National Center for Environmental Assessment. Office of Research and Development. EPA/600/R/06/096A.

U.S. Environmental Protection Agency. 2007a. EPA Region 10 Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia, August 2007.

U.S. Environmental Protection Agency. 2007b. Lead: Human Exposure and Health Risk Assessments for Selected Case Studies, Volume I. Human Exposure and Health Risk Assessments—Full-Scale and Volume II. Appendices. Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA–452/R–07–014a and EPA–452/R–07–014b.

Washington Department of Ecology. 1990. Final Environmental Impact Statement for the Washington State Sediment Management Standards – Chapter 173-204 WAC. Publication Number 90-50. December 1990.

Washington Department of Ecology. 2008. Site-Specific Proposal for Modifying the Default MTCA Fish Consumption Exposure Parameters. Questions and Background Information Prepared the MTCA Science Advisory Board. March 2008.

Washington State Department of Transportation (WSDOT). 2008. WSDOT Model Comprehensive Tribal Consultation Process for the National Environmental Policy Act. Appendix B includes summaries of U&A areas prepared by the Washington Attorney General's Office.

Proposal to Revise the Open-water Disposal Guidelines for Dioxins in Dredged Material

Attachment 3
Dioxin Risk Assessment Technical Memorandum

Dioxin Project Risk Assessment Technical Memorandum

Dredged Material Management Program

April 29, 2009

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1. Introduction

This memorandum is one of several that provide the Dredged Material Management Program (DMMP) agencies' rationale for development of a suitability framework for determining unconfined, open-water disposal of sediments containing polychlorinated dibenzodioxins and dibenzofurans (jointly referred to here as "dioxin," and expressed as TEQ or toxicity equivalents of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin). Because the agencies' current focus is on a dioxin suitability framework, this memorandum does not consider effects associated with other compounds, such as polychlorinated biphenyls (PCBs) that have "dioxin-like" effects.

The question addressed in this memorandum is, "What are the estimated cancer risks associated with eating fish and shellfish with background levels of dioxin from Puget Sound?" This background risk provides the context for policy decisions by the agencies as to whether any and/or what amount of additional risk would be acceptable.

Some key issues associated with this evaluation and discussed below include the following:

- What is meant by "Puget Sound background risk?"
- What is considered to be "acceptable" risk in context of background?
- What specific consumers are being evaluated for protection? Who in the population (e.g., an average consumer or an upper bound consumer) sets the seafood ingestion rate?
- What kinds of seafood are being considered? For instance, should species that spend only part of their time in Puget Sound (e.g., salmon) be included?
- What cancer potency factor will be used in the evaluation? What is the role of uncertainty in the cancer potency factor?

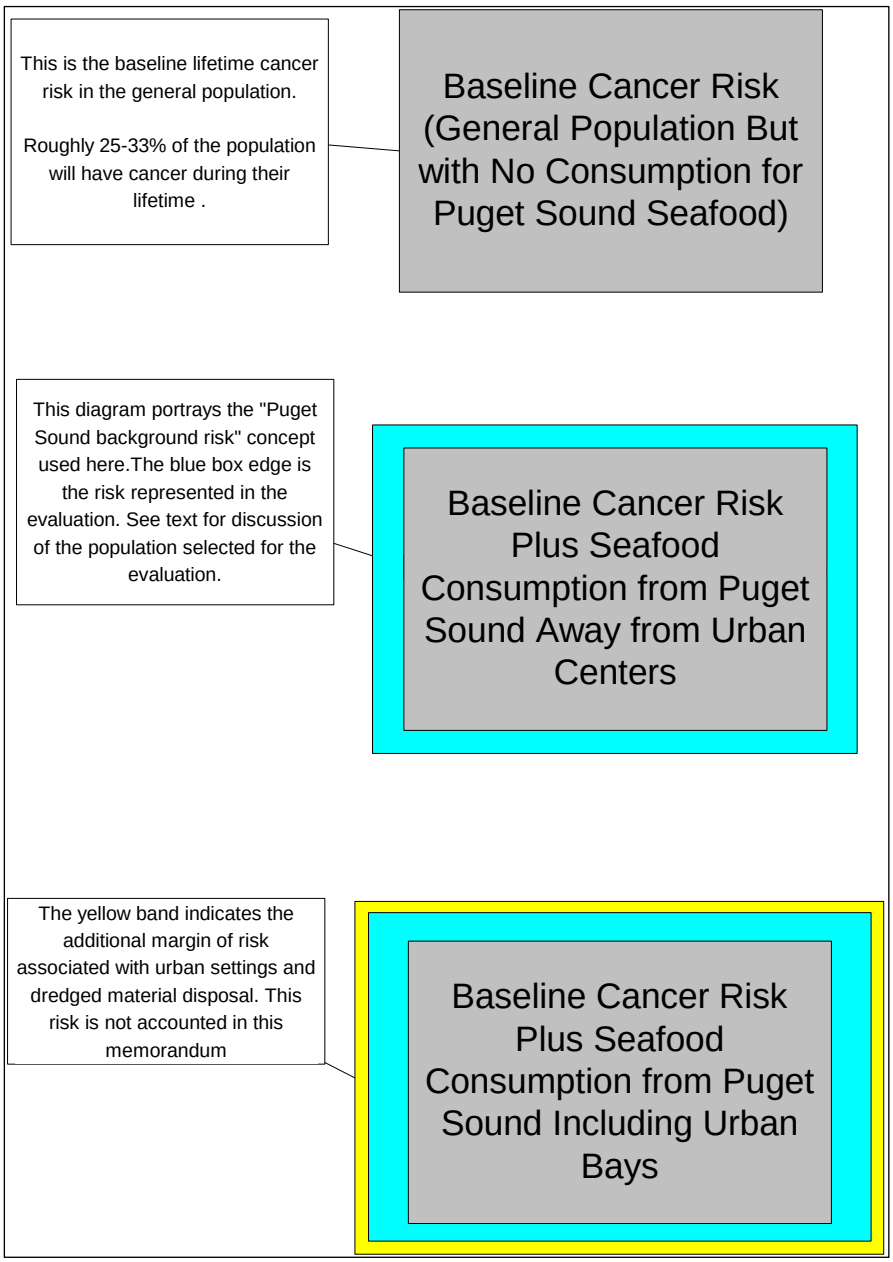
There are various ways to define background, and Figure 1 attempts to show options that the agencies considered. The gray box entitled "baseline cancer risk (general population)" represents risk associated with consumption of dairy, meat, and agricultural products not associated with Puget Sound seafood. The risks associated with other than Puget Sound seafood are not considered in this focused evaluation; this approach for risk evaluation is often used by environmental agencies when establishing media-specific standards.[1] The blue border in the middle box of Figure 1 represents the "background risk" that is the subject of this evaluation. Background risk, as defined and evaluated in this memorandum, does not include risks associated with consumption of seafood reflecting urban dioxin exposure. In the bottom part of Figure 1, these risks are depicted by the yellow border around the gray and blue

[1] As an example of this, EPA (2000) uses this type of baseline consideration when establishing water quality standards for carcinogenic substances.

boxes. This is because of the focus on non-urban areas associated with the regulations (see Regulatory and Policy Technical memorandum). The agencies wish to use this information to assess the importance of seafood consumption related risk in interpreting the Sediment Quality Standard (SQS) human health narrative standards, which describe non-anthropogenic or globally-distributed background risks as a potential regulatory threshold under certain conditions.

For the purpose of this memorandum, background risk is being determined using tissue dioxin data from reference areas and other non-urban locations in the Puget Sound main basin away from point sources of contamination. As described further below, these data are derived from “reference area” data associated with cleanup projects, Puget Sound Estuarine Program sampling, and from DMMP monitoring in the vicinity of Anderson and Ketron Islands. This data set is, however, limited in size and not as widely-representative of the main Puget Sound basin as are available sediment data for dioxin. A comprehensive characterization of dioxin in background sediments of Puget Sound has been recently completed by the DMMP agencies (SAIC 2009). However, these sediment data were not used to estimate background risk because there are currently no well established quantitative relationships between sediment and tissue dioxin for most of the seafood species considered.

Figure 1. Conceptual Illustration of Puget Sound Background



2. Risk Associated With Exposure to Background Concentrations of Dioxin in Puget Sound Seafood

Sediment-associated dioxin may move through the food chain and into the seafood consumed by various groups of people. The baseline or "background" risk associated with consumption of dioxin in Puget Sound seafood reflects exposure to main basin/reference conditions outside of urban areas.

2.1 Risk Estimation Approach

The DMMP agencies used a standard seafood-consumption equation from EPA (1989) with regional adjustments to estimate the cancer risk associated with various levels of consumption of seafood containing background concentrations of dioxin. The exposure parameter values used are presented in Table 1. The Chronic Daily Intake (CDI) was calculated using either equation 1 or equation 2 depending on the availability of species-specific ingestion rates for a given exposure group.

---

(1) Chronic Daily Intake (CDI) = $\frac{(IR_{seafood} \times Dioxin_{seafood}) \times ED \times EF \times SDF}{BW \times AT}$

---

(2) Chronic Daily Intake (CDI) =

$$\frac{[(WF_{crab} \times IR_{shellfish} \times Dioxin_{crab}) + (WF_{clam} \times IR_{shellfish} \times Dioxin_{clam}) + (IR_{finfish} \times Dioxin_{finfish})] \times UCF \times ED \times EF \times SDF}{BW \times AT}$$

Equation 2 can be rearranged and expressed as follows:

(3) CDI =

$$\frac{[IR_{shellfish} (WF_{crab} \times Dioxin_{crab} + WF_{clam} \times Dioxin_{clam}) + (IR_{finfish} \times Dioxin_{finfish})] \times UCF \times ED \times EF \times SDF}{BW \times AT}$$

Where:

CDI	= Chronic daily intake (mg/kg·day)
$IR_{seafood}$	= Ingestion rate for seafood (g/day) used when species-specific ingestion rates are not known
$IR_{finfish}$	= Ingestion rates for finfish (g/day)
$IR_{shellfish}$	= Ingestion rates for shellfish (g/day)
$WF_{crab/clam}$	= Shellfish weighting factor (fraction of total shellfish consumption represented by crab or clams)
$Dioxin_{seafood}$	= Tissue dioxin in consumed seafood (non species specific) (mg TEQ /kg wet)
$Dioxin_{crab, finfish, or clam}$	= Tissue dioxin in crab, finfish, and clams (mg TEQ /kg wet)

BW	= Average consumer body weight (kg)
AT	= Averaging time (years)
UCF	= Unit Conversion factor (0.001kg/g)
ED	= Exposure duration (years)
EF	= Exposure frequency (days/year)
SDF	= Seafood Diet Fraction: fraction of total seafood in diet obtained from Puget Sound

---

The cancer risk associated with the Chronic Daily Intake of a seafood consumer population was derived using equation 4.

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(4) Risk = CDI x CSF

Where:

Risk	= Calculated risk level (incremental lifetime cancer rate, ILCR)
CSF	= Cancer slope factor $(mg/kg \cdot day)^{-1}$

2.2 Formulation of Seafood Consumption Exposure Scenarios

Risk was calculated for three different exposure groups in order to provide a range of background risk estimates. The low-end of the exposure range was represented by the general public consumption, mid-range by the Tulalip tribe, and the high-end of the range by the Suquamish tribe. Risks were assessed using exposure parameter values selected using a “reasonable maximum exposure” (RME) paradigm (EPA, 1989a). RME assessment uses a blend of average and upper bound estimates for exposure parameters to produce an estimate of exposure that is high-end, but not worst case. Details on the variables used and their basis are presented in the following sections.

2.2.1 Tribal Consumption Rates and Species Composition

There are a number of groups that consume large amounts of seafood, including tribes, ethnic minorities, and recreational anglers. All DMMP disposal sites are located within the Usual and Accustomed fishing areas of one or more tribes. Consideration of tribal seafood consumption is therefore important for insuring that the guidelines derived are appropriately protective of the most highly exposed populations. As noted in the companion Regulatory and Policy Memorandum, tribes that consume seafood at the subsistence level are the most exposed to the hazards associated with dioxins. Therefore, the DMMP agencies calculated background risk using tribal consumption rates as a conservative estimate of high-end exposures.

There is variation between different tribes in both the species consumed and rates of consumption. Several consumption studies have been conducted for tribes fishing in Puget Sound (Toy et al., 1996; The Suquamish Tribe, 2000, 2007). Using these studies, EPA Region 10 recently developed a framework for selecting and using tribal fish and shellfish consumption rates for risk-based decision making (EPA, 2007). While EPA's Consumption Framework is intended for use in Comprehensive Environmental Restoration, Compensation, and Liabilities Act (CERCLA) and the Resource Conservation Recovery Act (RCRA) cleanup sites, it nevertheless provides a basis for policy choices used to predict seafood consumption risks in other contexts. The DMMP agencies decided that it was appropriate and important to use the exposure information from EPA's Consumption Framework for both the Tulalip and Suquamish tribes to generally cover a range of exposures to sensitive populations and specifically to estimate background risks to tribal consumers who derive a large percentage of their seafood from Puget Sound (Table 1).

2.2.2 General Population Consumption

Consumption rates associated with the general population represent a lower degree of exposure to seafood from Puget Sound than that associated with tribes, ethnic minorities, and recreational anglers. The DMMP used a consumption rate of 54 g/day from MTCA, representing a 90th percentile of the general population in coastal states (WAC 173-340-730).[1] Since there are no species-specific consumption values available for this category of consumer, a range of risk for the general population was derived by assuming that all consumption was of whole body crab, clams, or English sole.

2.2.3 Exposure Duration

The DMMP used the 70-year exposure duration for tribal consumers (Table 1) recommended in EPA's Consumption Framework (2007). This exposure duration is longer than the 30-year duration typically used for the general public. The 30-year general public's exposure duration is intended to reflect an upper-bound (90th percentile) period at one residence (EPA 1989b). The assumption that changing residence will eliminate exposure is not valid for tribal members, particularly given that individuals may relocate and continue to visit the same Usual and Accustomed fishing areas.

[1] According to the Responsiveness Summary for the MTCA promulgation, a 90th percentile on the mean is the RME. In EPA guidance, the 95th percentile Upper Confidence Limit is typically used.

Table 1. Exposure Information Used for Various Consumer Groups

Consumer Group	Body Weight (kg)	Exposure Duration (years)	Total Seafood Ingestion Rate (g/day)	Shellfish Ingestion Rate (g/day)	Percentage of Shellfish IR represented by Clams/Crabs[1] (%)
Tulalip[2]	81.8	70	194	81.9	54/46
Suquamish[3]	79	70	767	498.4	88/12
General Population[4]	70	30	54	Not Applicable	Not Applicable

[1] Personal Communication Lon Kissinger, 4/2009; based on Lower Duwamish Waterway Group (2007). Weighting contribution of individual species contaminant concentrations on the basis of species-specific consumption rates determined using guidance in EPA (2007).
[2] Exposure information from EPA (2007)
[3] Exposure information from EPA (2007)
[4] MTCA (WAC 173-340-730)

2.2.4 Body Weight

For estimates of risk to tribal consumers, the DMMP used the recommended tribe-specific body weights provided in the Consumption Framework (EPA, 2007). For estimates of risk to the general population, the DMMP used the EPA (1989b) default of 70 kg (Table 1).

2.2.5 Seafood Diet Fraction (SDF)

This represents the percentage of the total fish and/or shellfish in an individual's diet that is obtained or has the potential to be obtained from a specific location. The SDF was developed for recreational exposures based on comments received during MTCA rule development. However, the DMMP did not apply an SDF in estimates of background risk for any of the consumer groups evaluated.

The tribal consumption rates used to estimate risk to central and high-end consumers reflect harvest from Puget Sound only. Given that the goal of these calculations was to estimate the risk associated with exposure to background levels of dioxin in Puget Sound fish/shellfish tissue, it is appropriate to assume that 100% of all fish consumed are from Puget Sound for every level of consumer.

2.2.6 Background Tissue Dioxin from Puget Sound Seafood Species

There is limited data documenting dioxin in shellfish and finfish tissue from non-urban areas of Puget Sound. Ecology's EIM database was queried and the results screened to exclude data in the vicinity of sediment remedial activities (e.g., CERCLA or MTCA sites). The agencies also decided not to use nearly 19-year old crab data (PTI, 1991), as they do not likely represent current conditions in Puget Sound. Most of the accepted data were from north Puget Sound - Padilla Bay, Samish Island, and Dungeness and Freshwater Bays (Figure 2). The latter two locations are reference areas associated with cleanup studies.

Tissue data from site monitoring at the Anderson-Ketron (A/K), non-dispersive dredged material disposal site were also included in the data set used to estimate background dioxin in tissue. Specifically, English sole and clam data collected from offsite locations in 2006 and 2007 were included.[1] The A/K site is the only non-dispersive disposal site located in a non-urban area (Figure 2).

[1] Although Dungeness crab data is also available from the 2007 A/K site monitoring, the dioxin concentrations in whole body crab (4.5 ng/kg TEQ wet) are noticeably elevated in comparison to that observed at other disposal sites as well as to reference locations reported in Table 2. The reason for this elevation has yet to be determined, but may be the result of foraging activities extending into contaminated areas of the South Sound. As it appears to be an outlier, the A/K crab data were not used here. Note that all tissue data used were collected prior to 2008 disposal of dredged material from the COE's Port of Olympia maintenance dredging activities.

There are no known sources of dioxin contamination in the vicinity of the site, and prior to 2008, it had received a relatively low volume of dredged material (approx 33,000 CY since designation in 1989) in comparison to other disposal sites. The sediment dioxin data collected in the immediate site vicinity were within the range of dioxin the main basin and reference areas of Puget Sound (Figure 3). The Anderson-Ketron data are the only tissue dioxin information from South Sound.

Figure 2. Sites Used for Background Tissue Concentrations

Figure 3. Comparison of Sediment Dioxin from Main Basin with Anderson-Ketron Vicinity Dioxin

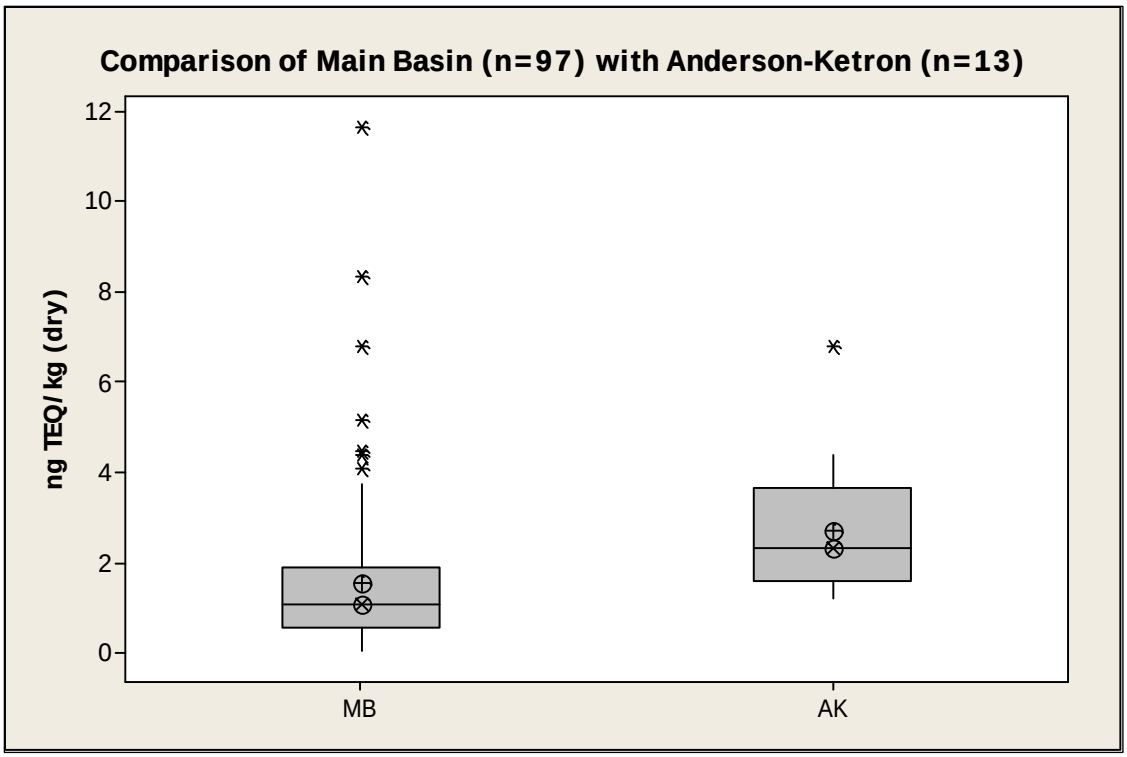

Figure Legend. AK is Anderson-Ketron; MB is Main Basin Plus Reference Bays compiled by the DMMP to calculate Puget Sound sediment background. The "box" is the second and third quartile. The "whiskers" are the first and fourth quartiles. The median for each location is shown by an X in a circle, and the mean is shown by a cross in a circle. The AK data are present in both summations because they are regarded as being in the Main Basin**.**

Table 2 summarizes the dioxin tissue data that were used in this risk assessment to represent background in Puget Sound. The fish data included Rock sole (whole and skinless filet), English sole (whole), and Starry flounder (whole and skinless fillet). Fillet data were used to generate an average fish concentration for the general population risk estimate; whole-fish concentrations were used for tribal consumers. Dungeness crab data have been calculated to whole crab based on weight proportions of edible meat and viscera (hepatopancreas) observed in the Lower Duwamish Remedial Investigation. The clam species used include Butter clam, Littleneck clam, Horse clam, Geoduck, *Yoldia*, *Macoma*, and *Compsomyax*. The latter three species are not commonly eaten, but represent species at deeper (subtidal) locations in Puget Sound which could be eaten.

Table 2. Synopsis of Tissue Dioxin Data Representing Background in Puget Sound

	Species	Organs	Locations	Number of Samples, n	Mean TEQ[8]	Std Error of Mean[9]	Survey[10]
Clams	Little neck clam	Whole	Padilla Bay - Pearson Rd.	1	0	NC	AJOH0012
	Butter clam	Whole	Samish Bay - Samish Is.	1	0.002	NC	AJOH0012
	All Geoduck[11]	Muscle (some), Viscera (some)	Dungeness, Freshwater Bays	22	0.007	0.002	RAYON05 PAMILLRI
	Horse Clam	Muscle (some), Viscera (some)	Dungeness, Freshwater Bays	38	0.009	0.0042	RAYON05 PAMILLRI
	Yoldia	Whole	Anderson-Ketron	1	0.516	NC	AK2007
	Compsomyax	Whole	Anderson-Ketron	4	0.014	0.0002	AK2007
	Macoma	Whole	Anderson-Ketron	1	0.096	NC	AK2007
	Sample-weighted Clam Mean[12]			*68*	*0.017*	--	
Fish	Rock Sole	Whole	Dungeness, Freshwater Bays	4	0.021	0.0121	RAYON05
	English Sole	Whole	Anderson-Ketron	3	0.266	0.0651	AK2007
	Whole English and Rock Sole Sample-weighted Mean			*7*	*0.127*	--	--
	Rock Sole	Skinless Fillet	Freshwater Bay	2	0.009	0.0092	RAYON05
	Starry Flounder	Skinless Fillet	Dungeness Bay	2	0.091	0.0912	RAYON05
	Skinless Fillet Sample-weighted Mean			*4*	*0.050*	--	--
Crab	Whole Dungeness Crab[13]		Dungeness and Freshwater Bays	23	*0.241*	0.051	PAMILLRI DIOXCRAB PSEPCRAB RAYON05

[8] TEQ determined by the Kaplan-Meier method (see text).
[9] Standard error of the mean is calculated by standard deviation of samples /square root of n.
[10] With the exception of AK2007 (Anderson-Ketron 2007), these are the survey codes from EIM.
[11] All tissue data for horse clam and geoduck were considered without respect to tissue type analyzed.
[12] Sample-weighted means for each category are derived by multiplying the species-specific tissue data by the associated number of samples, summing them by category, and divided by the total sum of the samples in that category.
[13] Crab data include muscle and hepatopancreas; these were combined into a "whole crab" by assuming 31% hepatopancreas by total tissue weight.

While it is generally accepted that anadromous fish such as salmon gain most of their PCB body-burden from open-ocean exposure, there is a relative paucity of evidence to suggest that this is true of dioxin. Two recent studies measured dioxin in adult and juvenile salmon from the Puget Sound/Georgia Basin region (Kelly et al., 2007; Cullon et al., 2009). The latter reported mean dioxin/furan in returning adult Chinook salmon from the Duwamish river (0.23 ng mammalian TEQ/kg wet; n=3) and from the Deschutes River (0.56 ng mammalian TEQ/kg wet; n=4). Dioxins were undetected in single composite sample of smolts collected from Puget Sound. Based on these findings as well as data from the Strait of Georgia, the authors estimated that 97–99% of the body burden of dioxins and furans in returning adult Chinook were accumulated during their time at sea. However, there are Puget Sound resident Chinook populations that do not go into the open ocean, and about which we have no information on dioxin in tissues. For the purposes of these background risk estimates, dioxin in bottom fish were presumed to represent exposure to all forms of finfish (including salmon).

The method used for summarizing species-specific TEQs in Table 2 was the Kaplan-Meier nonparametric method described in the Statistics Workshop Report (RSET 2008).[14] For reasons cited in that publication, this is widely considered to be an improved technique over the typical substitution of one-half the limit of detection for below-detection-limit values. This same process was used in evaluating the R/V Bold sediment dioxin data (SAIC, 2009). The method consisted of converting all of each sample's 17 dioxin congeners' concentrations to TEQ by multiplying by the Toxicity Equivalence Factor; retaining the identity of detected and non-detected values by a separate column of 1 or 0 (respectively); and using ProUCL (version 4 .00.2) (Singh and Singh 2007a, b) to derive a nonparametric mean TEQ concentration. Since by definition the sum is the mean times the number of samples, the derived nonparametric mean was then multiplied by the number of congeners (17) to derive a TEQ sum for that sample. This method will only function when there is more than one detected congener in a sample. For this data evaluation, when this occurred, if there were no detections, a value of zero was used for the tissue TEQ concentration; if only one detected congener occurred, that single value was used for the sum.

Table 2 also shows the mean tissue concentrations (shaded rows) for each seafood category derived using the species-specific data. Sample-weighted means for each category were derived by multiplying the species-specific tissue data by the associated number of samples, summing them by category (clam, fish, or crab), and dividing by the total sum of the samples in that category. The resulting mean food-category dioxin tissue values were used in the background risk estimates.

[14] https://www.nwp.usace.army.mil/pm/e/RSET/SEF/2009-StatisticalWorkshopReport.pdf

2.3 Risk Characterization for Human Exposure to Background Levels of Dioxin in Seafood

2.3.1 Toxicity Characterization: Cancer Slope Factor

The consensus decision of the DMMP agencies (see the companion Regulatory and Policy Memorandum) was to use a cancer slope factor (CSF) of 150,000 $(mg/kg \cdot d)^{-1}$ (EPA 1995). Use of this value is consistent with recommendations from the EPA Office of Water and Office of Solid Waste and Emergency Response. All Superfund and State dioxin remediation in this region have used this CSF.

2.3.2 Risk Characterization

Estimates of excess cancer risk associated with exposure to background concentrations of dioxin in Puget Sound seafood are presented in Table 3 for various exposure groups. Clam-, crab-, and fish-specific consumption data are not available for the general population. Therefore, the 54 g/d ingestion rate was separately applied to the three seafood categories to estimate the general population's risk for each case. The range of risk estimates derived for the general population were from 8 in 10 million (8.4E-07) for clam-only consumption to 1.2 in 100,000 (1.2E-05) for crab-only consumption; fish-only consumption was near 1 in one million. All excess risks estimated for tribal fishers were greater than 1E-05; for the Suquamish Tribe, they were greater than one-in-ten-thousand increased cancer risk (up to 2.7E-04).

Table 3. Estimated Background Risk for Several Consumer Groups and Consumed Species Categories

Consumer Group	Fish & Shellfish Ingestion	Fish Only	Crab Only	Clams Only
Tulalip	4.4E-05	Not Applicable	Not Applicable	Not Applicable
Suquamish	2.7E-04	Not Applicable	Not Applicable	Not Applicable
General Population	Not Applicable	2.5E-06	1.2E-05	8.4E-07

2.3.3 Uncertainty Characterization

Table 4 describes the prospective differences that assumptions or uncertainties might have made to the risk values above.

Table 4. Uncertainty Analysis of Background Risk Characterization

Uncertainty	Effect on Risk Estimate
Bottom-fish dioxin representing tissue background for all consumed pelagic fish.	Use of bottom fish data may over or under represent Puget Sound background dioxin in anadromous fish. Based on a small amount of data characterizing dioxin in returning adult Chinook salmon fish from Puget Sound, use of bottom fish dioxin could under estimate risk. However, there is no conclusive information documenting to what extent these residues are acquired during their time at sea. Furthermore, there are no dioxin data available for resident salmon. If body burden trends are similar to that observed with PCBs, dioxin in resident populations may be higher than ocean-going populations.
Use of mean (versus upper percentile) tissue dioxin concentrations from Background data set.	May under estimate exposure. EPA's Consumption Framework for CERCLA/RCRA risk assessments directs use of the 95% UCL on the mean for tribal consumers to derive the exposure concentration rather than the average as was done here.
Use of the 30 yr exposure duration for calculating risk to the General Population.	Likely under estimates exposure. 30 years is potentially an under estimate of exposure duration for recreational anglers because individuals may change residences over a limited area and still visit the same seafood harvest locations. For example, in assessing risks to consumers of fish from the Hudson River, it was found that the 90th percentile of residency time in counties bordering the Hudson was 40 years (L. Kissinger, EPA, pers. comm.).
Assumption that the general population consumes only clams, crabs, or fish.	While the scenarios are not very likely, the consumption information is limited, and in conjunction with the probable low bias of a "general coastal population" consumption rate, may either over or under estimate risk.

3. Discussion of Dioxin Risk in Background Puget Sound Tissues

The risk estimates presented in this memo were derived using exposure assumptions for various populations who consume seafood derived from Puget Sound. For all consumer groups, exposure to dioxins from seafood reflecting background conditions (away from urban embayments and clean-up areas) were greater than the one-in-one-million (1E-06) ILCR which is the limit of acceptable risk for dioxins under the Model Toxics Control Act, and greater than the one-in-one-hundred thousand (1E-05) ILCR threshold for significant impacts to human health in the DMMP dredging guidance. For subsistence consumers (represented by the Suquamish Tribe), cancer risks exceed one-in-ten thousand (1E-04) ILCR, which is the highest allowable risk in the Superfund "risk range," and is often interpreted as reason for initiating cleanup in Federal projects under CERCLA and RCRA.

Since the background dioxin cancer risk associated with consumption of Puget Sound seafood exceeds acceptable risk benchmarks, the agencies have concluded that a background-based regulatory framework, as opposed to a risk-based framework, would be appropriately protective and more effectively implemented. See the companion Regulatory and Policy Memorandum for further discussion of the statutory drivers and related policy decisions used for this risk evaluation.

References Cited

Cullon, D.L., M.B. Yunker, C. Alleyne, N.J. Dangerfield, S. O'Neill, M.J. Whiticar, P.S. Ross (2009) Persistent organic pollutant in chinook salmon (*Oncorhynchus tshawytscha*): Implications for resident killer whales of British Columbia and adjacent waters. Environmental Toxicology and Chemistry 28(1): 148-161. http://www.allenpress.com/pdf/ENTC_28.1_148.pdf

EPA. 1995 (Updated 1997). Health Effects Assessment Summary Tables (HEAST).

EPA. 1989a. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A. Interim Final. EPA/540/1-89//002.

EPA. 1989b. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/8-89/043.

EPA. 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000), EPA-822-B-00-004.

EPA. 2007. Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia, EPA Region 10 Offices of Environmental Cleanup; Air, Waste and Toxics; and Office of Environmental Assessment. Revision 00.

SAIC. 2008. 2007 Site Monitoring Report, Dioxin/Furan Concentrations at the Non-dispersive Open-Water Dredged Material Disposal Sites in Puget Sound. Prepared for the Dredged Material Management Program.

SAIC. 2009. Puget Sound Sediment PCB and Dioxin 2008 Survey . Data Report. Prepared by DMMP (US EPA, US Army Corps of Engineers Seattle District, Science Applications International Corp. (SAIC), Avocet Consulting, and Terrastat.

Kelly, B.C., S.L Gray, MG Ikonomou, J.S. Macdonald, S.M. Bandiera, and E.G. Hrycay (2007) Lipid reserve dynamics and magnification of persistent organic pollutants in spawning sockeye salmon (*Oncorhynchus nerka)* from the Fraser River, British Columbia. Environ. Sci. & Technol. 2007, *41* (9), pp 3083–3089.

Lower Duwamish Waterway Group (LDWG). 2007. Draft Lower Duwamish Waterway Remedial Investigation.

PTI Environmental Services. 1991. Dioxin and Furan Concentrations in Puget Sound Crabs. Prepared for EPA Region 10, Doc. No. EPA 910/9-01-040. 43 pages plus appendices.

Personal Communications, Lon Kissinger, Office of Environmental Assessment, EPA Region 10.

Singh, A. and Singh, A.K. 2007a. ProUCL Version 4.0 User Guide. Publication EPA/600/R-07/038. April 2007,

Singh, A. and Singh, A.K. 2007b. ProUCL Version 4.0 Technical Guide. Publication EPA/600/R-07/041. April 2007

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

The Suquamish Tribe. 2007. Selected Suquamish Tribe Seafood Ingestion Rates, Consumers Only. June 29. Prepared by Nayak Polissar, Ph.D. and Shiquan Liao, Ph.D.

Toy, K.A., N.L. Polissar, S. Liao, and G.D. Mittelstaedt. 1996. A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region. Tulalip Tribes, Department of Environment, Marysville, WA.

Background Risk Calculations for Dioxin Risk Assessment Technical Memorandum (4/29/09)

	Tulalip	Comments	**Suquamish**	Comments	**General Population in Coastal State (MTCA)**	Comments	**General Population in Coastal State (MTCA)**	Comments	**General Population in Coastal State (MTCA)**	Comments
Chronic daily intake[1]	2.93E-10		1.78E-09		1.65E-11		7.96E-11		5.62E-12	
Background Avg WB Fish TEQ conc mg/kg ww Kaplan-Meier method	1.26E-07	Fish value used in risk calculation	1.26E-07	Fish value used in risk calculation	1.26E-07		1.26E-07		1.26E-07	
Background Avg fillet (no skin) Fish TEQ conc mg/kg ww Kaplan-Meier method	5.00E-08		5.00E-08		5.00E-08	Fish value used in risk calculation	5.00E-08		5.00E-08	
Background Avg "whole" Crab TEQ conc mg/kg ww nd=0.5 DL method	2.41E-07		2.41E-07		2.41E-07		2.41E-07		2.41E-07	
Background Avg bivalve TEQ conc mg/kg ww Kaplan-Meier method	1.70E-08		1.70E-08		1.70E-08		1.70E-08		1.70E-08	
BW	81.8		79		70		70		70	
AT	25550		25550		25550		25550		25550	
EF	365		365		365		365		365	
ED	70		70		30		30		30	
SDF	1		1		1		1		1	
CSF	150000		150000		150000		150000		150000	
IR finfish	112.1		268.6							
IR Shellfish	81.9		498.4							
IR Total	194		767		54		54		54	
WF - bivalve	0.54		0.12							
WF - crab	0.46		0.88							
Cancer Risk [2]	4.39E-05		2.67E-04		2.48E-06	Risk for fish	1.19E-05	Risk for crabs	8.43E-07	Risk for bivalves

[1] Chronic Daily Intake (CDI) = $\frac{[IR_{shellfish} * (WF_{crab} \times Dioxin_{crab} + WF_{clams} \times Dioxin_{clams}) + (IR_{finfish} \times Dioxin_{finfish})] \times UCF \times ED \times EF \times SDF}{BW \times AT}$

[2] Risk = CDI x CSF

Where:

CDI	= Chronic daily intake (mg/kg·day)
$WF_{crab/clams}$	= Weighting Factor (fraction of total shellfish consumption represented by crab or bivalves)
$IR_{shellfish/fin\ fish}$	= Ingestion rates for shellfish or fin fish (g/day)
$Dioxin_{crab/clams/finfish}$	= Tissue dioxin in crab, clams and finfish (mg/kg wet)
UCF	= Unit conversion factor (0.001kg/g)
EF	= Exposure frequency (days/year)
ED	= Exposure duration (years)
BW	= Average consumer body weight (kg)
AT	= Averaging time (years)
Risk	= Calculated risk level (incremental lifetime cancer rate, ILCR)
CSF	= Cancer slope factor $(mg/kg \cdot day)^{-1}$
SDF	= Seafood Diet Fraction: fraction of total seafood in diet obtained from Puget Sound

Proposal to Revise the Open-water Disposal Guidelines for Dioxins in Dredged Material

Attachment 4
Dioxin Project Impact Analysis Technical Memorandum

Dioxin Project Impact Analysis Technical Memorandum

Dredged Material Management Program

April 29, 2009

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1. Introduction

This memorandum provides analysis of potential project impacts associated with implementation of the dioxin proposal. For this analysis, all Puget Sound dredging projects since the inception of the Dredged Material Management Program (DMMP) were reviewed, covering a period of approximately twenty-one years. During this time well over 200 projects were evaluated for open-water disposal. Of these, 20 projects had at least some material that was tested for dioxins, the tested quantity consisting of some 1.8 million cubic yards, or 6.2 percent of the total volume.

2. Puget Sound Projects with Dioxin Data

Table 1 lists the DMMP projects with dioxin data, arranged by year. In the early years of DMMP implementation, only projects in the vicinity of Kraft-process pulp and paper mills were tested for dioxin. In Puget Sound this included just three projects in Everett. Dioxin concentrations were relatively low for these projects. In recent years, however, concern for dioxins has increased. The "reason to believe" guidelines have evolved with this increase in concern, resulting in a growing number of projects requiring dioxin testing. Thus, most of the dioxin testing has occurred in the last five years.

Table 1. Dredging Projects Tested for Dioxin in Puget Sound

Project	Volume Tested for Dioxin (cy)	Year[1]	Range of Dioxin Concentrations (pptr TEQ, u = ½ DL)
Port of Everett 10th Street Boat Ramp	12,340	1992	6.7
Port of Everett 12th Street Marina	80,500	1992	0.6–8.7
US Navy Everett Homeport – Element II	39,200[2]	1993	1.2–8.4
Dakota Creek Industries – Anacortes	64,000[2]	2005	3.1–3.9
Port of Bellingham I&J Waterway	15,770	2006	21.1–32.4
Port of Olympia East Bay Marina	27,664	2006	5.6–56.0
MJB Properties – Anacortes	67,825	2007/2009	0.9–14.0
Port of Bellingham Squalicum Gate 3	49,884	2007	6.2–47.1
USACE/Port of Olympia	448,317	2007	0.1–52.6
Delta Marine Industries – Duwamish River	6,534	2008	0.8–3.5
Port of Anacortes Cap Sante Marina – Phase 3	40,900	2008	3.5–52.6
Port of Tacoma East Blair Cutback	317,017[2]	2008	0.3–7.3
USACE Duwamish	54,104	2008	1.7–3.9
Port of Seattle T5	6,900	2009	4.3–12.1

[1] The year refers to the dredging year (the dredging year begins on June 16) in which the DMMP suitability determination was finalized or, for those projects without a suitability determination, the year in which sampling occurred.
[2] There was additional native material for this project that was not tested for dioxin.

Project	Volume Tested for Dioxin (cy)	Year[1]	Range of Dioxin Concentrations (pptr TEQ, u = ½ DL)
Port of Seattle T18	6,800	2009	21.7
Port of Seattle T115	3,750	2009	23.2–29.9
Port of Tacoma Washington United Terminal	95,700[2]	2009	0.6–3.0
Puyallup Tribal Terminal – Blair Waterway	376,523[2]	2009	0.2–8.2
Skyline Marina – Anacortes	64,000	2009	1.3–6.4
USACE Port Townsend Marina Navigation Channel	1,250	2009	1.4–4.7

Things to note about these projects:

- Of the projects listed in Table 1, five had large volumes of native material that were not tested for dioxin. However, four of these five projects did include dioxin testing for some of the native material (Dakota Creek was the exception).
- Preliminary dioxin testing was conducted for Skyline Marina before a sampling and analysis plan was submitted to the DMMP agencies. The volume shown is an estimate.
- MJB Properties consists of three components: north dock, south dock, and boat ramp. These three components were tested separately, but have been combined for the purpose of this analysis.
- The Port of Everett 12th Street Marina project was known as the 12th Street Barge Channel at the time of testing.

Appendix A includes the dioxin concentration for each individual project sample used in the analysis. Figure 1 shows the projects that were tested for dioxin.

3. Pass/Fail Analysis

Dioxin concentrations from the 20 projects were compared to the former guideline, the interim guideline and the proposed guideline. Analysis for all projects was conducted using the nondispersive guidelines, and for five of the projects using the dispersive guidelines. Table 2 compares the three sets of guidelines. Table 3 provides the site-specific interim guidelines for the five DMMP nondispersive sites. Under the former and proposed guidelines, any DMMU exceeding the bioaccumulation trigger would be considered to have “failed” for this analysis. The DMMP agencies are looking into the possibility of a test-out option involving bioaccumulation testing. The dredging proponent would have the option of pursuing bioaccumulation testing to determine whether or not the DMMUs could qualify for open-water disposal. It should be noted that a test-out option was available under the former guidelines.

Table 2. Former, Interim and Proposed Guidelines

Guideline	Nondispersive	Dispersive
Former	Bioaccumulation Trigger (BT) = 15 pptr TEQ[3]	BT = 15 pptr TEQ
Interim	Disposal-site specific guidelines with a maximum concentration and volume-weighted average for the project (see Table 3)	Comparison to reference
Proposed	BT = 10 pptr TEQ Volume-weighted average <= 4 pptr TEQ	BT = 4 pptr TEQ

Table 3. Nondispersive Interim Guidelines (pptr TEQ with u = ½ DL)

Disposal Site	Volume-weighted Average	Maximum
Port Gardner	4.1	5.2
Anderson Ketron	3.6	6.8
Bellingham Bay	6.9	10.5
Elliott Bay	8.7	12.2
Commencement Bay	2.4	5.2

It should be noted that only dioxin results were considered. Failures due to other chemicals, bioassays, or bioaccumulation testing were not considered. Thus, a DMMU might have passed under the dioxin guidelines, but failed for other reasons. Therefore, the "pass" rates resulting from this analysis are not necessarily reflective of the actual pass rates when all test results are considered.

3.1 Nondispersive Guidelines

Table 4 includes the pass/fail results under the former, interim and proposed nondispersive guidelines. While five of the projects are closer to a dispersive site than to a nondispersive site, for the purpose of this analysis the nearest nondispersive site was used. Thus, the "proposed" and "interim" columns in Table 4 refer to the suitability for disposal at the nearest nondispersive site.

Under the former guideline, any DMMU with a TEQ (u = ½ DL) of 15 pptr or less would have been suitable for open-water disposal (in addition, the 2,3,7,8-TCDD concentration would have needed to be at or below 5 pptr). Under the proposed guidelines, the maximum TEQ for any individual DMMU would be 10 pptr, and the volume-weighted average of the DMMUs taken to a disposal site would need to be less than or equal to 4 pptr. The results in Table 4 reflect this 2-tiered screening process. The interim guidelines, while site-specific, were applied in a similar 2-tiered fashion.

[3] A concentration of 5 pptr for 2,3,7,8-TCDD would also trigger bioaccumulation testing.

Table 4. Project Impacts – Comparison of Nondispersive Guidelines

	Guideline:	Former	Interim	Proposed
Project	Project Volume[4] (cy)	Volume Passing	Volume Passing	Volume Passing
USACE Port Townsend	1,250	1,250	1,250	1,250
Port of Seattle T115	3,750	0	0	0
Delta Marine Industries	6,534	6,534	6,534	6,534
Port of Seattle T18	6,800	0	0	0
Port of Seattle T5	6,900	6,900	6,900	*0*
Port of Everett 10th St. Boat Ramp	12,340	12,340	*0*	*0*
Port of Bellingham I&J Waterway	15,770	0	0	0
Port of Olympia East Bay Marina	27,664	3,750	*0*	*0*
US Navy Everett Homeport	39,200	39,200	*35,200*	39,200
Port of Anacortes Cap Sante Marina – Phase 3	40,900	15,200	15,200	15,200
Port of Bellingham Gate 3	49,884[5]	24,942	*12,471*	*0*
USACE Duwamish	54,104	54,104	54,104	54,104
Skyline Marina	64,000	64,000	64,000	64,000
Dakota Creek Industries	64,000	64,000	64,000	64,000
MJB Properties	67,825	67,825	*59,034*	*59,034*
Port of Everett 12th St. Marina	80,500	80,500	*62,500*	80,500
Port of Tacoma Washington United Terminal	95,700	95,700	95,700	95,700
Port of Tacoma East Blair Cutback	317,017	317,017	*278,189*	317,017
Puyallup Tribal Terminal	376,523	376,523	*278,625*	376,523
USACE/Port of Olympia	448,317	235,360	*191,724*	*210,083*
Total volume:	1,778,978	1,465,145	1,225,431	1,383,145
Percent passing:		82.4	68.9	77.7
Number of projects impacted:		7	13	10

Indicates an impacted project – i.e., at least one failed DMMU.
Indicates a change in project impact when compared to the old 15 pptr guideline.

When compared to the former guideline, the pass rate under the proposed guideline dropped from 82% to 78% of the total tested volume. But this compares to a pass rate of just 69% under the interim guidelines. In terms of number of projects, of the ten projects, seven projects would have been impacted under the former guideline, while thirteen and ten projects would be impacted under the interim and proposed guidelines respectively. The volume pass/fail rates are presented graphically in Figure 2, while the numbers of impacted projects are displayed in Figure 3.

[4] The project volume does not include native material that was not tested for dioxin.
[5] For the purpose of this analysis, the Gate 3 volume was split into four equal-volume portions.

Results for individual projects are presently graphically in Figures 4 and 5. A comparison of these figures indicates that smaller projects could be affected more significantly than larger projects under the proposed guidelines. This makes sense since smaller projects have fewer DMMUs to include in volume-weighted averaging, and are less likely to include native material. However, a number of the projects under 50,000 cubic yards would be impacted regardless of the guidelines used. Examples include the Port of Olympia's East Bay Marina, the Port of Anacortes' Cap Sante Marina, the Port of Bellingham's I&J Waterway, and the Port of Seattle's T115. All, or nearly all, of the dredged material from these projects would have been found unsuitable for open-water disposal under the former guidelines.

Large projects have more flexibility than smaller projects and would be the least likely to be negatively impacted by the proposed guidelines. This is especially true for large projects with significant volumes of native material, which would tend to reduce the volume-weighted average for the project.

One project, the Port of Seattle's T5, would clearly be impacted under the proposed guideline, while not impacted under either the former or interim guidelines. Impacts to the Port of Bellingham's Gate 3 project would also be greater under the proposed guidelines than under the other guidelines. This is because the interim guidelines for Elliott Bay and Bellingham Bay are less restrictive than the proposed guidelines. For the other three nondispersive sites, the interim guidelines are more restrictive than the proposed guidelines. For example, in the case of projects on the Blair Waterway in Tacoma, impacts under the proposed guidelines would generally be less than under the interim guidelines.

3.2 Dispersive Guidelines

Under the former guideline, dispersive and nondispersive sites were treated the same with respect to dioxin. DMMUs with TEQs less than or equal to 15 pptr could be disposed of at either a dispersive or nondispersive site. Under the proposed guidelines, any DMMU with a TEQ greater than 4 pptr would be unsuitable for dispersive-site disposal. Under the interim guidelines, a comparison to reference-bay sediment is required. However, statistical analysis of data from the OSV Bold survey of main-basin and reference sites in Puget Sound indicated that there is no significant difference between reference and main-basin dioxin concentrations. Therefore, for this analysis, the interim guidelines for dispersive disposal were assumed to be equivalent to the proposed guidelines, which are based on a combined main-basin and reference data set.

Table 5 includes the results from the dispersive-site analysis. The following projects were included: 1) projects for which the nearest site is dispersive, and 2) Port of Bellingham projects. The latter were included because the nondispersive site in Bellingham Bay is currently closed, plus the dispersive site in Rosario Strait is often used for at least a portion of the dredged material volume for projects in Bellingham.

Table 5. Project Impacts – Comparison of Dispersive Guidelines

	Guideline:	15 pptr	Interim	Proposed
Project	Project Volume (cy)	Volume Passing	Volume Passing	Volume Passing
USACE Port Townsend	1,250	1,250	*850*	*850*
Port of Bellingham I&J Waterway	15,770	0	0	0
Port of Anacortes Cap Sante Marina	40,900	15,200	15,200	15,200
Port of Bellingham Gate 3	49,884[6]	24,942	*0*	*0*
Skyline Marina	64,000	64,000	*32,000*	*32,000*
Dakota Creek Industries	64,000	64,000	64,000	64,000
MJB Properties	67,825	67,825	*48,725*	*48,725*
Total volume:	303,629	237,217	160,775	160,775
Percent passing:		78.1	53.0	53.0
Number of projects impacted:		2	6	6

Indicates an impacted project – i.e., at least one failed DMMU.
Indicates a change in project impact when compared to the old 15 pptr guideline.

Table 5 indicates that the proposed (and interim) dispersive guidelines would impact six of the seven projects. Under the former guideline only two projects would have been impacted.

A comparison of Tables 4 and 5 indicates that two projects, USACE Port Townsend and Skyline Marina, would be impacted under the proposed dispersive guidelines, while not impacted under the proposed nondispersive guidelines.

3.3 Differential Impact of Proposed Guidelines

Projects that would be impacted under the proposed dioxin guidelines were evaluated to see whether dioxin alone would have affected them, or whether results from bioassays or bioaccumulation testing would also have affected these projects. The projects can be categorized as follows:

- Two projects, Cap Sante Marina and USACE/Port of Olympia, would be impacted due to dioxin alone. However, these projects would also have been impacted under the former dioxin guidelines.
- Two projects, MJB Properties and 10th Street Boat Ramp, would be impacted due to dioxin alone. These projects would *not* have been impacted under the former guidelines.
- Two projects, T18 and T115, had screening level exceedances (T115 also had bioaccumulation trigger exceedances) for other chemicals of concern, but did not have bioassays conducted because all material failed under the interim dioxin

[6] For the purpose of this analysis, the Gate 3 volume was split into four equal-volume portions.

guidelines. These projects would also have been affected under the former dioxin guidelines.

- One project, T5, had a DMMU that failed toxicity testing. Therefore, this project would have been impacted even without dioxin testing.
- Data for three projects, I&J Waterway, Gate 3, and East Bay Marina, have not been submitted for review. It was not possible to determine whether toxicity or bioaccumulation testing would have been required for these projects due to other chemicals of concern. However, all three projects would have been impacted under the former guidelines.
- Ten projects would not be impacted by the proposed dioxin guidelines, nor would they have been impacted under the former guidelines.

4. A Broader Look at DMMP Projects and Puget Sound Dioxin Data

In addition to the project-specific impact analysis conducted using only those DMMP projects with dioxin data, a broader review of DMMP projects was undertaken to determine such things as urban vs. non-urban and native vs. non-native volumes. There were also dioxin data available from surveys other than those conducted for DMMP dredging projects. An attempt was made to incorporate both sets of data into a broader analysis.

4.1 Review of all DMMP Projects

All Puget Sound dredging projects since the inception of the Dredged Material Management Program were reviewed (not just those with dioxin data). Projects were categorized as urban or non-urban, and DMMP suitability determinations were reviewed to determine the quantities of native and non-native sediment. The following table summarizes the results:

Number of Projects	210
Years	1989–2009
Total Volume	28,923,345
Urban Non-native	15,749,506 (54.5%)
Urban Native	9,535,385 (33.0%)
Non-urban Non-native	3,638,454 (12.5%)
Non-urban Native	0

Urban areas included Olympia, Tacoma, Seattle, Bremerton, Everett, Anacortes, Bellingham, Port Townsend, and Port Angeles.

4.2 Review of Additional Urban Dioxin Surveys

A number of large surveys were reviewed to assist in determining concentrations of dioxin that might be encountered in urban embayments. The surveys included the following:

- Budd Inlet Sediment Characterization Study – Phases 1 and 2
- Lower Duwamish Human Health Risk Assessment
- Lower Duwamish Remedial Investigation – Phases 1 and 2
- Fidalgo Bay Sediment Investigation
- Port Angeles Harbor Sediment Investigation
- DMMP Disposal-Site Monitoring – Commencement Bay, Elliott Bay, Port Gardner, Bellingham Bay
- Surface Sediment and Fish Tissue Chemistry in Greater Elliott Bay (Seattle) – Urban Waters Initiative
- USACE/Port of Olympia – Olympia Harbor (this project was also included in the project-specific analysis)

Results from this analysis are summarized in the following table:

Number of Dioxin Samples	421
Range of TEQs in Screened Samples	0.11 to 4,213 pptr
Number of Samples at or below 4 pptr	169 (40%)
Number of Samples at or below 10 pptr	272 (65%)
Number of Samples at or below 15 pptr	315 (75%)

These surveys included numerous samples taken to determine the extent of dioxin contamination at cleanup sites. As such, they are not representative of what might be encountered in the “typical” urban-bay dredging projects. In an attempt to better define urban “background,” the samples from these surveys were screened using GIS. Samples that were within 500 meters of municipal and industrial outfalls, or within 500 meters of a cleanup site listed in Ecology’s facility database, were eliminated.

The following table summarizes the results from the screening exercise:

Number of Dioxin Samples	170
Range of TEQs in Screened Samples	0.11 to 89.7 pptr
Number of Samples at or below 4 pptr	77 (45%)
Number of Samples at or below 10 pptr	122 (72%)
Number of Samples at or below 15 pptr	145 (85%)

4.3 Results of the Analysis

The results from the screened urban-bay dataset generally support the evidence provided by analysis of the DMMP projects with dioxin data. That is, the fail rate for urban-type dredged material for projects with dioxin data was 22.3%. For the screened urban-bay dataset, 28% of the samples were above 10 pptr and would fail the first-tier screen under the proposed guidelines. Of the samples falling below 10 pptr, the mean concentration was 3.3 pptr. This means that, taken as a whole, if each sample were assigned an equal volume of dredged material, all samples falling below 10 pptr would pass under the volume-weighted average guideline of 4 pptr and the fail rate would remain at 28%. In reality, the samples would be distributed among dredging projects of various sizes and the fail rate would be something greater than 28%. Nevertheless, it is important to note that the fail rate resulting from independent analyses is similar (except for the Olympia Harbor data).

5. Implications for Future Projects

There are a number of implications for future projects:

- More projects will require testing. In the last 21 years, 6.2 percent of the Puget Sound dredged material volume has been tested for dioxin (from approximately 10% of the total number of projects). Based on the updated reason-to-believe guidelines, approximately 55% of the dredged material volume will require dioxin testing (this assumes that non-urban projects and deeper native sediment will not require testing). It is important to note though that the percentage of material being tested has already increased within the DMMP program. During the three year period of 2007-2009, 33% of the total volume was tested.
- A larger annual volume of material will be found unsuitable under the proposed guidelines. This is due to a slightly higher fail rate (compared to the former guideline), and a higher percentage of material being tested. Assuming that all native and non-urban material either passes under the proposed guidelines or does not require testing, and if the future fail rate under the proposed guidelines were to remain the same as the fail rate for the twenty projects with dioxin data (22.3%), the annual volume of material that would be found unsuitable under the proposed guidelines will be approximately 167,000 cy. The calculation of this volume is as follows:
    - Total annual volume = 1,377,302 cy
    - Annual volume of native material = 454,066 cy
    - Annual volume of non-urban material = 173,260 cy
    - Annual volume of non-native urban material = 749,976 cy
    - 749,976 x 0.223 = 167,245 cy

  A comparison of volumes requiring dioxin testing and volumes failing under the former and proposed guidelines can be seen in Figure 6.
- Based on past data, it should be noted that at least some of the material that will be found unsuitable under the proposed dioxin guidelines will also have other chemicals of concern exceeding DMMP screening levels or bioaccumulation triggers. Some of

the material would fail bioassays or bioaccumulation testing if these tests were to be conducted. The analysis provided in this memorandum did not attempt to quantify the overlap in failed volumes.

- Some projects will have DMMUs that fail for dioxin alone. This will have cost implications for dredging and disposal and could result in project delay or cancellation. The “tipping point” at which additional costs for managing dioxin-contaminated dredged material result in project cancellation depends on a number of factors including the financial wherewithal of the dredging proponent, costs vs. benefits, and the ratio of incremental to total project cost.
- There are potential secondary economic impacts associated with cancelled projects including job loss due to decreased viability of businesses that rely on navigable waterways. However, these impacts are highly project-specific and information provided to date does not allow calculation of program-wide secondary impacts associated with this proposal vs. the previous or interim dioxin guidelines.
- Smaller projects will likely be impacted to a greater extent than larger projects.
- Projects that are nearer dispersive sites will be more heavily impacted than projects that are near nondispersive sites due to the more restrictive guidelines at dispersive sites. This includes projects in Anacortes and Port Townsend. Haul distances would increase if dredged material from these projects were to be found suitable for nondispersive disposal but not for dispersive disposal. Also, volume-weighted averaging might result in material, which would otherwise be suitable for dispersive-site disposal, being hauled to a nondispersive site to meet the required project average.
- Upland disposal costs are much higher than open-water disposal costs. The additional cost per cubic yard depends on such things as project size, availability of dewatering and transloading facilities, access to rail lines, haul distance to the disposal site, and tipping costs. Differential costs (over and above what would be incurred for open-water disposal) have been submitted for past and current projects, ranging from a low of $30 per cubic yard for Portland Harbor to a high of $162 per cubic yard for Port of Seattle T30.

FIGURES

Figure 1. DMMP Projects with Dioxin Data

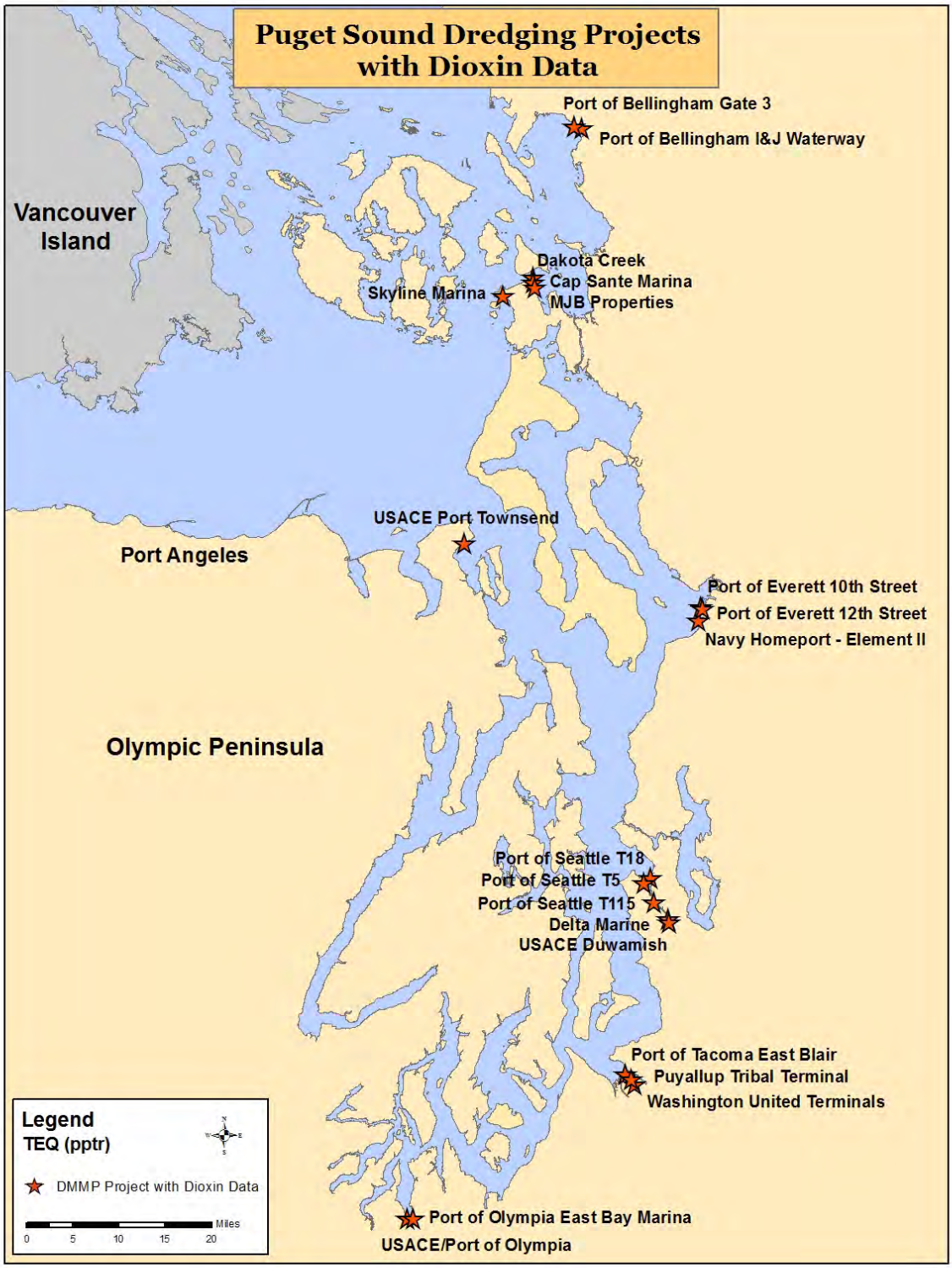
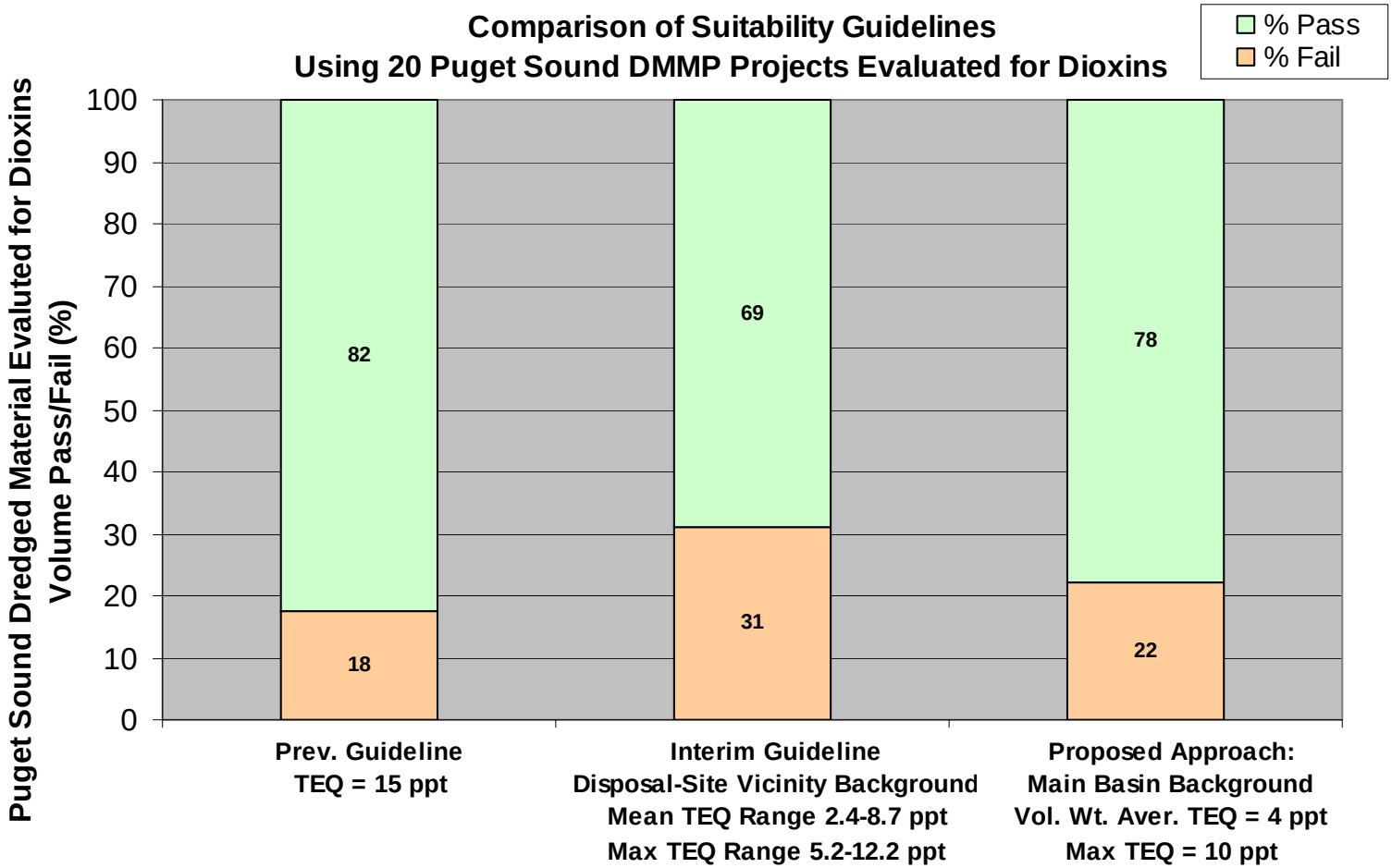
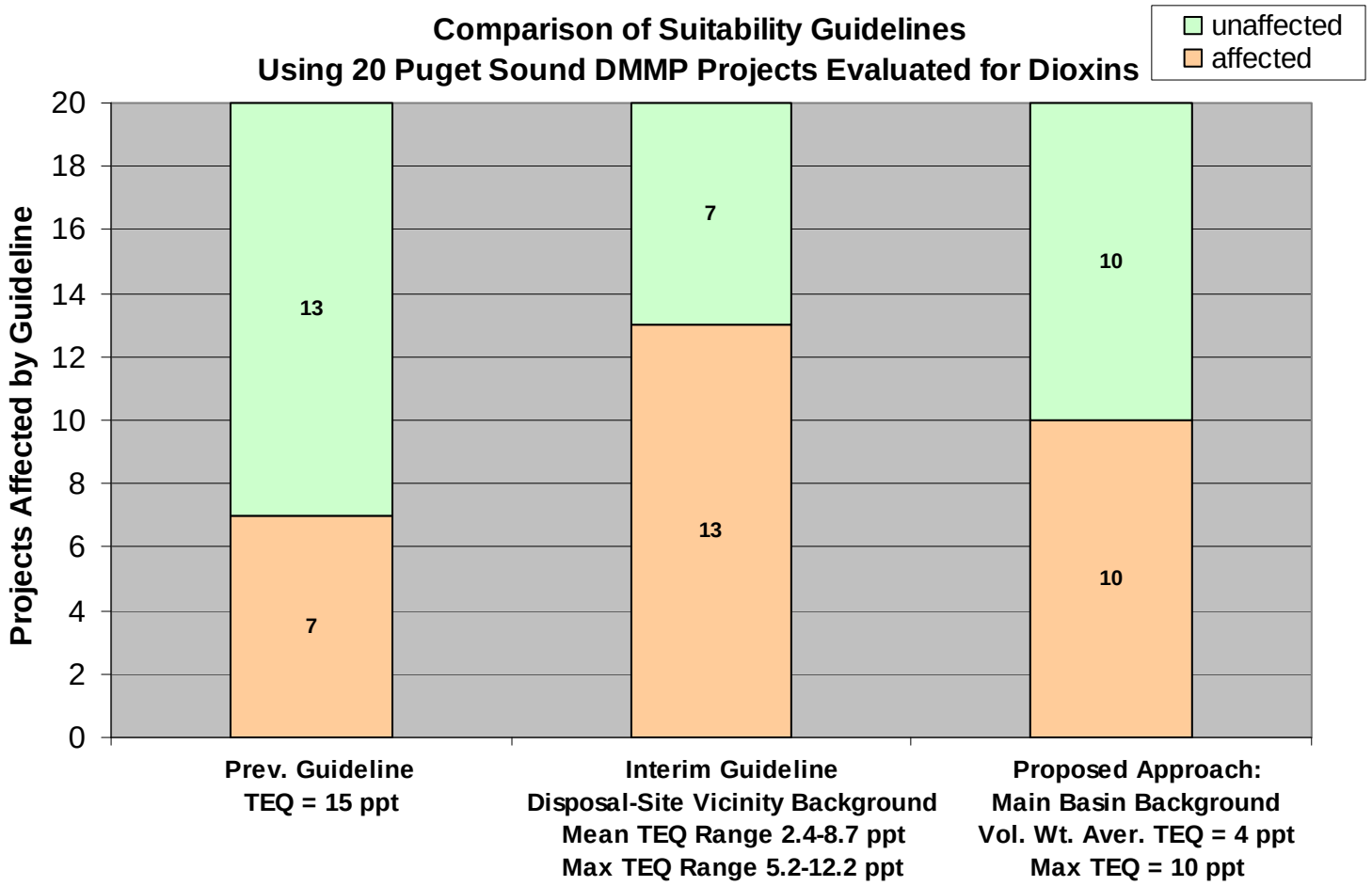


Figure 2. Guideline Comparison – Pass/Fail Volume



Note: native material included only where tested.

Figure 3. Guideline Comparison – Impacted Projects



Note: affected projects have one or more DMMUs that fail the dioxin guideline.

Figure 4. Guideline Comparison – Projects Less Than 50,000 CY

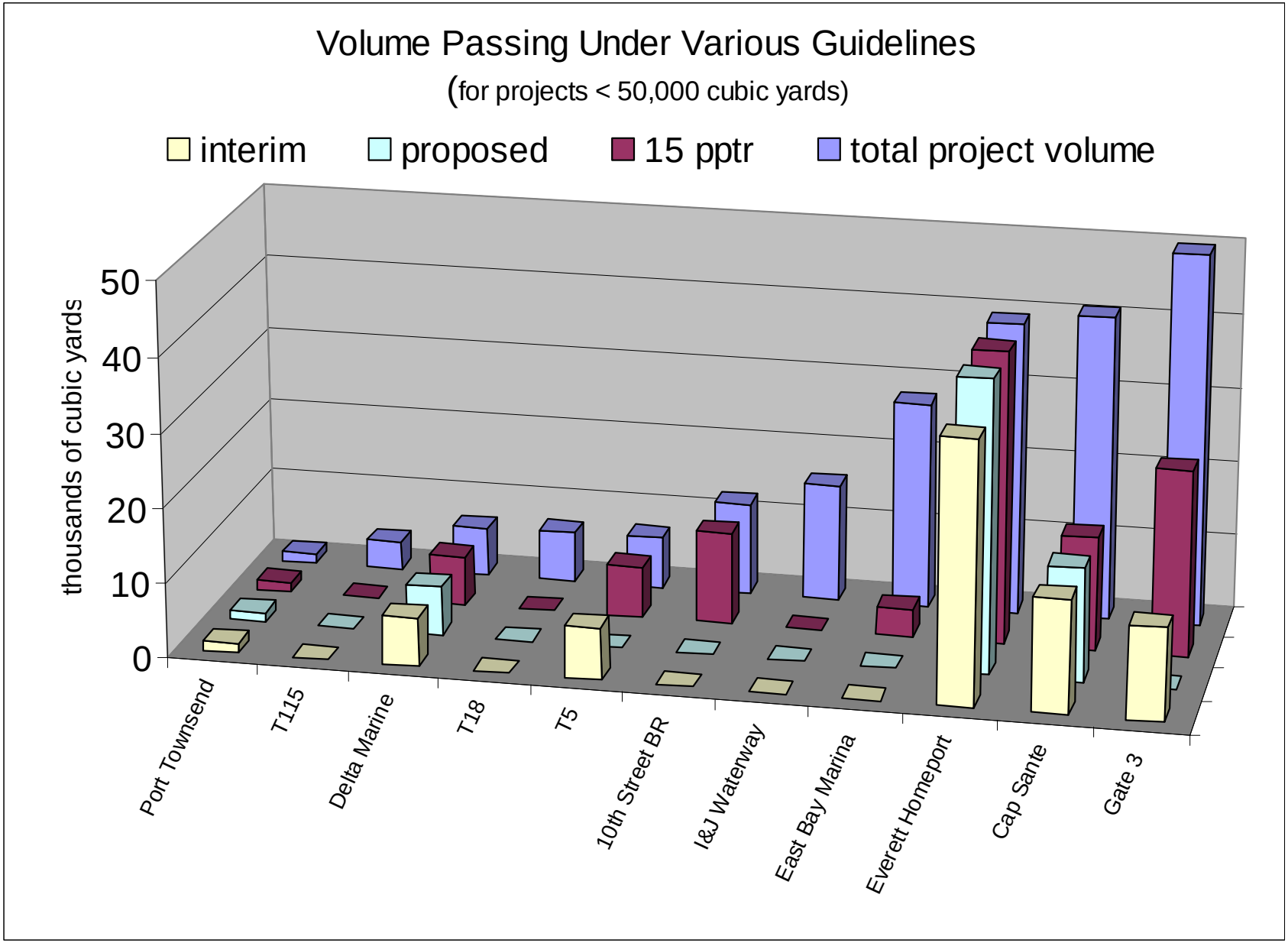


Figure 5. Guideline Comparison – Projects More Than 50,000 CY

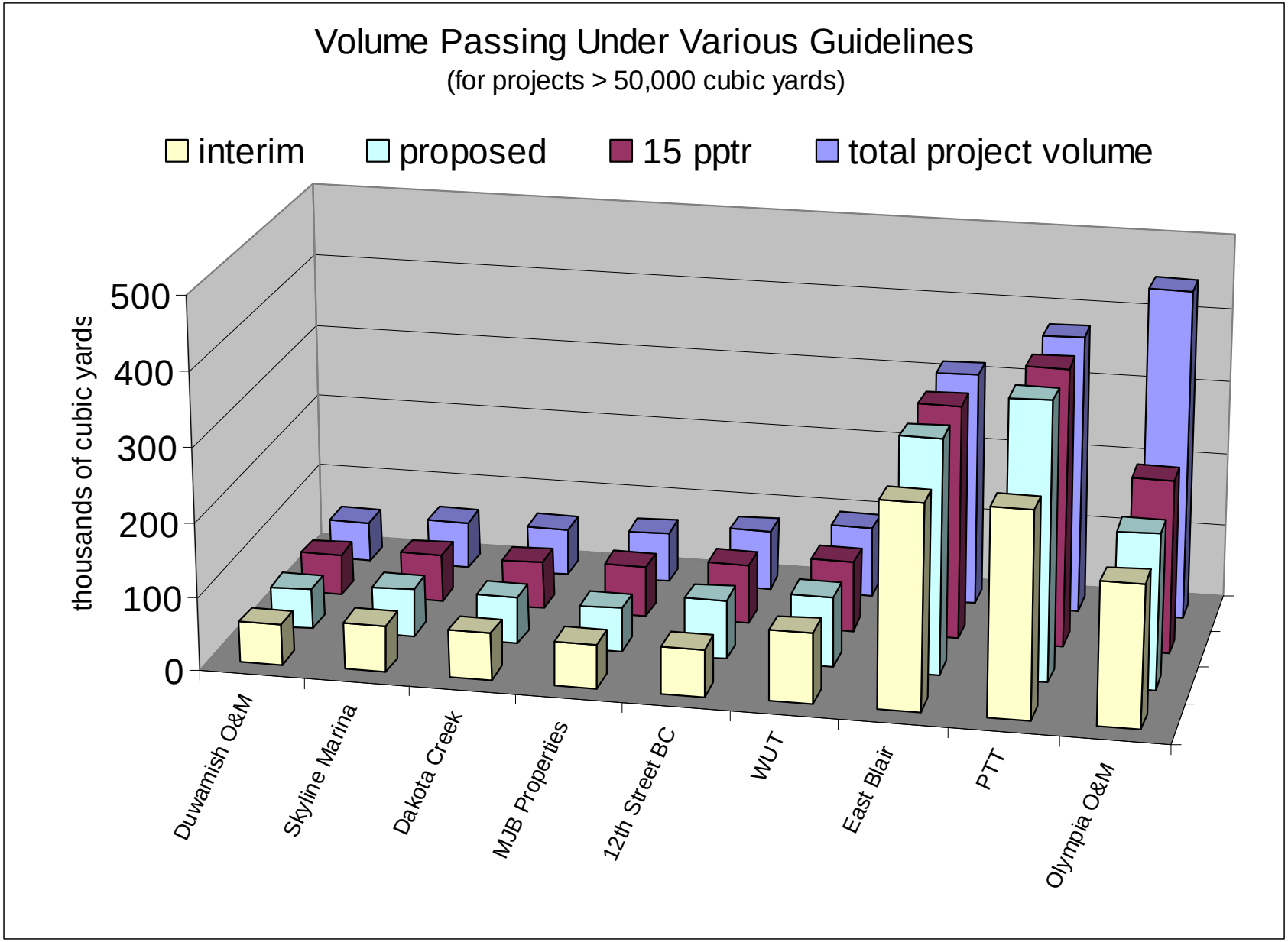
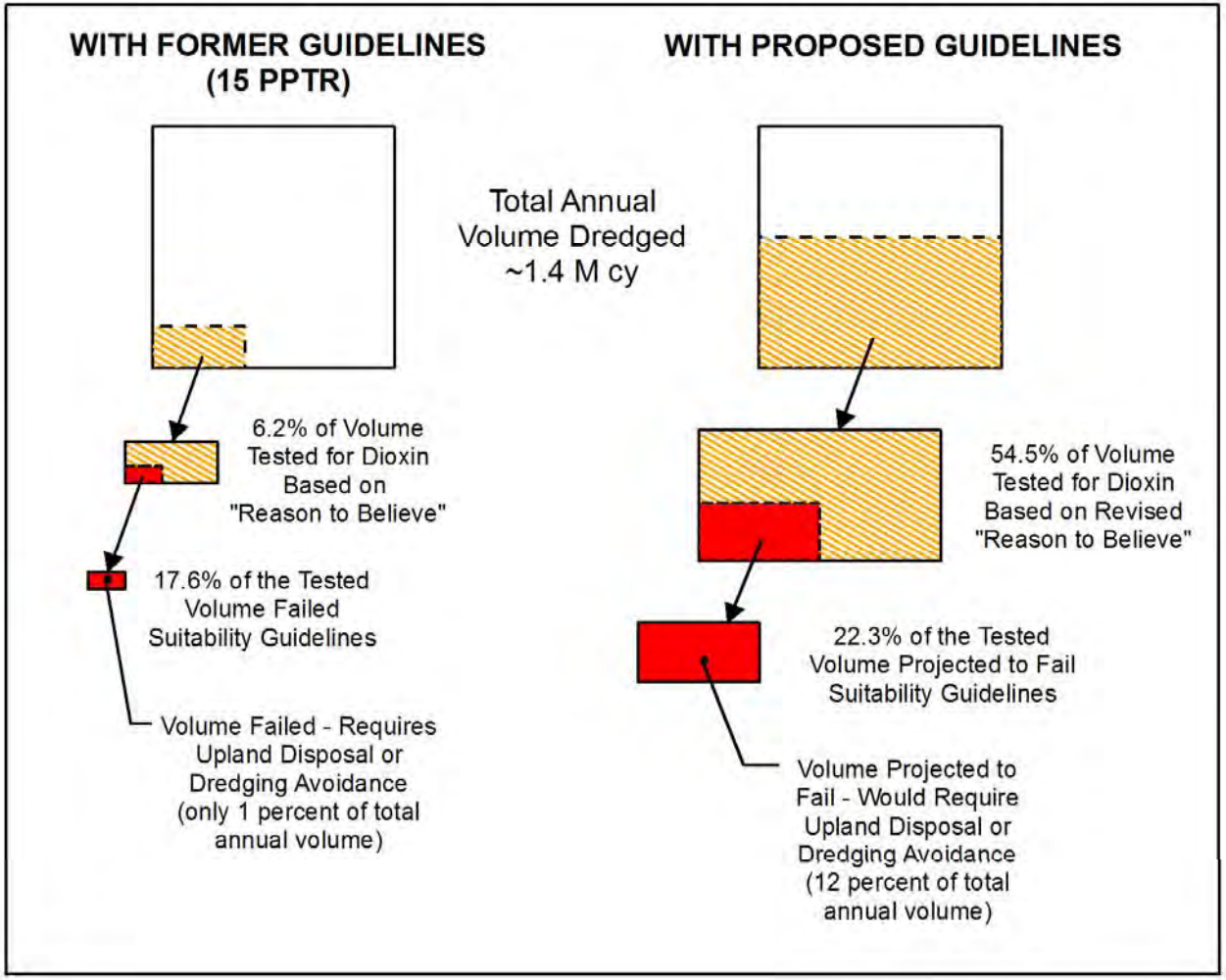


Figure 6. Comparison of Failed Volumes – Former and Proposed Guidelines



Appendix A – Dioxin Data for Individual Projects

Notes:
- Volumes are in cubic yards
- TEQ = toxic equivalents in parts per trillion
- DMMU = dredged material management unit

USACE/Port of Olympia

DMMU ID	Volume	TEQ
1a	7,547	1.9
2a	11,643	52.3
2b	6,752	1.6
3a	8,310	37.4
3b	5,898	2.0
4a	8,403	52.6
4b	9,264	4.6
5a	26,079	17.7
6a	29,434	16.9
7	25,277	10.8
8	21,716	19.2
9	18,422	18.8
10	29,062	25.6
11a	9,952	15.1
12a	13,827	5.3
11b	13,926	1.6
12b	27,864	0.2
13	20,774	31.2
14a	20,148	21.2
14b	24,056	0.7
15	21,283	3.2
16a	21,584	0.1
16b	31,771	0.1
17	18,359	6.9
18	9,014	32.3
19	7,952	6.4
total volume:	**448,317**	

Port of Anacortes Cap Sante Marina

DMMU ID	Volume	TEQ
1	3,000	34.3
2	15,200	3.51
3	14,500	52.6
4	8,200	44.4
total volume:	**40,900**	

Port of Bellingham Gate 3

Note: volumes are average for 4 DMMUs

DMMU ID	Volume	TEQ
1	*12,471*	6.24
2	*12,471*	10.6
3	*12,471*	27.3
4	*12,471*	47.1
total volume:	**49,884**	

Port of Bellingham I&J Waterway

DMMU ID	Volume	TEQ
DMMU3	3,650	22.3
DMMU4A	3,580	27
DMMU4B	2,240	21.1
DMMU5	3,760	29.8
DMMU6	2,540	32.4
total volume:	**15,770**	

USACE Port Townsend

DMMU ID	Volume	TEQ
DMMU1	400	4.71
DMMU2	850	1.36
total volume:	**1,250**	

Delta Marine Industries - Duwamish

DMMU ID	Volume	TEQ
DMMU3	2,629	3.53
DMMU4	3,905	0.821
total volume tested:	**6,534**	
DMMU 1/2	6,226	not tested

Port of Tacoma - Washington United Terminals

DMMU ID	Volume	TEQ
WUT5 high spot	5,600	0.633
WUT4 (maintenance dredge)	28,400	2.64
WUT 03 (native)	24,700	0.856
WUT 02 (cutback)	24,700	1.616
WUT 1 (cutback)	12,300	2.959
total volume tested:	**95,700**	
untested native volume:	138,300	

Port of Seattle T18

DMMU ID	Volume	TEQ
DMMU1	6,800	21.7
total volume:	**6,800**	

Port of Seattle T115

DMMU ID	Volume	TEQ
DMMU1	2,035	23.2
DMMU2	1,715	29.9
total volume:	**3,750**	

Port of Everett 10th Street

DMMU ID	Volume	TEQ
C2 10th St	12,340	6.71
total volume:	**12,340**	

Port of Everett 12th Street

DMMU ID	Volume	TEQ
C1 12th St	6,750	4.859
C2 12th St	6,750	0.615
C3 12th St	6,750	0.876
C4 12th St	6,750	3.266
C5 12th St	10,100	8.725
C6 12th St	7,900	6.545
C7 12th St	15,800	1.683
C8 12th St	19,700	1.73
total volume:	**80,500**	

U.S. Navy Everett Homeport - Element II (breakwater design)

DMMU ID	Volume	TEQ
S1	4,000	1.2
S2	1,200	1.7
S3	4,000	8.4
S4	12,000	2.9
S5	4,000	2
S6	14,000	1.6
total volume tested:	**39,200**	
untested native volume:	70,800	

Port of Tacoma East Blair Cutback

DMMU ID	Volume	TEQ
DMMU 1 (surface)	38,828	7.33
DMMU 2 (subsurf)	95,458	1.04
DMMU 3 (subsurf)	67,335	0.33
DMMU 4 (native)	115,396	0.32
total volume tested:	**317,017**	
untested native volume:	**1,282,983**	

Port of Olympia East Bay Marina

DMMU ID	Volume	TEQ
DMMU 1	3,999	56
DMMU 2	3,994	47
DMMU 3	3,881	41
DMMU 4	3,996	48
DMMU 5	3,750	5.6
DMMU 6	3,691	17
DMMU 7	2,403	31
DMMU 8	1,950	27
total volume:	**27,664**	

Dakota Creek Industries - Anacortes

DMMU ID	Volume	TEQ
DCI-1	16,000	3.9
DCI-2	16,000	3.5
P1-1	16,000	3.1
P1-2	16,000	3.1
total volume tested:	**64,000**	
untested native volume:	209,000	

Puyallup Tribal Terminal - Blair Waterway

DMMU ID	Volume	TEQ
H1, fill	61,083	8.2
H2, native	59,207	1.9
H3, native	65,879	1.23
H4, native	43,158	0.4
H5, native	42,330	2.55
H6, native	36,815	7.22
H7, native	43,694	0.45
H8, native	24,357	0.156
total volume tested:	**376,523**	
untested native volume:	1,373,477	

MJB Properties - Anacortes

DMMU ID	Volume	TEQ
ND-C1	13,591	1.7
ND-C2	14,091	3.1
ND-C3	9,841	1.1
ND-C4	11,202	0.9
SD-BCC-1	8,791	14
SD-BCC-2	8,309	9.87
SDBR-BRC-1	2,000	4.7
total volume:	**67,825**	

USACE Duwamish

DMMU ID	Volume	TEQ
DMMU 1	16,929	1.67
DMMU 2	16,580	2.75
DMMU 6	3,785	3.93
DMMU 8	3,459	2.77
DMMU 10	3,414	2.45
DMMU 12	3,370	2.03
DMMU 13	3,094	2.42
DMMU 14	3,473	3.52
total volume:	**54,104**	

Skyline Marina - Anacortes

DMMU ID	Volume	TEQ
SM-01	8,000	6.17
SM-02	8,000	6.39
SM-03	8,000	4.48
SM-04	8,000	4.86
SM-05	32,000	1.32
total volume:	**64,000**	

Port of Seattle T5

DMMU ID	Volume	TEQ
T5-S1	2,700	12.05
T5-S2	2,400	6.31
T5-S3	1,800	4.33
total volume:	**6,900**	