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CORPORATE HEADQUARTERS

October 26, 2012

SENT VIA EMAIL TO: fishconsumption@ecy.wa.gov
ORIGINAL TO FOLLOW VIE CERTIFIED MAIL #7009 0080 0001 0391 6303
RETURN RECEIPT REQUESTED

Mr. Ted Sturdevant
Director
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Dear Director Sturdevant:

The Department is seeking comments on *Fish Consumption Rates Technical Support Document* (version 2.0) as consideration is given to revising human health criteria found in the Surface Water Quality Standards (WAC 173-201A). The J.R. Simplot Company (Simplot) is a privately held agribusiness company with a number of operations in the State of Washington including: farming, beef cattle, potato processing, fertilizer distribution, fertilizer warehouses and a port facility. The human health criteria established as a part of the Surface Water Quality Standards are of direct interest to our operations in the State of Washington. After reviewing the Technical Support Document (TSD), Simplot has the following recommendations:

The State of Washington Should Conduct a State-Wide Fish Consumption Survey

The TSD discusses, with some detail, four studies (CRITFC, 1994; Toy et al. 1996; The Suquamish Tribe, 2000; and Sechena et al., 1999) which are focused on the fish consumption patterns of four sub-groups which have relatively high consumption rates. The TSD also reviews data from the National Health and Nutrition Examination Survey (NHANES) to estimate fish consumption rates for the general population of the State of Washington. As noted in the TSD, "Information about fish consumed by the general Washington population is available only through estimates."[1] Section 6 of the TSD discusses the following: the level of protection that should be provided in the revised standards (Section 6.8), the fish species to include when developing the standard (Sections 6.4 and 6.5) and several other factors the Department must consider when selecting the FCR. The Department does have flexibility in regards to level of protection used to establish a FCR. However, to properly do so, the Department not only needs data for high-consuming sub-populations but for the population in general. We believe

[1] Ecology. 2012, *Fish Consumption Rates Technical Support Document* (version 2.0) p.12.

that Ecology, as part of this rulemaking, should initiate a state-wide fish consumption survey.

FCR Studies Need to Have and Disclose Key Information

To accurately establish FCR a number of variables need to be accounted for such as:

- Origin of the fish (local fish vs. commercial fish);
- Type of fish: shellfish, finfish, marine, fresh-water, anadromous or non-anadromous; and
- Preparation method.

To accurately use such survey data, all data (including Tribal data) need to be available for the public and stakeholders to review. For example, one of the drawbacks of the CRITFC 1994 study was that certain data elements were not made available for public review. This limits the usefulness of the survey data particularly if the Department decides to use those data to estimate long-term fish consumption behavior.

Locally Caught, Non-Anadromous Freshwater Fish Should Be Used to Establish a FCR

Local, non-anadromous, freshwater fish are those that have been exposed to water conditions governed by the Washington Surface Water Quality Standards. The same is not true of marine fish, anadromous fish and shellfish. That is why conducting a state-wide general fish consumption survey, along with all data from all surveys being available for review are necessary to establish a technically sound FCR that is protective of the different fish consumption groups (sub-populations and general) in the State of Washington.

Attached are detailed comments on the TSD and further discussion of the recommendations.

We appreciate the opportunity to comment on the TSD. I can be reached at 208.389.7365 if you have any questions.

Sincerely,

Alan L. Prouty
Vice President
Environmental and Regulatory Affairs

C:
Association of Washington Business
Northwest Food Processors Association.
Northwest Pulp and Paper Association

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Review of the Fish Consumption Rates Technical Support Document: A Review of Data and Information about Fish Consumption in Washington

Public Review Draft
August 27, 2012
Version 2.0

Toxics Cleanup Program
Washington State Department of Ecology
Olympia, Washington

October 2012

ARCADIS

Review of the Fish Consumption Rates Technical Support Document: A Review of Data and Information about Fish Consumption in Washington

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1. Introduction

ARCADIS has reviewed the "Fish Consumption Rates Technical Support Document, A Review of Data and Information about Fish Consumption in Washington, Public Review Draft, August 27, 2012, Version 2.0" (TSD) prepared by the State of Washington Department of Ecology. Comments on select key findings are presented herein.

Before presenting those comments, some context is needed. The comments focus on the information presented in the TSD and not on how fish consumption rate (FCR) information could or should be used to derive statewide ambient water quality criteria (AWQC). The FCR is just one of many factors used in deriving an AWQC. All the factors need to be viewed in combination to assure that the appropriate and desired level of protectiveness is achieved by the AWQC. Indeed, perhaps the most important decision that needs to be made in setting a statewide AWQC is the level of protectiveness associated with the AWQC and how that varies between the general population and more highly exposed subpopulations. Because those other factors have not yet been identified by the State of Washington, nor does the TSD recommend a specific FCR for derivation of an AWQC, it is not possible to comment on whether any one of the several specific FCRs presented and discussed in the TSD is more or less appropriate for the derivation of a statewide AWQC. Thus, these comments focus on the technical basis of the FCRs presented in the TSD and limitations of those FCRs in the derivation of a statewide AWQC for the State of Washington.

2. General Comments

Several general observations about the FCRs discussed in the TSD are presented first. Some of these comments arise only a few times in the TSD and others occur repeatedly. In the interest of brevity, neither the general nor the specific comments (which are presented after the general comments) identify every instance in the TSD where a particular comment may be relevant.

2.1 Fish Consumption Rate for the General Population of Washington State

The TSD notes on page 41 of Section 4, "Currently, there are no fish dietary data available for the general fish-consuming populations in Washington State." Given that one of the key goals of an AWQC is to ensure the general population of Washington State is adequately protected, and given all of the uncertainties and limitations discussed in Section 4, including the use of short-term national fish consumption data

to establish long-term regional FCRs, the State of Washington should conduct a state-wide FCR survey. Such a survey could be designed to collect the information necessary to understand the various sources of fish its residents consume, as well as how to extrapolate short-term FCR information to long-term fish consumption rates appropriate for a statewide AWQC representative of and protective of lifetime exposures.

2.2 Using Short-Term Data to Estimate Long-Term Exposure

All the surveys reviewed by the TSD are based upon relatively short-term dietary surveys (generally one or a few days to a few weeks in duration). The data from those surveys are then used to establish FCRs, or a distribution of FCRs, representative of a lifetime of fish consumption.

As the TSD correctly recognizes, short-term dietary data are not representative of the fish consumption behavior of people in the lower and upper tails of the distribution of the population. For the reasons described on pages 84 and 85 of the TSD as well as in the technical issue paper "Estimating Annual Fish Consumption Rates Using Data from Short-Term Surveys," this is a critical consideration. The State of Washington is to be commended for including discussion about the importance of short-term to long-term extrapolation in the TSD and for pointing out the substantial effect this may have on FCRs based only upon short-term data. Comparison of Tables 18 and 19 of the TSD indicates that when long-term FCRs are extrapolated from short-term FCR data, directly accounting for some of the limitations of short-term dietary surveys, the estimated FCRs drop by 3- to nearly 10-fold depending upon type of fish (i.e., all fish, finfish, shellfish). The lower long-term FCR appears to be consistent throughout the distribution of FCRs. In other words, the mean, median and upper percentiles of the long-term FCR distribution are all lower than the corresponding statistical metrics of the short-term FCR distribution.

Surprisingly, however, after clearly demonstrating the importance of accounting for the limitations of short-term data to extrapolate to long-term behaviors for the general population using the national U.S. Environmental Protection Agency (USEPA) survey results, the TSD does not go on to adjust the FCRs developed by the regional Tribal surveys (see also the specific comment 3.8 below) . The Tribal surveys are also based upon relatively short-term dietary surveys. Therefore, the FCRs resulting from those surveys also need to be adjusted to better reflect long-term fish consumption behavior and are not appropriate to use directly in the setting of a statewide AWQC. If the information necessary to appropriately extrapolate short-term to long-term FCR

information is not available for the Tribal surveys, then such information needs to be developed prior to use of the Tribal survey data in a statewide AWQC.

2.3 The Distinction between Consumers and Non-Consumers

Throughout the TSD, reference is made to consumers and non-consumers. Fish (both finfish and shellfish) are a widely consumed dietary item. On page 13, the TSD indicates that only about 28% of adults living in the state of Washington are assumed to currently eat fish. This percentage is based upon a relatively short duration national U.S. Department of Agriculture (USDA) survey (two non-consecutive 24-hour periods separated by between 3 and 10 days, page 40 of the TSD). As discussed above, and noted several times in the TSD, short-term dietary surveys are not representative of long-term dietary behaviors. Most AWQC are designed to be protective of a lifetime of fish consumption, not behaviors that occur over the period of a week, a month, or even a year. Just because a person who responds to a one-day or one-week dietary recall survey indicates that he or she did not eat any fish in the past day or week, does not mean that he or she does not eat any fish. Yet, based on his or her response to the short time interval survey, he or she would be categorized as a non-consumer. For many, if not most, people such a categorization would be incorrect. When viewed over a year, and especially a lifetime, the vast majority of people likely eat some fish.

The repeated discussions in the TSD that refer to consumers and non-consumers need to be revised to better reflect the shortcomings and uncertainty associated with this dichotomy. Further, in those discussions the TSD should make clear how the consumer versus non-consumer classification was created and the uncertainties associated with it. In particular, Section 6.6, which discusses the distinction between "consumer versus per capita" FCRs, needs to be substantially revised to account for the likelihood that the distinction between consumers and non-consumers may largely be a false dichotomy when fish consumption is viewed over a lifetime.

2.4 Source of Fish

In several places, the TSD discusses the proportion of total fish consumed that is comprised of locally caught fish. As noted above, these comments do not discuss whether an FCR should include only locally caught fish (i.e., only those fish that are potentially affected by changes in AWQC adopted by Washington State) or be based on an FCR that includes all fish. The selection of one of those FCRs, or an FCR that is some combination of local and non-local fish, is affected by the selection of all the parameters used to derive the AWQC, and discussion regarding that selection process

should occur at the time of the derivation of the AWQC. That said, the TSD would be greatly improved by clearly discussing and presenting FCRs that are based upon total fish consumption and also FCRs that represent only consumption of locally caught fish. Understanding the difference between these two sets of FCRs will be critical when developing statewide AWQC because it is only the locally caught fish that have potential to be affected by chemicals in waters of the State of Washington. The concentration of chemicals in fish from other sources will not be affected by AWQC set by Washington State.

Additionally, marine, shellfish, and freshwater fish consumption rates can vary significantly, and these differences should be addressed in the development of AWQC. Specifically, consumption rates for marine finfish and shellfish are generally higher than those for freshwater fish, and the majority of finfish consumed by Americans are marine species (USEPA 2000). USEPA (2000) recommends that FCRs used to develop AWQC be based only on consumption of freshwater/estuarine species and that consumption of marine species be accounted for as an alternative source of exposure in the relative source contribution (RSC; used in derivation of AWQC) to avoid double-counting consumption. Notably, USEPA has classified salmon as a marine species (USEPA 2000). This is important because coastal state consumption includes marine species that would not necessarily be affected by releases to surface waters governed by AWQC. As such, as part of the TSD discussion it would be helpful to distinguish between fish harvested from fresh waters of Washington versus coastal waters. Fish caught from the former, with the exception of most anadromous fish, are likely to have concentrations of chemicals consistent with AWQC while fish caught from coastal waters where much greater dilution is present are not likely to have concentrations of chemicals consistent with AWQC.

Given that the vast majority of commercially landed fish (Table 3), recreationally caught fish (Table 4), and recreationally caught shellfish (Table 5) are from coastal or ocean waters and are unlikely to be affected by changes in the AWQC, the TSD should present FCRs for fish actually caught from fresh waters of Washington State. The consumption rate of such fish is likely to be substantially lower than the FCRs currently presented in the TSD. Moreover, while the TSD does make a distinction between FCRs for anadromous and non-anadromous fish in several places, to truly understand the consumption rate of non-anadromous fish caught from fresh waters (i.e., fish whose body burden of chemicals is most likely to be affected by changes in the AWQC), the TSD should include and discuss FCRs that represent consumption of only non-anadromous, locally caught, freshwater fish.

3. Specific Comments

This section provides specific comments on selected portions of the TSD. The comments are presented in the order that they arise in the TSD. As noted above, some of the issues discussed by the general comments arise repeatedly in the TSD. In order to keep these comments relatively brief, specific comments presented below do not identify each instance in the TSD where a particular general comment is applicable. The same is true for the specific comments; some of the issues addressed by a specific comment also arise repeatedly in the TSD and are only discussed a single time.

3.1 Change in the Size of the Population of Washington State

Section 2.3 of the TSD discusses the current size of the population of Washington State and the expected increase in the next 20 years. The purpose of the discussion of the change in population needs to be clarified and probably would be best linked with a discussion of the expected changes in the availability of fisheries resources. If the purpose of the discussion in Section 2.3 is to point out that ever more people will be eating fish at the FCRs described later in the TSD, such an assumption hinges on a concomitant increase in the productivity of fisheries resources. It's unclear if the harvest of naturally occurring fisheries resources (i.e. wild fish and shellfish) can be expected to increase at such a rate.

Alternatively, the purpose of the discussion could be to point out that the sustainable productivity of fisheries resources is currently at or near its maximum and that FCRs of fish harvested in Washington are likely to decrease in the future. A decrease in FCRs would be expected if the increase in population of 27% (between 2010 and 2030) is not matched by a similar increase in fishery resource productivity. In such a case, the FCRs listed in the TSD would not be representative of long-term fish consumption rates. Indeed, if extrapolated to expected population growth over the next 70 years, it may well be that use of the FCRs reported in the TSD in the derivation of statewide AWQC would overestimate potential fish consumption exposures by far more than just 27%. The TSD needs to discuss the potential effects of expected population growth on the FCRs reported from existing dietary surveys and how such FCRs should be adjusted prior to use in a statewide AWQC.

3.2 Custody of Tribal Fish Dietary Survey Data

The TSD points out (pages 34 and 35) that the Tribes generally do not share their detailed FCR data. If the State of Washington decides to use Tribal data to establish a statewide AWQC, then those data need to be made available to all interested parties. If the State were to commission a statewide fish consumption survey, we expect that all of those data would be made available to the general public. The same disclosure expectation should be applied to all FCR data (i.e., Tribal data, or data developed by other stakeholders).

3.3 Review of Recommended Subpopulation Fish Surveys

The fish consumption studies of high consuming subpopulations identified in the TSD (i.e., CRITFC 1994, Toy et al. 1996, The Suquamish Tribe 2000, Sechena et al. 1999) are not appropriate for setting statewide AWQC without additional evaluation of the data. Key aspects of each of the surveys are briefly reviewed below followed by a summary of the reasons why the surveys, as currently described in the TSD, are not appropriate for setting a statewide AWQC.

The four dietary recall surveys of subpopulations identified in the TSD were selected by Washington Ecology because they met measures of technical defensibility and contained data directly applicable to Washington populations groups. The Columbia River Inter-Tribal Fish Commission (CRITFC) Consumption Survey (1994) was conducted in 1991/1992 and was based on a relatively large sample size (n = 513 adults and 204 children) comprised of four tribes. Uncertainty associated with this study concerns the origin of consumed seafood, i.e., locally harvested or commercial source(s). The survey questionnaire asked the respondent to identify what percentage of fish consumed is locally harvested versus obtained from a commercial source (e.g., supermarket). The questionnaire did not ask for locally harvested percentages for individual fish groupings (e.g., anadromous, non-anadromous). The survey results indicated that 88% of fish is from the Columbia River system. This 88% was then applied to the derivation of FCRs for all species groups including all finfish, non-anadromous fish, and anadromous fish (95th percentile FCRs were 171 g/day, 87.9 g/day, and 82.8 g/day, respectively; Table 21 of TSD). Use of the 88% locally harvested fraction in the derivation of FCRs may overestimate actual percentages for each species group. The weighted mean consumers only FCR for adults was 63.2 g/day, which would decrease to 40 g/day if contribution of salmon to Tribal diets (50%) was considered. Also, this survey was conducted in 1991/1992 and as such, may not reflect current conditions.

The *Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region* (Toy et al. 1996) was conducted in 1994 with a sample size of 190 adults and 69 children. This survey identified a number of unusually high consumption rates. These elevated consumption rates were treated as outliers and surrogate values equal to the mean consumption rate plus three standard deviations were used to replace outlier consumption rates prior to the calculation of FCRs. (Note that the presence of outlier data may represent an overall bias in the results of this survey; a bias that remains uncorrected for all of the non-outlier data that the FCRs for the Tulalip and Squaxin Island Tribes reported in the TSD rely upon.) Resulting Tulalip Tribal FCRs (95th percentiles) for locally harvested finfish, non-anadromous fish, and anadromous fish from Puget Sound were 146 g/day, 145 g/day, and 148 g/day, respectively (means = 31.9, 35.5, and 30.4 g/day, respectively). Resulting Squaxin Island Tribal FCRs (95th percentiles) for locally harvested finfish, non-anadromous fish, and anadromous fish from Puget Sound were 143 g/day, 41.2 g/day, and 137 g/day, respectively (means = 45.0, 12.3, and 44.1 g/day, respectively). This study indicates that consumption rates were adjusted for individual body weight, which may skew resulting statistics for "average" consumption. For example, if a person consumes 1 gram of fish per day annually and that person's body weight is 70 kilograms, then the resulting FCR would be 0.014 g/kg/day (365 servings x 1 gram portion/365 days x 70 kg body weight). Likewise, if a person consumes 1 gram of fish per day and that person's weight is 87 kilograms, then the resulting FCR would be 0.011 g/kg/day. Other studies (i.e., Suquamish Tribe 2000; discussed below) have indicated no correlation between consumption rate and body weight. Therefore, adjusted consumption rates for body weight may lead to an overestimation or underestimation of FCRs. USEPA (2000) recommends using a default body weight of 70 kg for calculating AWQC. This is consistent with the methodology used to derive cancer slope factors and maintains consistency between the dose-response relationship and exposure factors (USEPA 2000). The age of the survey (1994) calls into question the applicability of these data with regards to current conditions.

The *Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region* (The Suquamish Tribe 2000) was conducted in 1998 and had a sample size of 92 adults and 31 children. Similar to the CRITFC (1994) study, this survey consisted of a 24-hour dietary recall. Survey timing coincided with Tribal participation in finfish and shellfish fisheries for subsistence, ceremonial, and commercial purposes (i.e., times of year when consumption would be expected to be high). Interestingly though, even during this time, 55% of respondents reported no seafood consumption the day before the interview. Consumption rates were computed for "in season" and "during the rest of the year" separately, and the sum of these two

time periods yielded an annual consumption rate. Consumption weights were standardized by body weights although the amount of fish consumed and body weight did not show a statistically significant relationship. In fact, the report states "Given that body weight may not play a particular role in consumption, the body weight should be carefully selected as a factor if the consumption rate per unit body weight reported in this survey is converted to total consumption for risk assessment or other purposes" (page 71). The FCRs derived from this study also incorporated salmon, which was the most commonly consumed finfish. Another uncertainty associated with this study is that up to three children from the same home could be included in the survey so long as they resided in the same home as an adult respondent. This may skew the child FCRs. It is unclear from the study if the consumption data for children were weighted to circumvent possible bias in the dataset. Similar to the two studies described above, data generated from this survey may not reflect current conditions.

The Asian and Pacific Islander (API) Seafood Consumption Study (Sechena et al. 1999) focused on ten API groups in King County, Washington (n = 202 respondents), which make up roughly 10% of Washington's total population. The proportion of seafood harvested by API ranged from a low of 3% to a high of 21%, indicating that the majority of API's seafood comes from commercial sources. Overall, the harvested portion of fish consumed by API accounted for less than one-fourth of the total consumption, but resulting FCRs do not account for this nor do they adjust for inclusion of anadromous fish such as salmon. Similar to CRITFC (1994) and Suquamish Tribe (2000) surveys, the resulting FCRs from this study were adjusted for the respondent's body weight, which may bias reported FCRs. A number of respondents reported unusually large consumption rates and these identified outlier consumption rates were replaced with surrogate values equal to the mean plus 3 standard deviations prior to calculation of FCRs. Data generated from this survey may not reflect current conditions. As noted above for the Tulalip and Squaxin Island Tribes survey, the survey protocol that led to the presence of data may represent an overall bias in the protocol of the survey that affects all reported FCRs, not just the highest that were judged to be outliers. Lastly, because the survey was conducted more than a decade ago, the results may not represent current conditions.

The key findings of the review of these four studies that suggest the data developed by the studies may not be appropriate for deriving FCRs for use in a statewide AWQC include:

- These studies target specific subpopulations and are not applicable to the general population.

- Many of these FCRs incorporate data for anadromous fish whose chemical concentration likely does not reflect the concentration of chemicals in the water from which they are caught and to which AWQC would be applied; .

- Several of these FCRs were adjusted for respondent body weight, which may bias resulting FCRs.

- Many of these FCRs do not consider the contribution of non-local sources of fish (e.g., outside Washington State) to the reported FCRs.

- All of these surveys are based on relatively short recall periods and, therefore, likely do not reflect long-term (i.e., lifetime) fish consumption behavior. As indicated in the TSD, when FCRs based on short-term recall data are adjusted to reflect longer term consumption, the FCRs decrease substantially.

- All of these surveys are more than 10 years old and some are now more than 20 years old. The age of these surveys would not represent current conditions if fish consumption behaviors have changed over the past one to two decades.

3.4 Loss of Weight during Cooking

On pages 66 and 67, the TSD presents FCRs that are adjusted for the assumed decrease of weight of fish during cooking. While the increase in FCR after adjustment for cooking loss is relatively minor, this is an excellent example of an assumption/adjustment that needs to be considered together with all the other assumptions used to derive an AWQC. In many cases, regulatory agencies do not consider the decrease in chemical concentrations associated with cooking of fish, even though such decreases are well established for certain classes of chemicals (i.e., chlorinated organic compounds). If, when deriving the AWQC, Washington State decides to include the change in weight of fish associated with cooking, then it should also include the change in chemical concentration associated with cooking of fish.

3.5 National Consumption Surveys May Underestimate Coastal State Consumption Rates

The first key finding on page 71 indicates that national survey data may underestimate fish consumption in coastal states because such states have large fish resources available for harvest and consumption. While that may be true for total fish consumption, as noted above in the general comments, a great deal of the fish caught in coastal states may be from coastal and ocean waters that are not affected by

changes in the AWQC and, therefore, fish from such waters may not be appropriate to include in the FCR used to establish the AWQC.

3.6 Food Frequency Questionnaire

On page 81, the TSD mentions the value of a food frequency questionnaire in improving the confidence of calculating the upper percentiles of the FCR distribution. The TSD should be revised to point out how many of the surveys reviewed therein included a food frequency questionnaire and, if not part of a particular survey, whether collected information was commensurate with that provided by a food frequency questionnaire. This should be included as an additional criterion in determining the quality of available fish consumption surveys.

3.7 Extrapolation of FCRs between Subpopulations and Water Bodies

The subpopulations evaluated by the studies reviewed above are typically small communities that consume fish from specific areas or water bodies (e.g., Puget Sound, Lake Coeur D'Alene, Columbia River). Their consumption rates are often directly related to the availability and abundance of specific, desirable species of fish. As described in Section 5.2.2, the TSD assumes these consumption rates are transferable to other areas of Washington State and that individuals will simply substitute other species if the preferred species is not available. This is likely to result in an overestimate of FCRs for individuals outside of these communities where the preferred and desirable fish and shellfish may either not be available or be less accessible. As noted in Section 6.3, considerable variation exists in the amount of fish and shellfish consumed throughout the state based on the characteristics of the water bodies and the types of fish available. For example, to assume that the rate of salmon consumed by Tribal members living in close proximity to Puget Sound is transferable to an individual primarily consuming fish caught from smaller inland rivers or ponds is unrealistic.

3.8 Estimating Lifetime Consumption Rates and Concept of "Regression to the Mean"

Upper percentile estimates of fish consumption rates are often used in risk-based models in order to establish conservative levels of protection for exposed populations. As discussed in the TSD, the approach of using short-term dietary surveys to characterize long-term consumption behavior works well when the arithmetic mean consumption rates are used. However, short-term survey results have been shown to overestimate the upper percentiles of FCR distributions compared to actual long-term

consumption rates. USEPA acknowledges this in its *Exposure Factors Handbook* (USEPA 2011) and states that "the distribution of average daily intake rates generated using short-term data (e.g., 2-day) does not necessarily reflect the long-term distribution of average daily intake rates. The distributions generated from short-term and long-term data will differ to the extent that each individual's intake varies from day to day; the distributions will be similar to the extent that individuals' intakes are constant from day to day."

The term "regression to the mean" (page 85) refers to the phenomenon by which high variability over the short-term tends to decrease over the long-term. While the underlying *population* mean is generally revealed by short-term data, the distribution generally is not—it is only over the long term that each *individual's* consumption habits approach an underlying mean and thus reduce the overall variability for the population. The Department of Ecology provides an example in the technical issue paper *Estimating Annual Fish Consumption Rates Using Data from Short-Term Surveys* (Ecology 2012) in which the 95th percentile intake rates collected by Mertz and Kelsay (1984) were 87.7 g/day over a 7-day period and 51.1 g/day over a 365-day period. The short-term survey results therefore overstated long-term rates by 72%. Similarly, the TSD presents two sets of consumption rates derived for the general population of Washington State. Both sets are based on 2003-2006 National Health and Nutrition Examination Survey (NHANES) data; one set is derived using the methodology outlined by USEPA's *Exposure Factors Handbook* (Table 18 of the TSD), and the other set of lower long-term FCRs is derived using the National Cancer Institute (NCI) statistical methodology developed by Tooze et al. (2006; Table 19 of the TSD). Moreover, if the consumption rates were further extrapolated to a lifetime (i.e., 70 or 80 years), which is the exposure duration assumed by most AWQC, and not just a 365-day consumption rate, the FCR would likely be further reduced from the 51.1 g/day reported for 365 days, though the exact amount of the additional reduction in FCR is unknown currently.

Short-term dietary survey data are also used to distinguish consumers from non-consumers. The USEPA methodology defines "consumers" as those respondents who ate fish on one or both dietary recall days. It draws in survey data only from those respondents, calculating their daily consumption rate as their total intake over the two days divided by two. However, as discussed by Polissar et al. (2012), this approach tends to "underestimate the number of consumers and overestimate consumption rates." Statistically, individuals who are frequent fish consumers are much more likely to have consumed fish on one or both dietary recall days. Therefore, data for infrequent consumers—individuals who are likely to have been non-consumers on both

recall days—are excluded from analysis, deflating the resulting consumer count. Furthermore, given that there may be a correlation between consumption frequency and consumption amount (i.e. individuals who frequently consume certain foods are likely to do so in larger amounts) (Tooze et al. 2006), the resulting consumption rates are likely to be positively skewed.

The NCI methodology outlined by Tooze and others accounts for several of the factors that tend to overestimate the upper percentile consumption rates when extrapolating from short-term dietary survey data. The NCI methodology has a more inclusive definition of "consumers"—respondents were excluded only if they indicated on their food frequency questionnaire that they never consume fish (regardless of whether they actually consumed fish on the two dietary recall days). The NCI statistical model incorporates within-person daily variability in fish consumption as well as the positive correlation between consumption frequency and amount.

Polissar et al. (2012) states that the consumption rates derived using the NCI methodology are based on realistic assumptions and have been demonstrated to well approximate "true" consumption rates, particularly at the upper percentiles of the distribution. Polissar also states that while the consumption rates derived using the NCI methodology are considerably more accurate than those derived using the USEPA methodology, "there will always be some demand for rates that are not based on modeling, no matter how realistic the modeling is. For this reason in this report the rates calculated by the NCI method are presented along with the rates calculated by the method used in the Exposure Factors Handbook." This is a key point, and one that appears to be missing from the TSD. The TSD presents the results of the USEPA methodology first, followed by the results of the NCI methodology, which are simply described as a secondary "reevaluation" of the NHANES data. The executive summary indicates that the NCI methodology was applied in order to "better estimate long-term consumption rates using short-term dietary records." However, the substantial improvement in accuracy and representativeness of actual fish consumption behavior that is obtained using the NCI methodology is not sufficiently emphasized. As noted above in the general comments, the TSD should be revised to include expanded discussion of the importance and effect of appropriate extrapolation of short-term FCRs (from both general population and Tribal surveys) to long-term consumption behavior prior to consideration in a statewide AWQC.

3.9 Characterizing and Estimating the Number of People Exposed

In Section 6.2, the TSD correctly notes that the selection of a summary measure to characterize population exposure reflects a policy choice on the appropriate balance between over and underestimating exposure levels. However, the TSD incorrectly refers to the mean Tribal fish consumption rates as representative of the "middle of the distribution". While those FCRs may represent the mean of the Tribal subpopulation, they reflect the upper bound of the general population. As previously noted, the most important decision that needs to be made in setting an AWQC is the level of protectiveness to be achieved. When making that decision, reliance primarily on data representative of small populations of high end consumers represents a policy choice to overestimate exposure to the majority of individuals.

3.10 Historic vs. Current Consumption Patterns

Additionally, on page 87 the TSD states that "While, historically fish provided the main source of dietary protein, this is true today for only a small subset of the Tribal population." This raises a series of questions about how many Tribal members are represented by the Tribal FCRs presented in the TSD. Specifically, how many Tribal members, on a statewide basis, actually consume fish and shellfish at the consumption rates in the TSD? How have those consumption rates changed in the past 20 years? And, how are consumption rates expected to change in the future? The discussion in the TSD should be expanded to include these data about potentially exposed subpopulations. Such information should provide important perspective about levels of protection and the number of people potentially exposed when Washington State begins the process of selecting an FCR for a statewide AWQC.

3.11 Summary of FCRs

The TSD indicates that Table 33 presents "credible" FCR information. For all the reasons stated above, most of the FCRs shown in this table are not representative of long-term fish consumption behavior. This is especially true for the Tribal FCRs which represent FCRs based on short-term fish consumption behavior and have not been adjusted to reflect long-term behavior. Further, Table 33 presents the FCRs for all finfish and shellfish. The TSD needs to be revised to present parallel summary tables of: (1) FCRs representing consumption of fish harvested only from waters of Washington State; (2) fish harvested only from fresh waters of Washington State; and (3) only non-anadromous fish harvested from fresh waters of Washington State. The

latter FCRs would be most representative of the concentrations of chemicals in fish most affected by changes in a statewide AWQC.

4. Biographies

Dr. Paul Anderson is a Vice President and Principal Scientist at ARCADIS and is also an adjunct professor in the Center for Energy and Environmental Studies within Boston University's Geography Department. Dr. Anderson has over 28 years of experience in human health and ecological risk assessment. Dr. Anderson received his B.A. in biology from Boston University in 1978, his M.A in biology from Harvard University in 1981 and his Ph. D. in biology from Harvard University in 1983. He was a postdoctoral fellow in the Interdisciplinary Programs in Health at the Harvard School of Public Health from 1983 until 1986. Dr. Anderson has performed numerous multimedia, multichemical and multipathway risk assessments for federal and state superfund sites throughout the United States including operating and abandoned chemical and manufacturing facilities, landfills, former wood treating sites, and pulp and paper mills. Dr. Anderson has, on a regular basis, been called upon to review proposed State and Federal regulatory initiatives by a variety of organizations. Dr. Anderson has reviewed and provided comment on general human health and ecological risk assessment guidance, on proposed toxicity factors for several chemicals, on proposed criteria for specific chemicals, on the Great Lakes water quality guidance, and on proposed methods to develop ambient water quality criteria including states in the southeast, mid-Atlantic, northeast, mid-west and northwest. Dr. Anderson has managed the development of a watershed based model that predicts environmental concentrations of pharmaceuticals and related compounds in United States surface waters and overseen a database containing all the information available in the peer-reviewed literature on the aquatic toxicity, fate and removal of active pharmaceuticals ingredients in surface waters. Dr. Anderson is a leading advocate of advanced risk assessment techniques such as Monte Carlo analysis, has written over 30 papers and lectured widely on ecological and human health risk assessment, and has testified throughout the United States on the potential risks posed by dioxin and other chemicals.

Ms. Nancy Bonnevie has more than 20 years of experience in ecological and human health risk assessment. An environmental scientist specializing in aquatic ecology and sediment quality evaluations, she has effectively managed teams on tasks ranging from preliminary site characterizations to multi-tasked field sampling programs, ecological risk evaluations and environmental impact statements. Ms. Bonnevie participated in the development of the ecological risk guidance for the American Society of Testing and Materials (ASTM) and has served as a peer-reviewer for

Environmental Toxicology and Chemistry on issues related to ecological risk assessment and sediment quality evaluations. She has designed and implemented a wide variety of field studies including sediment and surface water quality evaluations, benthic community analyses, and habitat assessments. In support of these investigations, she has critically evaluated varying approaches for deriving site-specific sediment quality criteria. In addition to her demonstrated expertise in the evaluation of risks to ecological communities, Ms. Bonnevie also has experience in human risk assessment. She has participated in the development and implementation of several fish consumption surveys, and has conducted numerous evaluations focusing on potential risks posed by consumption of fish and shellfish.

Ms. Serese Marotta has more than 13 years of experience in human health and ecological risk assessment. Ms. Marotta has managed numerous complex, multipathway human health risk assessments for project sites in the Midwest and eastern United States under the CERCLA and RCRA programs, many of which involved an evaluation of the fish consumption pathway and calculation of site-specific sediment cleanup goals. In addition, Ms. Marotta has also managed ecological risk assessments that involved site-specific biological studies and consideration of food chain exposures to higher trophic-level terrestrial and aquatic fauna.

Ms. Michele Buonanduci received her B.A. in environmental science from Boston University. Ms. Buonanduci is a Scientist at ARCADIS with experience supporting both human health and ecological risk assessments.

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