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BY EMAIL

Ms. Adrienne Dorrah
Washington Department of Ecology
Toxics Cleanup Program
P.O. Box 47600
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Subject: Fish Consumption Rates Technical Support Document

Dear Ms. Dorrah:

The Boeing Company ("Boeing") appreciates the opportunity to submit comments on the public review draft of *Fish Consumption Rates: Technical Support Document, Version 2.0* issued by the Washington Department of Ecology ("Ecology") on August 27, 2012.

Boeing is committed to working with Ecology and other stakeholders to ensure that meaningful progress is made in developing an effective, efficient, and sustainable means for achieving a cleaner environment and improved levels of human and environmental health. Today, Boeing employs more than 86,000 people in Washington. We build the 737 and P-8, 747-8, 767 and KC-46 Tanker, 777 and 787 here and are increasing production rates on all commercial airplane models. In 2011, we paid more than $4.3 billion to over 2,000 suppliers in Washington. And Boeing and our employees contributed nearly $50 million to local charitable organizations.

We are committed to creating a cleaner future. We are continually challenging ourselves to make our products, services, and operations more environmentally progressive, while at the same time saving energy, conserving water, and eliminating waste.[1] We are building the next generation of efficient aerospace products. We are pioneering research into cleaner fuels. We are improving the efficiency of the global air traffic management system to reduce the global carbon footprint of air travel. And we are investing in bold, new technologies to reduce our environmental footprint and create a brighter future.

[1] In 2007, Boeing established five year environmental targets to reduce Energy Consumption, Greenhouse Gas emissions, Water Consumption, and Hazardous Waste by 1% on an absolute basis. Boeing is currently on track to meet or beat all of these targets during a time of tremendous business growth. During this same period Boeing hired an additional 12,000 employees, added over 1 million square feet of manufacturing and office space and increased production by 25%.

We are also operating in an increasingly competitive international market for large commercial aircraft. Environmental stewardship and the cost of doing business are both important factors in our ability to compete. As such, it is critical that the Technical Support Document be accurate, complete and objective. If not done thoughtfully, a change in the state's fish consumption rate and associated rulemakings could, with minimal, if any, benefit to water quality, the environment or human health, drive hundreds of millions of dollars in costs to Boeing, disrupt our current operations and severely limit our ability to expand in Washington in the future. Boeing will not be alone—other industries, municipalities, counties, and ultimately, taxpayers, would likewise be negatively impacted. We believe our mutual investments must be predictable and targeted to real and achievable improvements. Therefore, we urge the Department to carefully consider the impacts on the state's economy and quality of life before moving forward with this document and proceeding with the associated rulemakings.

Executive Summary

The purpose of the Technical Support Document is to present accurate scientific information in a comprehensive and objective way to inform the legal and policy decisions that will follow. The second draft of the document significantly improves upon the original draft; however, Boeing has concerns that need to be addressed prior to finalizing the document.

Boeing applauds Ecology's decision to focus on separating technical information from policy decisions and to remove a default fish consumption rate from the Technical Support Document. Nevertheless, important information is missing from the second draft or is presented in a non-objective (biased) manner. Furthermore, multiple policy opinions remain in the document and should be removed. When presenting factual information and fish consumption survey results, the document should be clear about the source and species of consumed fish when it is known and should acknowledge the limitations of data when the source or species is not known. For example, the Technical Support Document should present population and subpopulation information in a clear and complete way. The document should include accurate information about the fish consumption of Washington's general population and should indicate the statistical relevance of data from subpopulation surveys.

Ecology should also acknowledge that significant information gaps remain. Critically, a fish consumption survey of Washington's general population has not been conducted. Ecology should conduct a state-wide fish consumption survey before finalizing the Technical Support Document and before undertaking the process of revising water quality standards, which will significantly impact the regulated community and the state economy.

Boeing respectfully requests that Ecology defer the Technical Support Document until the Department conducts a state-wide fish consumption survey and addresses the concerns raised in this letter.

Comments

I. The Technical Support Document should provide a comprehensive and objective presentation of the relevant factual and scientific information.

The Technical Support Document should be comprehensive and it should present information in an objective manner in order to inform future legal and policy discussions. In the second draft, Ecology filled some of the information gaps found in the original draft; however, some important information is still missing. In addition, the document often presents information in a non-objective (biased) manner that is particularly misleading to the lay reader. The following sections identify particular topics that should be addressed more comprehensively and even-handedly.

A. Washington Fish Consumption Survey

A fundamental assumption of Ecology's undertaking in producing the Technical Support Document is that it is important to understand how much fish Washington residents eat in order to develop criteria that protect human health. These criteria will be developed using a mathematical formula, one input of which is the fish consumption rate. In order to develop human health criteria that are based on sound science, Ecology must have defensible scientific data on the fish consumption patterns of Washington residents. Unfortunately, no such data exists. A fish consumption survey of Washington's general population has not been conducted.

The Technical Support Document acknowledges the lack of Washington data, but then presents national survey data in Section 4.2. It simply is not clear whether or not these national data are reflective of fish consumption patterns in Washington. Ecology has also included two attachments to the Technical Support Document that address that national survey data. A paper by Nayak Polissar and others entitled *Statistical Analysis of National and Washington State Fish Consumption Data* explains:

> We do not know of a representative survey that covers fish consumption among the general adult population in Washington State. We have developed consumption rates from the NHANES study for the USA as a whole, but we do not know how similar fish consumption rates are between the USA and Washington State.

See TSD Attachment C at 30. It is impossible to determine whether the national data is similar because there has been no survey of Washington's general population.[2] Before undertaking the process of significantly revising water quality standards, Ecology should take the time to conduct such a survey and gather needed data about current fish consumption patterns.

Noting a similar lack of survey data in Idaho, the Idaho Department of Environmental Quality (DEQ) is contemplating conducting its own fish consumption survey. The

[2] A recent review of the Polissar paper by Casey Olives, Ph.D. suggests without explanation that "there is strong reason to believe that the US data are NOT representative of WA State." *See* Attachment D to the Technical Support Document. Without any Washington data, however, there is no way to know whether national data are representative, and if not, how Washington consumption patterns might differ from national patterns.

Idaho DEQ determined that an ideal survey should provide a distribution of long-term fish consumption rates, account for seasonality, characterize consumption for the general population and high-consuming subgroups, and identify sources and species of consumed fish.[3]

Significantly, Ecology has also failed to take steps to evaluate data that is available to better understand Washington consumption patterns. As noted in the Polissar paper, it may be possible to obtain the NHANES study data and focus on various subsets of that data, such as data from Washington, the Pacific Northwest, or coastal states. *See* TSD Attachment C at 30-31. Ecology should make an effort to evaluate existing data before finalizing the Technical Support Document.

B. The Source of Fish

In considering fish consumption rates, the source of the fish being consumed is important for several reasons. First, the regulation of water and sediment quality in Washington has the potential to only affect tissue chemical concentrations in fish and shellfish raised in Washington waters. The consumption of fish raised in other geographic locations (e.g. salmon from Alaska, swordfish from the Grand Banks) has no relevance to the policy decisions surrounding Washington's sediment management standards or water quality standards.

The Department will eventually use fish consumption rates to perform complex risk calculations. Those calculations can be performed properly only if the source of fish being consumed is understood properly. Furthermore, in order for the public to properly understand how water and sediment quality regulations may affect the safety of the fish and shellfish they consume, it is important to be clear about the source of seafood.

Second, the Department will eventually have to make important policy decisions about how to regulate water and sediment quality. Among other things, the Department will have to decide whether human health criteria should be established on a site-specific basis, an intra-state regional basis, a state-wide basis, or in some other way. Understanding not only how much of the fish consumed is raised in Washington, but where it is raised is necessary to inform those policy decisions.

For these reasons, we believe that the Technical Support Document should provide as much information as possible about the source of fish being consumed. The document should be clear about the source when it is known and should acknowledge the limitations of data when the source is not known.

We have identified the following places in the Technical Support Document where source information is not provided:

- Pages 8-9. The Technical Support Document presents data on commercial fish landings in Washington, but no information about where this fish is sold and

[3] The Idaho DEQ initiated negotiated rulemaking to evaluate local and regional information in September 2012. The Department's presentation from the first public negotiated rulemaking meeting on October 4, 2012 is available at http://www.deq.idaho.gov/media/904469-58-0102-1201-negotiated-rulemaking-deq-presentation-1012.pdf.

consumed. The document implies that this fish is consumed in Washington, but provides no data to support that implication. The document should provide information about the percentage of fish and shellfish sold in commercial outlets that is from Washington versus imported from other states or countries. When discussing commercial fish landings, the document should also distinguish between the harvest of wild fish and the harvest of pen-raised fish that may be more affected by feed provided than the surrounding water quality.

- Page 13. In the discussion of the "High Estimate," the document notes that the Department of Health concluded that "in 2002 and 2004, 78 percent and 74 percent, respectively, of adults in Washington consumed store-bought fish. In 2005, 57 percent of the adults surveyed reported eating fresh fish purchased at a local grocery store or fish market (frozen fish excluded)." It then states that "Ecology estimated that between 2.9 and 3.8 million Washington adults currently consume some amount of finfish and/or shellfish." These estimates focus on the consumption of fish, not the consumption of fish raised in Washington waters. No factual information is provided to demonstrate that significant amounts of store-bought fish, even fish bought at local grocery stores or fish markets, were raised in Washington waters.

- Pages 14-16. Section 2.3.2 discusses overall fish consumption rates without identifying the source of the fish and shellfish being consumed. The consumption rates presented in this section often include seafood purchased in stores, which is less likely to have been raised in or harvested from Washington waters.

- Page 15. The first sentence states: "Information elsewhere in this report infers that many people in Washington consume fish from local waters—for example, recreational anglers and people shopping from local markets." This statement contains unsupported assumptions regarding the source of fish sold in local markets. The document presents no data indicating that local markets sell exclusively, predominantly, or even significant amounts of fish raised in Washington waters.

- Page 16. Section 2.3.2, Table 7, and the associated text should note that the Washington State Department of Health survey (the Behavioral Risk Factor Information Surveillance System) information used to define the percentage of fish consumers, and then extrapolated to the larger Washington population, does not differentiate between fish and shellfish from Washington versus other locations. A significant number of self-identified consumers might not consume any fish or shellfish from Washington waters. If information on the source of fish was collected in this survey, it should be presented. If not, the fact that the source of fish and shellfish is unknown should be stated clearly.

- Page 20. The last paragraph states: "Many Washington residents consume finfish and shellfish, with a significant amount likely coming from local sources (WDFW, 2008a, 2012)." This statement is unsupported. No data regarding the source of fish consumed is presented. The term "local sources" is also potentially misleading. Many residents may consume fish that is purchased

from a local store or local restaurant, but the fish may have been raised and harvested in another state.

- Page 63. In discussing the results of an Asian and Pacific Islander survey, the text notes that "79-97 percent of the seafood consumed came from either groceries/street vendors or restaurants." By itself, this provides no indication of whether or not the fish was raised or harvested in Washington waters. Table 28 should have indicated (on the table, not just in text) that most (79 to 97%) of the seafood consumption reported in the API survey was purchased from stores and markets.

- Page 95. The third paragraph concludes with the statement "locally or regionally harvested finfish and shellfish represents 67 to 96 percent of total finfish and shellfish reported in studies of tribal populations." The document should be more precise and distinguish between local and regional harvest. Washington water quality standards will have no impact on fish that are raised in other states within the region. The document should also note that these rates were found in studies of tribal populations *living on or near reservations*. The document should examine whether tribal members living in urban areas consume less locally harvested fish.

C. Fish Species

Which species of fish are consumed by Washington residents is important information that will be relevant to many of the policy questions that the Department will ultimately face. The Technical Support Document acknowledges that it is important to understand the type of fish consumed in order to characterize risks because different fish have different contaminant levels. *See* TSD at 31. In fact, the type of fish or shellfish can make a significant difference in the lipid content of the organism and the application of bioconcentration factors (BCFs) used to develop human health criteria.

Bioaccumulation differs substantially across species. Figure 1 shows the concentrations in several seafood types from non-urban locations in Puget Sound. Mean whole-body concentrations in the Puget Sound samples vary by over eight-fold across the species shown. In the calculation of human health criteria, bioaccumulation estimates for all these species consumed should be done using species-specific information weighted by tissue mass consumed. The type of fish or shellfish being consumed makes a big difference for exposures and risk.

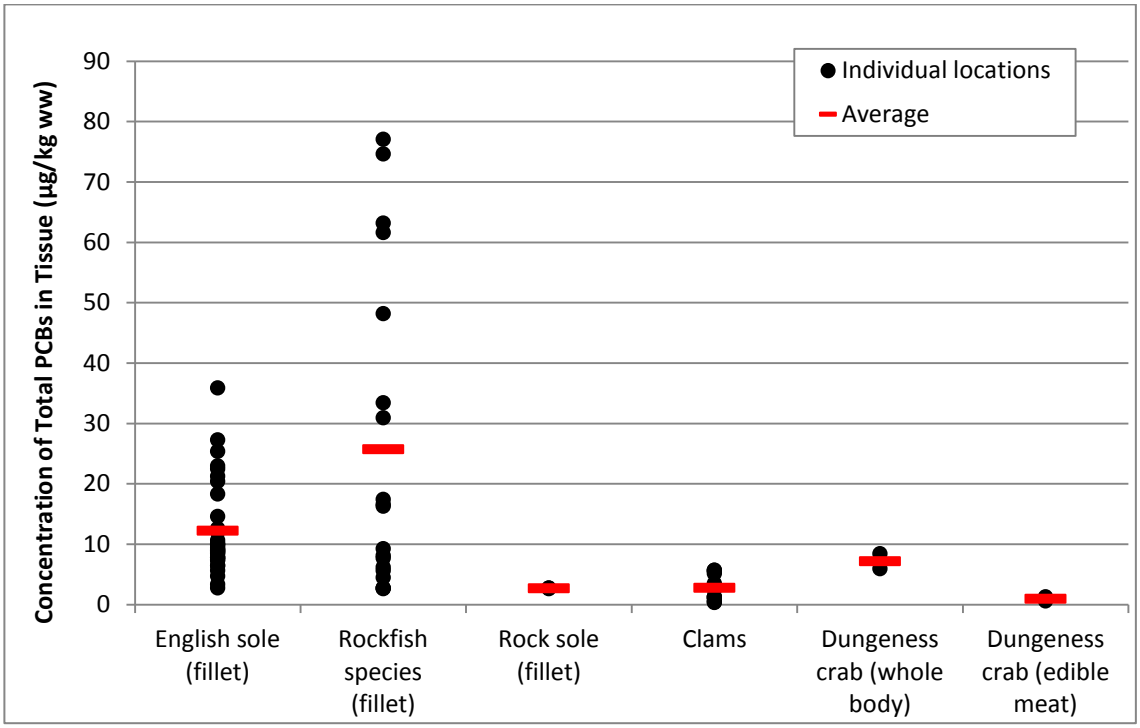

Figure 1. Total PCB concentrations in various seafood types from non-urban non-point source locations in Puget Sound

PCB BCF estimates vary widely (EPA 1980),[4] including BCFs from 13,000 L/kg for eastern oyster to over 200,000 L/kg for some fish. For hydrophobic organics, which tend to accumulate in lipids, bioaccumulation is substantially impacted by the lipid fraction of the organism. Lipid fraction is highly variable across species and contributes to the wide range of concentrations observed in different species with similar environmental exposures (Figure 1).

The BCFs used by EPA, including the BCF for total PCBs, assume 3% lipid concentration. This may be reasonable for finfish, which may constitute the majority of fish and shellfish consumed in the general US population. However, lipid concentrations in shellfish tend to be much lower, more often 1% or less (FDEP 2012). Thus, for any portion of the diet that is shellfish, the accumulation of PCBs may be overestimated by at least three-fold. The diets for some of the groups considered, such as Asian Pacific Islanders, the Suquamish Tribe, and the Tulalip Tribes, are more than 40% shellfish (based on mean consumption), which could contribute to a substantial overestimation of exposure to hydrophobic organic chemicals and therefore unnecessarily stringent water quality criteria.

Different species of fish are also found in different geographies and different types of waterbodies. As a result, different criteria might be protective of human health in different geographies. For example, it might be appropriate to develop a human health criteria for waterbodies that have active shellfish fisheries using shellfish consumption data and shellfish bioconcentration rates, while developing a different criteria for

[4] EPA advocates use of bioaccumulation factors (BAFs), which include exposure through prey and water rather than BCFs, which account only for water exposure (EPA 2000b). However, BAFs are unavailable for most chemicals.

waterbodies that have active finfish fisheries using finfish (or species specific) consumption data and bioconcentration rates.

The current draft of the Technical Support Document provides much more information about the types of fish consumed than the first draft. However, we have identified numerous places in the Technical Support Document where fish type or species information is not provided or addressed:

- Page xvi. Table 1 should provide consumption information by seafood category.

- Page 41. Although the general population information provides data broken down by species group, detailed information by species is not presented. Tables 18 and 19, for example, only provide information regarding consumption of finfish and shellfish.

- Page 63. Although the second paragraph provides some information about the kind of fish Asian and Pacific Islanders reported eating, detailed information is not presented. Table 28, for example, groups all types of fish together.

- Page 72. Table 33 should provide a summary of consumption information by seafood category rather than grouping all types of fish together to present fish consumption patterns.

D. Salmon and Other Anadromous Fish

As indicated in Appendix C of the Technical Support Document and the technical issue paper on salmon, the association of salmon tissue concentrations with local water and sediment concentrations is much more complex than for less-mobile species, and therefore, consumption of salmon should be addressed differently than consumption of other finfish. Attachment 1 to this letter, a memorandum prepared by Windward Environmental LLC, entitled "Exclusion of Salmon Consumption from the Fish Consumption Rate," addresses salmon issues in much greater detail. Its conclusions are summarized here.

The question of whether to include salmon in the fish consumption rate has previously been addressed in connection with the derivation of sediment cleanup standards for contaminated sites. EPA's tribal framework did not include salmon in the consumption rates of the Tulalip Tribes or Suquamish Tribe for risk-based decision making at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites.

> For sites in Region 10, particularly PCB-contaminated sediment sites, salmon have typically been excluded from the fish consumption rate used to estimate site-related risks. This exclusion has been based on the assumption that adult salmon spend most of their lives in the open ocean and take up

> bioaccumulative and persistent contaminants almost exclusively via the food chain in that environment.[5]

Section 4.4.1 of the Technical Support Document also notes that salmon were excluded from EPA's reanalysis of the API survey data because attributing salmon body burden to a specific site is problematic. *See* L. Kissinger, Application of Data from an Asian and Pacific Islander (API) Seafood Consumption Study to Derive Fish and Shellfish Consumption Rates for Risk Assessment (2005).

Page C-1 of Appendix C states that for cleanup decisions, Ecology has chosen to recognize that a default scenario based on a tribal reasonable maximum exposure should include salmon. This statement is provided without technical discussion, and should be deleted because it is a policy decision that is not appropriate in the Technical Support Document. Furthermore, currently available science does not support the concept that remediation of specific cleanup sites would result in lower body burdens in salmon consumed by people or wildlife.

We also believe that salmon should be excluded from any fish consumption rate used to develop human health criteria for Washington's water quality standards. Hope summarizes the tradeoff implicit in inclusion of salmon in water quality criteria as follows:

> If exposure occurs in waters within the State's jurisdiction ("waters of the state"), then more stringent [water quality standards] generated by a higher [fish consumption rate] may reduce both contaminant loads in anadromous fish and risk to humans from subsequent consumption of these fish. This benefit of lower risk, and thus increased availability for consumption, would partially offset regulatory costs associated with what are significantly more stringent [water quality standards]. If, however, anadromous species are primarily contaminated in waters beyond the State's jurisdiction (e.g., in the open ocean), then more stringent [water quality standards] may simply impose economic and legal costs on the State's economy without the offsetting benefits of reductions in contaminant loads and associated risk.[6]

As Hope and others have concluded, water quality standards would have little effect on the concentrations of hydrophobic compounds, such as PCBs, in most returning adult salmon.

Given the large amount of salmon consumed by those in Washington, it is particularly important that the Technical Support Document present fish consumption data in a way

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[5] EPA, 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 (2007).

[6] B.K. Hope, Acquisition of Polychlorinated Biphenyls (PCBs) By Pacific Chinook Salmon: An Exploration of Various Exposure Scenarios, 8 Integrated Environmental Assessment Management 553-562 (2012).

that distinguishes salmon consumption from other fish consumption. If consumption rates are properly understood, Ecology can then make science-based policy decisions about how to address salmon consumption in clean-up decisions and water quality standards development.

E. Population and Subpopulation Information

The Technical Support Document fails to provide important human population information, and often defines subpopulations in a narrow way that biases the fish consumption rate information that is presented. Ultimately, the State will have to make important policy decisions about relative health risks. In order to make those decisions, and to facilitate meaningful public input in the decision making process, the Technical Support Document should present population and subpopulation information in a clear and complete way.

1. General Population Fish Consumption Data

The Technical Support Document generally fails to provide population and subpopulation information necessary to put fish consumption into perspective. As a result, readers may not understand how many people are consuming fish at which rates. If Ecology is to have a meaningful discussion of the policy issues surrounding fish consumption rates, the Technical Support Document must present population numbers clearly and accurately.

For example, at page xiv, the Technical Support Document states that "Ecology estimates that between 1.4 and 3.8 million Washington adults and 290,000 children consume some amount of fish on a regular basis." Similar statements are made throughout the document. These statements should be put into perspective by providing statewide population numbers, which are presented at page 11 of the document but never referenced when the fish consumption rate is discussed. The Technical Support Document should explain, for example, that of the approximately 5.1 million adults and 1.7 million children living in Washington, Ecology estimates that between 1.4 and 3.8 million adults and 290,000 children consume some amount of fish.[7]

2. Population versus Consumer-Only Data

Whether fish consumption rates are described in terms of the entire population or just the subset of the population that consumes fish makes a significant difference. The Technical Support Document acknowledges that "[h]igh fish consumers make up a relatively small portion of the whole population, and may represent extreme upper percentiles in a distribution that includes both consumers and non-consumers of fish." TSD at 81. Nonetheless, the document typically presents fish consumption data solely in terms of percentiles of the fish consumers. This misleads the casual reader and creates a consistent bias suggesting a higher level of fish consumption in the general population than in fact exists.

In order to illustrate this point, consider the national fish consumption data presented in the Technical Support Document. According to a referenced EPA study, only 28% of

[7] More recent census data is available at http://quickfacts.census.gov/qfd/states/53000.html.

the U.S. adult population consumes fish. *See* TSD at 13. As a result, the 50th percentile of fish consumers in the United States would be the 76th percentile of the entire population, and the 90th percentile of fish consumers would be the 97th percentile of the entire population. Even though the EPA study estimated the mean fish consumption rate among fish consumers in the U.S. to be 121.8 g/day, it estimated the mean consumption rate of the *entire* population to be only 16.88 g/day. EPA, Estimated Per Capita Fish Consumption in the United States (Aug. 2002).

The issue is further complicated by differences in the way the term "fish consumer" is defined. Both Attachments C and D to the Technical Support Document identify this problem. If "fish consumer" is defined broadly to include infrequent consumers and so-called "sparse" consumers, surveys may show a greater number of fish consumers, but lower average fish consumption rates. A narrower definition would result in fewer consumers, but higher average fish consumption rates.

When subsequent policy discussions focus on average consumption rates or consumption rates at a particular percentile, it is essential that everyone understand what those rates mean, and how they would change if the entire population were considered or if fish consumers were defined differently.

The State may ultimately have to decide as a legal or policy matter whether it is appropriate to focus on all Washington residents or solely those who consume fish, but that will plainly be a policy decision. The Technical Support Document should present the information comprehensively, showing averages and percentile information for both the entire population and the fish consuming subpopulation.

We have identified the following specific changes that should be made to the Technical Support Document:

- Pages xvi, 72 and 91. Tables 1, 33 and 37 are misleading. They present fish consumption rates in terms of percentiles for fish consumers only, but do not state so clearly. The tables should be changed to include both fish consumer only and entire population percentiles.

- Page 15. The third paragraph states: "Based on EPA's *Estimated Per Capita Fish Consumption in the United States*, the 90th percentile of the estimated national fish consumption rate for adult fish consumers corresponds to 250 g/day (U.S. EPA, 2002a)." This statement is misleading because it provides a percentile that refers only to fish consumers. In fact, when the entire population is considered, the 90th percentile consumption rate is only 17.5 g/day. *See* TSD at 96. The document should provide both numbers.

- Pages 40-42. Tables 17-19 and Figures 1 and 2 present fish consumption data in terms of fish consumers only. It should also present percentile rates relative to all survey respondents.

3. Geographic Information

The consumption of fish and shellfish varies by location, as shown in the Attachment 2: Map Fish Consumption Rates,[8] which illustrates general consumption patterns based on tribal survey information. Consumption is influenced by population patterns, cultural practices, and availability of habitat to support fish and shellfish. Section 5.2 of the Technical Support Document acknowledges the influence of geographic differences; however, this section should also cite EPA Region 10's tribal framework document, which uses habitat consideration, in particular the availability of high-quality intertidal habitat, in the selection of seafood consumption rates for cleanup decisions.[9]

The variability in Washington State waters by location is an important factor in determining the types of fish and shellfish available for consumption and the quantity consumed. For example, a river or lake in eastern Washington would not support the same shellfish consumption rates as those reported for the Suquamish Tribe or even Tulalip Tribes. Although Section 6.3 of the Technical Support Document discusses geographic variability, the fish consumption data presented throughout the document is often presented in a way that does not highlight geographic distinctions.

4. Individual Tribal Populations

The Technical Support Document presents information gathered in fish consumption surveys of individual tribal populations in the Northwest. This information, however, is not always presented clearly and completely, and therefore, may mislead many readers.

First, the Technical Support Document should be clear when it is referring to these surveys. In several places the document refers to "regional" fish consumption information when in fact it is referring to studies focused on specific high-consuming tribal populations. When no qualifier is provided, most readers are likely to assume that regional fish consumption information is information about the typical fish consumption of the general population in the region. In fact, the Technical Support Document acknowledges that no general population surveys have been conducted in Washington or the region. We note the following specific statements that should be revised:

- Page 4. The fourth bullet should be revised to read: "In Version 1.0 of this Technical Support Document, Ecology provided the results of a statistical evaluation from ~~regional-specific~~ fish dietary surveys <u>of various high-</u>

[8] Fish consumption information in Attachment 2 was taken from the Technical Support Document, the EPA 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 (2007), and the fish consumption survey of the Tulalip and Squaxin Island Tribes referenced in the Technical Support Document.

[9] As part of the Framework, Region 10 recommends, as a policy decision, that for CERCLA and RCRA sites in Puget Sound or the Strait of Georgia with extensive intertidal habitat, the consumption rate derived by EPA from data collected by the Suquamish Tribe represents a sustainable consumption rate suitable for estimating site-related risks. Again, as a policy decision, for sites in Puget Sound and the Strait of Georgia that lack extensive intertidal habitat, the consumption rate derived by EPA from data from the Tulalip Tribes represents a sustainable consumption rate.

consuming population subgroups in the region." Likewise, the fifth bullet should be revised to read "This Technical Support Document is focused on finfish and shellfish resources in the Pacific Northwest, Washington State fish-consuming populations, and information from ~~regional-specific~~ fish dietary surveys of various high-consuming population subgroups in the region."

- Page 21. The fourth paragraph should be revised to state "in the absence of a statewide fish dietary survey, Ecology believes that the fish dietary information from ~~regional~~ fish-consuming tribal populations is useful and relevant for making sound risk management decisions that protect Washington State's residents."

- Page 22. The first full paragraph uses the phrases "[t]hese regional surveys" and "[t]hese regional fish dietary surveys" to refer to surveys that address small high-consuming populations. They should be revised to refer to surveys of individual tribal populations.

- Page 71. Heading "2. Regional Survey Data" should be revised to read "2. Northwest Tribal Survey Data. Likewise, the text should read "… the following regional tribal surveys . . ."

- Page 95. The third paragraph begins by referring to "four key fish consumption surveys conducted in the Pacific Northwest. It should refer to "four key tribal fish consumption surveys…"

Second, the Technical Support Document should present population data concerning American Indians and Alaskan natives in Washington when discussing fish consumption rates. At page 17, the document indicates that there are 103,869 American Indians and Alaskan natives in Washington (73,523 adults and 33,599 children), but does not indicate the number who live on or near reservations, or the number who live subsistence lifestyles. Ecology appears to be suggesting that the various surveys of tribal members living on or near tribal reservations can be used to estimate the fish consumption rates of all American Indians and Alaskan natives who live in Washington. Assuming it were appropriate to draw such inferences, it would be important for readers to understand how many of the American Indians and Alaskan natives live on or near reservations or live lifestyles comparable to the subsistence lifestyles described in some of the published surveys. It seems likely that American Indians and Alaskan natives who live away from reservations may eat a larger proportion of fish that is not locally raised or harvested, particularly if they live in urban areas.

Third, when presenting tribal fish consumption rate survey data in terms of percentiles, the Technical Support Document should include tribal population numbers. This would allow the reader to understand how many tribal members consume fish at or above the rates associated with various percentiles.

Fourth, Ecology should consider noting in the Technical Support Document that the highest individual consumption rates reported in the regional studies presented have been treated differently. In the Columbia River Inter-Tribal Fish Commission (CRITFC), and API data summaries presented in the Technical Support Document,

consumption rates that were deemed unreasonably high based on comparison with the population mean or distribution were either corrected or not used in calculations. None of the data were excluded and no corrections to the highest reported consumption rates were made in the analyses presented of the Suquamish, Tulalip Tribes, and Squaxin Island Tribe data. Inclusion of these highest rates strongly influences the mean and upper percentile estimates (e.g. 95th percentile and above) for these groups, making them much higher.

a. CRITFC Study

Section 4.3.1 of the Technical Support Document discusses the CRITFC fish consumption survey, which involved "adult tribal members who lived on or near the Yakama, Warm Springs, Umatilla or Nez Perce Reservations." The document should clearly state how many adult tribal members live on or near these four reservations. Membership information provided on tribal websites indicates that these four tribes have a total membership of approximately 17,000 (Yakama 6,300, Warm Springs 4,000, Umatilla 2,800. and Nez Pierce 3,363).[10]

When fish consumption is presented in terms of percentiles, the document should also indicate the number of tribal members associated with each percentile to demonstrate the statistical relevance of the survey data. For example, if the total population of these tribes is 17,000, and 7% of tribal members do not consume fish, then the 50th percentile consists of approximately 8,000 members, and the 95th percentile includes approximately 800 members. When consumption rates are presented without these population numbers, readers are likely to assume erroneously that many more individuals consume fish at the high rates shown.

Likewise, when the Technical Support Document provides consumption rates associated with subsistence lifestyles it should describe the lifestyle and indicate the number of people who live comparable lifestyles. At page 50, the document states that "Harris and Harper (1997) report that a fish consumption rate of 540 g/day represents a reasonable subsistence fish consumption rate for CRITFC's member tribes who pursue a traditional lifestyle." In order to understand the significance of this consumption rate, the document should indicate how many tribal members live the subsistence lifestyle represented by this rate, and how many other Washington residents have a similar subsistence lifestyle.

b. Tulalip and Squaxin Island Tribe

Section 4.3.2 discusses a survey of the Tulalip and Squaxin Island Tribe. This discussion should also include tribal population information. According to the websites of these tribes, the total membership of these two tribes is less than 4,700 (Tulalip 4,000 and Squaxin Island 650).[11] The numbers associated with the percentile consumption rates should be displayed on Tables 23 and 24. If the total population is

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[10] *See* http://www.yakamanation-nsn.gov/history3.php; http://warmsprings.com/warmsprings/Tribal_Community/; http://www.umatilla.nsn.us// ; http://nezperce.org/Official/FrequentlyAskedQ.htm#7. population of the NPT

[11] http://www.tulaliptribes-nsn.gov/; http://www.npaihb.org/member_tribes/tribe/squaxin_island_tribe/.

4,700, for example, there would be 235 people consuming fish at or above the 95th percentile rate.

c. Suquamish Tribe

Section 4.3.3 discusses the Suquamish tribal fish consumption survey. This survey focused on tribal members who live on the reservation. According to the Technical Support Document, 425 tribal members live on or near the reservation. TSD at 57. Consequently, 212 people are above the 50th percentile and consume 58 g/day or more of Puget Sound fish; 47 people are above the 90th percentile and consume more than 397 g/day; and 21 people are above the 95th percentile and consume more than 767 g/day. If policymakers and stakeholders are to understand the data presented in the Technical Support Document, they need this population information.

The presentation of population numbers is particularly important for the Suquamish Tribe survey data. As illustrated by Figure 12 on page 73, the 95th percentile for the Suquamish Tribe is almost 3 to 4 times the 95th percentile rate found in surveys of the other high-consuming tribes. In considering this data, it is important to understand that 4 people surveyed were at or above the 95th percentile, and even if it were appropriate to conclude that this was the 95th percentile consumption rate for the entire tribe, 21 people would consume that amount or more.

5. Asian-Pacific Islander Fish Consumption

According to the Technical Support Document, the number of Asian Pacific Islanders living in Washington is more than five times the number of American Indians and Alaskan natives. TSD at 17-18. Yet, the Technical Support Document focuses relatively little attention on the fish consumption rates of Asian Pacific Islanders. It is not clear why Ecology has apparently concluded that surveys of a few tribes should be used to provide statewide fish consumption information, yet a survey of Asian and Pacific Islander populations should not be applied statewide. *See* TSD at 71.

F. Cooking and Preparation

Ecology acknowledges that cooking and preparation methods are important. *See* TSD at 32. There are two different issues related to cooking and preparation methods and fish consumption rates.

The first issue is whether errors in the estimation of fish consumption have been made based on survey information for cooked weights, when uncooked weight is needed to apply bioconcentration factors and bioaccumulation factors. The Technical Support Document discusses this issue and appears to have properly corrected survey data where necessary so that results are presented in terms of uncooked weights.

The second issue is whether cooking and preparation affect concentrations of contaminants in fish tissue. The Technical Support Document does not include a discussion of preparation and cooking methods. Some preparation and cooking methods may dramatically decrease concentrations of some chemicals, particularly hydrophobic chemicals such as PCBs. For example, the concentrations of PCBs in raw fillet tissue have been shown to decrease by approximately 50% through the removal of the skin (EPA 2000a). Cooking may also reduce PCB concentrations in tissue, in some

cases by as much as 87%, depending on the cooking method (Wilson et al. 1998). Preparation methods such as skin removal and filleting are recommended practices to reduce chemical exposures in several pamphlets produced by the Washington State Department of Health. Of course, many of these recommendations are already common practice for consumers based on their consumption preferences. Although these preferences may differ among different population subgroups, the API and tribal studies indicate that most fish and shellfish consumed undergo some preparation (e.g., filleting, trimming) and some sort of cooking prior to consumption.

G. Information About Other States

Given the legal and policy decisions that the Department will ultimately have to make, it would be useful if the Technical Support Document provided more information about the fish consumption rates used in developing water quality standards in other states. In order to assist the Department, we have provided as Attachment 3 to this letter a matrix providing examples of fish consumption rates used in other states. We believe this information would be useful in informing further policy decisions. The final Technical Support Document should take a comprehensive look at the default fish consumption rates used in other states.

The current draft of the Technical Support Document is problematic because it repeatedly discusses policy decisions made in Oregon, without acknowledging different approaches taken by other states. The document references Oregon as an example in at least nineteen places, but does not mention the approaches taken by any other state. *See* TSD at xi, 12, 19, 22, 32, 48, 56, 61, 64, 69, 81, 86, 91, 94, 95, 99 and A-4. Other states' approaches may be relevant to the Department's ultimate policy decisions.

For example, the Idaho Department of Environmental Quality ("DEQ") reviewed nineteen fish consumption surveys and performed a quality review analysis to determine the surveys' relevance to a fish consumption rate for the Idaho general population.[12] The Idaho DEQ believes an Idaho-specific fish consumption survey would provide valuable information to support the development of water quality criteria.[13]

The Florida Department of Environmental Protection ("DEP") has determined that a probabilistic approach that directly incorporates risk levels is a more realistic and accurate assessment of the exposure risk to the general population than the more typical deterministic approach that relies on conservative estimates of key variables (e.g., body weight, fish consumption rate, water intake rate) in standard equations.[14] The probabilistic approach avoids the compounding levels of conservatism inherent in the

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[12] The Idaho DEQ's presentation from the first public negotiated rulemaking meeting on October 4, 2012 contains a summary of the Department's quality review analysis. The presentation is available at http://www.deq.idaho.gov/media/904469-58-0102-1201-negotiated-rulemaking-deq-presentation-1012.pdf.

[13] Letter from Barry N. Burnell to Mike Bussell dated August 6, 2012 (response to EPA disapproval of Idaho DEQ's submitted human health criteria for toxic pollutants).

[14] Florida DEP, Technical Support Document: Derivation of Human Health Criteria and Risk Assessment (Draft July 2012), *available at* http://www.dep.state.fl.us/water/wqssp/docs/tr_review/hhc_tsd_071112.pdf.

deterministic approach. The Florida DEP technical support document also benefits from a state-wide fish consumption survey and a baseline risk analysis that described fish consumption probability distributions for the state's general adult population.

A policy decision may ultimately be made to follow the example set by one state rather than another. At this stage, however, the Technical Support Document should present a complete picture rather than singling out a particular state as more relevant than all of the others.

II. The Technical Support Document should present facts, not legal or policy opinions or conclusions.

The Technical Support Document should focus on facts and science. It should not express or imply opinions, recommendations or conclusions on legal and policy issues. Indeed, the preface to the second draft states emphatically: "This Technical Support Document . . . does not address the policy questions. It focuses quite specifically on the issue of how much and what types of fish are consumed by the people of Washington, and what data are available about fish consumption rates." TSD at xi.

In response to comments on the first draft of the Technical Support Document, Ecology Director Ted Sturdevant announced the Department's intention to publish a second draft that would focus on facts rather than policy:

> This is a technical document. It is designed to compile and evaluate available information on fish consumption in Washington State. It is not designed to resolve the policy issues associated with using that information to make regulatory decisions. Those issues will be dealt with in separate rulemaking documents and processes. We will change the document to more clearly highlight this distinction.

Letter from T. Sturdevant to Interested Parties dated July 16, 2012.[15] Boeing agrees with the Department's decision. Legal, regulatory or policy decisions of this magnitude should be made after a robust debate and an appropriate process. Indeed, the Department is legally obligated to follow APA rulemaking procedures when

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[15] Director Sturdevant's letter announcing the publication of the second draft of the Technical Support Document echoed this same theme:

> [W]e have revised the document to focus more clearly on the scientific and technical issues associated with estimating the amount of fish and shellfish eaten by people in Washington. . . . Ecology agrees that policy decisions are appropriately addressed during the process for revising the state's water quality standards, in the sediment management standards, or through the preparation of cleanup action plans for individual sites. Consequently, the recommendations on selecting a default fish consumption rate for one or more programs (Chapter 7) have been removed. Other sections have been revised to better distinguish science issues and regulatory decisions associated with the scientific data.

Letter from T. Sturdevant to Interested Parties dated Aug. 30, 2012.

making these decisions. *See Simpson Tacoma Kraft Co. v. Ecology*, 119 Wn.2d 640, 835 P.2d 1030 (1992).

Boeing appreciates the Department's efforts to remove many of the policy statements that were found in the original draft. However, the current draft continues to contain many policy-laden opinions, recommendations and conclusions that should be removed. In particular, we have identified the following:

- Page xiii. The last sentence of the second paragraph states: "Current fish consumption rates used by the Washington State Department of Ecology (Ecology) to make regulatory decisions are not consistent with what we know about how much fish people in Washington eat." This is a policy conclusion that should be deleted. If the fish consumption rate is intended to reflect the average daily consumption of locally-harvested, non-anadromous fish by the average person in Washington, the current fish consumption rates used in connection with the sediment management standards and water quality standards are fairly consistent with the data presented in the Technical Support Document. Instead, this statement expresses a conclusion that reflects different assumptions about many legal and policy issues that have yet to be resolved.

- Page 21. The last sentence of the third paragraph states: "Regional-specific fish dietary information indicates that Washington State's fish-consuming populations eat more fish than what is reflected in the rates used to establish regulatory standards and, as a result, Ecology wishes to consider whether Washington's fish-consuming populations are adequately protected." Again, this statement expresses a conclusion that reflects assumptions about many legal and policy issues that have yet to be resolved. It should, therefore, be deleted.

- Page 71. The fourth paragraph states "Ecology believes that these surveys provide credible information about fish consumption in Washington and could be used to estimate fish consumption rates protective of Washington State's fish-consuming populations." This sentence refers to three surveys of tribal members living on or near reservations. Although those surveys provide information about the fish consumption of the surveyed tribal populations, it is a significant policy question whether the consumption rates of those individual tribal populations should be used to determine rates that are protective of Washington residents, most of whom consume fish at much lower rates. The Technical Support Document should not include this kind of policy-laden conclusion.

- Pages 89-100. Chapter 6 of the Technical Support Document addresses policy questions that Ecology may be considering in future proceedings. The Technical Support Document begins the chapter by stating that "[i]t is a technical document and is not designed to resolve policy issues associated with using that information to make regulatory decisions." This is correct. It is unclear, however, why this chapter discussing policy issues is included in the document at all. A much longer chapter would be required to fully and fairly place the fish consumption rate issue within its legal and policy context. This

document should stick to the facts and science associated with fish consumption, and therefore, this chapter should be deleted.

- Page 93. Section 6.3 identifies three options for addressing variations in fish consumption rates: a single statewide rate, multiple regional rates, and site-specific rates. This is clearly a policy position, and should be removed from the document. There are certainly other available options. For example, Ecology could use different consumption rates for different fish species or different categories of fish. Ecology could also use different rates for different types of waterbodies.

- Page 95. The first paragraph in section 6.5 ends with the statement: "in protecting waters of Washington State, a uniform level of protection should be maintained for all fish-consuming populations in Washington State." This is a legal and policy conclusion that does not belong in a purely technical document.

- Page 97. The last sentence of the fifth paragraph includes a parenthetical implying that an exposure scenario must fall between the 90th and 99th percentile of the exposure distribution in order to be "reasonable." The parenthetical should be deleted to avoid presenting a policy conclusion.

- Page C-1. The first paragraph concludes with the sentence: "MTCA provides greater flexibility for site-specific modifications to regulatory standards, whereas the CWA requirements are rigid and site-specific adjustments to human health criteria are rare." This is an opinion or conclusion about legal and policy issues that should not be included in this technical document.

III. The Technical Support Document should present scientific information accurately.

If the Technical Support Document is to fulfill its objective of informing future policy discussions, it must present scientific information accurately. An accurate presentation must acknowledge any limitations of the data or studies being discussed. Although the Technical Support Document generally presents the scientific information it discusses accurately, there are some inaccuracies that should be corrected.

- Page xiv. The fifth paragraph states: "Ecology estimates that between 1.4 and 3.8 million Washington adults and 290,000 children consume some amount of fish *on a regular basis*." (Emphasis added.) However, at page xvi, the document states "Ecology estimates that between 1.4 and 3.8 million adults in Washington eat finfish or shellfish *at least occasionally*." (Emphasis added) The second statement appears to be more accurate.

- Page 5. The first paragraph states: "Available information indicates that Washington residents consume some amount of local finfish or shellfish." This statement is inaccurate and imprecise. It incorrectly implies that all residents eat local fish. According to data elsewhere in the document, between 27% and 72% of adults in Washington eat some fish occasionally, and only 18% of children eat some fish occasionally. A significant portion of Washington's population eats no fish. No data are presented that establish rates of locally

raised or harvested fish. We suspect that a much greater percentage of the population eats no fish raised or harvested in Washington, particularly if salmon is excluded.

- Page 7. The first paragraph states: "Most Washington residents consume some local finfish or shellfish." There does not appear to be any support in the document for this statement.

- Section 4.1 of the Technical Support Document should cite EPA's tribal framework document and the Kissinger reinterpretation of API data rather than referencing solely Windward Environmental's Lower Duwamish Waterway remedial investigation as the source of agency decisions regarding the seafood consumption rate selection. The rates used in the Lower Duwamish Waterway Remedial Investigation are site-specific EPA and Ecology policy decisions and should be cited as such.

- Page A-7. Appendix A.3 of the Technical Support Document, Table A-7 should note that the Asian Pacific Islander data are for the consumption of King County fish and shellfish only, and that the rates are based on Kissinger's work for EPA's Office of Environmental Assessment. Kissinger should be referenced instead of Windward Environmental.

- Attachment D, page 5. The uncertainties associated with the upper percentiles of seafood consumption, particularly for studies with smaller sample sizes, should be acknowledged and explored. This point is raised in Attachment D by Dr. Casey Olives. He states, "In most cases, published tribal data are not accompanied by estimates of uncertainty and individual-level data is in general not available. At the very least, a full treatment of uncertainty for the national data and for the Tulalip tribe data would provide some benchmarks which could help the reader understand the order of magnitude of uncertainty in the reported rates." We agree with Dr. Olives that this simple analysis would be very useful in helping people understand the uncertainty associated with these values. It should be done for all data sets considered, or at *the very least, for* the national and Tulalip data sets, which are available to Dr. Polissar.

Conclusion

Thank you again for the opportunity to comment on the *Fish Consumption Rates: Technical Support Document, Version 2.0*. The second draft of the document significantly improves on the first, but, as expressed in this letter, many concerns remain. Boeing requests that Ecology defer the Technical Support Document until these concerns are addressed and Ecology conducts a state-wide survey to accurately determine fish consumption across all Washington populations.

The Technical Support Document should present accurate, comprehensive and objective scientific information and data to properly inform future legal and policy decisions on water quality and cleanup standards. Boeing applauds Ecology's decision to focus on separating technical information from policy decisions and to remove a default fish consumption rate from the Technical Support Document. Nevertheless, important information is missing from the second draft or is presented in a non-

objective (biased) manner. A key component missing from the Technical Support Document is a lack of sufficient data or information about the fish consumption patterns of Washington's general population. In order to properly inform the policy decisions, the document should present factual information, including both population information and fish survey results in context. The Technical Support Document should be clear about the source and species of consumed fish, and the geographic distribution of fish consuming populations throughout the state. And, the document should acknowledge where significant information gaps remain. Without these changes, we are very concerned that the Department's plan to drive a major increase in the fish consumption rate will result in unachievable standards that will negatively impact both our operations in Washington, the state's economy and quality of life, with little to no improvement to water quality. We urge Ecology to carefully consider these impacts before moving forward with this document and proceeding with the associated rulemakings.

Boeing remains committed to working with Ecology and other stakeholders on these significant issues. Please do not hesitate to contact me or Lori Blair at (425) 965-9776 on this important matter.

Sincerely,

Terry Mutter
Director Enterprise Strategy
Environment, Health & Safety
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Attachments:
1 – Exclusion of Salmon Consumption from the Fish Consumption Rate
2 – Tribal Consumption Rates Map
3 – State Fish Consumption Rate Table

ATTACHMENT 1

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MEMORANDUM

To: Perkins Coie

From: Windward Environmental

Subject: Exclusion of salmon consumption from the fish consumption rate

Date: October 24, 2012

This memorandum presents an overview of the available information regarding the question of whether to include salmon consumption in the fish consumption rates (FCRs) to be used in the derivation of water quality criteria (WQC) as well as the determination of site-specific sediment cleanup standards.

The Washington Department of Ecology (Ecology) recognizes that this issue is highly complex and controversial, and thus an appendix to the *Supplemental Information to Support the Fish Consumption Rates: Technical Support Document* (Ecology 2012b), hereafter referred to as the Technical Support Document (TSD), and a technical issue paper (TIP) (Ecology 2012c) were devoted to its evaluation.

Based on a review of this information as well as a review of salmon consumption information, we conclude that salmon should not be included as a default in the FCR for either purpose (WQC derivation or setting sediment cleanup standards). Inclusion of salmon may be considered under highly specific circumstances, which would require site-specific technical arguments.

PROBLEM STATEMENT

In Section 6.4 of the TSD, Ecology (2012b) identified two key questions in deciding whether and how salmon consumption should be incorporated into FCRs used in regulatory decision-making.

- How should the default rates take into account the consumption of fish species such as salmon that spend much of their life outside of Washington waters?

- How should the complex life cycle and biology of the different anadromous fish such as salmon be considered when making regulatory decisions?

Ecology (2012b) then laid out four options for consideration:

- Include salmon consumption in statewide FCR (e.g., Oregon State Department of Environmental Quality [ODEQ])
- Include salmon in regional FCR that reflects the diversity of water bodies, species, and fish consumption patterns
- Evaluate the inclusion of salmon in the FCR on a site-specific basis for cleanup sites or specific dischargers based on the site's contribution to salmon body burdens
- Exclude salmon consumption from the statewide FCR (e.g., EPA Region 10 framework, federal ambient water quality criteria [AWQC] for the protection of human health)

In the TSD (Ecology 2012b), Ecology did not state a preference for one option or another.

However, in Appendix C (p. C-1) of the TSD (Ecology 2012b), Ecology made the following statement:

> "For cleanup decisions Ecology has chosen to recognize that a default scenario – based on a tribal RME – should include salmon in the FCR, but that the regulatory framework should recognize that some of those fish spend time outside of WA waters and that this should be addressed on a site-specific basis. This choice – to include salmon for cleanup decisions – also highlights that the solutions depend on the question. Because of the flexibility afforded by the MTCA Cleanup Regulation, this answer is appropriate for cleanup decisions."

Thus, Ecology appears to imply that the policy decision has been made for the Model Toxics Control Act (MTCA)/Washington State Sediment Management Standards (SMS), although no mention of this decision is presented in the *Draft Sediment Management Standards (SMS) Rule Proposed Amendments* (Ecology 2012a), and the TSD "was not designed to resolve policy issues"(Ecology 2012b).

Appendix C of the TSD (Ecology 2012b) goes on to state, "Questions of using FCRs in the context of human health-based water quality criteria have a separate set of policy choices that could lead to a different solution."

We agree that derivation of WQC and site-specific sediment cleanup standards are quite distinct from one another. We disagree that salmon should be included by default in either case, and thus, the above text from Appendix C of the TSD should be deleted because:

- The TSD is not a policy document; and
- Currently available science does not support the concept that remediation of site-specific cleanup sites would result in lower body burdens in salmon consumed by people or wildlife.

For cleanup sites, special consideration of salmon was made in the US Environmental Protection Agency's (EPA's) tribal framework document (2007). In that document, salmon were not included in the consumption rates for the Tulalip Tribes or Suquamish Tribe for risk-based decision-making at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites.

> "For sites in Region 10, particularly PCB-contaminated sediment sites, salmon have typically been excluded from the fish consumption rate used to estimate site-related risks. This exclusion has been based on the assumption that adult salmon spend most of their lives in the open ocean and take up bioaccumulative and persistent contaminants almost exclusively via the food chain in that environment. "

Furthermore, Section 4.4.1 of the TSD, the Washington State Department of Ecology (Ecology) (2012b) notes that salmon were excluded from EPA's reanalysis of the Asian and Pacific Islander (API) survey data because attributing salmon body burden to a specific site is problematic (Kissinger 2005).

In deriving WQC, Hope (2012) summarizes the tradeoff implicit in the inclusion of salmon in WQC, as follows:

> "If exposure occurs in waters within the State's jurisdiction ('waters of the state'), then more stringent WQS generated by a higher FCR may reduce both contaminant loads in anadromous fish and risk to humans from subsequent consumption of these fish. This benefit of lower risk, and thus increased availability for consumption, would partially offset regulatory costs associated with what are significantly more stringent WQS. If, however, anadromous species are primarily contaminated in waters beyond the State's jurisdiction (e.g., in the open ocean), then more stringent WQS may simply impose economic and legal costs on the State's economy without the offsetting benefits of reductions in contaminant loads and associated risk."

TECHNICAL ANALYSIS REGARDING SALMON EXPOSURE

Before FCR policy can be set, several key technical questions need to be resolved. The most important technical question is:

- What is the potential for water quality standards (WQS) or site cleanups to affect body burdens of bioaccumulative chemicals in anadromous fish, such as salmon, that are consumed by people?

To address this question, Ecology has compiled a great deal of information in the TSD (Ecology 2012b) and salmon TIP (Ecology 2012c) demonstrating that salmon represent a diverse group of fish with a wide range of life history characteristics that influence their potential for exposure to contaminants in water, sediment, and food resources. To relate this array of information to FCR policy, two critical questions surface:

- What salmon species are consumed by people and at what percentages?
- What percentage of the body burden of the salmon species that are consumed might be attributable to exposure at a specific site (for SMS) or within Puget Sound (for WQS)?

We appreciate the information provided in the TSD (2012b) and TIP (Ecology 2012c) that helps to inform these questions. The following key facts summarized from the TSD and TIP are particularly germane.

1. Although Puget Sound salmon may accumulate contaminants from freshwater, estuarine, or marine habitats during their life cycle, several studies cited in the TIP indicate that salmon accumulate most of their adult body burden of persistent bioaccumulative toxins (PBTs) in the marine waters of Puget Sound and the Pacific Ocean.
    - Kelly et al. (2007) reported that sockeye salmon spawning 10 to 1,200 km upstream in the Fraser River accumulated the majority of their polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-*p*-dioxin (PCDD)/polychlorinated dibenzofuran (PCDF) body burdens from marine food sources and pathways.
    - O'Neill et al. (1998) reported that Chinook and coho salmon accumulate > 98% of their PCB body burden in the marine waters of Puget Sound and the Pacific Ocean.
    - O'Neill and West (2009) indicated that, even in the PCB-contaminated Lower Duwamish Waterway, the vast majority (> 96%) of PCB accumulation in Chinook salmon occurred in the marine environment, with little freshwater or estuarine contribution.
    - Cullon et al. (2009) reported that 97 to 99% of PCB, PCDD/PCDF, dichlorodiphenyltrichloroethane (DDT) and hexachlorocyclohexane (HCH) concentrations in returning adult Puget Sound Chinook were acquired during their time at sea, not in fresh water or estuaries.
    - The accumulation of relatively high contaminant body burdens in marine environments is consistent with the high metabolic rates, heavy feeding, and fast growth during marine residence (Quinn 2005; cited in Ecology 2012b).
2. Chinook salmon resident to Puget Sound have higher body burdens of PBTs than do other salmon, particularly PCBs. For resident Chinook salmon, the great

majority of their growth and contaminant uptake (> 96%) occurs in Puget Sound. Therefore, body burden accumulation for resident Chinook salmon may be an indicator of environmental conditions within Puget Sound. The TIP (Ecology 2012c) provides the following support:

- O'Neill et al. (1998) demonstrated that adult Chinook from Puget Sound and coastal populations had higher concentrations of PCBs than did coho from the same locations (53.9 and 28.9 µg/kg, respectively).
- O'Neill et al. (2006) reported that concentrations of PCBs, DDTs, and PBDEs were higher in coho and Chinook populations that have more coastal distributions than those measured in chum, pink, sockeye salmon, which have more oceanic distributions.
- O'Neill et al. (2006) also reported that resident Chinook, had 2 to 6 times the amount of PCBs than did non-residents, and 5 to 17 times the polybrominated diphenyl ether (PBDE) body burden.

3. Body burdens in resident Chinook are highly variable but generally correspond with the basins where they are captured. The TIP (Ecology 2012c) provides the following support:
   - O'Neill and West (2009) demonstrated that Chinook from central and southern Puget Sound tend to have higher contaminant body burdens than those from northern Puget Sound. PCB concentrations in returning adults from central and southern Puget Sound averaged 80 and 60 ng/g, respectively; whereas, PCB concentrations in Chinook from rivers in the northern portion of Puget Sound were significantly lower (40 ng/g).
   - O'Neill and West (2009) attributed the higher PBC concentrations in South Puget Sound stocks to more significant feeding and residency time in the more highly contaminated South Puget Sound habitats and attributed the high variability within stocks to poorly understood differences in diet, overwintering, and movement among individual fish.
4. Geographic differences in Chinook contaminant body burdens generally correspond with those of Pacific herring, which are a key prey item.
   - The TIP (Ecology 2012c) described the results of West et al. (2008), which reported that Pacific herring from central Puget Sound are 3 to 9 times more contaminated with PCBs and 1.5 to 2.5 times more contaminated with DDTs than those from northern Puget Sound and the southern Strait of Georgia.
5. Hope (2012) modeled the potential for changes in WQS to affect PCB concentrations in fall Chinook salmon under a variety of scenarios. A scenario for resident fall Chinook in a confined marine water body such as Puget Sound was specifically included. The results indicated that for resident Puget Sound

> Chinook, changes in WQS are predicted to affect contaminant body burdens by ≤ 2 times because non-point sources constitute the major source of legacy contaminants such as PCBs. For other salmon, with open ocean adult residency, WQS were not expected to affect body burdens.

The above information, as summarized from the TSD (Ecology 2012b) and TIP (Ecology 2012c), indicates that resident Chinook salmon contaminant uptake may be attributable to exposure within Puget Sound as a whole and to a lesser degree to regions within Puget Sound but not to specific locations or sites. Some fraction of coho and pink salmon contaminant uptake may also be attributable to exposure within Puget Sound, but the fraction of residents in the population is small relative to ocean migrants.

Given these findings, WQS are unlikely to have a significant effect on contaminant uptake by salmon, with the possible exception of resident species (primarily resident Chinook). The TSD and TIP should be revised to clearly state this information.

As an aside, much of the other information presented in the TIP (Ecology 2012c) (i.e., salmon abundance trends; life history information for egg, fry, and adult life stages; potential impacts on juvenile and adult salmon) does not address key questions relevant to the FCR. Although the impacts of contamination on salmon is of concern for both Puget Sound ecology and harvest, the inclusion of information on contaminant effects on salmon themselves is not germane to the determination of whether salmon should be included in FCR calculations. Thus, the TIP (REF) should be re-focused to evaluate the potential effects of life history information on exposure to people through the consumption of salmon, and this extraneous information should be deleted.

Technical Analysis Regarding Exposure to People Consuming Salmon

We appreciate the information provided in the TSD (Ecology 2012b) that describes the relative abundance of the different salmon species and harvest by human consumers. This information is helpful in determining the relative importance of the different species and runs to consumers, which is critical to providing the link to FCR policy. Based on the information summarized above, it is clear that Puget Sound exposure is likely to significantly affect only one salmon species (i.e., resident Chinook). To understand the ramifications on WQS, it is necessary to understand what percentage of consumed salmon is resident Chinook salmon.

Table C-4 of the TSD (Ecology 2012b) reports the population status of 208 individual runs among six salmon species, Chinook, chum, coho, pink, sockeye, and steelhead, as determined by the Washington State Department of Fish and Wildlife (WDFW) salmon and steelhead stock inventory assessment (SASI) (WDFW 2002). Although these data provide some indication of the variety of salmon populations present, because run sizes vary from dozens to thousands of fish, they do not clearly describe the relative numbers of the various species. Run size estimates for each stock are provided in SASI (WDFW 2002) and should be summarized in the TSD (Ecology 2012b).

Of greater importance to understanding the role of salmon consumption in FCRs is the contribution of each species and stock to harvest. Limited harvest data are provided in TSD Tables C-8 through C-10 (Ecology 2012b), which report sport catch of salmon for a subset of Puget Sound river systems (i.e., Dungeness River, Elwha River, Morse Creek, and Strait of Juan de Fuca [Port Angeles area]) for the years 2001 through 2003 (summarized in Table 1). This limited dataset indicates that coho and pink salmon constitute more than 90% of the recreational fish harvest. To facilitate an understanding of the relative importance of resident Chinook salmon, recreational harvest data that is summarized over a longer time period and includes all Puget Sound fisheries should be provided.

Table 1. Summary of 2001 to 2003 sport salmon catch for Strait of Juan de Fuca (Port Angeles area), Dungeness River, Elwha River, and Morse Creek

Species	Average Sport Salmon Catch (No. of Fish)	Percentage of Total Average Catch
Coho	14,584	70
Steelhead	647	4
Chinook	1,074	6
Pink	7,575	19
Sockeye	2	0.01
Chum	22	0.18

Note: Summarized from TSD, Appendix C, Tables C-8 through C-10 (Ecology 2012b).

Commercial and tribal fishery data should also be summarized to provide a complete picture of Puget Sound salmon harvest. Table 2 summarizes Puget Sound-wide commercial and tribal fisheries data for the years 2000 to 2011 (PFMC 2012). Combined, pink and sockeye salmon constitute 85% of the catch. The relatively high catches of sockeye and pink salmon have been attributed to a heavy reliance on returns to the Frazier River (NRC 1996). The contribution of different runs to the total harvest is not summarized in the TSD (Ecology 2012b). Puget Sound is divided into nine marine fishing areas (Marine Areas 5 through 13), and WDFW collects data on commercial, tribal, and sport catches in each area. A summary of harvest data over several years for each area would provide insight into the contribution of more- and less-contaminated salmon stocks to harvest. In particular, such data could provide insight into the contribution of resident central and southern Puget Sound Chinook to the fishery.

Table 2. Year 2000 to 2011 average annual commercial net and troll salmon catches in the Strait of Juan de Fuca and Puget Sound

Species	Annual Average Catch (No. of Fish)	Percentage of Total Average Catch
Chinook	110,451	3
Coho	301,490	9
Pink	1,108,114	34
Sockeye	1,330,546	41
Chum	407,649	13

Source: PFMC (2012)

The data presented in Tables 1 and 2 provide a gross indication of the relative importance of the different salmon species to human consumers, and clearly indicate that Chinook salmon are a minority contributor to sport and commercial catch.

For specific consumer groups, such as tribes, salmon species-specific estimates for various consumer groups are not provided in the TSD. The fish consumption survey of the Suquamish Tribe (2000) provides some insight (Table 3). Based on this study, Chinook salmon constitute approximately 17% of catch by this tribe.

Table 3. Relative percentage of different salmon species consumed by adult members of the Suquamish Tribe

Salmon Consumed	Percentage of Diet
King (Chinook)	17.06
Sockeye	14.42
Coho	16.30
Chum	20.65
Pink	2.99
Other salmon/unspecified	13.57
Steelhead	8.70
Salmon at gatherings	6.31

Source: Suquamish Tribe (2000)

TSD Table 24 (Ecology 2012b) indicates that Puget Sound salmon constitute 72% of fish consumption for Squaxin tribal members. Assuming that Squaxin tribal consumers eat Chinook salmon in the same proportion as do Suquamish tribal members (i.e., 17% of salmon consumed), the inclusion of Chinook in the FCR would account for 12% of their overall exposure; whereas, 60% of their overall exposure from fish (i.e., the percentage contributed by other salmon) would be attributable to salmon from oceanic sources. Given that WQS may reduce resident Chinook body burdens by only two-fold (Hope

2012), WQS are unlikely to result in a significant decrease in potential exposure to hydrophobic compounds, such as PCBs, from the consumption of salmon.

CONCLUSION

The technical analysis presented above shows that WQS would have little effect on the concentrations of hydrophobic compounds, such as PCBs, in most returning adult salmon consumed by people and thus salmon consumption should not be included in the FCR for WQS. The one notable exception is resident Puget Sound Chinook salmon, which have a higher exposure within Washington waters because they grow to adult size in Puget Sound rather than in the Pacific Ocean. Hope (2012) estimates that WQS could reduce the concentrations in these resident species by less than approximately 2 times. Given these findings, the following is recommended:

- Consumption of salmon should not be included in site-specific consumption rates for sediment cleanup sites. Salmon are highly mobile species that accumulate contaminants primarily throughout their migration in marine waters. The attribution of contaminant uptake from specific locations cannot reliably be determined because of the large home ranges of these fish and the high variability in contaminant uptake patterns within stocks stemming from differences in diet, overwintering, and movement among individual fish.
- Consumption of salmon should not be included in FCR used in the derivation of WQS. Only one type of salmon, resident Chinook salmon, appears to accumulate a significant portion of its body burden from exposure to Washington waters. And although data regarding the type of salmon consumed by people in Washington State are limited, the consumption of Chinook salmon (including resident Chinook) ranges from 3 to 17% of total salmon consumption (Tables 1 through 3).

REFERENCES

Cullon DL, Yunker MB, Alleyne C, Dangerfield NJ, O'Neill S, Whiticar MJ, Ross PS. 2009. Persistent organic pollutamts in chinook salmon (*Oncorhynchus tshawytscha*): implications for resident killer whales of British Columbia and adjacent waters. Environ Toxicol Chem 28(1):148-161.

Ecology. 2012a. Draft sediment management standards (SMS) rule proposed amendments. Chapter 173-204 WAC. Review version, August 15, 2012. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

Ecology. 2012b. Supplemental information to support the fish consumption rates: technical support document. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

Ecology. 2012c. Technical issue paper: Salmon life history and contaminant body burdens. In: Supplemental information to support the fish consumption rates technical support document. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

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. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

Hope BK. 2012. Acquisition of polychlorinated biphenyls (PCBs) by Pacific Chinook salmon: an exploration of various exposure scenarios. Integr Environ Assess Manag 8(3):553-562.

Kelly BC, Gray SL, Ikonomou MG. 2007. Lipid reserve dynamics and magnification of persistent organic pollutants in spawning sockeye salmon (*Oncorhynchus nerka*) from the Fraser River, British Columbia. Environ Sci Tech 41(9):3083-3089.

Kissinger L. 2005. Application of data from an Asian and Pacific Islander (API) seafood consumption study to derive fish and shellfish consumption rates for risk assessment. Office of Environmental Assessment, US Environmental Protection Agency Region 10, Seattle, WA.

NRC. 1996. Upstream: salmon and society in the Pacific Northwest. Committe on Protection and Management of Pacific Northwest Anadromous Salmonids, National Research Council. Published by National Acadamies Press, Washington, DC.

O'Neill SM, Ylitalo GM, West JE, Bolton J, Sloan CA, Krahn MM. 2006. Regional patterns of persistent organic pollutants in five Pacific salmon species (*Oncorhynchus spp*) and their contributions to contamination levels in northern and southern resident killer whales (*Orcinus orca*). Extended abstract. 2006 Southern Resident Killer Whale Symposium, April 3-5. 2006, Seattle, WA. National Oceanic and Atmospheric Administration; Fisheries and Oceans Canada.

O'Neill SM, West JE. 2009. Marine distribution, life history traits, and the accumulation of polychlorinated biphenyls in Chinook salmon from Puget Sound, Washington. Trans Am Fish Soc 138:616-632.

O'Neill SM, West JE, Hoeman JC. 1998. Spatial trends in the concentration of polychlorinated biphenyls (PCBs) in chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) in Puget Sound and factors affecting PCB accumulation: Results from the Puget Sound Ambient Monitoring Program. Puget Sound Research '98:312-328.

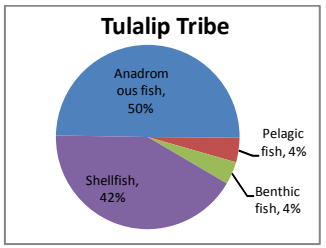
PFMC. 2012. Review of 2011 ocean salmon fisheries: Stock assessment and fishery evaluation document for the Pacific Coast Salmon Fishery Management Plan. Pacific Fishery Management Council, Portland, OR.

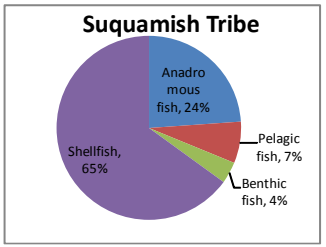
Quinn TP. 2005. The behavior and ecology of Pacific salmon and trout. American Fisheries Society in association with University of Washington Press, Seattle, WA.

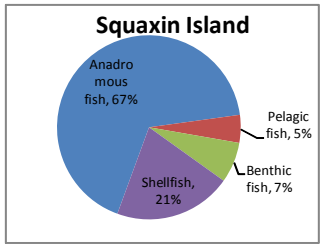
Suquamish Tribe. 2000. Fish consumption survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound region. The Suquamish Tribe, Suquamish, WA.

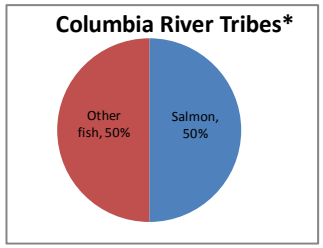
WDFW. 2002. Salmonid stock inventory (SaSI) 2002 [online]. Washington Department of Fish and Wildlife, Olympia, WA. [Cited May 2010.] Available from: http://wdfw.wa.gov/fish/sasi/.

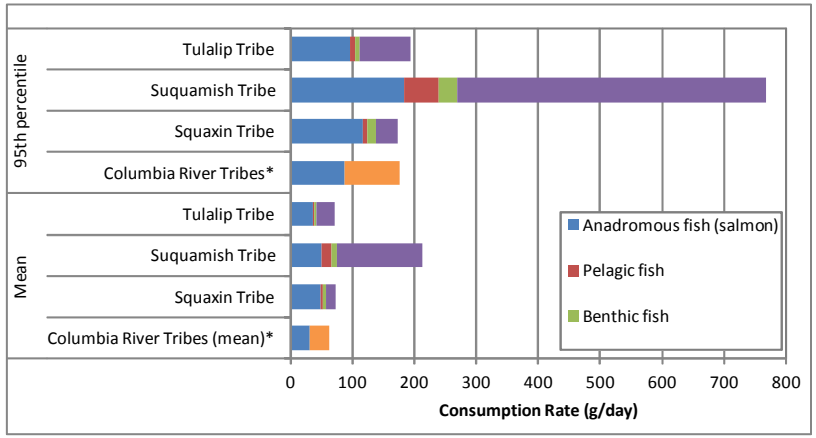
West JE, O'Neill SM, Ylitalo GM. 2008. Spatial extent, magnitude, and patterns of persistent organochlorine pollutants in Pacific herring (*Clupea pallasi*) populations in the Puget Sound (USA) and Straight of Georgia (Canada). Sci Tot Environ 394:369-378.











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Attachment 2: Tribal Consumption Rates Map

Prepared by craigh, 10/24/2012; W:\Projects\Boeing FCR Support\Data\GIS\5324 Tribal fish consumption.mxd

* For the Columbia River Tribes survey, respondents were not asked about shellfish consumption

ATTACHMENT 3

State Fish Consumption Rate Table

State	Default Fish Consumption Rate	Risk Level
Alabama	30 g/day	10^{-6}
Colorado	17.5 g/day	10^{-6}
Louisiana	6.5 g/day	10^{-6}
Maine	32.4 g/day	10^{-6}
Minnesota	30 g/day	10^{-5}
Montana	17.5 g/day	10^{-5}
North Carolina	17.5 g/day	10^{-6}
Oregon	175 g/day	10^{-6}
Vermont	6.5 g/day	10^{-6}