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CORPORATE HEADQUARTERS

November 7, 2012

SENT VIA EMAIL TO: paula.wilson@deq.idaho.gov
SENT VIA CERTIFIED MAIL #7009 0080 0001 0391 6389
RETURN RECEIPT REQUESTED

Ms. Paula Wilson
Idaho Department of Environmental Quality
1410 North Hilton
Boise, ID 83706

Dear Ms. Wilson:

The Department, at the October 4, 2012 rulemaking meeting on Fish Consumption Rates (FCR), asked for comments in regards to six studies that the Department identified as warranting review for this rulemaking. The J.R. Simplot Company (Simplot) retained ARCADIS Inc. to review these studies so as to determine the suitability of these studies in the Idaho rulemaking.

As detailed in the attached document, each of the six studies has a number of technical aspects that limit the use or applicability of the study results to the Idaho rulemaking. Examples include:

- There was no study that looked at specific fish consumption rates for either the general population or specific sub-populations in Idaho.
- The majority of the studies are focused on specific sub-populations that are from coastal states; thus the consumption of fish from marine sources is likely higher than that of a non-coastal state such as Idaho.
- Data are missing that allow determination of consumption of locally caught, non-anadromous species.
- Many of the studies include consumption of anadromous fish whose chemical concentrations likely do not reflect the concentration of chemicals in the water from which they are caught and to which Idaho-specific water quality standards would be applied.

We recommend that Idaho move forward with a state-specific fish consumption rate study. Appendix A in the attached document provides recommendations for the elements of such a study.

Please contact me if you have any questions about these comments.

Sincerely,

Alan L. Prouty
Vice President
Environmental & Regulatory Affairs

Attachment

C:
Association of Washington Business
Idaho Association of Commerce and Industry
Idaho Mining Association
Northwest Food Processors Association
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Review of Fish Consumption Surveys for Ambient Water Quality Criteria Rulemaking in Idaho

November 2012

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Review of Fish Consumption Surveys for Ambient Water Quality Criteria Rulemaking in Idaho

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1. Introduction

ARCADIS has conducted a technical review of the six fish consumption surveys identified by the Idaho Department of Environmental Quality (IDEQ 2012) as potentially being of sufficient quality to establish a statewide fish consumption rate (FCR) that could be used in the derivation of statewide ambient water quality criteria (AWQC). For reasons described herein, these surveys do not adequately reflect consumption patterns for the general population of, or specific subpopulations within, the State of Idaho. Several recurring themes in these surveys suggest the data may not be appropriate for deriving FCRs for use in statewide AWQC. These are summarized below and then described in more detail in the remainder of this report.

- With the exception of U.S. Environmental Protection Agency (USEPA 2002), which is a national survey and, therefore, specific to neither Idaho nor the Northwest, these studies target specific subpopulations and are not applicable to the general population of Idaho.
- Many of these studies include consumption of anadromous fish whose chemical concentrations likely do not reflect the concentration of chemicals in the water from which they are caught and to which Idaho-specific AWQC would be applied.
- Many of these studies report FCRs that include non-local sources of fish (e.g., not caught from the waters fished by the survey respondents) and do not provide the information needed to develop an FCR that represents consumption of locally caught, non-anadromous species.
- Most of these surveys are based on relatively short recall periods and, therefore, do not reflect long-term (i.e., lifetime) consumption patterns.
- Several of these studies did not collect the information needed to extrapolate results of short recall surveys into long-term (lifetime) fish consumption rates as would be needed for an AWQC designed to protect the population of Idaho from long-term (i.e., chronic) exposures.
- The distinction of “consumers” and “non-consumers” in some of these studies may bias resulting FCRs.
- Several of these FCRs were adjusted for body weight, which may bias resulting FCRs.
- Several of these surveys are more than 10 to 20 years old and may not represent current fish consumption patterns.

2. Technical Review of Fish Consumption Surveys

The IDEQ (2012) identified several survey components that should be considered when choosing a regulatory FCR. These survey quality factors include type of survey; method of reporting; quality assurance/quality control (QA/QC) procedures; representativeness of target population; seasonality; information on fish species, source, and preparation; and peer review. Six surveys were identified by Idaho as scoring a 10 or better in IDEQ’s quality review (IDEQ 2012). In addition to these factors, the relevance of

a study for the derivation of an FCR for Idaho increases if the study included respondents living in Idaho, was focused on a state with similar characteristics as Idaho (e.g., an inland as opposed to a coastal state), and developed information required to extrapolate short recall data to long-term fish consumption rates. The following presents a technical review of these six surveys including an identification of key features and uncertainties. Surveys are discussed in descending order based on IDEQ (2012) quality scores.

2.1 Columbia River Inter-Tribal Fish Commission Consumption Survey, 1994

The Columbia River Inter-Tribal Fish Commission Consumption Survey (CRITFC 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 representing the States of Washington, Oregon and Idaho. The study design was a 24-hour dietary recall and personal interview survey that was developed by the CRITFC in collaboration with the Washington Department of Health (DOH), USEPA, and USEPA Region 10. Uncertainties associated with this study concern the origin of consumed seafood, i.e., locally harvested or commercial source(s) and the extrapolation of short-term data to long-term consumption patterns. 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). However, 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. 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 grams per day (g/day), which would decrease to 40 g/day if contribution of salmon to Tribal diets (50%) was considered. This survey was conducted in 1991/1992 and, being 20 years old, may not reflect current fish consumption patterns. Further, because data were pooled for all four tribes, FCRs may not reflect consumption patterns observed solely in Idaho populations. In summary, the major uncertainties associated with this survey include: 1) the lack of species-specific information on the source of the fish consumed; 2) failure to extrapolate short-term recall data to long-term (i.e., lifetime) consumption patterns; 3) the combination of data across four tribes, some of which were located outside Idaho; and 4) the age of the survey.

2.2 Lummi Nation Seafood Consumption Study, 2012

The Lummi Nation Seafood Consumption Survey (Lummi 2012) was conducted between May 2011 and March 2012, and was based on a relatively small sample size (*n* = 82 adult males) specifically targeted to represent high-end consumers within the Lummi Nation, which is in close proximity to Puget Sound, from the State of Washington. Thus, it does not even reflect the consumption pattern of all the members of the Lummi Nation. The study design was a long-term dietary recall interview with the goal of estimating consumption rates for 1985, the targeted "baseline" year before seafood consumption historically began to decline. Technical oversight for this survey was provided by the Agency for Toxic Substances and Disease Registry (ATSDR) and survey results were reviewed by members of the Northwest Indian College

Institutional Review Board. Survey participants completed 171-page questionnaires and provided detailed information about their 1985 consumption habits , including species, source, portion sizes, and preparation methods as well as seasonality of consumption. The final mean FCR identified in this study was 4.73 grams per kilogram of body weight per day (g/kg/day). The data used to develop these FCRs reported by the study were adjusted to reflect respondent body weight. Thus, the FCR of approximately 383 g/day is based on the average weight of the respondents, which is reported to be 82.6 kilograms. This FCR equates to 0.84 pounds per day (lb/day) or 13.5 ounces per day (oz/day). Considerable uncertainty is associated with this study because it relies on a 27-year recall of fish consumption patterns and individual body weights. The study acknowledges that long-term dietary recall is typically unreliable for the general population, but argues that in cases where the food in question has particular cultural significance, recall is considerably enhanced. However, this study did not employ QA/QC methods to verify the data (e.g., interviewing participants a second time at a later date to see if similar information is provided), which leads to further uncertainty in the precision of the survey data. In addition, these data are representative of consumption patterns for very specific high-end consumers from the State of Washington, and does not reflect the consumption pattern of the general population of Idaho and likely does not reflect the consumption pattern of Idaho subpopulations In summary, the major uncertainties associated with this survey include: 1) the small sample size and preferential selection of high-end consumers as survey participants; 2) the survey methodology, which required participants to recall dietary information from 27 years ago; and 3) the lack of QA/QC procedures to validate the survey findings.

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

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 from the State of Washington. This study was developed in cooperation with the Washington DOH under a grant from the ATSDR. Similar to the Columbia River Inter-Tribal Fish Commission (CRITFC 1994) study, this survey consisted of a 24-hour dietary recall and food frequency questionnaire. Consumption rates were derived from the results of the food frequency questionnaire. 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. The resulting mean annual consumption rate of 2.7 g/kg/day was nearly twice as large as the mean 24-hour recall consumption rate of 1.5 g/kg/day, indicating a potential bias in the survey results. Interestingly, 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). However, even during this time, 55% of respondents reported no seafood consumption the day before the interview. This anomalously low percentage may, in part, explain the discrepancy seen between the annual and 24-hour mean consumption rates reported by the study. Consumption weights were standardized by body weight although the amount of fish consumed and body weight did not show a statistically significant relationship (The Suquamish Tribe 2000). 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. Approximately 90% of salmon was locally harvested (79% from Puget Sound and 11% from outside Puget Sound). 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, which 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. The major uncertainties associated with this study include: 1) data may not be reflective of populations within the State of Idaho; 2) data used to develop FCRs may be biased due to inclusion of body weight, unweighted data for children, and anadromous fish; 3) discrepancy between annual and 24-hour FCRs; 4) failure to extrapolate short-term recall data to long-term (i.e., lifetime) consumption patterns; 5) the authors reported that FCRs are quite skewed because the 90th percentile was several fold greater than the median consumption rate; and 6) FCRs do not appear to account for the fact that commercial sources provided more than 50% of non-anadromous fish.

2.4 Asian and Pacific Islander Seafood Consumption Study, 1999

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 made up roughly 10% of Washington's total population at the time of the survey (1997). Survey participants specifically consisted of adult seafood consumers. The survey consisted of a questionnaire administered by trained members of the API community with technical assistance provided by USEPA, King County Health Department, Washington Ecology, and other various state agencies, academia, and consultants. 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 the 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. As noted below for the Tulalip and Squaxin Island Tribes survey, the survey protocol that led to the presence of these outlier 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 fish consumption patterns. Furthermore, given that the survey is focused on seafood and King County is bounded to the west by Puget Sound, the reported fish consumption patterns may not apply to the population of, or even subpopulations within, the State of Idaho. In summary, the major uncertainties associated with this survey include: 1) survey demographics which are not be representative of the State of Idaho; 2) lack of adjustment in FCRs

for commercially obtained fish; 3) inclusion of anadromous fish in FCRs; and 4) the survey is 15 years old and may not reflect current fish consumption patterns.

2.5 Estimated Per Capita Fish Consumption in the United States, 2002

USEPA's (2002) document entitled *Estimated Per Capita Fish Consumption in the United States* presents estimates of daily average fish consumption for the general U.S. population based on the U.S. Department of Agriculture's (USDA's) 1994-1996 and 1998 Continuing Survey of Food Intakes by Individuals (CSFII), which involved the collection of two non-consecutive days of dietary recall data. The objective of this document was to provide fish consumption estimates that could be used to estimate human health risks associated with the consumption of freshwater and estuarine finfish and shellfish species. However, fish consumption estimates in the USEPA (2002) report represent empirical daily averages across two survey days rather than "usual intakes," which are defined as "the long run average of daily intakes of a dietary component by an individual" (page 1-5). Major uncertainties associated with this report include: 1) diminished precision of a respondent's daily average consumption rate because rates are based on only two days of data collection; 2) the parsing of data for "consumers" and "non-consumers", which leads to highly skewed data distributions; 3) lack of differentiation between locally harvested seafood and seafood obtained from commercial sources; and 4) derivation of FCRs that are based on national data rather than local or Idaho-specific data.

2.6 A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region, 1996

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 from the State of Washington. The study design involved a personal interview survey targeting the Tulalip and Squaxin Island Tribes. Technical assistance was provided by the Washington DOH, Washington Ecology, USEPA, and the U.S. Public Health Service. 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 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 above) 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. Another uncertainty associated with this survey is that it was conducted in 1994 and, being 18 years old, may not reflect current fish consumption patterns. In summary, the major uncertainties associated with this survey include: 1) the identification of unusually high consumption rates, which may represent an overall bias in the survey methodology; 2) the adjustment of FCRs for respondent body weight, which may skew resulting statistics for "average" consumption; 3) failure to extrapolate short-term recall data to long-term (i.e., lifetime) consumption patterns; and 4) the age of the survey (18 years old).

2.7 Summary of Survey Quality Review

IDEQ (2012) identifies several factors that are relevant to the development of a regulatory FCR for the State of Idaho. The following table presents a summary of these factors, among others, as they relate to the six surveys described above:

	CRITFC 1994	Suquamish Tribe 2000	Lummi Tribe 2012	Toy et al. 1996	API Study 1999	USEPA 2002
Specific to Idaho?	Yes [1]	No	No	No	No	No [2]
Target Population	4 Columbia River Tribes	Suquamish Tribe	High end consumers of Lummi Tribe	Tulalip and Squaxin Island Tribes	API community	General U.S. population
Survey Type	24-hour dietary recall and personal interview	24-hour dietary recall and food frequency questionnaire	Long-term dietary recall	Personal interview	Dietary recall	2 non-consecutive, 24-hour days of dietary recall
Sample Size	513 adults, 204 children	92 adults, 31 children	82 adult males	190 adults, 69 children	202 adults	20,607 individuals
Do Data Represent Long-Term FCRs?	No [3]	No [3]	No	No [3]	No	No [4]
Accounts for Seasonality?	Yes	Yes	Yes	No	No	No

	CRITFC 1994	Suquamish Tribe 2000	Lummi Tribe 2012	Toy et al. 1996	API Study 1999	USEPA 2002
Collected Fish Species Information?	Yes	Yes	Yes	Yes	Yes	Yes
Species-Specific FCRs?	No	No	No	Yes	Yes	No
Source of Fish Provided?	No	Yes	Yes	Yes	Yes	No
FCRs Adjusted for Body Weight?	Yes	Yes	Yes	Yes	Yes	Yes
Are Raw Data Publicly Available?	No	No	No	No	No	Yes
Peer-Reviewed?	Yes	Unknown	Yes	Yes	Unknown	Unknown
Date of Survey	1991/1992	1998	2011/12 (1985) [5]	1994	1997	1994-1996, 1998

Notes:
[1] Tribes were from States of Washington, Oregon, and Idaho.
[2] Likely includes some residents of Idaho.
[3] If data from the personal interview are available, and are of comparable content and quality as developed by a Food Frequency Questionnaire, it may be possible to use these results to develop a long-term FCR.
[4] Though USEPA did not extrapolate to long-term FCRs, data from two 24-hour surveys should permit such an extrapolation.
[5] Survey was conducted in 2011/2012, but respondents were asked to provide data for 1985 consumption patterns based on dietary recall.

3. Conclusions

AWQC for the protection of human health are designed to protect people from exposure to chemicals via ingestion of drinking water and consumption of fish obtained from surface waters (USEPA 2000). Therefore, a regulatory FCR used in the derivation of statewide AWQC for Idaho should be based on fish consumption patterns that reflect the population of the State of Idaho.

The key findings of the review of the above six FCR surveys suggest that the data developed by these studies may not be appropriate for deriving a regulatory FCR for the State of Idaho for numerous reasons.

- None of these studies are specific to the State of Idaho, though at least two likely include respondents who live in Idaho (CRIFTIC 1994, USEPA 2002).
- Five out of six of these studies target specific subpopulations and the reported FCRs are not applicable to the general population of Idaho, or any other state. Moreover, one these studies (Lummi 2012) report FCRs for only high-end consumers of a subpopulation.
- With the exception of USEPA 2002, all of these surveys were comprised exclusively of respondents living in a coastal state (either Washington or Oregon) or had a large proportion of respondents from one of those two coastal states (CRIFTIC 1994). As noted in Ecology (2012), national fish consumption surveys have found that people living in coastal states tend to consume more fish than people living in other areas. As Idaho is an inland state, fish consumption information developed from surveys of coastal states, which includes five of the six studies reviewed herein, may overestimate consumption of Idaho residents.
- Many of these studies report FCRs that incorporate consumption of anadromous fish whose chemical concentration likely does not reflect the concentration of chemicals in the water from which they are caught and to which Idaho-specific AWQC would be applied.
- Many of these FCRs do not consider the contribution of non-local sources of fish (e.g., fish caught from outside of the region in which the survey respondents live) to the reported FCRs. Assuming such fish are not harvested from waters of Idaho, the concentration of chemicals in such fish are not reflective of the concentration of chemicals in the waters of Idaho and are not affected by Idaho-specific AWQC.
- Some of these studies do not consider the effect of the distinction between “consumers” and “non-consumers”, which may bias resulting FCRs due to the omission of people who intermittently eat fish and whose long-term consumption behavior was not captured by, and was likely underestimated by, the short-term surveys.
- 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. With the exception of USEPA (2002) and possibly CRIFTIC (1994) and Toy et al. (1996), it also appears that the surveys do not have sufficient information to extrapolate the short-term dietary recall results to long-term fish consumption rates.
- These FCRs were adjusted for respondent body weight, which may bias resulting FCRs.
- Additionally, almost all of these surveys are 10 or more years old and some are now more than 20 years old. The age of these surveys would not represent current fish consumption rates if fish consumption behavior has changed over the past one to two decades.

The uncertainties identified and discussed above indicate that the existing fish consumption rate surveys identified by Idaho as part of its rulemaking process have enough limitations that the applicability of the fish consumptions rate data reported therein to residents of Idaho cannot be determined. If Idaho wishes to base

revised human health AWQC on an Idaho-specific fish consumption rate distribution, it will likely need to conduct a statewide survey that develops information on the long-term (i.e., lifetime) fish consumption rates for the whole population of Idaho, not just specific subpopulations. Appendix A summarizes some of the key components that should be included in an ideal fish consumption rate survey for the State of Idaho.

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. 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.

5. References

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Appendix A
Key Components of a Fish Consumption Rate Survey for the State of Idaho

The fish consumption rate (FCR) is one of many factors considered when deriving ambient water quality criteria (AWQC). Careful consideration of all factors, not just in isolation but also in combination, is critical for the development of appropriate and protective AWQC. This appendix provides a brief summary of only the key characteristics of a fish consumption survey whose results could be used to derive an FCR to be used in an AWQC. Ideally, the FCR used in the derivation of AWQC for the State of Idaho should be representative of the fish consumption pattern of the general population of Idaho and also specific subpopulations that may have unique fish consumption patterns. An ideal FCR survey for the State of Idaho should, at a minimum, include the characteristics listed below.

- Include only residents of Idaho.
- Collect information that allows for the development of a FCR distribution for the general population of Idaho.
- Collect information that allows for the development of a FCR distribution for subpopulations of Idaho assumed to have unique fish consumption behaviors. This information could be used to document that an AWQC protective of the general population is also protective of subpopulations.
- Be based on a study methodology that collects information needed to develop an FCR distribution representing long-term (i.e., lifetime) fish consumption patterns. Several methods exist that would allow for the collection of the information required to develop long-term FCRs from short-term dietary survey information. Such a methodology might consist of a 24-hour dietary recall survey given on two or more non-consecutive days or a single 24-hour dietary recall survey combined with a Food Frequency Questionnaire (or some other survey vehicle that provides equivalent information). The important point is that such information be collected.
- Identify the species of fish being consumed and how those fish were acquired (i.e., locally caught or store bought). The information should allow for the development of, at a minimum, distinct FCR distributions that represent: 1) overall fish consumption (all sources, all fish); 2) consumption of only locally caught fish; and 3) locally caught non-anadromous fish (only fish caught within Idaho and that have chemical concentrations accumulated from waters of Idaho).
- In addition to collecting information needed to estimate the FCR of locally caught fish, identify the location of where the fish were caught (i.e., specific water body).
- Collect information needed to evaluate seasonal changes in fish consumption patterns.
- Collect information on fish meal preparation including the portion that is consumed and cooking method.

- Study methodology should include appropriate quality control/quality assurance (QA/QC) procedures. For example, collect consumption information on other select dietary items to corroborate that the survey methodology reports consumption patterns of those other dietary items that are consistent with previously collected and accepted dietary survey information.