IACI Idaho Association of Commerce & Industry
Employers Advocating Economic Opportunity in Idaho®

November 6, 2015

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

Dear Ms. Wilson:

On October 7, 2015, the Idaho Department of Environmental Quality (DEQ) published a draft regulation for establishing human health water quality criteria. This rulemaking was necessary because, on May 10, 2012, the U.S. Environmental Protection Agency (EPA) disapproved the July 7, 2006 DEQ water quality standard rule submittal. The Idaho Association of Commerce & Industry (IACI) is the leading voice for Idaho business and has been an active participant throughout this rulemaking process. We appreciate DEQ's very comprehensive approach and extensive work to develop a fish consumption rate and associated human health water quality criteria calculations that utilize the best science and data applicable to Idaho residents.

IACI's comments focus on three areas for calculating human health water quality criteria: (a) technical inputs, (b) policy decisions, and (c) related issues.

Determining human health water quality criteria is a complex, technical matter. DEQ has approached this undertaking in a very systematic, technically based manner. The fish consumption survey that DEQ undertook has provided very valuable information for the foundation of this rule and is important for the protection of public health of Idaho's citizens. Along with the use of Idaho specific fish consumption survey results (utilizing Idaho fish), IACI recommends that DEQ use specific chemical data (for relative source contribution) and additional Idaho specific for determining bioaccumulation factors.

As a part of setting human health water quality criteria, DEQ also has policy decisions to make, especially in regards to selecting a risk target. The selection of a risk target significantly influences the final calculated human heath water quality criteria. There are a number of aspects of selecting the risk target, such as ensuring the criteria are protective of Idaho residents (including subpopulations that have high fish consumption rates), consideration of conservatism that is inherent in risk calculations, how the resulting calculated criteria compare to background and ubiquitous chemicals (such as PCBs) and the feasibility of achieving the criteria. EPA guidance provides latitude to DEQ in selecting risk targets. IACI recommends that a risk factor of one to $10^{-5}$ for both the Idaho and tribal populations provides the "balance" among these different aspects for determining human health water quality criteria.

During the rulemaking process, there was considerable discussion about whether fish consumption in Idaho is "suppressed" due to existing contamination levels, and whether the criteria need to reflect heritage rates for Idaho tribes. A related question is whether treaties for Idaho tribes result in Clean Water Act requirements for the State of Idaho. Nothing in the Clean Water Act imposes upon the State of Idaho an obligation to establish water quality standards at a level that would meet some unknown past level of beneficial use, a more pristine quality, or pre-Columbian water quality conditions. The Clean Water Act requires water quality standards meet existing beneficial uses.

One final recommendation is that the Department initiate a study to look at certain persistent bioaccumulative chemicals (such as mercury, arsenic and PCBs) in Idaho's waters. For a number of these chemicals, they are present due to natural sources, legacy activities and air deposition. Due to potential very low human health water quality criteria, further data is needed on the concentrations of these chemicals in Idaho waters (including pristine waters), changes in concentration of these chemicals in Idaho waters and chemical specific risks to Idaho residents through fish consumption. This information would be very useful to help set Idaho-specific human health water quality criteria for such chemicals; such information would be very helpful to ensure that any treatment needed by the regulated community to meet such criteria will provide human health benefits.

As stated in earlier comments, IACI commends DEQ for the significant work done in this rulemaking and the opportunity that has been provided to stakeholders to participate in this process.

Sincerely,

Alex LaBeau
President

attachments
cc: Alan Prouty, Chair
IACI Environment Committee

IACI Idaho Association of Commerce & Industry

Employers Advocating Economic Opportunity in Idaho®

# Comments: Proposed Regulation for Establishing Human Health Water Quality Criteria

November 6, 2015

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**Appendices**

**A. Introduction**

This rulemaking has been focused on developing information and selecting inputs to the very technical calculations associated with determining human health water quality criteria (HHWQC). Essentially, three equations are used to develop ambient water quality criteria for toxic substances: one for non-carcinogens and two for carcinogens.

For non-carcinogenic toxics, criteria (AWQC as shown in the equations or HHWQC as referred to in these comments) are calculated as follows:

$$AWQC = RfD * RSC * (\frac{BW}{DI+(FCR*BAF)}) \quad \text{[Eq-1]}$$

Where:

RfD = reference dose for non-cancer effects (mg/kg-day)
RSC = relative source contribution factor
BW = human body weight (kg)
DI = drinking water intake (L/day)
FCR = fish consumption rate (kg/day)
BAF = bioaccumulation factor (L/kg)

For carcinogens, HHWQC (AWQC) are calculated following either the nonlinear or linear low-dose extrapolation equations. The nonlinear low-dose extrapolation equation is used for carcinogens where there is evidence of a threshold below which there is no risk for cancer. The nonlinear low-dose equation is as follows:

$$AWQC = \frac{POD}{UF} * RSC * (\frac{BW}{DI+(FCR*BAF)}) \quad \text{[Eq-2]}$$

Where:

POD = point of departure for carcinogens based on a nonlinear low-dose extrapolation (mg/kg-day)
UF = uncertainty factor for carcinogens based on a nonlinear low-dose extrapolation
RSC = relative source contribution factor
BW = human body weight (kg)
DI = drinking water intake (L/day)
FCR = fish consumption rate (kg/day)
BAF = bioaccumulation factor (L/kg)

The linear low-dose extrapolation equation, which is used when there is assumed to be no risk-free dose, is as follows:

$$AWQC = RSD * (\frac{BW}{DI+(FCR*BAF)}) \quad \text{[Eq-3]}$$

Where:

RSD = risk-specific dose for carcinogens (mg/kg-day)
BW = human body weight (kg)
DI = drinking water intake (L/day)
FCR = fish consumption rate (kg/day)
BAF = bioaccumulation factor (L/kg)

These calculations with technical inputs that included an Idaho state specific fish consumption survey, an Idaho tribal fish consumption survey (conducted by U.S. Environmental Protection Agency - EPA), and other values, were used to determine the proposed criteria. One key factor in the calculations is DEQ of Environmental Quality's (DEQ) risk policy decision. DEQ chose to apply an incremental excess lifetime cancer risk of $1x10^{-6}$ for carcinogens and a hazard quotient of one for non-carcinogens. These risk levels were applied at the $95^{th}$ %tile for the general Idaho population and at the mean for three higher fish consuming populations.

Based on the State of Idaho survey and a National Cancer Institute methodology analysis of dietary recall results, the $95^{th}$ %tile Idaho Fish consumption rate for the general population was 11.2 g/day. The estimated mean Idaho Fish consumption rate for the three higher exposure populations (Idaho angler, Shoshone-Bannock Tribes and the Nez Perce Tribe) were 4.5, 5.6 and 16.1 g/day respectively.[1]

Idaho used a probabilistic methodology to derive the draft criteria by using distributions for Idaho specific fish consumption rate and body weight, and a national distribution for drinking water rate. The proposed criteria are the more stringent calculated result based on either protecting the Idaho general population or the Nez Perce Tribe.

Because of the importance of factors/data inputs and the role of policy decisions in calculating human health water quality criteria, IACI has consistently focused comments on the scientific validity of the data inputs and the implications of policy decisions.

## B. Technical Factors Considered in Calculating Human Health Water Quality Criteria

### B.1. Utilization of Best Science

Criteria for the protection of human health in water quality are traditionally derived using EPA recommended equations that include parameters for risk, toxicity, and exposure. The values for these parameters are revisited and periodically adjusted based on the availability of new science and changes in policy decisions. Because of the potential effects on regulated entities and for protection of public health, the scientific rigor of the parameters used to derive criteria is very important.

[1] DEQ calculated these fish consumption rates based on a Food Frequency Questionnaire and made adjustments for Idaho Fish. Since then, the recall survey data have been made available which provide more accurate information to calculate tribal fish consumption rates for Idaho fish.

IACI has consistently advocated that DEQ fully utilize the best science information and calculation methodology to determine new human health water quality criteria. This includes Idaho-specific bioaccumulation factors, Idaho-specific fish consumption information, informed Relative Source Contribution (RSC) factors, and probabilistic risk assessment methodology. The resulting calculated values, along with appropriate risk management policy decisions should be the basis of setting the new criteria.

Such an approach is consistent with federal and state requirements. Both federal rules and Idaho statute require the use of "sound" or "best" science in setting criteria. EPA rules for establishing water quality criteria state the following (see 40 CFR §131.11(a)(1)):

> States must adopt those water quality criteria that protect the designated use. Such **criteria must be based on sound scientific rationale** and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use. [emphasis added].

The Idaho Legislature has directed DEQ to use the best available science when promulgating rules (see Idaho Code § 39-107D(2)).

> 2) To the degree that a department action is based on science, in proposing any rule or portions of any rule subject to this section, DEQ shall utilize:
>
> > (a) The best available peer reviewed science and supporting studies conducted in accordance with sound and objective scientific practices; and
> >
> > (b) Data collected by accepted methods or best available methods if the reliability of the method and the nature of the decision justify use of the data.

DEQ initiated this rulemaking with the approach of collecting Idaho-specific data and applying the best available science in determining new human health criteria. As described in the following comments, we believe the use of the Idaho fish consumption survey data in a probabilistic risk assessment methodology, adjusted RSC factors and Idaho specific BAF will provide the "sound science" to develop the new criteria.

**B.2. Calculation Methodology**

Traditionally, a "deterministic" approach is taken to calculate water quality criteria: single values are used to represent factors determining exposure and results in a single discrete estimate of exposure and risk. An alternate approach is the use of probabilistic methods which use distributions of values to represent factors determining exposure and allow for the estimation of a distribution of potential risks.

IACI supports the use of a probabilistic methodology in calculating water quality criteria for the following reasons:

*Probabilistic Methodology is the Best Science*. One of the conundrums of calculating human health water quality criteria is how to account for the differences among the population in fish consumption rates, water ingestion rates, body weight, etc. The probabilistic methodology allows an incorporation of all data for the different inputs that go into calculating human health water quality standards. By evaluating these types of differences among the population, the probabilistic methodology allows the calculation of risk across the entire population. Such a statistical method has been used for a number of years; EPA has published guidance on using Monte Carlo simulations for risk assessment associated with hazardous contaminants clean-ups. The State of Florida has used such a methodology for a portion of their recent work to determine human health water quality criteria. Such an approach is consistent with Idaho Code 39-107D, which requires the use of best available peer-reviewed science.

*Probabilistic Methodology Avoids Compounded Conservatism*. The traditional method of calculating human health water quality criteria is a deterministic approach with "one size fits all" inputs to the calculations. Such an approach leads to "compounded conservatism," where each inputted factor has a degree of conservatism included, and the use of several such factors drastically increases the "conservatism" in the calculated final number. The use of a probabilistic methodology will result in a more realistic "risk" based criteria calculation.

*Probabilistic Methodology Facilitates a Transparent Determination of Criteria*. The use of this methodology, especially for calculation inputs that have a considerable range (such as fish consumption rates, water ingestion rates, etc.) allows the public and stakeholders to see how the range of data affects calculated human health values. This will facilitate the public providing meaningful input to DEQ on risk management decisions the agency will be required to make in setting human health criteria. This method also better assists DEQ in fulfilling its obligations for setting standards for protecting human health as stated in Idaho Code 39-107D.

DEQ is using the probabilistic methodology for Idaho and tribal specific fish consumption rates, Idaho specific body weight, and a national distribution for drinking water intake. IACI supports the decisions made by DEQ in the use of a probabilistic methodology for these parameters.

**B.3. Body Weight/Drinking Water Intake Values**

DEQ used the body weight distribution from its Idaho general population survey (mean of the distribution is 80 kg). Exposure from drinking water was determined by using data provided by EPA; the $90^{th}$ %tile value was 2.4 liters/day. IACI supports the use of these representative distributions of body weight and drinking water intake for the calculation of water quality criteria.

### B.4. Bioaccumulation Factors, Calculation and Trophic Weighing

DEQ is moving towards the use of bioaccumulation factors (BAFs) instead of bioconcentration factors (BCFs). A bioaccumulation factor (BAF) is an estimate of the ratio of the concentration of a chemical in the tissue of an aquatic organism to its concentration in water. IACI supports the use BAFs instead of BCFs, however as noted below, there are a number of technical considerations in using and determining BAFs.

Uncertainty in the BAF estimate can be of substantial consequence to the final HHWQC. An overestimation of the BAF predicts higher concentrations in fish tissue at a given water concentration resulting in a HHWQC lower than necessary to protect human health at the target risk level specified by the HHWQC. BAFs are species dependent and those species feeding at a higher trophic level (TL) are generally expected to have more bioaccumulation and thus higher chemical concentrations than those feeding at a lower TL. Therefore BAFs are estimated by TL to reduce uncertainty. Based on intake rates of fish species grouped by TL (i.e. TL2, TL3, and TL4), EPA developed an equation to calculate a BAF that is weighted by expected fish intake within each TL. DEQ (2015), using Idaho fish consumption rates by species data available from the fish consumption survey, devised a similar equation for the general population using Idaho specific weights. (The TL for each species of Idaho fish are provided in Appendix A of IDEQ, 2015). DEQ (2015) also developed separate TL weights for the Nez Perce population using information from the Nez Perce tribal survey (Ridolfi, et al. 2015). However, because the dietary recall data were not available to DEQ at the time the TL weights were developed for the Nez Perce tribe, DEQ used data from the food frequency questionnaire (FFQ). The dietary recall data are generally judged to be more accurate for use in the estimation of usual intake and should be used rather than the FFQ data to derive TL weights for the Nez Perce population. Using, the dietary recall data from the tribal survey, Aracdis was able to calculate the percentage of fish consumption within each trophic level and calculated more accurate weights for use in the BAF weighting equation. A summary of the TL weights used by EPA and DEQ as well as the alternate weights calculated for the Nez Perce by Arcadis are presented in the table below.

**Table 1**

| Intake Based Weights for Weighted Average BAF Calculation | | | | |
|---|---|---|---|---|
| | Weights Presented in DEQ, 2015 | | | Alternate Nez Perce Based on Dietary Recall Survey Data by Arcadis |
| Trophic Level | EPA Default | DEQ General Population | DEQ Nez Perce | |
| TL2 | 36% | 9% | 19% | 5% |
| TL3 | 41% | 73% | 27% | 70% |
| TL4 | 23% | 17% | 55% | 25% |

Higher trophic levels have higher estimated BAFs for most compounds, therefore higher weights within a higher trophic level result in a larger BAF than when weights are higher for lower trophic levels. As shown above the weights used by DEQ for the Nez Perce presume higher consumption of fish in TL4. The weights calculated by Arcadis for the Nez Perce based on the dietary recall data indicate that consumption in TL4 is lower and that the highest consumption is within TL3. Therefore, the weighted BAFs, using the alternate weights for the Nez Perce are generally lower than those reported by DEQ for the Nez Perce. A summary of the BAFs presented by IDEQ (Windward, 2015) along with the BAFs calculated using the alternate weights for the Nez Perce based on dietary recall data are presented in Appendix A. As shown in the table, the alternate BAFs for the Nez Perce (based on dietary recall data) are generally lower than those presented by DEQ, (based on FFQ data).

Finally, IACI recommends that where data are available, Idaho specific bioaccumulation factors be developed and used to calculate HHWQC.

**B.5. Relative Source Contribution**

DEQ used 2015 EPA recommended relative source contribution (RSC) factors; the default factor of 0.2 (20%) was used for most chemicals.

IACI recommends that DEQ use a RSC other than 0.2 based on chemical specific information and the rate of fish consumption.

The first, and most recognized instance for using a RSC of greater than 20% is when data indicate that the sources of daily exposure to a chemical, other than the sources regulated by a water quality criteria (HHWQC) (i.e., consumption of fish from a local water or consumption of fish from a local water body to which the HHWQC applies) comprise less than 80% of the allowable daily intake.[2] When available data indicate exposures from sources other than local waters are a small fraction of the allowable daily exposure, the RSC can be set at a percentage of the allowable daily intake (i.e., reference dose (RfD)) greater than the USEPA default of 20%. For some chemicals, that percentage can be substantially greater than the default of 20%, sometimes exceeding the USEPA maximum default of 80%. The Florida Department of Environmental Protection (FDEP) recently reviewed the literature and developed RSCs for 21 non-carcinogenic compounds that ranged from 0.2 to 1.0.[3]

Consistent with these recent developments, the California Office of Environmental Health Hazard Assessment (OEHHA) had previously concluded that the default use of an RSC of 20% is unreasonably conservative for most chemicals.[4] In fact, for 22 of 57 chemicals, a RSC of greater than 20% was used in the calculation of California Public Health Goals for those chemicals in drinking water. It also bears pointing out that the development of chemical-specific RSCs is not necessarily time or resource intensive and DEQ should undertake developing RSCs for chemicals

[2] November 3, 2000. *Federal Register*, Volume: 65, Issue: 214, pages: 66472-3 (65 FR 66472-3). Available at: http://www.epa.gov/fedrgstr/EPA-WATER/2000/November/Day-03/w27924.htm

[3] Florida Department of Environmental Protection (FDEP). 2014. DRAFT Technical Support Document: Derivation of Human Health-Based Criteria and Risk Impact Statement. February.

[4] Howd RA, Brown JP, FanAM. 2004. Risk assessment for chemicals in drinking water: Estimation of relative source contribution. *The Toxicologist* 78(1–S). Lichtenberg E. 2010. Economics of health risk assessment. *Annu Rev Resour Econ* 2:53–75.

with available data. Alternatively, given the availability of recently developed chemical-specific RSCs by FDEP, DEQ can also consider using those when developing HHWQC.

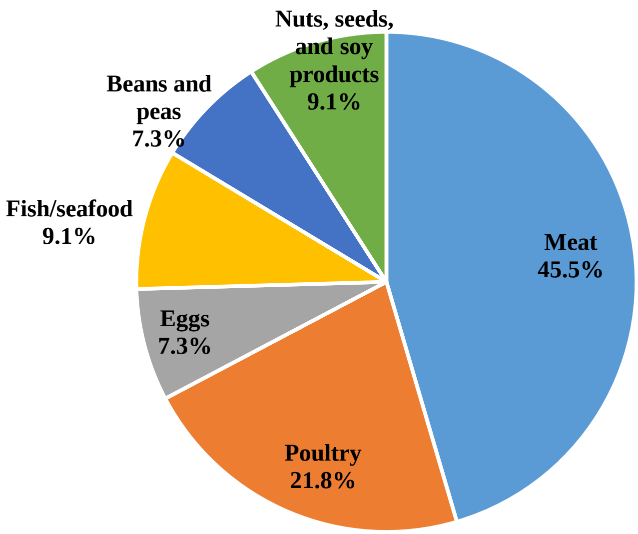
ARCADIS has derived chemical-specific RSCs for eleven chemicals: acenaphthalene, anthracene, fluoranthene, fluorene, pyrene, 2-chlorophenol, selenium, diethyl phthalate, chloroform, butylbenzyl phthalate and toluene (see Table 2 and Appendix B). IACI recommends that these RSCs be used to derive Idaho human health water quality criteria.

The other instance when the RSC can be substantially greater than EPA's default of 20% is when the fish consumption rate assumed by a HHWQC is large and, therefore, comprises a majority of an individual's daily protein intake. For such situations, the use of the 20% default RSC will underestimate exposures from consumption of fish caught from waters to which the HHWQC is applied. In such instances, particularly for chemicals that tend to bioaccumulate in the food chain and for which dietary exposure is assumed to be the dominant exposure pathway, an assumed high fish consumption rate can effectively mean that virtually all of an individual's daily protein intake is comprised of fish from local waters (waters regulated by the HHWQC). In such cases, other dietary sources of protein which are also the sources of a bioaccumulative compound in the human food chain, become negligible and are replaced by locally caught fish. When that happens, the RSC can be set at value greater than the USEPA default of 20%, perhaps even close to or equal to 100%.

**Table 2**
**Recommended RSC Factors**

| | IDEQ Draft RSCs | ARCADIS Proposed RSCs | Idaho Draft HHWQC (ug/L) | Idaho Draft HHWQC Adjusted with ARCADIS RSC (ug/L) |
|---|---|---|---|---|
| Acenaphthene | 0.2 | 0.99 | 78 | 386 |
| Anthracene | 0.2 | 1.00 | 340 | 1700 |
| Fluoranthene | 0.2 | 1.00 | 20 | 100 |
| Fluorene | 0.2 | 0.99 | 51 | 252 |
| Pyrene | 0.2 | 1.00 | 26 | 130 |
| 2-chlorophenol | 0.2 | 0.91 | 19 | 86 |
| Selenium | 0.2 | 0.65 | 20 | 65 |
| Diethyl phthalate | 0.2 | 0.97 | 620 | 3007 |
| Chloroform | 0.2 | 0.64 | 39 | 125 |
| Toluene | 0.2 | 0.31 | 36 | 56 |
| Butylbenzyl phthalate | 0.2 | 0.95 | 0.11 | 0.54 |

**Figure 1: Total Protein Intake (156 g/day)**

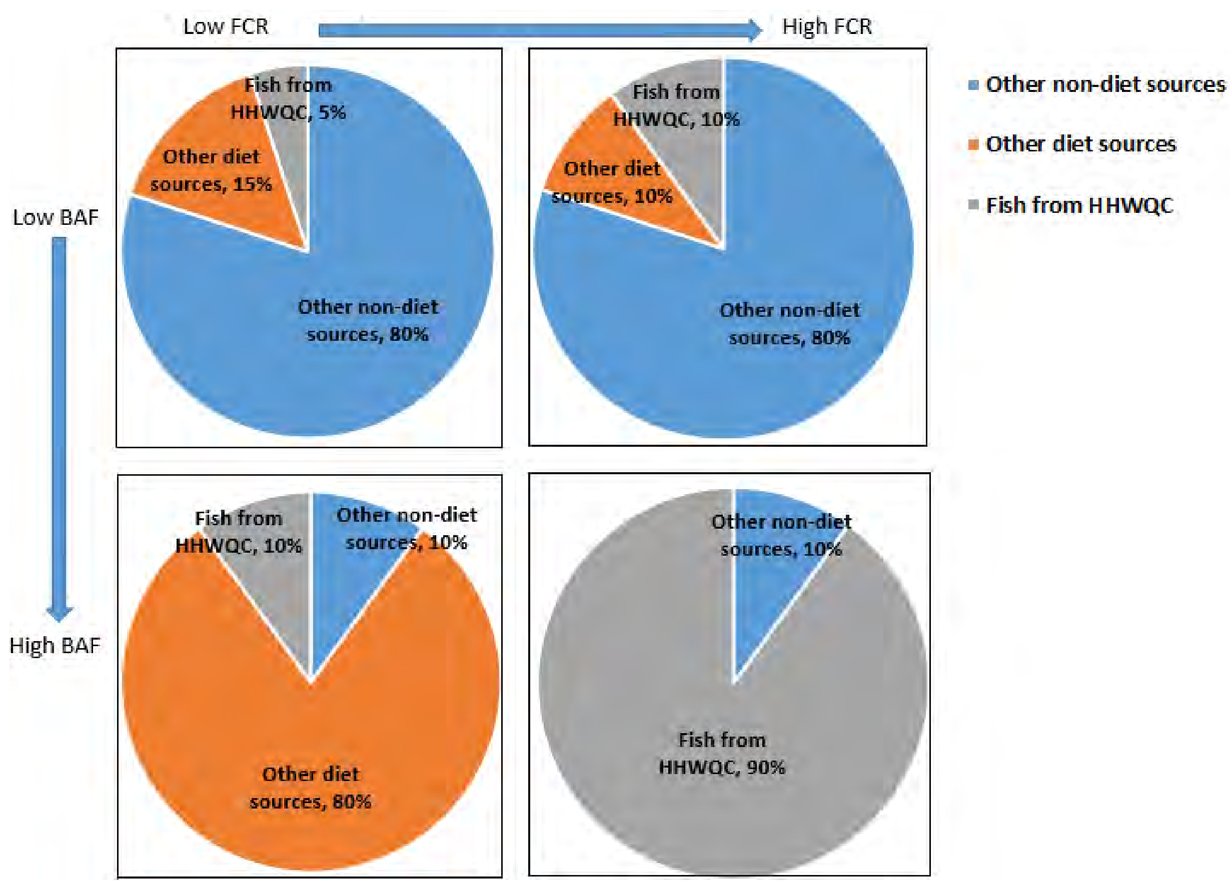



Based on the National Health and Nutrition Examination Survey (NHANES) 2001–2004 Survey, the average intake of protein in America is approximately 156 grams per day and, as shown in in the chart on the left (Figure 1), fish comprises about 9 percent of the total protein intake (14 grams per day).[5] If a HHWQC uses a high fish consumption rate, for example 175 g/d as is used by Oregon (and has been proposed in the state of Washington), such a consumption rate accounts for essentially an individual's entire daily protein intake. For bioaccumulative chemicals that tend to concentrate in animals, concentrations of the chemical in other food items, including marine fish, become inconsequential contributors to dietary exposure. The high fish consumption rate used in the HHWQC effectively makes local fish consumption the sole source of dietary exposure to the chemical and eliminates exposure from the other sources of protein in an average person's diet. The charts below (Figure 2) provide a hypothetical example where the RSC for a bioaccumulative chemical can range from 20% for a HHWQC using an average fish consumption rate to 90% for a HHWQC using a high fish consumption rate. As discussed above, the high fish consumption rate means that the HHWQC effectively assumes all of an individual's dietary protein and exposure is from locally caught fish.

One example of such a chemical is endrin (CAS# 72-20-8). Endrin bioaccumulates significantly in aquatic organisms and data suggest that the vast majority of a person's daily exposure comes from a fish diet and no other sources such as drinking water, occupational exposures, inhalation, or other foods.[6] When a HHWQC uses a fish consumption rate that effectively represents all of an individual's daily protein intake, an RSC approaching 100% is appropriate. Oregon derived an RSC of 80% for endrin, although data suggests that exposure to non-fish sources of endrin are insignificant.[7]

[5] U.S. Department of Agriculture, Agricultural Research Service and U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. What We Eat In America, NHANES 2001-2004, 1 day mean intakes for adult males and females, adjusted to 2,000 calories and averaged.
[6] U.S. Department of Health and Human Services. Toxicological Profile for Endrin. August 1996
[7] U.S Environmental Protection Agency (US EPA). 2011. Technical Support Document for EPA's Action on Oregon's New and Revised Human Health Water Quality Criteria for Toxics and Associated Implementation Provisions. Submitted July 12 and 21, 2011 October 17, 2011.

**Figure 2**
**Hypothetical Relative Source Contribution Variations**




In summary, IACI recommends DEQ use available information to develop (or use existing) chemical-specific RSCs for all human health water quality criteria based on protecting Idahoans from non-carcinogenic effects of compounds in Idaho surface waters.

### B.6. Fish Inclusion for FCR Survey and Idaho Water Quality Rules

Relating Source of Contamination to Idaho Water Quality Rules

The ultimate result of the fish consumption rate rulemaking is the refinement of Idaho's human health water quality criteria (HHWQC) to ensure such criteria are protective of public health. Thus, understanding the potential exposure of the public to contaminants from eating fish from Idaho's waters and drinking Idaho water is key to setting water quality criteria and subsequent discharge levels for the regulated community. *Underpinning this regulatory framework is the assumption that regulation of dischargers in Idaho directly affects the contaminants in Idaho fish and water being consumed*. Thus, the substantive question related to fish consumption by Idaho residents is, what fish should be included in determining fish consumption rates for Idaho residents? A number of fish found in the marketplace come from marine sources, international sources or fish that are anadromous. Once again, back to the foundational assumption that Idaho water quality standards influence the contaminant levels in fish and water, where do these different sources of fish acquire contaminants and can Idaho water quality rules change these levels of contaminants in these fish?

Anadromous Species

Unlike true freshwater species, anadromous fish spend a substantial portion of their life in marine or estuarine environments that are outside the jurisdiction of Idaho. If a substantial fraction of the chemical-specific body burden (mass per fish) found in returning adult salmon is acquired during time spent in the ocean, there is effectively nothing Idaho water quality criteria can do to reduce risks to humans resulting from exposure to chemicals in the salmon they eat. Thus, the ultimate question is, what fraction of the final chemical burden in Idaho's returning adult salmon is acquired in Idaho vs. in the ocean?

A review of the scientific literature shows several studies providing results relevant to this question. It is to be expected that if salmon spend time in both freshwater and saltwater habitats, they will accumulate contaminants in both types of habitats. The scientific literature (i.e., Johnson et al. 2007a,b) shows that juvenile salmon caught in freshwater contain some mass of persistent bioaccumulative toxins [PBT; i.e., chemicals such as polychlorinated biphenyls (PCBs)] prior to outmigration to the ocean.[8, 9] O'Neill and West (2009) found that PCB levels in adult Chinook salmon (fillets) collected from a wide range of geographic locations are relatively uniform except for fish taken from Puget Sound, which show three to five times higher levels of PCBs than fish taken from other locations.[10] As discussed by the authors, these data can be interpreted as indicating accumulation of PCBs in Puget Sound and/or along the migratory routes of these fish, which, depending on the specific runs, can pass through some highly contaminated Superfund sites (i.e., Duwamish Waterway). Ultimately, however, O'Neill and West (2009) concluded that, on average, greater than 96% of the total body burden (mass) of PCBs in these Puget Sound Chinook was accumulated in the Sound and not in natal river(s) based on a comparison of PCB concentrations and body burdens in out migrating Chinook smolts collected from the Duwamish River and adults returning to the Duwamish.

Even the most contaminated out migrating smolts contained no more than 4% of the body burden (mass) of PCBs found in returning adults. Thus, greater than 96% of the PCB mass (burden) found in the returning adults was accumulated in marine or ocean waters (including Puget Sound). Even allowing for an order of magnitude underestimate in the body burden of out migrating smolts, O'Neill and West (2009) concluded that accumulation in freshwater would account for less than 10% of the average PCB burden ultimately found in adults returning to the Duwamish River. By extension, this analysis supports the conclusion that Chinook

[8] Johnson, L.L., Ylitalo, G.M., Arkoosh, M.R., Kagley, A.N., Stafford, C., Bolton, J.L., Buzitis, J., Anulacion, B.F., and Collier, T.K. 2007a. Contaminant exposure in outmigrant juvenile salmon from Pacific Northwest estuaries of the United States. Environmental Monitoring and Assessment 124:167-194.

[9] Johnson, L.L., Ylitalo, G.M., Sloan, C.A., Anulacion, B.F., Kagley, A.N., Arkoosh, M.R., Lundrigan, T.A., Larson, K, Siipola, M., and Collier, T.K. 2007b. Persistent organic pollutants in outmigrant juvenile Chinook salmon from the Lower Columbia estuary, USA. Science of the Total Environment 374:342-366.

[10] O'Neill, S.M., and West, J.E. 2009. Marine distribution, life history traits, and the accumulation of polychlorinated biphenyls in Chinook salmon from Puget Sound, Washington. Transactions of the American Fisheries Society 138:616-632.

salmon passing through uncontaminated estuaries during out migration accumulate a dominant fraction of their ultimate PCB body burdens in the open ocean. Cullen et al. (2009) concluded that 97% to 99% of the body burdens of various PBT chemicals were acquired during the time at sea (based on measurements in out-migrant juvenile and returning adult Chinook from multiple natal rivers).[11]

EPA Guidance

This research showing anadromous fish acquire the majority of the contaminant burden in marine waters has been reflected in EPA guidance. EPA has recently made proposals implicitly acknowledging that the body burden of PBTs in harvested (non-farmed) adult salmon is acquired predominantly in the ocean or marine phase of their life history.

First, as part of a recent proposal to increase the national default fish consumption rate (FCR) from 17.5 g/d to 22 g/d, EPA (USEPA 2014a) affirmed that it considers salmon to be marine fish.[12] Although EPA also decided to include salmon in the updated FCR at a discounted rate, this was a policy decision unrelated to the issue of where salmon accumulate PBTs. Thus, EPA decided to include 4% of salmon consumption in the recommended FCR based on National Oceanic and Atmospheric Administration (NOAA) data showing that 4% of salmon consumed in the US was caught in fresh and estuarine waters.[13]

Second, as part of guidance on implementing the proposed aquatic life tissue residue criterion for selenium (USEPA 2014b), EPA specifically states that anadromous fish should not be used to assess compliance (see Section 1.2.1. in Appendix I of the draft criteria document):[14]

> "States and tribes should target nonanadromous species (species that do not migrate from salt water to spawn in fresh water), because selenium exposure and subsequent bioaccumulation occurs over a relatively long period of time through consumption of locally contaminated aquatic organisms."

[11] Cullon, D.L., Yunker, M.B., Alleyne, C., Dangerfield, N.J., O'Neill, S., Whiticar, M.J., and Ross, P.S. 2009. Persistent organic pollutants in Chinook salmon (Oncorhynchus tshawytscha): Implications for resident killer whales of British Columbia and adjacent waters. Environmental Toxicology and Chemistry 28(1):148-161.

[12] United States Environmental Protection Agency (USEPA). 2014a. Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (NHANES 2003-2010). EPA 820-R-14-002. April 2014. Washington DC: United States Environmental Protection Agency.

[13] As reported by EPA, NOAA's landing data indicate that 96%, 3.5%, and 0.5% of salmon are caught in marine, estuarine, and freshwaters, respectively, and EPA ultimately included salmon in the recommended FCR at a discounted rate (4% of total consumption) reflecting catch in estuarine and fresh waters. If Idaho chooses to follow EPA's lead on this, including 0.5% of total salmon consumption (reflecting catch in freshwater only) in an FCR would be more appropriate considering that Idaho has no estuarine waters. In any case, to be clear: apportionment based on catch location does not accurately account for where salmon accumulate chemicals, so this decision on EPA's part was truly a matter of policy, not science.

[14] United States Environmental Protection Agency (USEPA). 2014b. External Peer Review Draft Aquatic Life Ambient Water Quality Criterion for Selenium–Freshwater 2014. EPA 822-P-14-001. May 2014. Washington DC: United States Environmental Protection Agency.

Consistency with Northwest States

During the rulemaking process, the question has arisen whether Idaho needs to be consistent with other northwest states in how anadromous fish are treated in determining FCR. For example, Oregon includes salmon in the FCR determination. There are several key facts that differentiate Idaho from other northwest states.

First, Idaho water quality rules cannot regulate estuarine and marine waters and, thus, cannot influence concentrations of chemicals present in such waters or the accumulation of chemicals by fish from such waters. There are significant different geographic settings between Idaho and other northwest states (Oregon, Washington and Alaska); the other states being coastal states and Idaho an inland state. Excluding anadromous fish from the Idaho FCR computation would differ from Oregon but such exclusion recognizes and accounts for clear geographic differences between the two states. Also, it is not clear if Oregon considered the science noted above demonstrating that anadromous fish accumulate almost all PBTs in the open ocean. In this instance, consistency with Oregon or any other coastal state is an inappropriate and scientifically unsupportable reason for including anadromous fish in the FCR used to derive the Idaho HHWQC.

Also, unlike Oregon, Washington or Alaska, Idaho conducted a state-wide fish consumption survey. Oregon established a state-wide FCR based on a subpopulation study of four Native American tribes published by the Columbia River Inter-Tribal Fish Commission (CRITFC).[15] This study has a number of uncertainties which include the origin and species of consumed fish (locally harvested or commercial) and the type of local harvested (anadromous, non-anadromous) fish. Furthermore, the raw data from the study have never been available for public review.

Though EPA has implied that studies such as CRITFIC (1994) provide information that can be used to establish a FCR for the State of Idaho, such a study does not represent the Idaho population, geography, and fish availability. The survey conducted by the state of Idaho provides a scientifically sound basis for FCR for Idaho residents.

Bioaccumulative Contaminants, Anadromous Fish and Human Health

Another question raised during the rulemaking was whether including anadromous fish, either at a full or discounted rate, leads to greater protection of public health. This is not correct, at least as it applies to protecting the public that consumes anadromous fish. For the reasons described above, namely that essentially all of the concentrations of chemicals in anadromous fish are accumulated outside of waters of Idaho, lowering Idaho HHWQC (i.e., making them more stringent) will not change the concentration of chemicals in anadromous fish caught in Idaho. Therefore, it will not improve public health by decreasing risks associated with chemicals in anadromous fish.

[15] CRITFC. 1994. *A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin.* Technical Report 94-3.

It is true that including anadromous fish in the FCR used to derive HHWQC will lower the HHWQC (i.e., make them more stringent) and that may, in turn, be potentially more protective of public health by reducing exposures from sources other than consumption of anadromous fish (i.e., consumption of native fish and ingestion of drinking water). However, more stringent HHWQC do not necessarily translate directly to greater protection of public health.

Including anadromous fish in the FCR, the State creates the impression that it can protect Idahoans from exposure to chemicals in anadromous fish using HHWQC. That is a false impression. Idaho HHWQC has essentially no effect on concentrations of chemicals in anadromous fish. If the State were to determine the concentrations of chemicals in anadromous fish were posing a risk to Idahoans, reducing those risks would need to occur through a program other than Idaho HHWQC because HHWQC have no effect on anadromous fish concentrations. An example of such a program might be the implementation of a fish consumption advisory recommending or directing Idahoans not to eat anadromous fish caught in Idaho waters because of chemicals accumulated by the fish prior to entering Idaho waters.

Anadromous fish have great cultural importance in the Northwest and represent an important source of protein for many people. If chemicals in anadromous fish truly pose a public health risk, regulations should be adopted that will actually mitigate that risk and improve public health, not create false hope and misappropriate scarce public resources. We urge DEQ not to mislead the public into thinking that HHWQC can affect the concentration of chemicals in anadromous fish.[16]

DEQ, for purposes of determining the fish consumption rate for developing the water quality criteria, included resident, freshwater species that can be caught in Idaho waters, excluded most market fish (the exception being rainbow trout) and also excluded anadromous fish (except steelhead).[17] Market rainbow fish were included due to the large aquaculture industry in Idaho, of which rainbow trout is the primary fish raised. Steelhead trout, due to a complex life history, were also included in the Idaho fish consumption rate.

IACI supports DEQ's definition of "Idaho Fish" and the decision to exclude market fish (other than rainbow trout), anadromous salmon, marine fish and other non-Idaho resident fish for determining fish consumption rates for the purpose of setting Idaho water quality standards. As discussed earlier, Idaho water quality regulations cannot control the level of contaminants in these excluded fish. For example, the predominant fraction of the ultimate PBT burden found in harvested adult salmon, even salmon passing through highly contaminated fresh and estuarine waters during out migration, is accumulated while in the ocean phase of their life cycle (i.e., Cullon et al. 2009; O'Neill and West 2009). This conclusion is supported by modeling

[16] Note that this observation applies to market fish as well. Because most market fish are not from Idaho, if the State were to determine that concentrations of chemicals in market fish posed a risk, to reduce those levels, regulations separate from HHWQC would need to be put in place to monitor and reduce those concentrations. HHWQC have no effect on concentrations of chemicals in market fish raised or caught outside of Idaho.

[17] "Idaho fish" are defined as resident trout, steelhead, whitefish, perch, walleye, catfish, bass, bluegill, black crappie, north pike, white sturgeon, crayfish, kokanee sockeye, and blueback salmon.

as well (Hope 2012).[18] Indeed, HHWQC could be set to zero and human health risks associated with consumption of these fish, assuming such risks are present, would remain unchanged. In short, Idahoans could be faced with substantially increased compliance costs and garner no benefit from such increased costs.

**B.7. Fish Consumption Survey Results and Data Use**

As described earlier, DEQ recently completed a state-wide survey on fish consumption in Idaho (NWRG 2015). National Cancer Institute (NCI)-adjusted usual intake distributions for fish consumption, as reported by Buckman et al. (2015), were used to develop FCR distributions for the general population of Idaho. DEQ chose to base its draft HHWQC on consumption of resident freshwater fish, referred to as Idaho Fish.

EPA in collaboration with the Nez Perce and Shoshone-Bannock Tribes, recently completed a survey of tribal fish consumption (Ridolfi and Pacific Market Research 2015). Similar methods were used to survey both tribes, and NCI modelling was conducted using data from both tribes with a tribal identifier used as a covariate in the modelling. Information from this survey was used by IDEQ to develop FCR distributions for the Nez Perce tribal population of Idaho. The Nez Perce fish consumption survey data were reported based on different species groupings than the state-wide Idaho fish consumption survey.

Arcadis followed the process outlined by DEQ (2015) to derive an adjustment factor using the Nez Perce dietary recall data to calculate consumption of "Idaho Fish" (known as a Group 2 adjustment factor). The calculations were conducted separately for each of the two dietary recalls because there were some missing responses for the second recall. The NCI methodology for estimating usual intake distributions for fish consumption rely on the dietary recall data, and therefore deriving a Group 2 adjustment factor from these data is more appropriate than relying on the FFQ data.[19] The mean adjustment factor for the two recall events is 7.04%.[20] Arcadis applied the alternate adjustment factor to the mean and each fifth percentile of the empirical distribution of Nez Perce Group 2 fish consumption to derive an alternate estimated distribution of Nez Perce Idaho fish consumption.

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[18] Hope, B.K. 2012. Acquisition of polychlorinated biphenyls (PCBs) by Pacific Chinook salmon: An exploration of various exposure scenarios. Integrated Environmental Assessment and Management 8(3):553-562.

[19] DEQ recognized that use of the FFQ is not the preferred data set from which to derive the adjustment factor and that species-specific data from the dietary recall survey would be preferred as indicated in the footnote to the FCR summary table prepared by IDEQ for the August 6, 2105 Negotiated Rulemaking meeting: "Because the Idaho FFQ does not provide species level data, Idaho fish is based on a survey question that asks respondents to say what percentage of the fish they ate over the past year came from Idaho waters. It thus includes Chinook and Coho salmon, and likely excludes some rainbow trout purchased rather than caught. THEREFORE IT IS NOT COMPRABLE TO THE DIETARY RECALL IDAHO FISH GROUP." (Emphasis in the original). IDEQ used the FFQ data to derive the adjustment factor because species-specific data for the Idaho fish group from the dietary recall survey were not available to IDEQ at the time they had to develop FCR distributions and derive draft HHWQC.

[20] The survey data included two weighting variables to adjust for missing responses in the data. The calculations were conducted twice, once for each of the two survey weight variables. The effect on the adjustment factor was minimal. Using the variable "survey_wt1" resulted in an estimate of 7.03% compared to the adjustment factor of 7.04% presented in the text of this report.

Rather than fitting a continuous theoretical distribution to the empirical FCR distribution using the @Risk software, Windward (2015) used linear interpolation to estimate the FCR at each tenth-of-a-percentile increment and used the resulting empirical and interpolated values in a discrete @Risk distribution, assigning equal probability to each tenth-of-a-percentile estimate (See Appendix C – Figure 1). While the individual percentiles of the discrete distribution fit the empirical distribution quite well, the arithmetic mean of the discrete distribution is nearly four times greater than that of the empirical distribution (8.74 g/day versus 2.34 g/day), driven upward by the inclusion of the estimated 100$^{th}$ percentile value of 1,261 g/day and the interpolated tenth-of-a-percentile estimates between the 99$^{th}$ and 100$^{th}$ percentiles. In addition, using linear interpolation between percentiles of a positively skewed distribution increases the likelihood of less probable values, particularly in the upper tail of the distribution, and therefore is not an ideal method for estimating between the percentiles of the FCR distribution.

Arcadis used the @Risk "Distribution Fitting" function to fit a theoretical distribution to the IDEQ estimated (i.e., based on 24.2% adjustment factor) empirical Nez Perce Idaho fish consumption distribution. The best fitting single theoretical distribution (i.e., the theoretical distribution with the lowest root mean square error) was an inverse Gaussian distribution, which provides a close fit to the individual percentiles of the empirical distribution, comparable to IDEQ's discrete distribution, but provides a much closer fit to the arithmetic mean (16.6 g/day versus 16.1 g/day) (see Appendix C, Table 5, Figure 2).

Arcadis also used the @Risk "Distribution Fitting" function to fit a theoretical distribution to the alternate estimated (i.e., based on 7.04% adjustment factor) empirical Nez Perce Idaho fish consumption distribution. The best fitting single theoretical distribution was an inverse Gaussian distribution, which fits the empirical percentiles well as well as the arithmetic mean (4.81 g/day versus 4.68 g/day) (see Appendix C, Table 6 and Figure 3). This tribal Idaho fish FCR distribution based on the recall survey adjustment factor (7.04%) should be used to derive HHWQC for the tribal population in lieu of a distribution based on the FFQ (24.2%) because, as noted by the authors of the tribal FCR survey report (Ridolfi and Pacific Market Research 2015), the recall survey results are likely closer to the true tribal consumption rate than the FFQ results.

To derive probabilistically based HHWQC using @Risk, empirical FCR distributions must be modelled using theoretical distributions defined within the @Risk software. Windward (2015) used discrete distributions to model FCR in @Risk, incorporating a highly uncertain 100$^{th}$ percentile FCR estimate reported by Buckman et al. (2015). This approach results in theoretical distributions that fit the individual percentiles of the empirical distributions well but overestimate the arithmetic means of the empirical distributions by nearly a factor of four for the general population and approximately 20% for the Nez Perce tribal population. While the overestimation of the mean for the general population is the larger of the two, the overestimation of the mean for the Nez Perce population is of particular practical importance because DEQ is targeting the arithmetic mean of the Nez Perce population to derive draft

HHWQC. Using FCR distributions that overestimate the arithmetic mean FCR, results in draft HHWQC that are more stringent than warranted based on the tribal FCR data.

In lieu of the discrete distributions used by the draft HHWQC that overestimate the arithmetic mean of the empirical FCR data substantially and which require interpolation between existing percentiles with no basis to determine if the interpolation model is correct, Arcadis recommends that DEQ use continuous theoretical curves to model FCR distributions in @Risk when deriving probabilistic HHWQC. This approach, as described in detail in Appendix C, results in theoretical distributions that fit the individual percentiles of the empirical distributions as well as DEQ's discrete distribution, but provide a much closer fit to the arithmetic mean FCRs. It is crucial that both of these statistics be accurately represented when developing distributions to derive probabilistic HHWQC so that risk managers can knowledgeably and appropriately manage risk for the average member of the population as well as any given percentile.

## C. Policy Decisions and Risk Factors in Calculating Human Health Water Quality Criteria

### C.1. Conservatism in Calculating Criteria

States, under the Clean Water Act, are to establish numeric water quality criteria for toxic substances and to periodically consider the need for revisions to those criteria. Toxics criteria are designed to protect both aquatic life and human exposure through the consumption of fish or drinking water. Criteria for the protection of human health (human health water quality criteria – HHWQC) are typically determined using EPA-recommended equations that include parameters for risk, toxicity, and exposure. The parameters used in these equations often are chosen from the upper end of the range of possible values (see Table 2). The overall effect of the selection of "upper end" values, is a compounded conservatism in the HHWQC value calculated.

The term "conservatism," in the context of calculating HHWQC, is used to describe the use of assumptions and defaults that are likely to overstate the true risks from exposure to substances in drinking water and fish tissues. The policy choice to use such overstatements is rooted in EPA's approach to dealing with uncertainty and variability in the data upon with defaults and assumptions are based. Uncertainty is an inherent property of scientific data and thus of the process of risk assessment and calculation of HHWQC. Since uncertainty is due to lack of knowledge, it can be reduced by the collection of additional data, but never eliminated completely. Variability is an inherent characteristic of a population because people vary in their levels and types of exposures and their susceptibility to potentially harmful effects of the exposures.

As indicated in Table 3, the values commonly used for each parameter can have the effect of lowering the calculated HHWQC by large factors. For example:[21]

[21] Details on how the values in these four bullet points were arrived at is found in NCASI. 2012. A Review of Methods for Deriving Human Health-Based Water Quality Criteria with Consideration of Protectiveness.

- Substance toxicity values are commonly reduced by 10 to 3000 times below demonstrated toxicity thresholds as a means of ensuring protection of human health.
- Assumptions about chemical exposure via drinking water results in some criteria being as much as 30 times lower than needed to afford the degree of protection targeted by most states and EPA.
- The assumption that a person lives in the same place and is exposed to the same level of contamination for a 70-year lifetime results in criteria that are up to 8 times more stringent than if a median exposure period were assumed.
- The assumption that waters would exist at the allowable HHWQC for 70 years is in opposition to water management policies in virtually all states and results in criteria values that are 1.5 to 6 times more stringent than would be the case if actual water quality management practices were considered.

**Table 3**

**Parameter Values Used in Human Health Water Quality Criteria Calculations**

| Parameter | Typical Value | Location in Range of Possible Values[1] (maximum possible, upper-end, or central tendency) |
|---|---|---|
| **Explicit Parameters** | | |
| substance toxicity | substance-specific | upper-end |
| body weight of a person | 70 kg (actual mean is 80kg) | central tendency |
| drinking water intake | 2 L/day (86th percentile), but assumes drinking water is untreated surface water | (extreme) upper-end |
| fish ingestion/consumption rate | 17.5 g/day (90th percentile of sport fishers) | upper-end |
| substance exposure from other sources | 80% | upper-end |
| **Implicit Parameters** | | |
| cooking loss | 0% (no loss due to cooking) | maximum possible |
| duration of exposure | 70 years | (extreme) upper-end |
| exposure concentration | At HHAWQC 100% of the time | maximum possible |
| relative bioavailability | 1 | maximum possible |
| bioaccumulation/concentration factor of fish | substance-specific | substance-specific (not evaluated) |

[1]"maximum possible" would be the most conservative (over protective) choice possible, "upper-end" a very conservative choice, and "central tendency" a typical or average value for a population. "Extreme" denotes a value that is very near maximum.

Parameters such as target cancer risk, fish consumption rates, and exposure from other sources can also have significant effects on the calculated human health water quality criteria.

The fish consumption rates used in calculating HHWQC can have a significant impact because the HHWQC are proportional to the fish consumption rate: as the rate increases, the HHWQC decreases. The decrease is particularly pronounced for high BAF/BCF substances. Potential exposure through the fish consumption pathway is dependent upon a number of variables including the types of fish consumed, the sources of those fish, and that rates at which they are consumed, all of which vary widely among the population.

EPA chose to use the one-in-one million ($10^{-6}$) risk level as the default value when calculating HHWQC because it believes this risk level "reflects an appropriate risk for the general population."[22] However, EPA also notes that risk levels of $10^{-5}$ for the general population and $10^{-4}$ for highly exposed populations are acceptable.[23] A target risk level of $10^{-4}$ is sometimes interpreted as meaning that highly exposed populations are not as well protected. However, as discussed in a paper by Kocher, "if only a small population would be at greatest risk, the expected number of excess cancers corresponding to individual risks at the *de minimis* level of $10^{-4}$ would still be (essentially) zero."[24] Given that the $10^{-4}$ risk level has been identified as an acceptable/*de minimis* risk level for highly exposed populations, it may be useful to consider exactly what that risk level represents in terms of fish consumption rates. If the default fish consumption rate is 17.5 g/day represents a $10^{-6}$ target risk level, then a highly exposed population that eats as much as 1,750 g/day will still be protected at a $10^{-4}$ risk level.

### C.2. Risk and Policy Decisions

As discussed throughout this rulemaking, there is a recognition that risks vary among different members of the population; we all eat different amounts and kinds of fish. Faced with this variation, public health policy makers must make decisions about the level of protection afforded different segments of the population (i.e., the average member of the population, more highly exposed individuals, highly exposed subpopulations). EPA recognizes this variation in potential risk and provides guidance on how to address it:

> "With AWQC derived for carcinogens based on a linear low-dose extrapolation, the Agency will publish recommended criteria values at a $10^{-6}$ risk level. States and authorized Tribes can always choose a more stringent risk level, such as $10^{-7}$. USEPA also believes that criteria based on a $10^{-5}$ risk level are acceptable for the general population as long as States and authorized Tribes ensure that the risk to more highly exposed subgroups (sport fishers or subsistence fishers) does not exceed the $10^{-4}$ level."

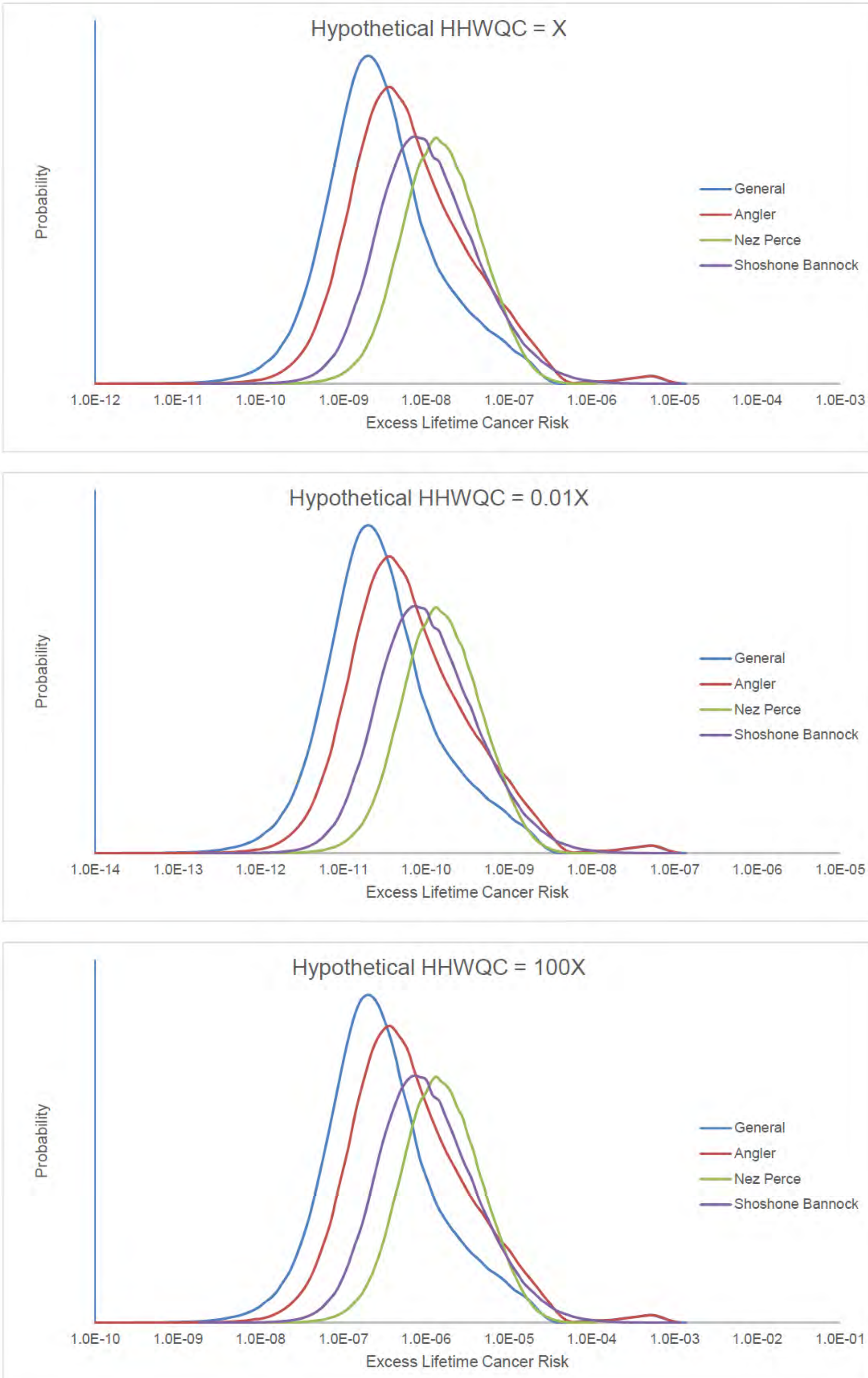
[22] EPA. 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health. EPA/822/B-00/004.
[23] Ibid.
[24] Kocher. 1996. Criteria for Establishing *de minimis* Levels of Radionuclides and Hazardous Chemicals in the Environment. Report ES/ER/TM-187 prepared by the Oak Ridge National Laboratory for the U.S. Department of Energy.

It is also important to recognize that risk varies across all Idahoans and that this has implications for what target risk goals can be achieved. One sometimes mentioned goal is "equal protection" for everyone. During the course of the last two years of rule making meetings DEQ has on more than one occasion made the point that it is impossible for water quality criteria to provide equal protection for all Idahoans. It is an incontrovertible fact that the more water a person drinks and the more fish a person consumes, the higher will be his or her exposure and lifetime risk. For a given water quality criterion, each Idahoan has a unique exposure and risk because each Idahoan consumes different amounts of water and fish from waters regulated by the State over his or her lifetime. As long as each chemical is regulated with a single statewide criterion, and that criterion is not zero, these risks can never be made equal across the population.

Figure 3 shows the risk distributions for the general, angler, Nez Perce, and Shoshone Bannock populations of Idaho exposed to a hypothetical water quality criterion with a concentration equal to X ug/L. This figure demonstrates the relative positions of the risk distributions for these four populations.[25] While all four risk distributions overlap to a large extent, the bulk of the general population has the lowest risk, followed by the angler population, Shoshone Bannock population, and Nez Perce population, respectively. These relative positions remain the same regardless of the concentration of the hypothetical water quality criterion to which the populations are exposed. At concentrations equal to 0.01X ug/L and 100X ug/L of the hypothetical chemical, all four risk distributions shift downward by a factor of 100 or upward by a factor of 100, respectively. However, regardless whether the hypothetical criterion is increased or decreased, the risk distributions do not converge, and they never will. Highly exposed populations will always have greater risks no matter how big or small the water quality criterion and no single water quality criterion can afford equal protection to everyone.

[25] The distributions were developed using the same inputs as the Department used to develop the draft HHAWQC with the exception that the fish consumption rate distributions for the Nez Perce and Shoshone Bannock tribes were adjusted using the results of the recall survey and not the FFQ.

**Figure 3**
**Variation in Risk**



Utilizing the analysis of the fish consumption survey data in Appendix B, alternative HHWQC were calculated for three different scenarios utilizing EPA guidance (see Appendix D).

Scenario 1

- General population 95th percentile at Excess Lifetime Cancer Risk (ELCR) of $10^{-5}$ and Hazard Index (HI) of 1
- Tribal population mean at ELCR of $10^{-5}$ and HI of 1

Scenario 2

- General population 95th percentile at ELCR of $10^{-5}$ and HI of 1
- Tribal population 95th percentile at ELCR of $10^{-4}$ and HI of 1

Scenario 3

- General population 95th percentile at ELCR of $10^{-5}$ and HI of 1
- Tribal population 95th percentile at ELCR of $10^{-5}$ and HI of 1.

Table 4 shows the results of using this alternative risk targets for select chemicals.

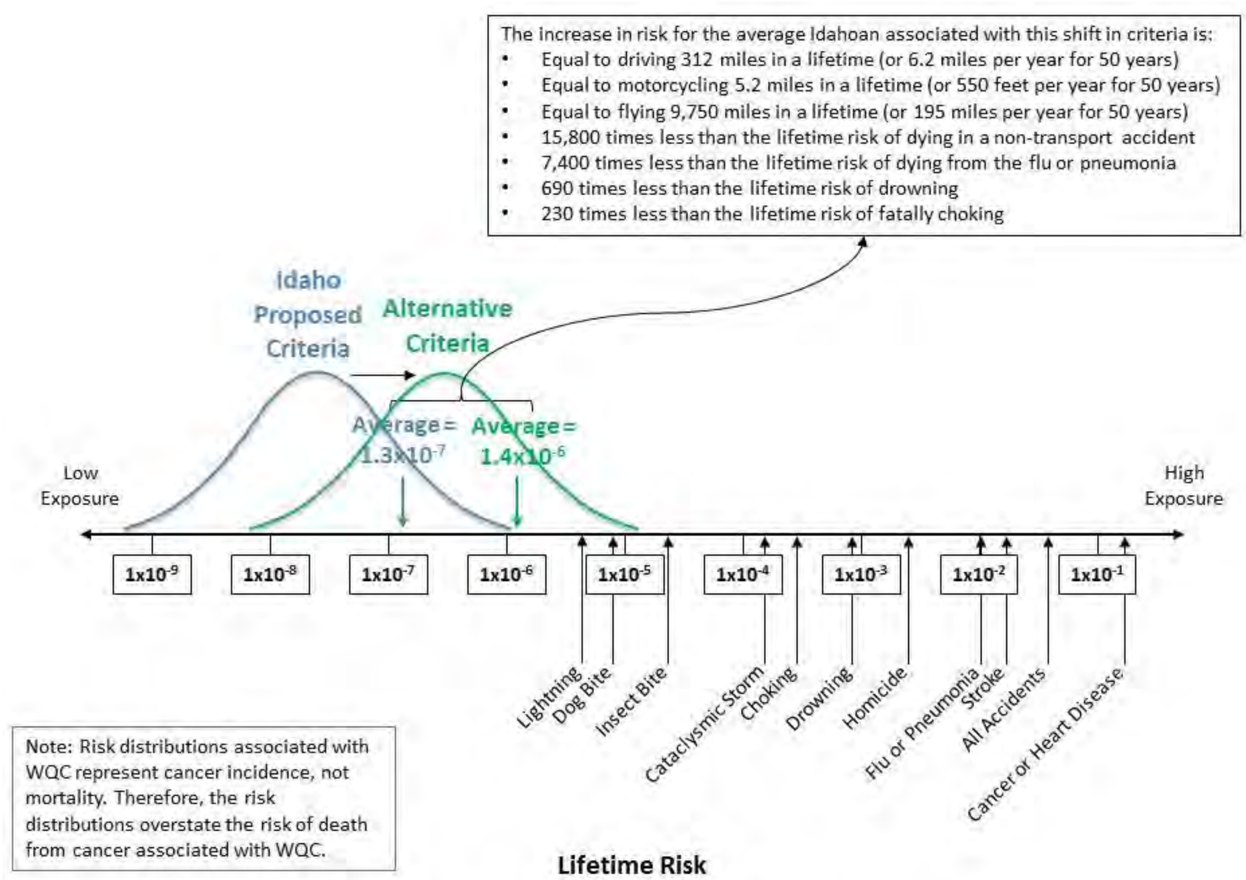
**Table 4**
**Alternate HHWQC Calculations**

| Chemical Name | Water + Organism HHWQC (µg/L) | | | | Organism Only HHWQC (µg/L) | | | |
|---|---|---|---|---|---|---|---|---|
| | **DEQ Proposal** | **Scenario 1** | **Scenario 2** | **Scenario 3** | **DEQ Proposal** | **Scenario 1** | **Scenario 2** | **Scenario 3** |
| **Selenium** | 20 | 20 | 20 | 20 | 800 | 1400 | 890 | 910 |
| **Thallium** | 0.038 | 0.036 | 0.035 | 0.035 | 0.075 | 0.13 | 0.081 | 0.083 |
| **Tetrachloro-ethylene** | 8.6 | 22 | 22 | 22 | 28 | 120 | 75 | 77 |
| **Dimethyl Phthalate** | 2000 | 3200 | 2100 | 2200 | 2000 | 3400 | 2100 | 2200 |
| **PCBs** | 0.000061 | 0.0011 | 0.0011 | 0.0007 | 0.000063 | 0.0011 | 0.0011 | 0.0007 |
| | | | | | | | | |

As Table 4 shows, depending upon the fish consumption and drinking water distributions, and other factors that go into the equations for calculating HHWQC, the criteria values can either stay the same, can decrease or increase as compared to the values proposed by DEQ. IACI recommends that a target risk of $10^{-5}$ for the 95th %tile of both general and NPT populations (scenario 3) provides protection of human health for Idaho residents. Such a risk target is consistent with guidance provided by EPA (EPA 2000).

Such a target risk value (as illustrated by Figure 4) shows that the relative risk to human health at a $10^{-5}$ is still much smaller than other risks that the public is exposed to daily. Additionally, the change in target risk from that used to calculate the proposed HHWQC to that used to calculate the alternative HHWQC as recommended by IACI is very small and will not result in a measureable change overall to public health (Figure 4). When the lack of a measureable change in public health is coupled with the dramatic increase in compliance costs for municipalities and industry described below, the target risk levels recommended by IACI represent a better public health policy choice than the target levels employed in the draft HHWQC proposed by DEQ.

**Figure 4**
**Lifetime Comparison of Risk and Death from Various Causes and Increased Cancer Risk Associated with HHWQC**




IACI believes that DEQ should utilize the flexibility provided in EPA guidance that allows for a range of risks and is also consistent with Idaho stringency statutes (Idaho Code 39-3602 and 39-107D). These laws direct DEQ not to adopt rules that are more stringent than the minimum requirements of the CWA unless specific conditions are met. DEQ's selection of $10^{-6}$ risk level is more stringent than required by the CWA. Therefore, we urge DEQ to consider a $10^{-5}$ risk target as noted herein, as it would be consistent with directives from the Idaho legislature.

### C.3. Effects of Science and Risk Policy Decisions

Risk management decisions can have a great influence on criteria values; the level of protection needs to assure protecting designated uses and not unrealistic risk scenarios. Risk thresholds need to accommodate that balance. Otherwise, the result are criteria, which because of unrealistic risk thresholds, exceed "background" or are otherwise unattainable or nearly unattainable. This issue is of utmost importance to the regulated community (and as described below also to Idaho residents) as certain of these chemicals exist naturally in Idaho (arsenic being an example), are primarily legacy contaminants (such as PCBs) or due to air deposition (which is primary source today of mercury addition to Idaho waters) [26]. Having unrealistic risk thresholds will result in significant expenditures to meet criteria that provide minimal (at best) improvements for human or ecological health.

The combination of conservative parameter values and risk policy decisions may result in HHWQC that are over-protective (i.e., lower in concentration) than are necessary to achieve public health protection. This is evidenced by looking at persistent bioaccumulative toxics such as PCBs and mercury. A review by NCASI (see Appendix E) of available fish tissue data for certain PBTs, concentrations of PBTs in the water column, a range of fish consumption rates and allowable concentrations of by various health agencies showed the following:[27]

- Concentrations of PCBs and mercury in fish from virtually all surface waters in the U.S. exceed fish tissue concentrations associated with HHWQC derived using a fish consumption rate for subsistence anglers (142 g/day).
- Fish tissue concentrations associated with HHWQC derived using a fish consumption rate for the general public (17.5 g/day) are 20 times to 4,000 times lower (more stringent) than fish consumption advisory "trigger levels" commonly used by state programs.
- The FDA food tolerances for PCBs, chlordane, and mercury in fish are, respectively, 500, 27, and 2.5 times greater than the fish tissue concentrations associated with HHWQC for those chemicals. If a fish consumption rate of 142 g/day is used to calculate the HHWQC, the FDA food tolerances for those chemicals are, respectively, 4,000, 214, and 20 times greater.

Idaho businesses and municipalities will have to upgrade treatment systems to meet discharge limits associated with water quality bodies that do not meet these overprotective HHWQC. A study done of potential costs to meet very low PCB numbers show potential implementation costs are in the tens of millions of dollars or possibly hundreds of millions of dollars. Such costs would be seen not only by industry, but also by municipalities. Sewer rates paid by Idaho residents would increase significantly to pay for the treatment needed to try to meet unrealistic HHWQC. That will increase the cost of living for those residents (and as noted above, with little

[26] This issue is discussed in detail in a recent paper by Judd et al 2015. Fish Consumption as a Driver of Risk-Management Decisions and Human Health-Based Water Quality Criteria. Env Toxicology and Chemistry. 34 (11), 2427. See pages 2434-2435 for discussion of PBTs.

[27] NCASI. 2012.

or no measurable benefit) (HDR 2013).[28] Increases in cost of living can lead to decreased socioeconomic status unless a concomitant increase in income occurs. Little reason exists to think that changes in HHWQC will lead to increases in income. In fact, the opposite may happen. If compliance costs rise substantially, the companies with facilities in Idaho that provide jobs to Idahoans may choose to relocate, further lowering the socioeconomic status of some Idahoans. Thus, the costs of more stringent HHWQC seem unwarranted in the absence of clear public health benefits that outweigh the potential costs.

Under state law, DEQ is required to estimate the costs, economic impact and evaluation of benefits for the proposed rule.[29] In light of the potentially significant costs associated with the proposed rule, DEQ should evaluate the costs and any benefits associated with its proposed risk policy decision. Such an analysis should be done for both the proposed target risk value and with a target risk value such as $10^{-5}$ so that a differential of benefits and costs can be examined.

IACI believes that DEQ needs to reconsider risk targets for both the state of Idaho and high-consuming subpopulations. Besides making this risk target change, DEQ should seek funding for a statewide study looking at concentrations of these PBTs in Idaho waters and associated risk to Idaho and high-consuming subpopulations. Such a study would provide state-specific data to understand PBTs in the environment, risk to the general and subpopulations, and any potential changes needed in the future for HHWQC.

## D. Other Considerations in Establishing Human Health Water Quality Criteria

### D.1. Concept of Suppression

During the rulemaking process, there was discussion of the concept of "suppression": whether the levels of contamination in game fish in Idaho "suppress" fish consumption rates. A similar concept is that historically subpopulations had higher fish consumption rates, but these "heritage rates" are no longer possible due to either "suppression" or lack of available fish.

To determine if contamination levels in Idaho fish might be "suppressing" fish consumption rates, health-advisories for fish consumption were reviewed. As described in Appendix F, there is one state-wide advisory for bass consumption and 22 water body-specific advisories for consumption of various other species. All these advisories are based on mercury, with the exception of Lake Coeur d'Alene, which has advisories based on arsenic and lead in addition to mercury.

A fish consumption advisory is based on when concentrations of a contaminant exceed risk thresholds based on consuming monthly 8.5 meals (4 ounces uncooked per meal) of fish per month. This equates to a fish consumption rate of 32 grams per day. The risk threshold is adjusted for sensitive populations (children and pregnant women); this may reduce the fish consumption. It should be noted that, as shown in Table 1 of Appendix F, for the general population, more than 8.5 meals per month of fish can be eaten for most of the waters that

[28] HDR Engineering, Inc (HDR). 2013. *Treatment Technology Review and Assessment*. December 4.
[29] See Idaho Code 67-5223 and 39-102A(6).

have fish advisories.[30] Thus, it is unlikely that fish contaminant concentrations have any measureable "suppression" effect on the consumption rates of Idaho game fish.

There have been documents prepared to try to determine "heritage" or "suppression rates." A review of such information (see Appendix G) shows that information in such documents has not gone through a rigorous scientific validation process (similar to the process that current fish consumption rate studies go through) and thus is too speculative and unreliable in setting water quality standards. We note that EPA has published protocols for conducting fish surveys and for quantifying fish consumption rates around the United States.[31] These studies represent the most current and best available methods for quantifying fish consumption rates in setting human heath criteria. The focus of these studies and methodologies is on obtaining objectively defensible fish consumption rates based on current and actual fish consumption. Hypothetical fish consumption rates are not considered, and therefore none of these studies rely upon suppression or heritage rates in quantifying fish consumption rates.

Moreover, use of suppression rates or heritage rates to set water quality standards is beyond the minimum requirements of the Clean Water Act and, as such, is prohibited under Idaho law. As described earlier in these comments, *The Idaho Environmental Protection and Health Act* at Idaho Code Section 107D(2) specifies that whenever DEQ promulgates a rule based on science, DEQ shall "utilize the best available peer reviewed science and supporting studies conducted in accordance with sound and objective scientific objectives and data collected by accepted methods or best available methods…" IACI is unaware of any peer reviewed science and studies that support the use of suppression rates in setting human health criteria. Similarly, we are unaware of any accepted or best available methods to collect suppression rates that would warrant using such "data" in setting human health criteria. Accordingly, IACI believes that DEQ is precluded from relying on suppression rates in setting human health criteria pursuant to Idaho Code 39-107D.

For similar reasons, we believe that DEQ cannot rely on suppression rates in setting human health criteria because Idaho law stipulates that DEQ-promulgated water quality rules "not impose requirements beyond [the requirements] of the federal clean water act." Idaho Code 39-3601. IACI is unaware of any requirement under the Clean Water Act which requires that states must rely upon suppression rates in setting human health criteria. On the contrary, EPA has published national recommended human health criteria as well as methodologies for states to follow in quantifying fish consumption. None of these documents specify that suppression rates should be considered in setting human health criteria. Consideration of suppression rates in setting human health criteria is not a requirement of the Clean Water Act, and accordingly should not be utilized by DEQ in setting human health criteria under Idaho's stringency statutes.

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[30] This is equivalent to 31 grams/day of fish.

[31] *See e.g. Estimated Fish Consumption Rates for the U.S. Population and Sub-Population* (NHANES 2003-2010) (EPA 2014); *Guidance for Conducting Fish and Wildlife Consumption Survey* (EPA 1998).

It is clear that federal rules require that state human health criteria be based on "sound scientific rationale" before they can be approved by EPA. 40 CFR 131.11(a)(1). As noted above, use of suppression rates in setting human health criteria is not scientifically defensible and there are no peer reviewed methodologies that support reliance upon this type of information. Accordingly, we believe that reliance upon suppression rates in setting human health criteria would not be based on "sound scientific rationale" and, as such, do not meet the requirements of the Clean Water Act.

Finally, the adoption of a heritage rate would be a new or revised designated use. When revising designated uses, DEQ must consider the economic costs of fully meeting a revised designated use. Idaho Code § 39-3604. No such evaluation has been undertaken.

IACI supports DEQ's decision not to include "suppression" or "heritage" rates in determining Idaho fish consumption rates.

**D.2. Tribal Treaties and Idaho Water Quality Standards**

At various times in the rulemaking process, there has been an assertion by several stakeholders that tribes have a legally protected property interest associated with treaty right rights to take fish in usual and accustomed places, including the preservation of the physical condition of fish taken. For example, in its January 16, 2015 letter to DEQ, CRITFC stated, "Tribal rights to fish are guaranteed in treaties with the United States. CRITFC's member tribes ceded roughly one-third of the Columbia Basin to the United States government, but forever retained the right to take fish from these waters. <u>Implicit in the treaty promises of 1855 was the understanding that the fish taken would be healthy and safe to eat</u>" (emphasis added). Additionally, the Nez Perce Tribe asserted that its treaty rights included "a legally protected property interest" covering both access to usual and customary places and the taking of fish destined for those places.[32]

These representations are not supported by federal law interpreting the Nez Perce Tribe's 1855 treaty rights concerning the right to fish (see Appendix H). In Nez Perce Tribe v. Idaho Power Co., the court held that the Nez Perce Tribe "does not own the fish runs or the fish but rather, it owns a treaty right to take fish from its usual and customary places as specified in the 1855 treaty." Moreover, the Court found that "Indian tribes do not have an absolute right to the preservation of the fish runs in their original 1855 condition, free from all environmental damage caused by the migration of increasing numbers of settlers and the resulting development of land." The court went on to state that "the Tribe's right to fish pursuant to the 1855 Stevens treaty only guarantees access to certain off-reservation fishing grounds and the right to attempt to catch available fish….The Stevens treaties require that any development authorized by the states which injures the fish runs be non-discriminatory in nature, but does not however, guarantee that subsequent development will not diminish or eventually, and unfortunately, destroy the fish." The Court's ruling is consistent with *Blackfeet, etc. Nations or Tribes of Indians,* in which the Court of Claims held that "the right to hunt the common grounds did not include 'any terms guaranteeing to the Indians a maintenance of the status quo for

[32] See Nez Perce Tribe written comments, January 15, 2015.

almost a century." Therefore, representations that treaty rights implicitly include the right to take fish of a certain quantity or condition is not supported by Idaho law examining the question.

IACI does not believe that treaty rights result in a special designated use for water quality purposes or result in additional provisions of the recreation designed use.

**D.3. Downstream Waters**

IACI requests that proposed Section 070.08 be withdrawn for the reason articulated in our letter of August 21, 2015 as well as Clearwater Paper's letter of August 20, 2015. In sum the downstream waters provision does not appear necessary and if it is in the future, it should be subject to a different negotiated rule-making. The provision also introduces a variety of new and undefined concepts that IACI cannot discern their potential impact to this rulemaking or future activities by DEQ and EPA. Illustrative of this uncertainty, does the proposed human health criteria rule comply with this new provision? As noted above, Oregon has adopted human health criteria that are likely an order of magnitude more stringent than DEQ's proposed rule. Many Idaho waters directly or indirectly flow into Oregon waters. In fact, the Snake River forms the border between the two states for hundreds of miles.

Does this new provision mean that Idaho waters must meet Oregon's human health criteria? If so, then it appears that DEQ's efforts in relying upon a science-based approach to setting human health criteria has been a wasted effort. We are hopeful that such is not intent of the downstream water provision and that this provision is not abdicating the state of Idaho's sovereignty to establish designated uses and water quality criteria to downstream states or Tribes. However in light of the vague terms used in this provision, we are concerned that third parties may use this provision to suggest such a result. Accordingly we believe DEQ should withdraw this provision and consider addressing this issue in another negotiated rulemaking.

**E. Recommendations for the Integration of Science and Risk Policy**

The selection of values used for parameters in a health risk equation for deriving human health water quality criteria is a combination of science and policy choices. Responsible evaluation of risk (and thus protection of health) is best considered in total rather than by a simple alteration of a simple parameter value with due consideration of the others. An examination of the parameter values with utilization of the best scientific information (an in particular, Idaho specific data), and balanced target risk management leads IACI to recommend the following parameters and decisions in regards to calculating human health water quality criteria:

- Use a probabilistic methodology for representing distributions of data.
- Use of Idaho body weight and U.S. drinking water intake distributions.
- The use of bioaccumulation factors, and in particular Idaho waters specific BAF when the data are available.

- Chemical-specific calculation of Relative Source Contribution when the data are available. IACI has provided data for eleven substances for which a RSC other than EPA's default can be used.
- The use of "Idaho fish" for determining fish consumption rates in Idaho.
- That the HHWQC be calculated using a probabilistic methodology at a target risk rate of $10^{-5}$ for the 95 %tile for Idaho's general and tribal populations.
- Regulatory provisions are needed to address ubiquitous persistent bioaccumulative toxins such as mercury, PCBs and arsenic. This would include conducting statewide studies to further determine ambient water quality concentrations (including in pristine waters) and an accompanying focused risk assessment for such substances. Such a study would provide a scientific foundation to understand background concentrations (including natural sources), levels of contributions from current regulated sources, provide data to more accurately access risks and make any adjustments needed in HHWQC.

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# Appendix A:

# Bioaccumulation Factor Calculations

### Table 1 Weighted BAFs as Presented by IDEQ and Alternate BAFs Calculated for the Nez Perce

| Chemical | Idaho WQS Number | BAF as Presented by IDEQ[1] Trophic Level 2 | Trophic Level 3 | Trophic Level 4 | Weighted Average (EPA Defaults) | Weighted Average (General Population) | Weighted Average (Nez Perce-specific) | Alternate[2] Weighted Average (Nez Perce-specific) | BCF[1] | Selected BAF or BCF Value[1] General Population (using EPA defaults) | General Population (Idaho-specific) | Nez Perce (Idaho-specific) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antimony | 1 | - | - | - | - | - | - | - | 1.0 | 1.0 | 1.0 | 1.0 |
| Nickel | 9 | - | - | - | - | - | - | - | 47 | 47 | 47 | 47 |
| Selenium | 10 | - | - | - | - | - | - | - | 4.8 | 4.8 | 4.8 | 4.8 |
| Thallium | 12 | - | - | - | - | - | - | - | 116 | 116 | 116 | 116 |
| Zinc | 13 | - | - | - | - | - | - | - | 47 | 47 | 47 | 47 |
| Cyanide | 14 | - | - | - | - | - | - | - | 1.0 | 1.0 | 1.0 | 1.0 |
| 2,3,7,8 TCDD | 16 | - | - | - | - | - | - | - | 5000 | 5000 | 5000 | 5000 |
| Acrolein | 17 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | - | 1.0 | 1.0 | 1.0 |
| Acrylonitrile | 18 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | - | 1.0 | 1.0 | 1.0 |
| Benzene | 19 | 3.6 | 4.5 | 5 | 4.3 | 4.5 | 4.6 | 4.6 | - | 4.3 | 4.5 | 4.6 |
| Bromoform | 20 | 5.8 | 7.5 | 8.5 | 7.1 | 7.5 | 7.7 | 7.6 | - | 7.1 | 7.5 | 7.7 |
| Carbon Tetrachloride | 21 | 9.3 | 12 | 14 | 11 | 12 | 13 | 12 | - | 11 | 12 | 13 |
| Chlorobenzene | 22 | 14 | 19 | 22 | 18 | 19 | 20 | 19 | - | 18 | 19 | 20 |
| Chlorodibromomethane | 23 | 3.7 | 4.8 | 5.3 | 4.5 | 4.8 | 4.9 | 4.8 | - | 4.5 | 4.8 | 4.9 |
| Chloroform | 26 | 2.8 | 3.4 | 3.8 | 3.3 | 3.4 | 3.5 | 3.5 | - | 3.3 | 3.4 | 3.5 |
| Dichlorobromomethane | 27 | 3.4 | 4.3 | 4.8 | 4.1 | 4.3 | 4.4 | 4.4 | - | 4.1 | 4.3 | 4.4 |
| 1,2-Dichloroethane | 29 | 1.6 | 1.8 | 1.9 | 1.8 | 1.8 | 1.8 | 1.8 | - | 1.8 | 1.8 | 1.8 |
| 1,1-Dichloroethylene | 30 | 2.0 | 2.4 | 2.6 | 2.3 | 2.4 | 2.4 | 2.4 | - | 2.3 | 2.4 | 2.4 |
| 1,2-Dichloropropane | 31 | 2.9 | 3.5 | 3.9 | 3.4 | 3.5 | 3.6 | 3.6 | - | 3.4 | 3.5 | 3.6 |
| 1,3-Dichloropropene | 32 | 2.3 | 2.7 | 3 | 2.6 | 2.7 | 2.8 | 2.7 | - | 2.6 | 2.7 | 2.8 |
| Ethylbenzene | 33 | 100 | 140 | 160 | 130 | 140 | 140 | 142 | - | 130 | 140 | 140 |
| Methyl Bromide | 34 | 1.2 | 1.3 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | - | 1.3 | 1.3 | 1.3 |
| Methylene Chloride | 36 | 1.4 | 1.5 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | - | 1.5 | 1.5 | 1.5 |
| 1,1,2,2-Tetrachloroethane | 37 | 5.7 | 7.4 | 8.4 | 7.0 | 7.4 | 7.6 | 7.5 | - | 7.0 | 7.4 | 7.6 |
| Tetrachloroethylene (Perchloroethylene) | 38 | 49 | 66 | 76 | 62 | 66 | 68 | 67 | - | 62 | 66 | 68 |
| Toluene | 39 | 11 | 15 | 17 | 14 | 15 | 15 | 15 | - | 14 | 15 | 15 |
| trans-1,2-Dichloroethylene (DCE) | 40 | 3.3 | 4.2 | 4.7 | 4.0 | 4.2 | 4.3 | 4.3 | - | 4.0 | 4.2 | 4.3 |
| 1,1,1-Trichloroethane | 41 | 6.9 | 9.0 | 10 | 8.5 | 9.0 | 9.2 | 9.1 | - | 8.5 | 9.0 | 9.2 |
| 1,1,2-Trichloroethane | 42 | 6.0 | 7.8 | 8.9 | 7.4 | 7.8 | 8.1 | 7.9 | - | 7.4 | 7.8 | 8.1 |
| Trichloroethylene (TCE) | 43 | 8.7 | 12 | 13 | 11 | 12 | 12 | 12.0 | - | 11 | 12 | 12 |
| Vinyl Chloride | 44 | 1.4 | 1.6 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | - | 1.6 | 1.6 | 1.6 |
| 2-Chlorophenol | 45 | 3.8 | 4.8 | 5.4 | 4.6 | 4.8 | 4.9 | 4.9 | - | 4.6 | 4.8 | 4.9 |
| 2,4-Dichlorophenol | 46 | 31 | 42 | 48 | 39 | 42 | 43 | 43 | - | 39 | 42 | 43 |
| 2,4-Dimethylphenol | 47 | 4.8 | 6.2 | 7.0 | 5.9 | 6.2 | 6.4 | 6.3 | - | 5.9 | 6.2 | 6.4 |
| 2-Methyl-4,6-Dinitrophenol | 48 | 6.8 | 8.9 | 10 | 8.4 | 8.9 | 9.1 | 9.0 | - | 8.4 | 8.9 | 9.1 |
| 2,4-Dinitrophenol | 49 | - | - | - | - | - | - | - | 4.4 | 4.4 | 4.4 | 4.4 |
| 3-Methyl-4-Chlorophenol | 52 | 25 | 34 | 39 | 32 | 34 | 35 | 35 | - | 32 | 34 | 35 |
| Pentachlorophenol | 53 | 44 | 290 | 520 | 250 | 310 | 370 | 334 | - | 250 | 310 | 370 |
| Phenol | 54 | 1.5 | 1.7 | 1.9 | 1.7 | 1.7 | 1.8 | 1.7 | - | 1.7 | 1.7 | 1.8 |
| 2,4,6-Trichlorophenol | 55 | 94 | 130 | 150 | 120 | 130 | 130 | 133 | - | 120 | 130 | 130 |
| Acenaphthene | 56 | - | - | - | - | - | - | - | 510 | 510 | 510 | 510 |
| Anthracene | 58 | - | - | - | - | - | - | - | 610 | 610 | 610 | 610 |
| Benzidine | 59 | 1.4 | 1.6 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | - | 1.6 | 1.6 | 1.6 |
| Benzo(a)anthracene | 60 | - | - | - | - | - | - | - | 3900 | 3900 | 3900 | 3900 |
| Benzo(a)pyrene | 61 | - | - | - | - | - | - | - | 3900 | 3900 | 3900 | 3900 |
| Benzo(b)fluoranthene | 62 | - | - | - | - | - | - | - | 3900 | 3900 | 3900 | 3900 |
| Benzo(k)fluoranthene | 64 | - | - | - | - | - | - | - | 3900 | 3900 | 3900 | 3900 |
| Bis(2-Chloroethyl) Ether | 66 | 1.4 | 1.6 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | - | 1.6 | 1.6 | 1.6 |
| Bis(2-Chloro-1-Methylethyl) Ether | 67 | 6.7 | 8.8 | 10 | 8.3 | 8.8 | 9.1 | 9.0 | - | 8.3 | 8.8 | 9.1 |
| Bis(2-Ethylhexyl) Phthalate | 68 | - | - | - | - | - | - | - | 710 | 710 | 710 | 710 |
| Butylbenzyl Phthalate | 70 | - | - | - | - | - | - | - | 19000 | 19000 | 19000 | 19000 |
| 2-Chloronaphthalene | 71 | 150 | 210 | 240 | 200 | 210 | 220 | 213 | - | 200 | 210 | 220 |
| Chrysene | 73 | - | - | - | - | - | - | - | 3900 | 3900 | 3900 | 3900 |
| Dibenzo(a,h)anthracene | 74 | - | - | - | - | - | - | - | 3900 | 3900 | 3900 | 3900 |
| 1,2-Dichlorobenzene | 75 | 52 | 71 | 82 | 67 | 71 | 74 | 72 | - | 67 | 71 | 74 |
| 1,3-Dichlorobenzene | 76 | 31 | 120 | 190 | 100 | 120 | 140 | 132 | - | 100 | 120 | 140 |
| 1,4-Dichlorobenzene | 77 | 28 | 66 | 84 | 56 | 66 | 69 | 68 | - | 56 | 66 | 69 |
| 3,3'-Dichlorobenzidine | 78 | 44 | 60 | 69 | 56 | 60 | 62 | 61 | - | 56 | 60 | 62 |
| Diethyl Phthalate | 79 | - | - | - | - | - | - | - | 920 | 920 | 920 | 920 |
| Dimethyl Phthalate | 80 | - | - | - | - | - | - | - | 4000 | 4000 | 4000 | 4000 |
| Di-n-Butyl Phthalate | 81 | - | - | - | - | - | - | - | 2900 | 2900 | 2900 | 2900 |
| 2,4-Dinitrotoluene | 82 | 2.8 | 3.5 | 3.9 | 3.3 | 3.5 | 3.6 | 3.5 | - | 3.3 | 3.5 | 3.6 |
| 1,2-Diphenylhydrazine | 85 | 18 | 24 | 27 | 23 | 24 | 25 | 24 | - | 23 | 24 | 25 |
| Fluoranthene | 86 | - | - | - | - | - | - | - | 1500 | 1500 | 1500 | 1500 |
| Fluorene | 87 | 230 | 450 | 710 | 430 | 480 | 550 | 502 | - | 430 | 480 | 550 |
| Hexachlorobenzene | 88 | 18000 | 46000 | 90000 | 46000 | 51000 | 65000 | 55370 | - | 46000 | 51000 | 65000 |
| Hexachlorobutadiene | 89 | 23000 | 2800 | 1100 | 9800 | 4300 | 5600 | 3371 | - | 9800 | 4300 | 5600 |
| Hexachlorocyclopentadiene | 90 | 620 | 1500 | 1300 | 1100 | 1400 | 1200 | 1399 | - | 1100 | 1400 | 1200 |
| Hexachloroethane | 91 | 1200 | 280 | 600 | 690 | 420 | 630 | 405 | - | 690 | 420 | 630 |
| Indeno(1,2,3-cd)pyrene | 92 | - | - | - | - | - | - | - | 3900 | 3900 | 3900 | 3900 |
| Isophorone | 93 | 1.9 | 2.2 | 2.4 | 2.1 | 2.2 | 2.3 | 2.2 | - | 2.1 | 2.2 | 2.3 |
| Nitrobenzene | 95 | 2.3 | 2.8 | 3.1 | 2.7 | 2.8 | 2.9 | 2.8 | - | 2.7 | 2.8 | 2.9 |
| N-nitrosodimethylamine | 96 | - | - | - | - | - | - | - | 0.026 | 0.026 | 0.026 | 0.026 |
| N-Nitrosodi-n-Propylamine | 97 | - | - | - | - | - | - | - | 1.13 | 1.13 | 1.13 | 1.13 |
| N-Nitrosodiphenylamine | 98 | - | - | - | - | - | - | - | 136 | 136 | 136 | 136 |
| Pyrene | 100 | - | - | - | - | - | - | - | 860 | 860 | 860 | 860 |
| 1,2,4-Trichlorobenzene | 101 | 2800 | 1500 | 430 | 1700 | 1400 | 1200 | 1290 | - | 1700 | 1400 | 1200 |
| Aldrin | 102 | 18000 | 310000 | 650000 | 280000 | 340000 | 440000 | 378850 | - | 280000 | 340000 | 440000 |
| alpha-Hexachlorocyclohexane (HCH) | 103 | 1700 | 1400 | 1500 | 1500 | 1400 | 1500 | 1433 | - | 1500 | 1400 | 1500 |
| beta-Hexachlorocyclohexane (HCH) | 104 | 110 | 160 | 180 | 150 | 160 | 160 | 162 | - | 150 | 160 | 160 |
| gamma- Hexachlorocyclohexane (HCH) | 105 | 1200 | 2400 | 2500 | 2000 | 2300 | 2200 | 2353 | - | 2000 | 2300 | 2200 |
| Chlordane | 107 | 5300 | 44000 | 60000 | 34000 | 43000 | 46000 | 45845 | - | 34000 | 43000 | 46000 |
| p,p'-Dichlorodiphenyltrichloroethane (DDT) | 108 | 35000 | 240000 | 1100000 | 360000 | 370000 | 670000 | 443550 | - | 360000 | 370000 | 670000 |
| p,p'-Dichlorodiphenyldichloroethylene (DDE) | 109 | 270000 | 1100000 | 3100000 | 1300000 | 1400000 | 2000000 | 1553000 | - | 1300000 | 1400000 | 2000000 |
| p,p'-Dichlorodiphenyldichloroethane (DDD) | 110 | 33000 | 140000 | 240000 | 120000 | 150000 | 170000 | 158950 | - | 120000 | 150000 | 170000 |
| Dieldrin | 111 | 14000 | 210000 | 410000 | 180000 | 230000 | 280000 | 249150 | - | 180000 | 230000 | 280000 |
| alpha-Endosulfan | 112 | 130 | 180 | 200 | 170 | 180 | 180 | 182 | - | 170 | 180 | 180 |
| beta-Endosulfan | 113 | 80 | 110 | 130 | 100 | 110 | 120 | 113 | - | 100 | 110 | 120 |
| Endosulfan Sulfate | 114 | 88 | 120 | 140 | 110 | 120 | 130 | 123 | - | 110 | 120 | 130 |
| Endrin | 115 | 4600 | 36000 | 46000 | 27000 | 35000 | 36000 | 36750 | - | 27000 | 35000 | 36000 |
| Endrin Aldehyde | 116 | 440 | 920 | 850 | 730 | 860 | 790 | 874 | - | 730 | 860 | 790 |
| Heptachlor | 117 | 12000 | 180000 | 330000 | 150000 | 190000 | 230000 | 208200 | - | 150000 | 190000 | 230000 |
| Heptachlor Epoxide | 118 | 4000 | 28000 | 35000 | 21000 | 27000 | 27000 | 28410 | - | 21000 | 27000 | 27000 |
| PCBs | 119 | - | - | - | - | - | - | - | 31200 | 31200 | 31200 | 31200 |
| Toxaphene | 120 | 1700 | 6600 | 6300 | 4800 | 6100 | 5500 | 6247 | - | 4800 | 6100 | 5500 |
| 1,2,4,5-Tetrachlorobenzene | none | 17000 | 2900 | 1500 | 7700 | 3900 | 4800 | 3241 | - | 7700 | 3900 | 4800 |
| 2,4,5-Trichlorophenol | none | 100 | 140 | 160 | 130 | 140 | 140 | 142 | - | 130 | 140 | 140 |
| Bis(Chloromethyl) Ether | none | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | - | 1.0 | 1.0 | 1.0 |
| Chlorophenoxy Herbicide (2,4,5-TP) [Silvex] | none | - | - | - | - | - | - | - | 58 | 58 | 58 | 58 |
| Chlorophenoxy Herbicide (2,4-D) | none | - | - | - | - | - | - | - | 13 | 13 | 13 | 13 |
| Dinitrophenols | none | - | - | - | - | - | - | - | 1.51 | 1.51 | 1.51 | 1.51 |
| Hexachlorocyclohexane (HCH)-Technical | none | 160 | 220 | 250 | 210 | 220 | 230 | 223 | - | 210 | 220 | 230 |
| Methoxychlor | none | 1400 | 4800 | 4400 | 3500 | 4400 | 3900 | 4506 | - | 3500 | 4400 | 3900 |
| Pentachlorobenzene | none | 3500 | 4500 | 10000 | 5400 | 5400 | 7300 | 5803 | - | 5400 | 5400 | 7300 |

**BAF - bioaccumulation factor**
**BCF - bioconcentration factor**
**HH - human health**
**NRWQC - National Recommended Water Quality Criteria**
**WQC - water quality criteria**
**WQS - water quality standard**
[1] **Windward 2015**
[2] **Calculated using Weights developed by Arcadis using dietary recall data from the Nez Perce tribal fish consumption survey.**

# Appendix B:

# Release Source Contribution Data

# DERIVATION OF ALTERNATE RELATIVE SOURCE CONTRIBUTION FACTORS

November 2015

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Date:

November 2015

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AMA | Ambient Monitoring Archive |
| BAF | bioaccumulation factor |
| BBP | butylbenzyl phthalate |
| EWG | Environmental Working Group |
| FDEP | Florida Department of Environmental Protection |
| HHAWQC | human health ambient water quality criteria |
| IDEQ | Idaho Department of Environmental Quality |
| IRIS | Integrated Risk Information System |
| MCL | maximum contaminant level |
| PAH | polycyclic aromatic hydrocarbons |
| ppb | parts per billion |
| RfD | reference dose |
| RSC | relative source contribution |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |

# 1 INTRODUCTION

On October 7, 2015, the Idaho Department of Environmental Quality (IDEQ) released its draft human health ambient water quality criteria (HHAWQC) rule. The draft HHAWQC were calculated using relative source contribution (RSC) factors adopted from the 2015 United States Environmental Protection Agency (USEPA) update of HHAWQC (USEPA 2015). The recent USEPA guidance (2015) and the proposed IDEQ draft HHAWQC recommend using an RSC factor to account for non-ambient exposures when deriving human health water quality criteria (HHWQC) for non-carcinogens. The RSCs can be based on chemical-specific information or on an arbitrary default value of 0.2 when the USEPA determines that data or resources are not available to derive reliable quantitative estimates for all (surface water and non-surface water) relevant exposure pathways. However, if exposure estimates are available for all non-surface water related exposure pathways, the remaining exposure below the allowable daily intake or exposure (typically the reference dose, RfD) can be conservatively allocated to surface water sources.

This report presents the calculation of chemical-specific RSCs for the following 11 compounds: acenaphthalene, anthracene, fluoranthene, fluorene, pyrene, 2-chlorophenol, selenium, diethyl phthalate, chloroform, butylbenzyl phthalate (BBP) and toluene. The recent USEPA updated HHAWQC (USEPA 2015) concluded that insufficient data are available to derive exposure estimates for all 11 of these compounds and have thus incorporated the default RSC of 0.2 in the calculation of each HHAWQC. Contrary to USEPA's conclusions and consistent with the recent information compiled by the Florida Department of Environmental Protection (FDEP 2014), Arcadis determined that sufficient data are available to develop conservative estimates of non-surface water exposures and robust, scientifically defensible and conservative RSCs. As summarized in the table below, the Arcadis derived RSCs are greater than the default RSC of 0.2. Using the chemical-specific RSCs results in HHAWQC that are 2 to 5 times greater than HHAWQC derived using a default RSC. Arcadis recommends that final Idaho HHAWQC for these eleven compounds incorporate the RSCs derived in this report.

| Compound | IDEQ Draft RSCs | Arcadis Proposed RSCs | Idaho Draft HHAWQC (ug/L) | Idaho Draft HHAWQC adjusted with Arcadis RSC (ug/L) |
|---|---|---|---|---|
| Acenaphthene | 0.2 | 0.99 | 78 | 386 |
| Anthracene | 0.2 | 1.0 | 340 | 1700 |
| Fluoranthene | 0.2 | 1.0 | 20 | 100 |
| Fluorene | 0.2 | 0.99 | 51 | 252 |
| Pyrene | 0.2 | 1.0 | 26 | 130 |
| 2-chlorophenol | 0.2 | 0.91 | 19 | 86 |
| Selenium | 0.2 | 0.65 | 20 | 65 |
| Diethyl phthalate | 0.2 | 0.97 | 620 | 3007 |
| Chloroform | 0.2 | 0.64 | 39 | 125 |
| Toluene | 0.2 | 0.31 | 36 | 56 |
| Butylbenzyl phthalate | 0.2 | 0.99 | 0.11 | 0.54 |

# 2 NON-CARCINOGENIC PAHS

The recent 2015 USEPA Update of HHAWQC (USEPA 2015) selects an RSC of 0.2 for the following five polycyclic aromatic hydrocarbons (PAHs) that are considered to be non-carcinogenic: acenaphthene, anthracene, fluoranthene, fluorene, and pyrene. USEPA (2015) indicates that information is not available to quantitatively characterize exposure from all potentially significant sources of PAHs. According to the USEPA (2000), relevant sources and pathways for consideration in the RSC include both ingestion and routes other than oral for water-related exposures and non-water sources of exposure, including ingestion exposures (e.g., food), inhalation, and/or dermal. In 2014, the FDEP conducted an extensive review of the information available on exposure to these five non-carcinogenic PAHs. As a result of that review FDEP derived the following RSCs:

| PAH | FDEP (2014) RSC |
|---|---|
| Acenaphthene | 0.95 |
| Anthracene | 1 |
| Fluoranthene | 0.99 |
| Fluorene | 0.92 |
| Pyrene | 0.99 |

Arcadis reviewed information relevant to the derivation of an RSC for acenaphthene, anthracene, fluoranthene, fluorene, and pyrene. Specifically, information about concentrations of these PAHs in various environmental media and exposure assessment approaches used by FDEP and USEPA were reviewed and updated as appropriate. Based on the physical properties and available exposure information for acenaphthene, anthracene, fluoranthene, fluorene, and pyrene; air, diet, soil, and drinking water are potential exposure sources. To the contrary of USEPA's conclusions and consistent with the information developed by FDEP in 2014, sufficient data are available to develop conservative estimates of non-surface water exposure to these non-carcinogenic PAHs and to develop a robust, scientifically defensible and conservative RSCs.

Ambient air exposures were estimated in FDEP (2014) using concentration data obtained from a Florida – specific study (Poor et al. 2004). For this assessment, available ambient air data collected by the IDEQ were obtained for acenaphthene, anthracene, fluoranthene, and pyrene from the USEPA Ambient Monitoring Archive[1] (AMA). Idaho-specific ambient air data for fluorene was not reported in the AMA. The following table summarizes the AMA data for individual PAH ambient air concentrations collected from December 2002 through March 2005 for Site ID 160270004 located in Nampa, the second largest city in Idaho, and centrally located in the Treasure Valley[2]. These data are reported as the total of both gas-phase and particle-phase ambient air concentrations for individual PAHs, as PAHs occur in the atmosphere in both the vapor phase and the particle phase.

[1] http://www.epa.gov/ttnamti1/toxdat.html#data

[2] According to the IDEQ (IDEQ 2009), Nampa has a diverse source profile including Title V (major point sources) and minor sources, light industry, and sprawling residential areas feeding heavy commuter traffic. As such, these concentrations likely overestimate the concentrations of these PAHs in many areas of Idaho and can, therefore, be considered conservative estimates of the air concentrations of these PAHs for Idaho.

| PAH | Minimum Total Gas and Particle Phase Result ($ng/m^3$) | Maximum Total Gas and Particle Phase Result ($ng/m^3$) | Mean Total Gas and Particle Phase Result ($ng/m^3$) |
|---|---|---|---|
| Acenaphthene | <0.05 | 4.48 | 0.68 |
| Anthracene | <0.05 | 4.65 | 0.85 |
| Fluoranthene | 0.05 | 5.97 | 1.52 |
| Pyrene | 0.05 | 5.29 | 1.42 |

**Note**: Data obtained from USEPA Ambient Monitoring Archive.

Mean outdoor air values were combined with a revised upper percentile outdoor breathing rate of 3.6 $m^3$/day and an updated body weight of 80 kg to derive ambient air exposures to acenaphthene, anthracene, fluoranthene, and pyrene. FDEP uses an assumed bodyweight of 70 kg, whereas Arcadis assumes a bodyweight of 80 kg per USEPA (2011a) and consistent with the bodyweight assumed by USEPA recently updated HHAWQC (USEPA 2015). For the outdoor breathing rate, FDEP (2014) assumes a value of 3.12 $m^3$/day derived from a mean breathing rate of 16 $m^3$/day obtained from USEPA (2011a) and an adjustment to account for time spent outdoors (20%) versus indoors (80%) per Table 16-22a of USEPA (2011a). Arcadis uses this same 20% adjustment to determine an outdoor breathing rate of 3.6 $m^3$/day; however, Arcadis applies this adjustment to the 90$^{th}$ percentile breathing rate of 18 $m^3$/day (Table 6-4 USEPA 2011a; mean of 90$^{th}$ percentile male and female values) instead of the mean breathing rate. Ambient air exposures for fluorene are consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight of 80 kg and the revised upper percentile breathing rate of 3.6 $m^3$/day.

Methods used in this assessment to determine indoor air exposures to individual PAHs are consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight (80 kg was used in this assessment versus 70 kg) and the use of a revised upper percentile indoor breathing rate. Specifically, mean indoor air PAH concentrations identified in FDEP (2014) were combined with an indoor breathing rate of 14.4 $m^3$/day and a body weight of 80 kg. FDEP assumes indoor breathing rate of 12.88 $m^3$/day derived from a mean breathing rate of 16 $m^3$/day (USEPA 2011a) and an adjustment to account for time spent indoors (80% per Table 16-22a of USEPA 2011a), while Arcadis applies the 80% indoor adjustment to the 90$^{th}$ percentile breathing rate of 18 $m^3$/day (Table 6-4 USEPA 2011a; mean of 90$^{th}$ percentile male and female values).

Exposure from diet was estimated using methods consistent with methods presented in FDEP (2014). As summarized in FDEP (2014), acenaphthene and fluorene exposures were estimated from Santodonato et al. (1981) and are conservatively based on the total PAH concentrations reported in that study. Dietary exposures for anthracene, fluoranthene, and pyrene were obtained from an occurrence study prepared by the European Commission (EC 2002).

Soil ingestion exposures for individual non-carcinogenic PAHs were presented in FDEP (2014). For anthracene, fluoranthene, fluorene, and pyrene, FDEP (2014) relies on PAH concentrations presented in Chahal et al. (2010), a Florida-specific study on urban residential soil in Pinellas County, Florida. For acenaphthene, the FDEP (2014) soil exposures are based on data presented in Wang et al. (2008). The Wang study reported PAHs from two major United States cities, New Orleans and Detroit, and the sampling sites included house foundations, open spaces, and soils bordering residential (light to moderate traffic) and busy (heavy traffic) streets. For this assessment, one additional background PAH study (Bradley et al. 1994) was reviewed. The Bradley study focuses on background PAH surface soil concentrations in three urban areas of New England: Boston, Massachusetts; Springfield, Massachusetts; and Providence, Rhode Island. A summary of mean soil concentrations reported in these three studies is provided below.

| Mean Background Soil Data (ug/kg) | | | |
|---|---|---|---|
| **PAH** | **Chahal et al. (2010)** | **Wang et al. (2008)** | **Bradley et al. (1994)** |
| Acenaphthene | Not Evaluated | 16.5 | **201** |
| Anthracene | 110 | **679** | 351 |
| Fluoranthene | 133 | 12.8 | **3,047** |
| Fluorene | 33 | 46.6 | **214** |
| Pyrene | 297 | 573 | **2,393** |

**Note**: Maximum values for each non-carcinogenic PAH are bolded

The maximum of the three available mean background concentrations (in bold above) were combined with a soil ingestion rates of 50 mg/day and a bodyweight of 80 kg (USEPA 2011a) to derive soil exposure estimates for acenaphthene, anthracene, fluoranthene, fluorene, and pyrene. The soil exposure estimates are conservative, as data available from Bradley et al. (1994) and Wang et al. (2008) were collected from highly urbanized locations with historic development and have many more sources that expected in most of Idaho. Additionally, data from Bradley et al (1994) represent PAH concentrations from sources present 25 years ago. Present day soils would be expected to be much lower based on emission controls on mobile sources such as cars, trucks, and buses.

Treated drinking water exposures to non-carcinogenic PAHs were presented in FDEP (2014). FDEP relies on concentration data published in Kabziński et al. (2002), which reports individual PAH concentrations in drinking water from several Polish cities. Arcadis researched available drinking water data within the United States, including the National Drinking Water Database created by the Environmental Working Group (EWG). EWG requested water data from public and environmental health agencies from around the country and has compiled nearly 20 million records from 45 states. According to EWG's analysis of water quality data supplied by state water agencies, no water utilities in Idaho reported detecting these five non-carcinogenic PAHs in treated tap water between 2005 and 2009. However, EWG does list the highest of the average reported concentrations in United States drinking water for acenaphthene (3.7 ug/L), anthracene (0.1 ug/L), fluoranthene (1.1 ug/L), fluorene (9.1 ug/L), and pyrene (0.4 ug/L). In this assessment, these average reported United States drinking water concentrations were combined with an assumed bodyweight and a drinking water ingestion rate of 2.4 L/day to derive drinking water exposures.

When the changes described above (i.e., updated drinking water, soil, ambient air concentrations; updated drinking water ingestion rate; updated indoor and outdoor inhalation rates; and updated body weight for drinking water, inhalation, and soil exposures) are incorporated into the exposure estimates, the

RSCs for acenaphthene, anthracene, fluoranthene, fluorene, and pyrene are 0.99, 1, 1, 0.99, and 1, respectively[3]. The environmental media concentration data reviewed to develop the above estimated exposures from non-surface water exposures overestimate, likely greatly in most cases, PAH concentrations in Idaho. When these estimated concentrations are combined with high-end assumptions about intake rates, background exposures are overestimated. As a result, the estimated RSCs are smaller (more conservative) than necessary to prevent the total exposure of Idahoans with high-end exposures from exceeding the reference dose for each of these PAHs. Arcadis recommends that final HHAWQC for these five PAHs incorporate the RSCs derived in this report.

| Exposure Route | Acenaphthene | Anthracene | Fluoranthene | Fluorene | Pyrene |
|---|---|---|---|---|---|
| | mg/kg-day | | | | |
| Inhalation of Outdoor Air | 3.06E-08 | 3.81E-08 | 6.82E-08 | 2.89E-07 | 6.41E-08 |
| Inhalation of Indoor Air | 6.84E-07 | 1.75E-06 | 3.96E-07 | 8.28E-07 | 2.16E-07 |
| Diet | 2.90E-04 | 9.00E-06 | 2.40E-05 | 2.90E-04 | 1.6E-05 |
| Soil Ingestion | 1.26E-07 | 4.24E-07 | 1.90E-06 | 1.34E-07 | 1.50E-06 |
| Treated Drinking Water | 1.11E-04 | 3.00E-06 | 3.30E-05 | 2.73E-04 | 1.20E-05 |
| Estimated Total Daily Dose | **4.02E-04** | **1.42E-05** | **6.02E-05** | **5.64E-04** | **3.07E-05** |
| Reference Dose | 0.06 | 0.3 | 0.04 | 0.04 | 0.03 |
| Relative Source Contribution | **0.99** | **1** | **1** | **0.99** | **1** |

# 3 2-CHLOROPHENOL

The recent 2015 USEPA HHAWQC (USEPA 2015) selects an RSC of 0.2 for 2-chlorophenol and indicates that information is not available to quantitatively characterize exposure from potential significant exposures. According to the USEPA (2000), relevant sources and pathways for consideration in the RSC include both ingestion and routes other than oral for water-related exposures and non-water sources of exposure, including ingestion exposures (e.g., food), inhalation, and/or dermal. In 2014, the FDEP conducted an extensive review of the information available on exposure to 2-chlorophenol. As a result of that review, FDEP derived an RSC of 0.89 for 2-chlorophenol (FDEP 2014). Ultimately, FDEP selected a final RSC of 0.8 for 2-chlorophenol for reasons described below.

> *"…the estimated exposure was calculated based on limited data or surrogate estimates (i.e., drinking water); therefore, it only serves as one line of evidence supporting an RSC. FDEP also considered the fact that 2-chlorophenol, like most chlorophenols, exhibits objectionable taste and odor at very low concentrations. The ATSDR (1999) noted that potential exposure, for the general population, to chlorophenols tends to be limited because of the pronounced odor and taste imparted by the presence of these substances. Taste and odor thresholds for 2-chlorophenol have been noted in the range of 2 to 4 parts per billion (ppb) and have been noted to affect the flavor of fish at concentrations of about 2 to 43*

[3] RSCs of 1.0 arise when the fraction of the RfD taken up by non-surface water sources is less than 0.005 and, therefore, the RSC rounds to 1, meaning that essentially all of the RfD can be allotted to exposures associated with regulated surface water exposures.

> *times lower than the odor thresholds for these compounds in water. Thus, it is highly unlikely that the general population is exposed to significant levels of the compound. An RSC of 0.8 (USEPA ceiling) was selected based on a consideration of both the characteristics of the compound (i.e., objectionable taste and odor) and the estimated low total non-ambient exposure."*

Arcadis reviewed information relevant to the derivation of an RSC for 2-chlorophenol. Specifically, information about concentrations of 2-chlorophenol in various environmental media and exposure assessment approaches used by FDEP and USEPA were reviewed and updated as appropriate. Based on the physical properties and available exposure information for 2-chlorophenol, drinking water, air, and diet are potential exposure sources. To the contrary of USEPA's conclusions and consistent with the information developed by FDEP in 2014, sufficient data are available to develop conservative estimates of non-surface water exposure to 2-chlorophenol and to develop a robust, scientifically defensible and conservative RSC for 2-chlorophenol.

Treated drinking water exposures were calculated consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight and the drinking water ingestion rate (80 kg was used as the bodyweight in this assessment versus 70 kg used by FDEP; 2.4 L/day was used as the ingestion rate in this assessment versus 2 L/day). As summarized in FDEP (2014), a value of 0.1 ug/L was selected as a 2-chlorophenol drinking water concentration because this is the concentration that USEPA recommends to mitigate chemical-specific taste (ATSDR 1999).

Ambient air inhalation exposures were calculated consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight. FDEP uses an assumed bodyweight of 70 kg, whereas Arcadis assumes a bodyweight of 80 kg per USEPA (2011a). An assumed air concentration of 2 ug/m$^3$ was combined with a 90$^{th}$ percentile daily breathing rate of 18 m$^3$/day (average of men and women) and a mean body weight of 80 kg. The assumed air concentration is based on available ambient air data collected after the accidental derailment and rupture of a train tanker. On the day of the accident, air concentrations ranging from 0.02 to 0.7 mg/m$^3$ were detected in the immediate vicinity of the spill (Scow et al. 1982). Eighteen days after the spill, 2-chlorophenol was not detected in ambient air (< 2 µg/m$^3$) and 2-chlorophenol levels in urine of clean-up workers and people living within 40 to 200 feet of the spill had no detectable levels in their urine two to three months after the spill. Similar to FDEP, this assessment assumes that concentrations below the detection limit of 2 µg/m$^3$ represent typical ambient air conditions. Using the full detection limit in the exposure calculations is conservative since actual concentrations of 2-chlorophenol in air are likely lower than the detection limit.

Data concerning typical concentrations of 2-chlorophenol in soils are limited; however, soil exposures to 2-chlorophenol were presented in FDEP (2014). The same methodology was used in this assessment, with the exception of the assumed bodyweight used in the exposure calculations and the assumed soil concentration (80 kg was used in this assessment versus 70 kg used by FDEP). FDEP assumes a soil concentration of 130 mg/kg based on the FDEP residential direct exposure soil clean-up target level of 130 mg/kg (FDEP 2005). In this assessment, the Idaho Initial Default Target Level of 0.365 mg/kg (based on groundwater protection) developed by the Idaho IDEQ (2004) was combined with a soil ingestion rate of 50 mg/day and a bodyweight of 80 kg (USEPA 2011a) to derive soil exposure estimates for 2-

chlorophenol. The IDTL represents a level above which the state of Idaho would initiate clean-up protocols.

Based on a review of literature data, FDEP (2014) concludes that exposures to 2-chlorophenol in diet is negligible. Few data were found on the levels of chlorophenols in United States Foods and most of the data or estimates are for concentrations in fish or shellfish. Based on Arcadis' additional review of the DeVault (1985) study in which 2-chlorophenol was not detected in 22 composite samples of fish collected from harbors and tributaries of the Great Lakes (DeVault 1985), Arcadis concurs with FDEPs assessment of dietary exposures.

When the changes described above (updated drinking water ingestion rate; updated inhalation rate; updated bodyweight for water, air, and soil exposures; and an updated soil concentration for soil exposures) are incorporated into the exposure estimates, the RSC for 2-chlorophenol becomes 0.91. The RSC is slightly higher than the RSC of 0.89 derived by FDEP (2014) because of the change in assumed soil concentration. The RSC is also higher than the final RSC of 0.8 selected by FDEP, as FDEP further reduced the derived value of 0.89 to account for limited data on background exposures to 2-chlorophenol. The environmental media concentration data reviewed to develop the above estimated exposures from non-surface water exposures overestimate, likely greatly in most cases, 2-chlorophenol concentrations in Idaho. When these estimated concentrations are combined with high-end assumptions about intake rates, background exposures are overestimated. As a result, the estimated RSC is smaller (more conservative) than necessary to prevent the total exposure of Idahoans with high-end exposures from exceeding the reference dose for 2-chlorophenol. Arcadis recommends that final HHAWQC for 2-chlorophenol incorporate the RSC derived in this report.

| Exposure Route | Arcadis Estimated Exposure mg/kg-day |
|---|---|
| Treated Drinking Water | 3.00E-06 |
| Inhalation of Air | 4.50E-04 |
| Soil Ingestion | 2.28E-07 |
| Estimated Total Daily Dose | **4.53E-04** |
| Reference Dose | 0.005 |
| Relative Source Contribution | **0.91** |

# 4 SELENIUM

The recent 2015 USEPA HHAWQC (USEPA 2015) did not apply an RSC for ambient water quality criteria development and cited "*outstanding technical issues related to toxicity values and/or bioaccumulation factors*". However, the proposed Idaho HHAWQC selected an RSC of 0.2 for selenium and indicates that information is not available to quantitatively characterize exposure from potential significant exposures. In 2014, the FDEP conducted an extensive review of the information available on exposure to selenium. As a result of that review, FDEP derived an RSC value of 0.58 for selenium (FDEP 2014).

Arcadis reviewed information relevant to the derivation of an RSC for selenium. Specifically, information about concentrations of selenium in various environmental media and exposure assessment approaches used by FDEP and USEPA were reviewed and updated as appropriate. Based on the physical properties and available exposure information for selenium, air, drinking water, soil, and diet are potential exposure sources. To the contrary of USEPA's conclusions and consistent with the information developed by FDEP in 2014, sufficient data are available to develop conservative estimates of non-surface water exposure to selenium and to develop a robust, scientifically defensible and conservative RSC for selenium.

Treated drinking water exposures were calculated consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight and the drinking water ingestion rate (80 kg was used as the bodyweight in this assessment versus 70 kg used by FDEP; 2.4 L/day was used as the ingestion rate in this assessment versus 2 L/day). As summarized in FDEP (2014), a value of 10 ug/L was selected as a selenium drinking water concentration based on ATSDR (2003), which reported that levels of selenium are less than 10 µg/L/ in 99.5 percent of drinking water sources tested. A recent review of Idaho-specific data between 2004 and 2009 correlates well with the FDEP selected exposure data, as the highest reported average level of selenium in Idaho tap water was 8 ug/L (http://www.ewg.org/tap-water/whatsinyourwater/1045/ID/Idaho/Selenium-total/).

Outdoor air inhalation exposures were calculated consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight and inhalation rate. FDEP uses an assumed bodyweight of 70 kg, whereas Arcadis assumes a bodyweight of 80 kg per USEPA (2011a). An upper-bound outdoor air breathing rate of 3.6 $m^3$/d was calculated based on the 90$^{th}$ percentile daily breathing rate of 18 $m^3$/d for the average of male and female adults (Table 6-4 from USEPA 2011a) and an assumption that 20% of time is spent outdoors (Table 16-22 of USEPA 2011a). An upper-bound outdoor air selenium concentration of 10 ng/$m^3$ (World Health Organization 2011) was combined with the outdoor air breathing rate of 3.6 $m^3$/day and a body weight of 80 kg. As part of this assessment, available ambient air data collected by the IDEQ were obtained for selenium from the USEPA AMA (http://www.epa.gov/ttnamti1/toxdat.html#data). A review of the 2013 AMA data indicates maximum detected concentrations of selenium PM 2.5 at three Idaho ambient air sampling sites of 1.5 ng/$m^3$, 0.56 ng/$m^3$, and 0.43 ng/$m^3$. As such, the FDEP ambient air exposures are conservative estimates of Idaho-specific exposures.

In this assessment, diet exposures differ from those by FDEP (2014) in that the assumed bodyweight was updated and selenium intake values were revised. FDEP uses an assumed bodyweight of 70 kg, whereas Arcadis assumes a bodyweight of 80 kg per USEPA (2011). In FDEP (2014), dietary exposure estimates were derived from dietary intake data presented in Bialostosky et al. (2002), which reports a mean selenium intake of 114 ug/day for the total population sampled. This is consistent with dietary intake estimates summarized in ATSDR (2003), which range from 71 to 152 ug/day for the general United States Population. This is also consistent with the more recent NHANES 2011-2012 study that reports a mean selenium intake from food and supplements of 129.7 ug/day for all individuals ages 2 and over (Table 37 of NHANES 2011-2012).

Soil ingestion exposures for selenium were presented in FDEP (2014) and were based on a Florida-specific study (ATSDR (2003). For this assessment, an Idaho-specific soil background study completed for the Ballard, Henry and Enoch Valley phosphate mines was reviewed (MWH Americas, Inc. 2013) and proposed an upland soil background selenium concentration of 1.8 mg/kg. This is consistent with the range of selenium concentrations reported in Western United States soils by Shacklette and Boerngen, (1984) (<0.1 – 4.3 mg/kg). A concentration of 1.8 mg/kg was combined with a soil ingestion rate of 50 mg/day and a bodyweight of 80 kg (USEPA 2011a) to derive soil exposure estimates for selenium. When the changes described above (i.e., updated drinking water ingestion rate; updated body weight for drinking water, inhalation, diet, and soil exposures; and updated soil concentrations) are incorporated into the exposure estimates, the RSC for selenium becomes 0.65. The RSC is higher than that the RSC developed by FDEP (2014) primarily because of an increase in assumed bodyweight and a calculation error by FDEP in their estimate of soil ingestion exposure. The Arcadis derived RSC combines upper bound exposure parameters with scientifically defensible and conservative exposure concentrations. Arcadis recommends that final HHAWQC for selenium incorporate the RSC derived in this report.

| Exposure Route | Arcadis Estimated Exposure mg/kg-day |
|---|---|
| Treated Drinking Water | 3.00E-04 |
| Inhalation of Outdoor Air | 4.50E-07 |
| Diet | 1.43E-03 |
| Soil Ingestion | 1.13E-06 |
| Estimated Total Daily Dose | 1.73E-03 |
| Reference Dose | 5.0E-03 |
| Relative Source Contribution | 0.65 |

# 5 DIETHYL PHTHALATE

The recent 2015 USEPA Update of HHAWQC (USEPA 2015) selected an RSC of 0.2 for diethyl phthalate and indicates that information is not available to quantitatively characterize exposure from some of those different sources. In 2014, the FDEP conducted an extensive review of the information available on exposure to diethyl phthalate. As a result of that review, FDEP derived an RSC of 0.96 for diethyl phthalate (FDEP 2014).

Arcadis reviewed information relevant to the derivation of an RSC for diethyl phthalate. Specifically, information about concentrations of diethyl phthalate in various environmental media and exposure assessment approaches used by FDEP and USEPA were reviewed and updated as appropriate. Based on the physical properties and available exposure information for diethyl phthalate, drinking water, air, soil, dust, cosmetics/personal care products, and food are potential exposure sources. To the contrary of USEPA's conclusions and consistent with the information developed by FDEP in 2014, sufficient data are available to develop conservative estimates of non-surface water exposure to diethyl phthalate and to develop a robust, scientifically defensible and conservative RSC for diethyl phthalate.

Treated drinking water exposures to diethyl phthalate were presented in FDEP (2014). The same methodology was used in this assessment, with the exception of the assumed bodyweight and drinking water ingestion rates used in the exposure calculations, which were updated to be consistent with USEPA (2011a) exposure assumptions (80 kg was used as the bodyweight in this assessment versus 70 kg used by FDEP; 2.4 L/day was used as the ingestion rate in this assessment versus 2 L/day). FDEP assumes a diethyl phthalate concentration of 2 ug/L in treated water based on the average concentration in treated drinking water reported in a United States Geological Survey (USGS) study conducted in Miami-Dade County Florida (USGS 2008). This assumption is consistent with other available national studies (IPCS 2003, ATSDR 1995, Clark et al. 2011) and was retained for this assessment. In addition, a review of 2012 discharge sampling results from the Brownlee Reservoir in Idaho indicates non-detect levels (< 10 ug/L) of diethyl phthalate (Harrison 2012).

Outdoor and indoor air inhalation diethyl phthalate exposures were calculated consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight and breathing rate. FDEP uses an assumed bodyweight of 70 kg, whereas Arcadis assumes a bodyweight of 80 kg per USEPA (2011a). FDEP assumes outdoor and indoor breathing rates of 3.12 $m^3$/day and 12.88 $m^3$/day, respectively, derived from a mean breathing rate of 16 $m^3$/day obtained from USEPA 2011a and an adjustment to account for time spent outdoors (20%) versus indoors (80%) per Table 16-22a of USEPA 2011a. Arcadis uses this same 20%/80% adjustment to determine outdoor versus indoor exposures; however, Arcadis applies these adjustments to the 90$^{th}$ percentile breathing rate of 18 $m^3$/day (Table 6-4 USEPA 2011a; mean of 90$^{th}$ percentile male and female values) instead of the mean breathing rate, resulting in outdoor and indoor breathing rates of 3.6 $m^3$/day and 14.4 $m^3$/day, respectively. For the purpose of RSC calculation, a mean outdoor air concentration of 0.47 μg/$m^3$ and a mean indoor air concentration of 1.81 μg/$m^3$ were selected as exposure concentrations based on a volatile organic compounds study conducted by Shields and Weschler (1987) in New Jersey. These exposure concentrations are conservative, as exposure estimates from several intake and primary metabolite studies compiled in Clark et al. (2011) indicate lower mean outdoor air concentration of 0.013 μg/$m^3$ and a lower mean indoor air concentration of 0.91 μg/$m^3$.

Soil and dust ingestion exposures to diethyl phthalate were presented by FDEP (2014). The same methodology was used in this assessment, with the exception of the assumed bodyweight used in the exposure calculations (80 kg was used in this assessment versus 70 kg used by FDEP (2014) and the soil ingestion rate used for soil exposures (50 mg/day was used in this assessment versus 20 mg/day used by FDEP). Mean soil and dust concentrations of 0.0023 ug/g and 25 ug/g were combined with soil and dust ingestion rates of 50 mg/day and 30 mg/day, respectively, to derive exposure estimates. The mean soil and dust concentrations are based on values reported in Clark et al. (2011). These concentrations were selected because they represent the highest estimates concerning diethyl phthalate soil/dust exposures available for the United States.

As summarized in FDEP (2014), Schecter et al. (2013) conducted an analysis of 72 different foods collected from the Albany, New York area to determine phthalate concentrations in different food groups. Arcadis re-grouped and modified the values presented in Schecter et al. (2013) using upper percentile consumption rates available from USEPA (2008, 2011) for most food types. The dietary exposures include exposure to beverages, dairy, fish, fruits, vegetables, meats, condiments, and infant foods. Arcadis assumed an Idaho-specific marine fish consumption rate of 42.68 g/day based on the 90$^{th}$ percentile value of market fish as presented in Buckman et al. (2015). This is conservative as it assumes that all market fish are marine fish.

Given the presence of diethyl phthalate in cosmetics and personal care products, FDEP (2014) reviewed available data from this exposure source. As presented in FDEP (2014), Koo and Lee (2004) conducted an investigation that analyzed phthalate concentrations in a variety of different commonly used cosmetic products including 42 perfumes, 21 nail polishes, 31 hair products, and 8 deodorants. Koo and Lee (2004) estimated a total exposure to diethyl phthalate from the use of consumer care products of 24.879 µg/kg-day, based on both dermal and inhalation exposure routes. FDEP (2014) used this value in the computation of total estimated non-ambient exposure to diethyl phthalate. The same value was also used in this assessment.

When the changes described above (updated drinking water ingestion rate; updated bodyweight for water, air, soil and dust exposures; and updated soil and dust ingestion rates for soil exposures, revised dietary consumption rates based on upper percentiles and an Idaho specific fish consumption rate) are incorporated into the exposure estimates, the RSC for diethyl phthalate becomes 0.97. The RSC is slightly higher than the RSC derived by FDEP (2014) because of the change in assumed bodyweight.

| Exposure Route | Arcadis Estimated Exposure mg/kg-day |
|---|---|
| Treated Drinking Water | 6.00E-05 |
| Inhalation of Indoor Air | 3.26E-04 |
| Inhalation of Outdoor Air | 2.12E-05 |
| Soil Ingestion | 1.44E-09 |
| Dust Ingestion | 9.38E-06 |
| Diet | 1.46E-04 |
| Personal Care Products | 2.49E-02 |
| Estimated Total Daily Dose | **2.54E-02** |
| Reference Dose | 0.8 |
| Relative Source Contribution | **0.97** |

It should be noted that phthalates are widely used in laboratory equipment, which can result in higher estimated concentrations in analyzed samples (Guo and Kannan 2012). The dietary exposure estimates above assume 100% bioavailability, which is likely to overestimate intakes as well. For these reasons, the estimated exposures may be biased high and contribute to the derivation of a more conservative RSC. The RSC is further supported by total exposure estimates based on extrapolations from urinary metabolites. Blount et al. (2000) estimates the geometric mean and the 95$^{th}$ percentile of total daily exposures for the general population (based on 289 individuals) to be 1.2E-02 mg/kg-day and 1.1E-01 mg/kg-day, respectively. When Blount et al (2000) exposure estimates are compared with the diethyl phthalate Reference Dose (0.8 mg/kg-day), RSC estimates range from 0.86 (95$^{th}$ percentile of exposure) to 0.99 (geometric mean exposure). The Chronic Hazard Advisory Panel (CHAP 2014) reports more recent exposure data from the 2005-2006 NHANES study in United States women of childbearing age (considered to be a more highly exposed subgroup). Total daily FDEP intakes of 3.3 ug/kg bw-d (median) and 37.6 ug/kg bw-d (95$^{th}$ percentile) were back-calculated from measured urinary metabolites (CHAP 2014), which correspond to RSC values of 0.99 and 0.95, respectively. Additionally, exposure to diethyl phthalate is decreasing; urinary metabolite concentrations have decreased monotonically in the general population since 2005-2006, and were 42% lower in 2009-2010 than in 2001 (Zota et al. 2014).

Therefore, although the RSC calculated herein exceeds the ceiling value of 0.8 (USEPA 2015), diethyl phthalate exposure from non-ambient sources (diet and consumer product) contributes a small fraction of the RfD and exposure from these sources is likely to decline given recent trends diethyl phthalate use, the 0.97 RSC is considered conservative and appropriate for use in water quality criteria derivation. Arcadis recommends that final HHAWQC for diethyl phthalate incorporate the RSC derived in this report.

# 6 CHLOROFORM

The recent 2015 USEPA Update of HHAWQC (USEPA 2015) selected an RSC of 0.2 for chloroform and indicates that information is not available to quantitatively characterize exposure from some of those different sources. Specifically, USEPA notes that exposures from inland, nearshore, and ocean fish and shellfish could not be quantified due to the lack of data. However, as described below, information to quantitatively characterize exposure from these difference sources, including fish, is available. In 2014, the FDEP conducted an extensive review of the information available on exposure to chloroform. As a result of that review, FDEP derived an RSC of 0.76 for chloroform (FDEP 2014).

Arcadis reviewed information relevant to the derivation of an RSC for chloroform. Specifically, information about concentrations of chloroform in various environmental media and exposure assessment approaches used by FDEP and USEPA were reviewed and updated as appropriate. Based on the physical properties and available exposure information for chloroform, air, drinking water, and food are potentially significant sources. To the contrary of USEPA's conclusions and consistent with the information developed by FDEP in 2014, sufficient data are available to develop conservative estimates of non-surface water exposure to chloroform and to develop a robust, scientifically defensible and conservative RSC for chloroform.

Outdoor and indoor air inhalation chloroform exposures were calculated consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight, the outdoor and indoor breathing rates, and the inhalation fraction term. FDEP uses an assumed bodyweight of 70 kg, whereas Arcadis assumes a bodyweight of 80 kg per USEPA (2011a) and consistent with the bodyweight assumed by USEPA recently updated HHAWQC (USEPA 2015). FDEP assumes outdoor and indoor breathing rates of 3.12 $m^3$/day and 12.88 $m^3$/day, respectively, derived from a mean breathing rate of 16 $m^3$/day obtained from USEPA 2011a and an adjustment to account for time spent outdoors (20%) versus indoors (80%) per Table 16-22a of USEPA 2011a. Arcadis uses this same 20%/80% adjustment to determine outdoor versus indoor exposures; however, Arcadis applies these adjustments to the 90$^{th}$ percentile breathing rate of 18 $m^3$/day (Table 6-4 USEPA 2011a; mean of 90$^{th}$ percentile male and female values) instead of the mean breathing rate, resulting in outdoor and indoor breathing rates of 3.6 $m^3$/day and 14.4 $m^3$/day, respectively. The inhalation exposure estimates in this assessment do not include the inhalation fraction term of 0.63 used by FDEP (2014), as the basis of this term was not clear. The mean outdoor air chloroform concentration for locations in the United States presented in USEPA 2001 (1.6 ug/$m^3$) was combined with a breathing rate of 3.6 $m^3$/day and a body weight of 80 kg. The mean indoor air chloroform concentration in USEPA (2001) (3 ug/$m^3$) was combined with a breathing rate of 14.4 $m^3$/day and a body weight of 80 kg. As part of this assessment, available ambient air data collected in Idaho were obtained for chloroform from the USEPA AMA (http://www.epa.gov/ttnamti1/toxdat.html#data). A review of the ambient air sampling data collected routinely from five sampling sites[4] in Idaho between May 2006 and April 2007 indicates average detected concentrations of chloroform ranging from 0.02 ug/m$^3$ to 0.065 ug/m$^3$, while more recent AMA data collected at two sampling sites[5] in Idaho in 2009 and 2011 indicate a maximum detected concentration of chloroform of 0.024 ug/m$^3$. As such, the FDEP outdoor ambient air exposures are conservative estimates of Idaho-specific exposures.

Inhalation and dermal exposures to chloroform while showering and exposure to treated drinking water were derived in USEPA (2003) and in FDEP (2014). The same methodology was used in this assessment, with the exception of the assumed bodyweight, the use of an upper percentile value instead of a mean value for the shower breathing rate, and revised values for surface area and shower durations per USEPA (2011a). Specifically, Arcadis used a bodyweight of 80 kg versus 70 kg, an upper bound shower breathing rate of 0.75 m$^3$/hour versus the FDEP value of 0.67 m$^3$/hour, a whole body surface area 20,900 cm$^3$ obtained from USEPA (2011a) versus the value of 20,300 cm$^3$ used by FDEP from an undisclosed source, and an average shower duration time of 17 minutes based on USEPA (2011a, Table 16.1) versus a duration of 7.3 minutes used by FDEP from an undisclosed source. These conservative exposure parameters were combined with the USEPA (2001) recommended mean concentration of chloroform in air during showering (190 ug/m$^3$) and mean concentration of chloroform in treated water (24 ug/L) to determine inhalation and dermal exposures.

Exposure from diet was estimated in USEPA (2003) and was recently updated by the FDEP (2014) to account for more recent average per capita food ingestion rate data available in USEPA (2011a). In this assessment, Arcadis calculates diet exposures by combining the estimated concentrations in dietary items from USEPA (2003) with upper percentile per capita food consumption rates available from USEPA (2011a) rather than the average consumption rates used by FDEP (2014). The dietary exposures include exposure to fruits, vegetables, meats, grain, dairy, and marine fish. Arcadis assumed an Idaho-specific marine fish consumption rate of 42.68 g/day based on the 90$^{th}$ percentile value of market fish as presented in Buckman et al. 2015. This fish consumption rate is conservative as it assumes that all market fish are marine fish.

Given USEPA's statement that information is not available to estimate exposures to fish and shellfish (USEPA 2015), Arcadis reviewed fish data available from studies in Florida (Staples et al. 1985) and additional fish data (not reviewed in FDEP (2014)) from Texas (http://fishadvisoryonline.epa.gov/). Median biota concentrations in Staples et al (1985) are reported as 0.032 mg/kg, while no concentrations of chloroform (in 199 samples) were detected above the reporting limits (0.04 and 0.02 mg/kg) in available fish tissue data from Texas. These results are lower than the concentration of 0.052 mg/kg assumed by FDEP to be in marine fish when developing the RSC of 0.76 for chloroform. Additionally, the national-level

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[4] Station 160690006 in Nez Perce County (n=113), 160690009 in Nez Perce County (n=54), 160690012 in Nez Perce County (n=51), 160690013 in Nez Perce County (n=57), and 160690222 in Nez Perce County (n=58).

[5] Station 160695501 via School Air Toxics Program (n=13; collected from September 2009 to December 2009), 160695502 via School Air Toxics Program (n=10; collected from June 2011 to August 2011).

bioaccumulation factor (BAF) estimates for chloroform range from 2.8 L/kg (T2) to 3.8 L/kg (TL4), which indicate that chloroform has a low potential for bioaccumulation (USEPA 2011b) supporting the low and non-detectable concentrations described above and the concentrations used by FDEP (2014) when deriving their RSC.

Based on the information summarize above, the exposures estimated by FDEP (2014) for all exposures were updated to account for USEPA's increase of the default body weight from 70 to 80 kilograms and to account for upper percentile exposure parameter values, including an Idaho-specific fish consumption rate. In addition, the inhalation fraction terms was not considered for inhalation exposure estimates. When those changes are made the RSC for chloroform becomes 0.64. The Arcadis derived RSC combines upper bound exposure parameters with scientifically defensible and conservative exposure concentrations that likely overestimate exposures in Idaho. Arcadis recommends that final HHAWQC for chloroform incorporate the RSC derived in this report.

| Exposure Route | Arcadis Estimated Exposure mg/kg-day |
|---|---|
| Inhalation of Indoor Air | 5.40E-04 |
| Inhalation of Outdoor Air | 7.20E-05 |
| Inhalation while showering | 4.99E-04 |
| Dermal during showering | 3.75E-04 |
| Treated drinking water ingestion | 7.20E-04 |
| Diet | 1.40E-03 |
| Estimated Total Daily Dose | **3.61E-03** |
| Reference Dose | 0.01 |
| Relative Source Contribution | **0.64** |

# 7 BUTYLBENZYL PHTHALATE (BBP)

The recent 2015 USEPA Update of HHAWQC (USEPA 2015) selected an RSC of 0.2 for BBP and indicates that information is not available to quantitatively characterize exposure from potentially significant sources. In 2014, the FDEP conducted an extensive review of the information available on exposure to BBP. As a result of that review, FDEP derived an RSC of 0.95 for BBP (FDEP 2014).

Arcadis reviewed information relevant to the derivation of an RSC for BBP. Specifically, information about concentrations of BBP in various environmental media and exposure assessment approaches used by FDEP and USEPA were reviewed and updated as appropriate. Based on the physical properties and available exposure information for BBP, fish and shellfish, non-fish food, inhalation, and consumer products are potential sources. Contrary of USEPA's conclusions and consistent with the information developed by FDEP in 2014, sufficient data are available to develop conservative estimates of non-surface water exposure to BBP and to develop a robust, scientifically defensible and conservative RSC for BBP.

Based on available data, FDEP (2014) concludes that exposures to drinking water and soils are negligible. Arcadis concurs with FDEPs assessment of these exposures.

Ambient air inhalation BBP exposures were calculated consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight and inhalation rate. FDEP uses an assumed bodyweight of 70 kg, whereas Arcadis assumes a bodyweight of 80 kg per USEPA (2011a) and consistent with the bodyweight assumed by USEPA recently updated HHAWQC (USEPA 2015). A $90^{th}$ percentile daily breathing rate of 18 $m^3$/day was selected based on the average for male and female adults (Table 6-4 from USEPA 2011a). A $90^{th}$ percentile outdoor air BBP concentration of 6.7 ng/$m^3$ (IPCS 1999) from a survey of 65 California homes was combined with the daily breathing rate of 18 $m^3$/day and a body weight of 80 kg. It is expected that Idaho homes will have similar air concentrations to those reported in the California study.

In this assessment, dietary exposures are identical to those presented by FDEP (2014) and are based on a 2000-2001 study from the USEPA (2011b) that assessed total exposure to BBP in preschool aged children from Ohio and North Carolina. The daily intake was estimated to be 10 µg/kg-day based on median estimates from individual sources (based on Ohio children; North Carolina exposure was reported as lower). Sources included in the study were indoor and outdoor air, soil, dust, drinking water, food, and dermal absorption. However, the FDEP conservatively assumes that the reported daily intake was solely related to exposure to BBP through food.

Given the presence of BBP in consumer and personal care products, FDEP (2014) reviewed available data from these exposure sources. As summarizes in FDEP (2014), Wormuth et al. (2006) conducted an extensive analysis of exposure to eight phthalate esters, including BBP, in seven consumer groups in Europe. The analysis included exposures from inhalation of indoor air, outdoor air, and while using spray paints; dermal exposure from personal care products, gloves, and textiles; and oral exposure from food, dust, mouthing (young children) and ingestion of personal care products. As such, the results of this study are not representative of consumer products alone. However, mean total daily intakes for these exposure pathways estimated by Wormuth et al. (2006) never exceeded 0.001 mg/kg bw-d, and were due primarily to food intake. As the dietary exposure estimate of 0.010 mg/kg bw-d selected above (USEPA 2011b) already accounts for many of these additional consumer product exposure pathways and is an order of magnitude greater than estimated by Wormuth et al. (2006), no additional exposure due to consumer product use was assumed.

Based on the information summarized above, the inhalation exposures estimated by FDEP (2014) were updated to account for USEPA’s increase of the default body weight from 70 to 80 kilograms and use of a daily inhalation rate based on the $90^{th}$ percentile of adults. When that change is made, the RSC for BBP is 0.95, which is consistent with the selected FDEP RSC.

| Exposure Route | Arcadis Estimated Exposure mg/kg-day |
|---|---|
| Soil Ingestion | Negligible |
| Treated Drinking Water ingestion | Negligible |
| Inhalation of Air | 1.51E-06 |
| Diet | 1.00E-02 |
| Estimated Total Daily Dose | 1.00E-02 |
| Reference Dose | 1.3 |
| Relative Source Contribution | 0.99 |

This RSC exceeds the 0.8 ceiling value recommended by USEPA (2015). However, the selected RSC of 0.99 is considered to be conservative and appropriate even for highly exposed populations for the following reasons. First, the dietary and consumer product exposure assumption is likely greater than actual exposures in the United States. United States studies of phthalate dietary intake (Schecter et al. 2013, Clark et al. 2011, Clark et al. 2003) generally report lower food concentrations than in Wormuth et al (2006), and exposures are decreasing as BBP has been replaced with substitute products (Clark et al. 2011, Zota et al. 2014). The European estimates from Wormuth et al. (2006) showed much lower levels of total exposure than estimated above in all consumer groups, including infants and toddlers, even when consumer and personal care products were considered (mean estimates for the consumer groups ranged from 0.00004 mg/kg-day to 0.00073 mg/kg-day), which is 13 to more than 200 times lower than the estimate of exposure used to derive this RSC. Median daily intake estimates for highly exposed populations (pregnant women, women of reproductive age, children, and infants) back-calculated from BBP metabolites are also below the exposure estimate used to derive this RSC (Table 2.7 in CHAP 2014), and modelled 95$^{th}$ percentile exposures are also below 0.010 mg/kg bw-d (Table 2.11 in CHAP 2014). Additionally, phthalates are widely used in laboratory equipment, which can result in higher estimated concentrations in analyzed food samples (Guo and Kannan 2012), and the dietary estimates above assume 100% bioavailability, which is likely to overestimate intakes. As BBP exposure from non-ambient sources (diet and consumer product) contributes a small fraction of the RfD and exposure from these sources is likely overestimated given recent trends BBP use, a default RSC ceiling of 0.8 is not warranted.

It should also be noted that the recent 2015 USEPA update of HHAWQC for BBP (USEPA 2015) and the Idaho proposed HHAWQC for BBP selected an RfD of 1.3 mg/kg-day based on a Health Canada assessment (Health Canada 2000) and that the RSC of 0.99 is specific to the RfD of 1.3 mg/kg-day. The FDEP used and RfD of 0.2 mg/kg-day based on the USEPA Integrated Risk Information System (IRIS) assessment (USEPA 1989) when deriving their RSC. If the more stringent (lower) IRIS RfD is considered, the RSC would decrease to 0.95. The use of the current IRIS RfD and lower RSC would result in a decrease in the HHAWQC. If the final HHAWQC is based on the more recent Health Canada RfD, Arcadis recommends the final HHAWQC for BBP incorporate the RSC of 0.99.

# 8 TOLUENE

The recent 2015 USEPA update of HHAWQC (USEPA 2015) selected an RSC of 0.2 for toluene and indicates that information is not available to quantitatively characterize exposure from potentially significant sources. In 2014, the FDEP conducted an extensive review of the information available on exposure to toluene. As a result of that review, FDEP derived an RSC of 0.55 for toluene (FDEP 2014).

Arcadis reviewed information relevant to the derivation of an RSC for toluene. Specifically, information about concentrations of toluene in various environmental media and exposure assessment approaches used by FDEP and USEPA were reviewed and updated as appropriate. Based on the physical properties and available exposure information for toluene, air, drinking and diet are potentially significant sources. To the contrary of USEPA's conclusions and consistent with the information developed by FDEP in 2014, sufficient data are available to develop conservative estimates of non-surface water exposure to toluene and to develop a robust, scientifically defensible and conservative RSCs.

The FDEP (2014) review of American surface, tap, and drinking waters, indicates that toluene concentrations typically found in treated drinking water are scarce. However, to calculate the RSC for the drinking water ingestion route, FDEP (2014) uses the Maximum Contaminant level (MCL), which defines the threshold above which water is not suitable for drinking, of 1,000 µg/L. Arcadis researched available drinking water data for Idaho, including the National Drinking Water Database created by the EWG. EWG requested water data from public and environmental health agencies from around the country and has compiled nearly 20 million records from 45 states. According to EWG's analysis of water quality data supplied by state water agencies, seven water utilities in Idaho reported detecting toluene in tap water between 2005 and 2009. The average concentrations ranged from 0.01 ug/L to 0.65 ug/L, with a maximum reported value of 2.8 ug/L. In this assessment, the maximum reported concentration was utilized because it represents a conservative estimate of exposure. A standard water intake rate of 2.4 L/day and a standard body weight of 80 kg were also utilized in this drinking water exposure calculation (USEPA 2011a).

Outdoor and indoor air inhalation toluene exposures were calculated consistent with methods presented in FDEP (2014) with the exception of the assumed bodyweight and breathing rates. FDEP uses an assumed bodyweight of 70 kg, whereas Arcadis assumes a bodyweight of 80 kg per USEPA (2011a). FDEP assumes outdoor and indoor breathing rates of 3.12 $m^3$/day and 12.88 $m^3$/day, respectively, derived from a mean breathing rate of 16 $m^3$/day obtained from USEPA (2011a) and an adjustment to account for time spent outdoors (20%) versus indoors (80%) per Table 16-22a of USEPA 2011a. Arcadis uses this same 20%/80% adjustment to determine outdoor versus indoor exposures; however, Arcadis applies these adjustments to the 90$^{th}$ percentile breathing rate of 18 $m^3$/day (Table 6-4 USEPA, 2011a; mean of 90$^{th}$ percentile male and female values) instead of the mean breathing rate, resulting in outdoor and indoor breathing rates of 3.6 $m^3$/day and 14.4 $m^3$/day, respectively. The USEPA reports that average levels of toluene measured in rural, urban, and indoor air are 1.3, 10.8, and 31.5 µg/$m^3$ respectively (USEPA 2012). For the purposes of RSC calculation, the urban outdoor air average concentration of 10.8 µg/$m^3$ was selected to represent Idaho and combined with a breathing rate of 3.6 $m^3$/day and a body weight of 80 kg to determine outdoor inhalation exposures, while the mean indoor air toluene concentration (31.5 ug/$m^3$) was combined with a breathing rate of 14.4 m3/day and a body weight of 80 kg to determine indoor inhalation exposures. The mean California state-wide concentration of air-borne toluene measured in 1996 was reported as 2.26 µg/m$^3$. The outdoor exposure concentration selected for this assessment is a conservative estimate for Idaho-specific exposures because it does not account for rural areas with lower reported concentrations. It is expected that Idaho state-wide ambient air concentrations would be similar to those reported for California.

In this assessment, Arcadis calculates diet exposures by combining the estimated concentrations of toluene in dietary items obtained from USFDA (2006) with per capita upper percentile food consumption rates available from USEPA (2011a). This differs from FDEP in that FDEP (2014) relies on average per capita consumption rates from USEPA (2011a) to derive dietary exposures to toluene. The dietary exposures include exposure to fruits, vegetables, meats, grain, dairy, and marine fish. Arcadis assumed an Idaho-specific marine fish consumption rate of 42.68 g/day based on the 90$^{th}$ percentile value of "market fish" as presented in Buckman et al. (2015). This fish consumption rate is conservative as it assumes that all market fish are marine fish. An Idaho-specific value exclusively for marine fish was not presented in Buckman et al. (2015).

The recent 2015 USEPA update of HHAWQC (USEPA 2015) and the IDEQ proposed draft HHAWQC selected an RfD of 0.0097 mg/kg-day for toluene based on a recent Health Canada assessment (Health Canada 2015), while the value used in the FDEP RfD evaluation is 0.08 mg/kg-day based on the USEPA IRIS assessment (USEPA 2005). The RfD used in the IDEQ proposed draft HHAWQC for toluene was used in this assessment.

When the changes described above (i.e., updated drinking water concentrations; updated drinking water ingestion rate; updated body weight for drinking water and inhalation exposures, updated indoor and outdoor inhalation rates, revised food intake values, and a RfD of 0.0097 mg/kg-day) are incorporated into the exposure estimates, the RSC for toluene becomes 0.92. The RSC is lower than that the RSC developed by FDEP (2014) primarily because the RfD is more stringent (lower) than the RfD assumed by FDEP. The Arcadis derived RSC combines upper bound exposure parameters with scientifically defensible and conservative exposure concentrations that likely overestimate toluene exposures in Idaho. Arcadis recommends that final HHAWQC for toluene incorporate the RSC derived in this report.

| Exposure Route | Arcadis Estimated Exposure mg/kg-day |
|---|---|
| Treated Drinking Water | 8.4E-05 |
| Inhalation of Indoor Air | 5.67E-03 |
| Inhalation of Outdoor Air | 4.86E-04 |
| Diet | 4.67E-04 |
| Estimated Total Daily Dose | 6.71E-03 |
| Reference Dose | 0.0097 |
| Relative Source Contribution | 0.31 |

It should be noted that if the current USEPA IRIS RfD of 0.08 mg/kg-day is considered, the resulting toluene RSC would increase to 0.92 and the HHAWQC would also increase, both because of the increase in the RSC and the increase in the RfD.

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# Appendix C:

# Fish Tissue Curve Fitting

# FISH CONSUMPTION RATE DISTRIBUTION FITTING FOR IDAHO HUMAN HEALTH CRITERIA

November 5, 2015

# FISH CONSUMPTION RATE DISTRIBUTION FITTING FOR IDAHO HUMAN HEALTH CRITERIA

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ELCR | excess lifetime cancer risk |
| FCR | fish consumption rate |
| FFQ | food frequency questionnaire |
| g/day | grams per day |
| HHAWQC | human health ambient water quality criteria |
| HI | hazard index |
| IDEQ | Idaho Department of Environmental Quality |
| NCI | National Cancer Institute |
| USEPA | United States Environmental Protection Agency |

# 1 INTRODUCTION

On October 7, 2015, the Idaho Department of Environmental Quality (IDEQ) released its draft human health ambient water quality criteria (HHAWQC) rule. The draft HHAWQC were calculated using probabilistic risk assessment methods, using distributions capturing the variability in fish consumption rate (FCR), drinking water intake, and body weight across the Idaho population. IDEQ derived two sets of HHAWQC: one set focused on the general Idaho population and the other set focused on high consuming subpopulations, represented by Nez Perce tribal members. The 95th percentile of the general population and arithmetic mean of the high consuming subpopulation were targeted with an acceptable excess lifetime cancer risk (ELCR) of $1x10^{-6}$ and non-carcinogenic hazard index (HI) of 1.0.

The process used to derive IDEQ's draft HHAWQC is described in greater detail by Windward (2015). This report focuses specifically on the FCR distributions used to derive the draft HHAWQC, both for the general and tribal populations of Idaho.

# 2 EMPIRICAL FISH CONSUMPTION RATE DISTRIBUTIONS

IDEQ recently completed a state-wide survey on fish consumption in Idaho (NWRG 2015). National Cancer Institute (NCI)-adjusted usual intake distributions for fish consumption, as reported by Buckman et al. (2015), were used to develop FCR distributions for the general population of Idaho. IDEQ chose to base its draft HHAWQC on consumption of resident freshwater fish, referred to as Idaho fish[1] (IDEQ 2015, NWRG 2015). Buckman et al. (2015) reports summary statistics for the empirical NCI-adjusted distribution of general population Idaho fish consumption, including the mean and each integer percentile (**Table 1**).

The empirical Idaho fish distribution includes a 100th percentile[2] value of 1,261 grams per day (g/day), equivalent to approximately 1,000-2,000 calories per day, depending on the species. This estimated value has a reported standard error of 612 g/day and is more than two times larger than the 100th percentile value reported for consumption of all fish (533 g/day), of which Idaho fish is by definition a subset (Buckman et al. 2015). The 99th percentile reported for consumption of Idaho fish is 40.6 g/day, over 30 times lower than the 100th percentile estimate. This increase between the 99th and 100th percentiles is extreme; in comparison, the 99th and 100th percentile estimates for consumption of all fish (118 g/day and 553 g/day, respectively) only differ by a factor of five. Therefore, this 100th percentile estimate is highly uncertain and should either be used with great caution or not used at all in the derivation of a FCR distribution for the purpose of establishing HHAWQC for Idaho.

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[1] Idaho fish is defined as freshwater fish resident to Idaho waters. Idaho fish includes all trout, regardless of where acquired, as well as the following species when caught in an Idaho lake or stream: whitefish, yellow perch, walleye, catfish, bass, bluegill, black crappie, northern pike, white sturgeon, crayfish, Kokanee Salmon, or Sockeye Salmon (also known as Blueback Salmon).

[2] The SAS macros used in the NCI method do not routinely report estimates beyond the 99th percentile of the distribution due to the inherent uncertainty of this value. This 100th percentile value was generated at the request of IDEQ.

The United States Environmental Protection Agency (USEPA), in collaboration with the Nez Perce and Shoshone-Bannock Tribes, recently completed a survey of tribal fish consumption (Ridolfi and Pacific Market Research 2015). Similar methods were used to survey both tribes, and NCI modelling was conducted using data from both tribes with a tribal identifier used as a covariate in the modelling. Information from this survey was used by IDEQ to develop FCR distributions for the Nez Perce tribal population of Idaho. The Nez Perce were chosen to represent the tribal population of Idaho as their estimated mean FCR is the highest among the tribes. The following is a brief discussion of the Nez Perce survey report.

Estimates of the FCR, given as edible mass of uncooked finfish and/or shellfish in g/day, are presented based on two different survey methods resulting in two data sets collected from the same set of respondents. One set of data is provided by a food frequency questionnaire (FFQ), wherein for each species survey respondents directly provide estimates of frequency of consumption, portion sizes and duration of their consumption seasons during the past year. The second method, a statistical method developed by the National Cancer Institute ("NCI method"), uses responses to questions asked on two separate days, about fish consumption "yesterday" (a 24-hour recall period).The survey covered adult members (age 18 and over) of the Nez Perce residing within approximately 50 miles of two major tribal centers, Lapwai and Kamiah. A stratified (gender, age) random sample was drawn from tribal enrolment files. Tribal interviewers were employed and trained to administer the questionnaire in person. Interviews were conducted from May 2014 to May 2015 either at the respondent's home or an agreed upon location. Due to the difficulty in locating and contacting sampled members, a survey design change resulted in interviews and/or initial contacts taking place at special tribal events. The second 24-hour dietary recall interview was conducted sometime after the first interview by telephone. Respondents were offered an incentive for participation in the survey, financed by the Tribe, that included a raffle drawing (approximately $1000 worth of prizes were available), t-shirts and paid time off for Tribal employees who were sampled. Respondents to the survey answered questions about species consumed (frequency and quantity), covering consumption over the past year, as well as answering questions about fish consumption "yesterday" (the 24-hour recall).

The tribe has 2,727 recorded adult members. A sample of 1,250 was drawn but only 38% (460 members) responded, 98% of whom (451) were fish consumers. Due to differences in the response rate among demographic subgroups within the Tribe, statistical weighting was used to estimate FCRs so as to be unbiased and representative of the entire Tribe. The authors described the following limitations of the study:

- A number of cases had missing data which had to be imputed in order for the respondent's other responses to be included. However, they also report that a sensitivity analysis indicates little effect on FCRs due to imputation.
- With an interview-guided survey, there is a possibility of a social desirability bias, where individuals tend to over- or under-report consumption due to perceived social norms.
- The survey had a "modest" response rate, 38% which is low among tribal fish consumption surveys. It is possible that those who were either not reached or reached but did not agree to an interview have different consumption rates than those included.

While the first limitation did not appear to have an effect on the FCRs it is unclear how the second and third limitations affect FCR. However, given that the Tribe has emphasized the cultural importance of fish, it is unlikely that under-reporting bias would be an issue.

Ridolfi and Pacific Market Research (2015) reports summary statistics for the empirical NCI-adjusted distribution of Nez Perce tribal population fish consumption for all fish (i.e., Group 1) and Group 2 fish, a subset of Group 1. Although species level data were recorded by the interviewers for dietary recall, these data were not reported or modelled using NCI methods. The mean and each fifth percentile of Group 2 FCR are given in **Table 2**.

The Nez Perce fish consumption survey data were reported based on different species groupings than the state-wide Idaho fish consumption survey (**Table 3**). While the Nez Perce species Group 2 consumption is more similar to the species group defined as Idaho fish than Group 1, it includes some species excluded from Idaho fish. Therefore, IDEQ had to derive an adjustment factor to apply to the Group 2 fish consumption distribution to estimate the Nez Perce Idaho fish consumption distribution. IDEQ derived this Idaho fish adjustment factor using data from the FFQ. Rather than subtracting species from Group 2, IDEQ subtracted Chinook, Coho, and other salmon from Group 3; subtracted tilapia from Group 5; and summed these modified Groups with the existing Group 4. The resulting mean consumption rate, expressed as a ratio of reported Group 2 fish consumption, is 24.2%. Calculations were done by respondent and were appropriately weighted by the demographic based statistical weighting variable. This process is described in greater detail by IDEQ (2015). IDEQ applied the adjustment factor to the mean and each fifth percentile of the empirical distribution of Nez Perce Group 2 fish consumption to derive the estimated distribution of Nez Perce Idaho fish consumption (**Table 2**). Given that NCI-based Idaho fish FCRs were not reported for the tribes, IDEQ's approach is appropriate but should have been conducted using dietary recall data rather than the FFQ data. The FFQ data rely on one's memory over an entire year and involve mental averaging over that period. The authors of the survey report state the following:

> *"The NCI method results are probably closer to the true consumption rate distribution for the Tribe, but the FFQ consumption rates are also plausible. The truth probably lies somewhere in between, though likely closer to the NCI-method rates, which are based on consumption 'yesterday' (24-hour recall) rather than on memory of the preceding year's consumption. (A report on the OPEN study by Subar et al, 2003, found that 24-hour recall data were more accurate than FFQ data in predicting total energy and protein intake.)"*

Arcadis followed the process outlined by IDEQ (2015) to derive a Group 2 adjustment factor using the Nez Perce dietary recall data rather than the FFQ data.[3] The calculations were conducted separately for each of the two dietary recalls since there were some missing responses for the second recall. The NCI methodology for estimating usual intake distributions for fish consumption rely on the dietary recall data, and therefore deriving a Group 2 adjustment factor from these data is more appropriate than relying on

[3] The dietary recall data were obtained by Arcadis via the expedited Freedom of Information Act process mentioned in USEPA's August 6, 2015 presentation given at the IDEQ Negotiated Rulemaking meeting.

the FFQ data[4]. The mean adjustment factor for the two recall events is 7.04%.[5] Arcadis applied the alternate adjustment factor to the mean and each fifth percentile of the empirical distribution of Nez Perce Group 2 fish consumption to derive an alternate estimated distribution of Nez Perce Idaho fish consumption (**Table 2**). A similar analysis was conducted for the Shoshone-Bannock data set as a check of the assumption that their mean Idaho fish FCR is not greater than that of the Nez Perce, which would result in the Shoshone-Bannock Tribe being the more sensitive population. The mean Group 2 FCR for the Shoshone-Bannock is 18.6 grams per day. The percentage of Group 2 fish that are Idaho fish based on dietary recall data is 22.8%, resulting in a mean Idaho fish FCR of 4.2 grams per day. Therefore, it can still be assumed that the Nez Perce Tribe have a higher Idaho fish FCR than the Shoshone-Bannock Tribe.

# 3 IDEQ DISTRIBUTION FITTING

Although empirical distributions are available from the abovementioned sources for both Idaho populations, the software used to conduct probabilistic derivation of HHAWQC (i.e., @Risk; Palisade [2013]) requires that, in the absence of an empirical dataset, each distribution be described formulaically. Because the empirical distributions were produced by NCI modelling and individual data points are not available, theoretical distributions must be "fit" to the empirical distributions to conduct the probabilistic analysis.

The @Risk software allows users to fit distributions to data using the "Distribution Fitting" tool. This tool generates numerous potential "fits" to the data (i.e., theoretical distributions with inherent statistics, such as arithmetic mean and percentiles, comparable to those associated with the empirical data) and ranks them in order of increasing error. Additional goodness-of-fit tests, such as the chi-square goodness-of-fit test, can be performed to determine whether the theoretical distribution's inherent statistics are consistent with the empirical distribution. The distribution fitting process should focus on the bulk of the distribution rather than the extreme tails of the distribution. This is particularly true in cases such as the general

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[4] IDEQ recognized that use of the FFQ is not the preferred data set from which to derive the adjustment factor and that species-specific data from the dietary recall survey would be preferred as indicated in the footnote to the FCR summary table prepared by IDEQ for the August 6, 2105 Negotiated Rulemaking meeting: "Because the Idaho FFQ does not provide species level data, Idaho fish is based on a survey question that asks respondents to say what percentage of the fish they ate over the past year came from Idaho waters. It thus includes Chinook and Coho salmon, and likely excludes some rainbow trout purchased rather than caught. THEREFORE IT IS NOT COMPRABLE TO THE DIETARY RECALL IDAHO FISH GROUP." (Emphasis in the original). IDEQ used the FFQ data to derive the adjustment factor because species-specific data for the Idaho fish group from the dietary recall survey were not available to IDEQ at the time they had to develop FCR distributions and derive draft HHAWQC.

[5] The survey data included two weighting variables to adjust for missing responses in the data. The calculations were conducted twice, once for each of the two survey weight variables. The effect on the adjustment factor was minimal. Using the variable "survey_wt1" resulted in an estimate of 7.03% compared to the adjustment factor of 7.04% presented in the text of this report.

population distribution for consumption of Idaho fish, which, as described above in **Section 2**, has an extreme upper percentile value that has great uncertainty and appears inconsistent with the remainder of the distribution.

The distribution fitting approach used by IDEQ for each distribution is discussed below.

## 3.1 General Population

Rather than fitting a continuous theoretical distribution to the empirical FCR distribution using the @Risk software, Windward (2015) used linear interpolation to estimate the FCR at each tenth-of-a-percentile increment and used the resulting empirical and interpolated values in a discrete @Risk distribution, assigning equal probability to each tenth-of-a-percentile estimate (**Appendix A**, **Figure 1**). While the individual percentiles of the discrete distribution fit the empirical distribution quite well, the arithmetic mean of the discrete distribution is nearly four times greater than that of the empirical distribution (8.74 g/day versus 2.34 g/day), driven upward by the inclusion of the estimated 100$^{th}$ percentile value of 1,261 g/day and the interpolated tenth-of-a-percentile estimates between the 99$^{th}$ and 100$^{th}$ percentiles. In addition, using linear interpolation between percentiles of a positively skewed distribution increases the likelihood of less probable values, particularly in the upper tail of the distribution, and therefore is not an ideal method for estimating between the percentiles of the FCR distribution.

## 3.2 Nez Perce Tribal Population

As with the general population, Windward (2015) used linear interpolation to estimate the FCR at each tenth-of-a-percentile increment and used the resulting empirical and interpolated values in a discrete @Risk distribution, assigning equal probability to each tenth-of-a-percentile estimate (**Appendix A**, **Figure 2**). Ridolfi and Pacific Market Research (2015) only reported every fifth percentile through the 95$^{th}$ because the higher percentiles were considered to be too uncertain to report.[6] In the absence of such

[6] The authors noted the following with respect to the upper percentiles of the distribution: "The NCI method as implemented in SAS software provides integer percentiles of usual consumption rates up to the 99$^{th}$ percentile. However, an analysis of species Group 1 and species Group 2 consumption for the NPT (all respondents) showed a lower calculated 99$^{th}$ percentile consumption rate for Group 1 (373.2 g/day) than for Group 2 (409.6 g/day), even though the nearby 95$^{th}$ percentile values were in the order expected (232.1 g/day and 221.8 g/day, respectively). The number of respondents in the two analyses was very similar (though small for the NCI method), and Group 2 is a subset of the species in Group 1 and would be expected to have a smaller true 99$^{th}$ percentile in the population. However, it is not an error for these two estimated values of the 99$^{th}$ percentiles to be in an unexpected order. These are both estimates—not population values—for the 99$^{th}$ percentile for each group of species, and—as indicated by the width of the confidence interval for the 99$^{th}$ percentile for Group 1 (276.2-692.7g/day)—there is a range of plausible values for these kinds of estimates. Among the plausible estimates for each of the two 99$^{th}$ percentiles, some of the plausible choices will have the 99$^{th}$ in the expected order (Group 2 having a smaller 99$^{th}$ percentile than Group 1). In order to avoid confusion in presentation of results, all NCI-method percentiles for Group 1 and Group 2 have been reported only up to the 95$^{th}$ percentile."

percentiles Windward (2015) assumed the maximum tribal FCR was equal to the 100th percentile Idaho fish FCR for the general population (i.e., 1,261 g/day), multiplied by the 24.2% adjustment factor for Idaho fish. This approach is not appropriate for at least two reasons. First, Ridolfi and Pacific Market Research (2015) evaluated the higher percentiles of tribal consumption and believed those to be too uncertain to report. Substituting general population FCRs for those percentiles using a highly uncertain maximum general population FCR contradicts the findings of Ridolfi and Pacific Market Research (2015) and suggests tribal and general population consumption are interchangeable. Second, the 1,261 g/day FCR for the general population already represents consumption of Idaho fish. Therefore, the adjustment of 24.2% to estimate the Idaho fish FCR from the tribal Group 2 fish is not necessary for this maximum value.

While the individual percentiles of the discrete distribution fit the empirical distribution quite well, the arithmetic mean of the discrete distribution is approximately 20% greater than that of the empirical distribution (19.2 g/day versus 16.1 g/day), driven upward by the inclusion of a maximum value derived from the highly uncertain 100th percentile value reported for the general population. The overestimation of the arithmetic mean is of particular importance for the Nez Perce tribal distribution, because the draft HHAWQC for the tribal population are derived by targeting the arithmetic mean of the Nez Perce population. Using a FCR distribution that overestimates the arithmetic mean in a probabilistic approach that targets the arithmetic mean will result in HHAWQC that are more stringent than warranted based on the tribal FCR data.

# 4 ALTERNATIVE DISTRIBUTION FITTING

Arcadis used the same data used by IDEQ to develop FCR distributions for the general and Nez Perce tribal populations of Idaho. Arcadis fit continuous theoretical curves to the data in @Risk as well as alternate discrete distributions. This process is described below.

## 4.1 General Population

After investigating alternative fits to the empirical data using the @Risk “Distribution Fitting” function, Arcadis found that no single theoretical distribution matched all percentiles of the empirical distribution well. Therefore, Arcadis used the “RiskSplice” function within @Risk, which enabled Arcadis to fit two theoretical distributions to the empirical distribution reported by Buckman et al. (2015) – one fitting well to the lower percentiles (i.e., 0 to 75th) and the other fitting well to the upper percentiles (i.e., 76th to 100th) – and combine the two. Samples below the “splice point” (in this case, the 75th percentile) are selected from the first distribution (a lognormal distribution), and samples above the “splice point” are selected from the second distribution (an inverse Gaussian distribution). This approach of describing the tail of a distribution with a separate function is supported by USEPA probabilistic risk assessment guidance (USEPA 2001), which discusses an example of extending the tails of a distribution using an exponential distribution, stating that this method is “based on extreme value theory, and the observation that extreme values for many continuous, unbounded distributions follow an exponential distribution.” The resulting theoretical distribution provides a close fit to the individual percentiles of the empirical distribution, comparable to IDEQ’s discrete distribution, but provides a much closer fit to the arithmetic mean (2.28 g/day versus 2.34 g/day) (**Table 4**, **Figure 1**).

Arcadis also developed two alternate discrete distributions using the empirical data. First, Arcadis used the empirical percentile values in a discrete @Risk distribution, assigning equal probability to each empirical percentile value and excluding the highly uncertain 100th percentile responsible for driving up the arithmetic mean of IDEQ's discrete distribution. While the individual percentiles of the discrete distribution fit the empirical distribution quite well, the arithmetic mean of the discrete distribution is approximately 23% lower than that of the empirical distribution (1.81 g/day versus 2.34 g/day). Next, Arcadis followed the interpolation approach used by Windward (2015), however instead of using linear interpolation between each empirical percentile, Arcadis used logarithmic interpolation to estimate the FCR at each tenth-of-a-percentile increment and used the resulting values in a discrete @Risk distribution, assigning equal probability to each tenth-of-a-percentile estimate (**Appendix A**). Again, the individual percentiles of the discrete distribution fit the empirical distribution quite well, but the arithmetic mean of the distribution is 2.5 times greater than that of the empirical distribution (5.81 g/day versus 2.34 g/day).

These multiple attempts at trying to create a discrete distribution that tries to address the highly uncertain maximum FCR highlight both the uncertainty of the FCR and its inconsistency with remainder of the FCR distribution for the general population, as well as the sensitivity of the discrete function to the assumptions used to interpolate tenths of percentiles between reported percentiles. While it is possible that tenths of percentiles could eventually be estimated that fit both the percentiles of the FCR distribution and its arithmetic mean, neither the linear interpolation used to derive the draft HHAWQC nor the logarithmic interpolation used as an alternative by Arcadis do so. Rather, the combination of two continuous distributions developed by Arcadis provide the best fit of both the percentiles and arithmetic mean of the empirical FCR distribution and should be used to derive HHAWQC for Idaho.

## 4.2 Nez Perce Tribal Population

Arcadis used the @Risk "Distribution Fitting" function to fit a theoretical distribution to the IDEQ estimated (i.e., based on 24.2% adjustment factor) empirical Nez Perce Idaho fish consumption distribution. The best fitting single theoretical distribution (i.e., the theoretical distribution with the lowest root mean square error) was an inverse Gaussian distribution, which provides a close fit to the individual percentiles of the empirical distribution, comparable to IDEQ's discrete distribution, but provides a much closer fit to the arithmetic mean (16.6 g/day versus 16.1 g/day) (**Table 5**, **Figure 2**).

Arcadis also used the @Risk "Distribution Fitting" function to fit a theoretical distribution to the alternate estimated (i.e., based on 7.04% adjustment factor) empirical Nez Perce Idaho fish consumption distribution. The best fitting single theoretical distribution was an inverse Gaussian distribution, which fits the empirical percentiles well as well as the arithmetic mean (4.81 g/day versus 4.68 g/day) (**Table 6**, **Figure 3**). This tribal Idaho fish FCR distribution based on the recall survey adjustment factor (7.04%) should be used to derive HHAWQC for the tribal population in lieu of a distribution based on the FFQ (24.2%) because, as noted by the authors of the tribal FCR survey report (Ridolfi and Pacific Market Research 2015), the recall survey results are likely closer to the true tribal consumption rate than the FFQ results.

# 5 CONCLUSION

To derive probabilistically based HHAWQC using @Risk, empirical FCR distributions must be modelled using theoretical distributions defined within the @Risk software. Windward (2015) used discrete distributions to model FCR in @Risk, incorporating a highly uncertain 100th percentile FCR estimate reported by Buckman et al. (2015). This approach results in theoretical distributions that fit the individual percentiles of the empirical distributions well but overestimate the arithmetic means of the empirical distributions by nearly a factor of four for the general population and approximately 20% for the Nez Perce tribal population. While the overestimation of the mean for the general population is the larger of the two, the overestimation of the mean for the Nez Perce population is of particular practical importance because IDEQ is targeting the arithmetic mean of the Nez Perce population to derive draft HHAWQC. Using FCR distributions that overestimate the arithmetic mean results in draft HHAWQC that are more stringent than warranted based on the tribal FCR data.

In lieu of the discrete distributions used by the draft HHAWQC that overestimate the arithmetic mean of the empirical FCR data substantially and which require interpolation between existing percentiles with no basis to determine if the interpolation model is correct, Arcadis recommends that IDEQ use continuous theoretical curves to model FCR distributions in @Risk when deriving probabilistic HHAWQC. This approach, as described in detail in **Section 4** of this report, results in theoretical distributions that fit the individual percentiles of the empirical distributions as well as IDEQ's discrete distribution, but provide a much closer fit to the arithmetic means. It is crucial that both of these statistics be accurately represented when developing distributions to derive probabilistic HHAWQC so that risk managers can knowledgeably and appropriately manage risk for the average member of the population as well as any given percentile.

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# TABLES

**Table 1. General Population Empirical Idaho Fish Consumption Distribution**

| Statistic | Idaho Fish FCR (g/day) | Statistic | Idaho Fish FCR (g/day) |
|---|---|---|---|
| Mean | 2.34 | 50% | 0.0928 |
| 0% | 0 | 51% | 0.101 |
| 1% | 0.00000918 | 52% | 0.111 |
| 2% | 0.0000377 | 53% | 0.121 |
| 3% | 0.000078 | 54% | 0.131 |
| 4% | 0.000131 | 55% | 0.143 |
| 5% | 0.000196 | 56% | 0.156 |
| 6% | 0.000277 | 57% | 0.170 |
| 7% | 0.000371 | 58% | 0.185 |
| 8% | 0.000484 | 59% | 0.202 |
| 9% | 0.000617 | 60% | 0.220 |
| 10% | 0.000766 | 61% | 0.239 |
| 11% | 0.000951 | 62% | 0.261 |
| 12% | 0.00116 | 63% | 0.285 |
| 13% | 0.00140 | 64% | 0.310 |
| 14% | 0.00167 | 65% | 0.339 |
| 15% | 0.00199 | 66% | 0.370 |
| 16% | 0.00234 | 67% | 0.403 |
| 17% | 0.00273 | 68% | 0.442 |
| 18% | 0.00317 | 69% | 0.483 |
| 19% | 0.00366 | 70% | 0.529 |
| 20% | 0.00420 | 71% | 0.580 |
| 21% | 0.00480 | 72% | 0.635 |
| 22% | 0.00545 | 73% | 0.698 |
| 23% | 0.00618 | 74% | 0.765 |
| 24% | 0.0070 | 75% | 0.840 |
| 25% | 0.00791 | 76% | 0.923 |
| 26% | 0.00891 | 77% | 1.02 |
| 27% | 0.0100 | 78% | 1.12 |
| 28% | 0.0112 | 79% | 1.24 |
| 29% | 0.0125 | 80% | 1.38 |
| 30% | 0.0140 | 81% | 1.53 |
| 31% | 0.0156 | 82% | 1.71 |
| 32% | 0.0173 | 83% | 1.91 |
| 33% | 0.0191 | 84% | 2.15 |
| 34% | 0.0212 | 85% | 2.42 |
| 35% | 0.0234 | 86% | 2.74 |
| 36% | 0.0258 | 87% | 3.09 |
| 37% | 0.0285 | 88% | 3.53 |
| 38% | 0.0313 | 89% | 4.03 |
| 39% | 0.0345 | 90% | 4.66 |
| 40% | 0.0379 | 91% | 5.42 |
| 41% | 0.0415 | 92% | 6.36 |
| 42% | 0.0455 | 93% | 7.53 |
| 43% | 0.0500 | 94% | 9.14 |
| 44% | 0.0546 | 95% | 11.2 |
| 45% | 0.0597 | 96% | 14.1 |
| 46% | 0.0653 | 97% | 18.2 |
| 47% | 0.0714 | 98% | 25.3 |
| 48% | 0.0780 | 99% | 40.5 |
| 49% | 0.0852 | 100% | 1261 |

**Table 2. Nez Perce Empirical Fish Consumption Distributions**

| Statistic | Group 2 FCR (g/day) | IDEQ Estimated Idaho Fish FCR (g/day)[a] | Alternate Estimated Idaho Fish FCR (g/day)[b] |
|---|---|---|---|
| Mean | 66.5 | 16.1 | 4.68 |
| 5% | 4.10 | 0.992 | 0.289 |
| 10% | 6.80 | 1.65 | 0.479 |
| 15% | 9.40 | 2.27 | 0.662 |
| 20% | 12.2 | 2.95 | 0.859 |
| 25% | 15.1 | 3.65 | 1.06 |
| 30% | 18.3 | 4.43 | 1.29 |
| 35% | 21.9 | 5.30 | 1.54 |
| 40% | 26.1 | 6.32 | 1.84 |
| 45% | 30.8 | 7.45 | 2.17 |
| 50% | 36.0 | 8.71 | 2.53 |
| 55% | 42.1 | 10.2 | 2.96 |
| 60% | 49.5 | 12.0 | 3.48 |
| 65% | 58.0 | 14.0 | 4.08 |
| 70% | 68.7 | 16.6 | 4.84 |
| 75% | 81.7 | 19.8 | 5.75 |
| 80% | 98.2 | 23.8 | 6.91 |
| 85% | 122 | 29.5 | 8.57 |
| 90% | 159 | 38.6 | 11.2 |
| 95% | 234 | 56.6 | 16.5 |

**Notes:**
Both Group 2 to Idaho fish adjustment factors were derived using the process outlined by IDEQ (2015).
a. Estimated as 24.2% of the Group 2 FCR, derived from Nez Perce food frequency questionnaire.
b. Estimated as 7.04% of the Group 2 FCR, derived from the Nez Perce dietary recall data.

**Table 3. Nez Perce Tribal Survey Species Groups**

| Group | Description | Species and Groups Included |
|---|---|---|
| Group 1 | All finfish and shellfish | Combination of Groups 3, 4, 5, 6, and 7 |
| Group 2 | Near coastal, estuarine, freshwater, and anadromous | All species in Groups 3, 4, and 5 as well as <u>lobster, crab, shrimp, marine clams or mussels, octopus, and scallops</u> |
| Group 3 | Salmon or steelhead | <u>Chinook, coho,</u> sockeye, kokanee, steelhead, <u>other salmon,</u> and any unspecified salmon species |
| Group 4 | Resident trout | Rainbow, cutthroat, cutbow, bull, brook, lake, brown, other trout, and any unspecified trout species. |
| Group 5 | Other freshwater finfish or shellfish | Lamprey, sturgeon, whitefish, sucker, bass, bluegill, carp, catfish, crappie, sunfish, <u>tilapia,</u> walleye, yellow perch, crayfish, freshwater clams or mussels, other freshwater finfish, and any unspecified freshwater species |
| Group 6 | Marine finfish or shellfish | Cod, halibut, pollock, tuna, lobster, crab, marine clams or mussels, shrimp, other marine fish, or shellfish |
| Group 7 | Unspecified finfish or shellfish | Any response where the species was not specified sufficiently to be placed into Groups 3, 4, 5, or 6 |

**Notes:**
Species <u>underlined</u> in Groups 2 through 5 are not considered Idaho fish (IDEQ 2015).

**Table 4. General Population Alternate Theoretical Distribution**

| Statistic | Empirical Idaho Fish FCR (g/day) | Continuous Theoretical Idaho Fish FCR (g/day)[a] |
|---|---|---|
| Mean | 2.34 | 2.28 |
| 1% | 0.00000918 | 0.00003814 |
| 5% | 0.000196 | 0.000326 |
| 10% | 0.000766 | 0.00107 |
| 15% | 0.00199 | 0.00244 |
| 20% | 0.00420 | 0.00473 |
| 25% | 0.00791 | 0.00837 |
| 30% | 0.0140 | 0.0140 |
| 35% | 0.0234 | 0.0226 |
| 40% | 0.0379 | 0.0356 |
| 45% | 0.0597 | 0.0552 |
| 50% | 0.0928 | 0.0851 |
| 55% | 0.143 | 0.131 |
| 60% | 0.220 | 0.203 |
| 65% | 0.339 | 0.319 |
| 70% | 0.529 | 0.511 |
| 75% | 0.840 | 0.847 |
| 80% | 1.38 | 1.43 |
| 85% | 2.42 | 2.48 |
| 90% | 4.66 | 4.70 |
| 95% | 11.2 | 11.3 |
| 99% | 40.5 | 44.2 |

**Notes:**
a. This continuous theoretical distribution fits the arithmetic mean of the empirical distribution better than the IDEQ discrete theoretical distribution.
@Risk formula: =RiskSplice(RiskLognorm(49.066,27171.1,RiskShift(-0.0000285067),RiskTruncate(0.0000285067)),RiskInvgauss(2.698,0.19327,RiskShift(-0.49512),RiskTruncate(0.49512)),0.84)

**Table 5. Nez Perce Alternate Theoretical Distribution for IDEQ Estimated Idaho Fish**

| Statistic | IDEQ Estimated Empirical Idaho Fish FCR (g/day) | Continuous Theoretical Idaho Fish FCR (g/day)[a] |
|---|---|---|
| Mean | 16.1 | 16.6 |
| 5% | 0.992 | 1.01 |
| 10% | 1.65 | 1.72 |
| 15% | 2.27 | 2.40 |
| 20% | 2.95 | 3.09 |
| 25% | 3.65 | 3.82 |
| 30% | 4.43 | 4.61 |
| 35% | 5.30 | 5.47 |
| 40% | 6.32 | 6.44 |
| 45% | 7.45 | 7.53 |
| 50% | 8.71 | 8.78 |
| 55% | 10.2 | 10.2 |
| 60% | 12.0 | 12.0 |
| 65% | 14.0 | 14.0 |
| 70% | 16.6 | 16.6 |
| 75% | 19.8 | 19.8 |
| 80% | 23.8 | 24.2 |
| 85% | 29.5 | 30.3 |
| 90% | 38.6 | 39.9 |
| 95% | 56.6 | 58.7 |

**Notes:**

a. This continuous theoretical distribution fits the arithmetic mean of the empirical distribution better than the IDEQ discrete theoretical distribution.

@Risk formula: =RiskInvgauss(17.802,10.944,RiskShift(-1.3888),RiskTruncate(1.3888))

**Table 6. Nez Perce Theoretical Distribution for Alternate Estimated Idaho Fish**

| Statistic | Alternate Estimated Empirical Idaho Fish FCR (g/day) | Continuous Theoretical Idaho Fish FCR (g/day)[a] |
|---|---|---|
| Mean | 4.67 | 4.82 |
| 5% | 0.288 | 0.294 |
| 10% | 0.478 | 0.502 |
| 15% | 0.661 | 0.699 |
| 20% | 0.858 | 0.899 |
| 25% | 1.06 | 1.11 |
| 30% | 1.29 | 1.34 |
| 35% | 1.54 | 1.59 |
| 40% | 1.83 | 1.87 |
| 45% | 2.17 | 2.19 |
| 50% | 2.53 | 2.56 |
| 55% | 2.96 | 2.98 |
| 60% | 3.48 | 3.48 |
| 65% | 4.08 | 4.08 |
| 70% | 4.83 | 4.82 |
| 75% | 5.74 | 5.77 |
| 80% | 6.90 | 7.03 |
| 85% | 8.56 | 8.80 |
| 90% | 11.2 | 11.6 |
| 95% | 16.4 | 17.1 |

**Notes:**
a. @Risk formula: =RiskInvgauss(5.1782,3.1855,RiskShift(-0.40434),RiskTruncate(0.40434))

# FIGURES

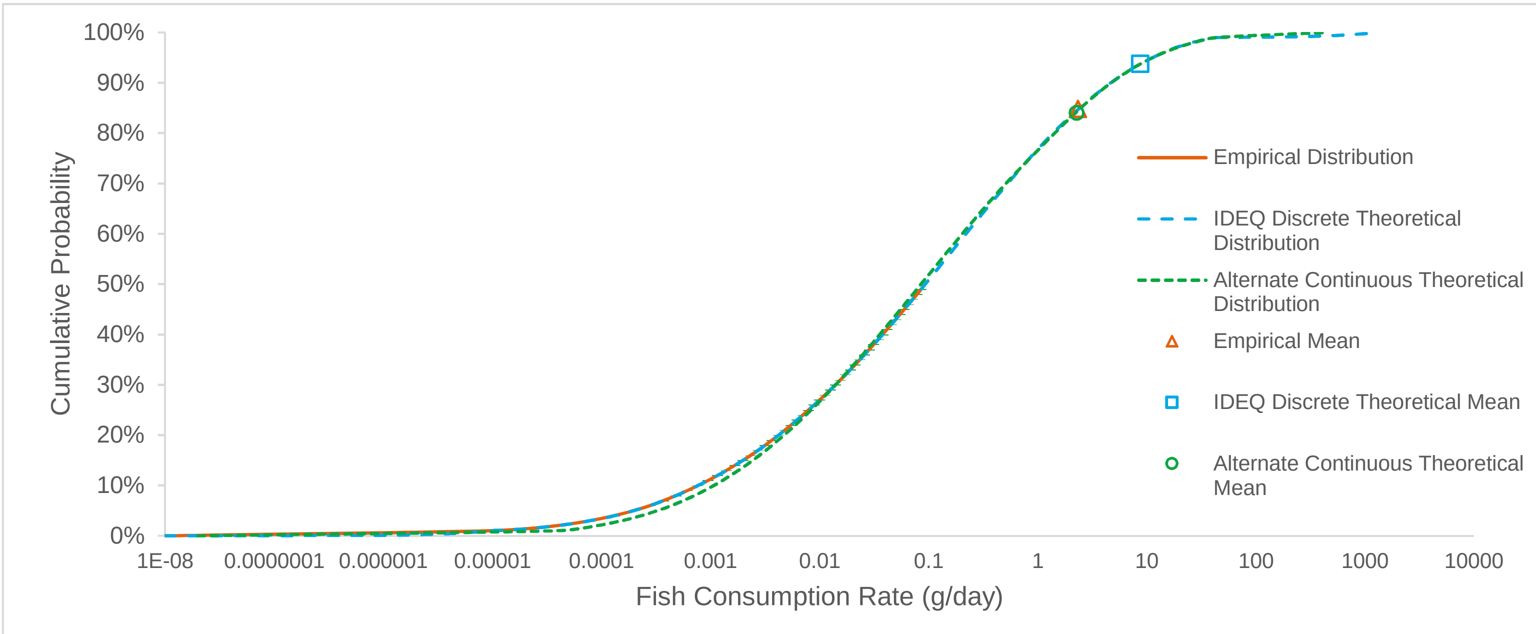


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**Figure 1**
**General Population Idaho Fish Consumption Distributions**

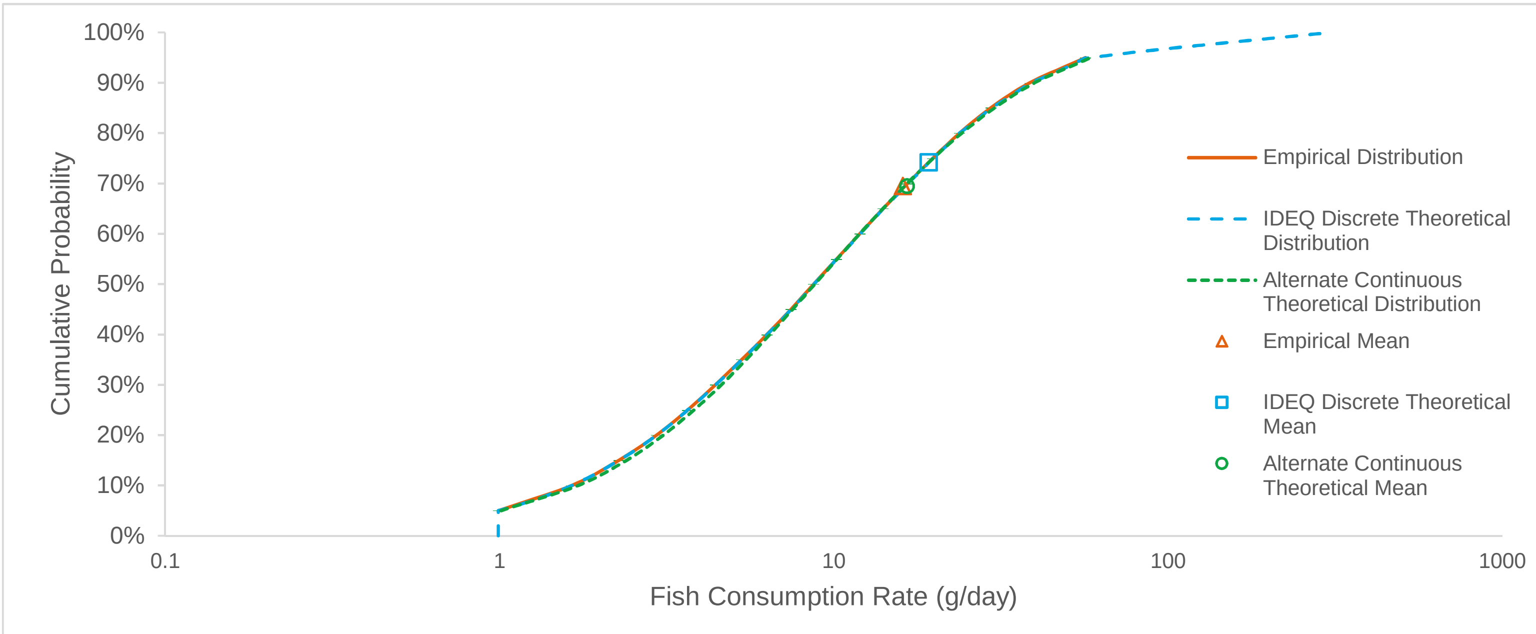


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**Figure 2**
**Nez Perce Tribal Population IDEQ Estimated Idaho Fish Consumption Distributions**

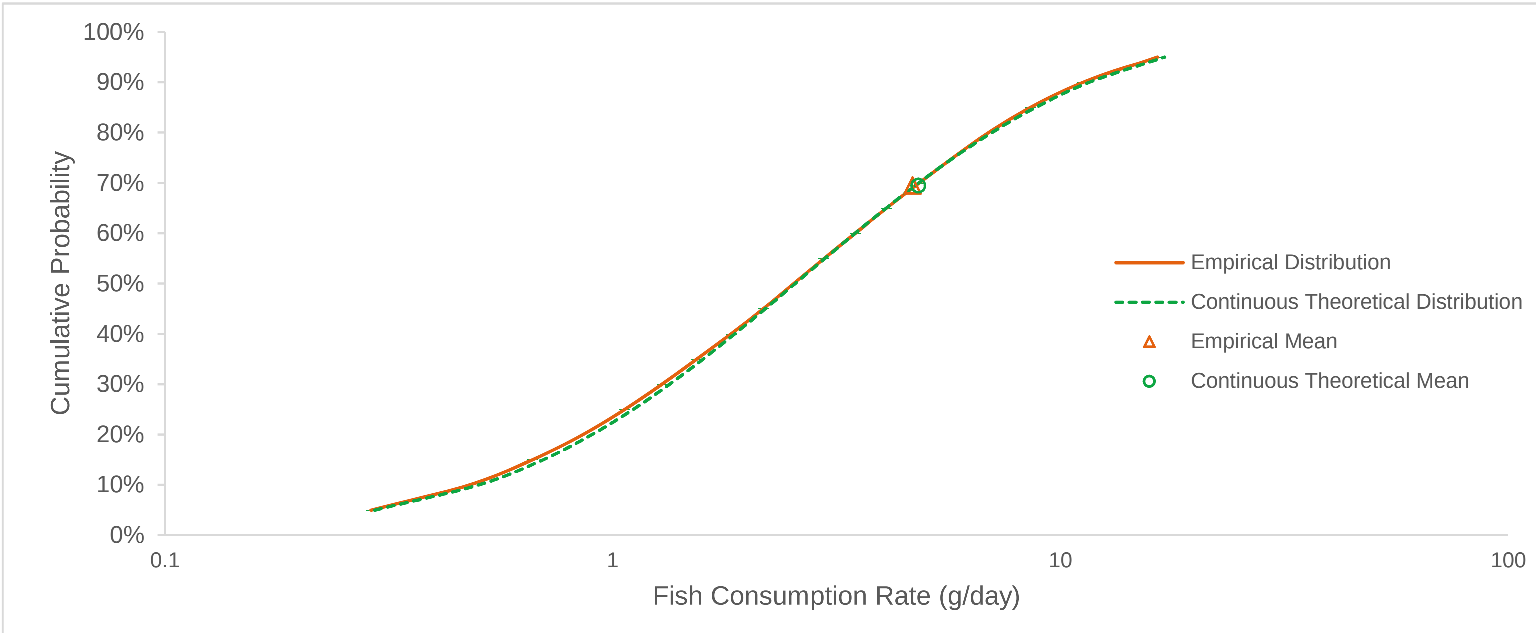


**Figure 3**
**Nez Perce Tribal Population Alternate Estimated Idaho Fish Consumption Distributions**

# APPENDIX A

## Interpolated Fish Consumption Distributions

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| Mean | -- | 8.47 | arithmetic mean of discrete distribution |
| 0% | 0.0999% | 0 | estimate from Buckman et al. (2015) using the NCI method |
| 0.1% | 0.0999% | 0.000000918 | linear interpolation |
| 0.2% | 0.0999% | 0.00000184 | linear interpolation |
| 0.3% | 0.0999% | 0.00000275 | linear interpolation |
| 0.4% | 0.0999% | 0.00000367 | linear interpolation |
| 0.5% | 0.0999% | 0.00000459 | linear interpolation |
| 0.6% | 0.0999% | 0.00000551 | linear interpolation |
| 0.7% | 0.0999% | 0.00000642 | linear interpolation |
| 0.8% | 0.0999% | 0.00000734 | linear interpolation |
| 0.9% | 0.0999% | 0.00000826 | linear interpolation |
| 1.0% | 0.0999% | 0.00000918 | estimate from Buckman et al. (2015) using the NCI method |
| 1.1% | 0.0999% | 0.0000120 | linear interpolation |
| 1.2% | 0.0999% | 0.0000149 | linear interpolation |
| 1.3% | 0.0999% | 0.0000177 | linear interpolation |
| 1.4% | 0.0999% | 0.0000206 | linear interpolation |
| 1.5% | 0.0999% | 0.0000234 | linear interpolation |
| 1.6% | 0.0999% | 0.0000263 | linear interpolation |
| 1.7% | 0.0999% | 0.0000291 | linear interpolation |
| 1.8% | 0.0999% | 0.0000320 | linear interpolation |
| 1.9% | 0.0999% | 0.0000348 | linear interpolation |
| 2.0% | 0.0999% | 0.0000377 | estimate from Buckman et al. (2015) using the NCI method |
| 2.1% | 0.0999% | 0.0000417 | linear interpolation |
| 2.2% | 0.0999% | 0.0000458 | linear interpolation |
| 2.3% | 0.0999% | 0.0000498 | linear interpolation |
| 2.4% | 0.0999% | 0.0000538 | linear interpolation |
| 2.5% | 0.0999% | 0.0000579 | linear interpolation |
| 2.6% | 0.0999% | 0.0000619 | linear interpolation |
| 2.7% | 0.0999% | 0.0000659 | linear interpolation |
| 2.8% | 0.0999% | 0.0000700 | linear interpolation |
| 2.9% | 0.0999% | 0.0000740 | linear interpolation |
| 3.0% | 0.0999% | 0.0000780 | estimate from Buckman et al. (2015) using the NCI method |
| 3.1% | 0.0999% | 0.0000834 | linear interpolation |
| 3.2% | 0.0999% | 0.0000887 | linear interpolation |
| 3.3% | 0.0999% | 0.0000941 | linear interpolation |
| 3.4% | 0.0999% | 0.0000994 | linear interpolation |
| 3.5% | 0.0999% | 0.000105 | linear interpolation |
| 3.6% | 0.0999% | 0.000110 | linear interpolation |
| 3.7% | 0.0999% | 0.000115 | linear interpolation |
| 3.8% | 0.0999% | 0.000121 | linear interpolation |
| 3.9% | 0.0999% | 0.000126 | linear interpolation |
| 4.0% | 0.0999% | 0.000131 | estimate from Buckman et al. (2015) using the NCI method |
| 4.1% | 0.0999% | 0.000138 | linear interpolation |
| 4.2% | 0.0999% | 0.000144 | linear interpolation |
| 4.3% | 0.0999% | 0.000151 | linear interpolation |
| 4.4% | 0.0999% | 0.000157 | linear interpolation |
| 4.5% | 0.0999% | 0.000164 | linear interpolation |
| 4.6% | 0.0999% | 0.000170 | linear interpolation |
| 4.7% | 0.0999% | 0.000177 | linear interpolation |
| 4.8% | 0.0999% | 0.000183 | linear interpolation |
| 4.9% | 0.0999% | 0.000189 | linear interpolation |
| 5.0% | 0.0999% | 0.000196 | estimate from Buckman et al. (2015) using the NCI method |
| 5.1% | 0.0999% | 0.000204 | linear interpolation |
| 5.2% | 0.0999% | 0.000212 | linear interpolation |
| 5.3% | 0.0999% | 0.000220 | linear interpolation |
| 5.4% | 0.0999% | 0.000228 | linear interpolation |
| 5.5% | 0.0999% | 0.000236 | linear interpolation |
| 5.6% | 0.0999% | 0.000245 | linear interpolation |
| 5.7% | 0.0999% | 0.000253 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 5.8% | 0.0999% | 0.000261 | linear interpolation |
| 5.9% | 0.0999% | 0.000269 | linear interpolation |
| 6.0% | 0.0999% | 0.000277 | estimate from Buckman et al. (2015) using the NCI method |
| 6.1% | 0.0999% | 0.000286 | linear interpolation |
| 6.2% | 0.0999% | 0.000296 | linear interpolation |
| 6.3% | 0.0999% | 0.000305 | linear interpolation |
| 6.4% | 0.0999% | 0.000315 | linear interpolation |
| 6.5% | 0.0999% | 0.000324 | linear interpolation |
| 6.6% | 0.0999% | 0.000333 | linear interpolation |
| 6.7% | 0.0999% | 0.000343 | linear interpolation |
| 6.8% | 0.0999% | 0.000352 | linear interpolation |
| 6.9% | 0.0999% | 0.000362 | linear interpolation |
| 7.0% | 0.0999% | 0.000371 | estimate from Buckman et al. (2015) using the NCI method |
| 7.1% | 0.0999% | 0.000382 | linear interpolation |
| 7.2% | 0.0999% | 0.000394 | linear interpolation |
| 7.3% | 0.0999% | 0.000405 | linear interpolation |
| 7.4% | 0.0999% | 0.000416 | linear interpolation |
| 7.5% | 0.0999% | 0.000428 | linear interpolation |
| 7.6% | 0.0999% | 0.000439 | linear interpolation |
| 7.7% | 0.0999% | 0.000450 | linear interpolation |
| 7.8% | 0.0999% | 0.000461 | linear interpolation |
| 7.9% | 0.0999% | 0.000473 | linear interpolation |
| 8.0% | 0.0999% | 0.000484 | estimate from Buckman et al. (2015) using the NCI method |
| 8.1% | 0.0999% | 0.000497 | linear interpolation |
| 8.2% | 0.0999% | 0.000511 | linear interpolation |
| 8.3% | 0.0999% | 0.000524 | linear interpolation |
| 8.4% | 0.0999% | 0.000537 | linear interpolation |
| 8.5% | 0.0999% | 0.000551 | linear interpolation |
| 8.6% | 0.0999% | 0.000564 | linear interpolation |
| 8.7% | 0.0999% | 0.000577 | linear interpolation |
| 8.8% | 0.0999% | 0.000590 | linear interpolation |
| 8.9% | 0.0999% | 0.000604 | linear interpolation |
| 9.0% | 0.0999% | 0.000617 | estimate from Buckman et al. (2015) using the NCI method |
| 9.1% | 0.0999% | 0.000632 | linear interpolation |
| 9.2% | 0.0999% | 0.000647 | linear interpolation |
| 9.3% | 0.0999% | 0.000662 | linear interpolation |
| 9.4% | 0.0999% | 0.000677 | linear interpolation |
| 9.5% | 0.0999% | 0.000692 | linear interpolation |
| 9.6% | 0.0999% | 0.000706 | linear interpolation |
| 9.7% | 0.0999% | 0.000721 | linear interpolation |
| 9.8% | 0.0999% | 0.000736 | linear interpolation |
| 9.9% | 0.0999% | 0.000751 | linear interpolation |
| 10.0% | 0.0999% | 0.000766 | estimate from Buckman et al. (2015) using the NCI method |
| 10.1% | 0.0999% | 0.000785 | linear interpolation |
| 10.2% | 0.0999% | 0.000803 | linear interpolation |
| 10.3% | 0.0999% | 0.000822 | linear interpolation |
| 10.4% | 0.0999% | 0.000840 | linear interpolation |
| 10.5% | 0.0999% | 0.000859 | linear interpolation |
| 10.6% | 0.0999% | 0.000877 | linear interpolation |
| 10.7% | 0.0999% | 0.000896 | linear interpolation |
| 10.8% | 0.0999% | 0.000914 | linear interpolation |
| 10.9% | 0.0999% | 0.000933 | linear interpolation |
| 11.0% | 0.0999% | 0.000951 | estimate from Buckman et al. (2015) using the NCI method |
| 11.1% | 0.0999% | 0.000972 | linear interpolation |
| 11.2% | 0.0999% | 0.000993 | linear interpolation |
| 11.3% | 0.0999% | 0.00101 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 11.4% | 0.0999% | 0.00104 | linear interpolation |
| 11.5% | 0.0999% | 0.00106 | linear interpolation |
| 11.6% | 0.0999% | 0.00108 | linear interpolation |
| 11.7% | 0.0999% | 0.00110 | linear interpolation |
| 11.8% | 0.0999% | 0.00112 | linear interpolation |
| 11.9% | 0.0999% | 0.00114 | linear interpolation |
| 12.0% | 0.0999% | 0.00116 | estimate from Buckman et al. (2015) using the NCI method |
| 12.1% | 0.0999% | 0.00119 | linear interpolation |
| 12.2% | 0.0999% | 0.00121 | linear interpolation |
| 12.3% | 0.0999% | 0.00123 | linear interpolation |
| 12.4% | 0.0999% | 0.00126 | linear interpolation |
| 12.5% | 0.0999% | 0.00128 | linear interpolation |
| 12.6% | 0.0999% | 0.00131 | linear interpolation |
| 12.7% | 0.0999% | 0.00133 | linear interpolation |
| 12.8% | 0.0999% | 0.00135 | linear interpolation |
| 12.9% | 0.0999% | 0.00138 | linear interpolation |
| 13.0% | 0.0999% | 0.00140 | estimate from Buckman et al. (2015) using the NCI method |
| 13.1% | 0.0999% | 0.00143 | linear interpolation |
| 13.2% | 0.0999% | 0.00146 | linear interpolation |
| 13.3% | 0.0999% | 0.00148 | linear interpolation |
| 13.4% | 0.0999% | 0.00151 | linear interpolation |
| 13.5% | 0.0999% | 0.00154 | linear interpolation |
| 13.6% | 0.0999% | 0.00156 | linear interpolation |
| 13.7% | 0.0999% | 0.00159 | linear interpolation |
| 13.8% | 0.0999% | 0.00162 | linear interpolation |
| 13.9% | 0.0999% | 0.00165 | linear interpolation |
| 14.0% | 0.0999% | 0.00167 | estimate from Buckman et al. (2015) using the NCI method |
| 14.1% | 0.0999% | 0.00171 | linear interpolation |
| 14.2% | 0.0999% | 0.00174 | linear interpolation |
| 14.3% | 0.0999% | 0.00177 | linear interpolation |
| 14.4% | 0.0999% | 0.00180 | linear interpolation |
| 14.5% | 0.0999% | 0.00183 | linear interpolation |
| 14.6% | 0.0999% | 0.00186 | linear interpolation |
| 14.7% | 0.0999% | 0.00189 | linear interpolation |
| 14.8% | 0.0999% | 0.00192 | linear interpolation |
| 14.9% | 0.0999% | 0.00195 | linear interpolation |
| 15.0% | 0.0999% | 0.00199 | estimate from Buckman et al. (2015) using the NCI method |
| 15.1% | 0.0999% | 0.00202 | linear interpolation |
| 15.2% | 0.0999% | 0.00206 | linear interpolation |
| 15.3% | 0.0999% | 0.00209 | linear interpolation |
| 15.4% | 0.0999% | 0.00213 | linear interpolation |
| 15.5% | 0.0999% | 0.00216 | linear interpolation |
| 15.6% | 0.0999% | 0.00220 | linear interpolation |
| 15.7% | 0.0999% | 0.00223 | linear interpolation |
| 15.8% | 0.0999% | 0.00227 | linear interpolation |
| 15.9% | 0.0999% | 0.00230 | linear interpolation |
| 16.0% | 0.0999% | 0.00234 | estimate from Buckman et al. (2015) using the NCI method |
| 16.1% | 0.0999% | 0.00238 | linear interpolation |
| 16.2% | 0.0999% | 0.00242 | linear interpolation |
| 16.3% | 0.0999% | 0.00246 | linear interpolation |
| 16.4% | 0.0999% | 0.00250 | linear interpolation |
| 16.5% | 0.0999% | 0.00254 | linear interpolation |
| 16.6% | 0.0999% | 0.00258 | linear interpolation |
| 16.7% | 0.0999% | 0.00262 | linear interpolation |
| 16.8% | 0.0999% | 0.00266 | linear interpolation |
| 16.9% | 0.0999% | 0.00269 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 17.0% | 0.0999% | 0.00273 | estimate from Buckman et al. (2015) using the NCI method |
| 17.1% | 0.0999% | 0.00278 | linear interpolation |
| 17.2% | 0.0999% | 0.00282 | linear interpolation |
| 17.3% | 0.0999% | 0.00286 | linear interpolation |
| 17.4% | 0.0999% | 0.00291 | linear interpolation |
| 17.5% | 0.0999% | 0.00295 | linear interpolation |
| 17.6% | 0.0999% | 0.00299 | linear interpolation |
| 17.7% | 0.0999% | 0.00304 | linear interpolation |
| 17.8% | 0.0999% | 0.00308 | linear interpolation |
| 17.9% | 0.0999% | 0.00312 | linear interpolation |
| 18.0% | 0.0999% | 0.00317 | estimate from Buckman et al. (2015) using the NCI method |
| 18.1% | 0.0999% | 0.00322 | linear interpolation |
| 18.2% | 0.0999% | 0.00327 | linear interpolation |
| 18.3% | 0.0999% | 0.00331 | linear interpolation |
| 18.4% | 0.0999% | 0.00336 | linear interpolation |
| 18.5% | 0.0999% | 0.00341 | linear interpolation |
| 18.6% | 0.0999% | 0.00346 | linear interpolation |
| 18.7% | 0.0999% | 0.00351 | linear interpolation |
| 18.8% | 0.0999% | 0.00356 | linear interpolation |
| 18.9% | 0.0999% | 0.00361 | linear interpolation |
| 19.0% | 0.0999% | 0.00366 | estimate from Buckman et al. (2015) using the NCI method |
| 19.1% | 0.0999% | 0.00371 | linear interpolation |
| 19.2% | 0.0999% | 0.00377 | linear interpolation |
| 19.3% | 0.0999% | 0.00382 | linear interpolation |
| 19.4% | 0.0999% | 0.00388 | linear interpolation |
| 19.5% | 0.0999% | 0.00393 | linear interpolation |
| 19.6% | 0.0999% | 0.00399 | linear interpolation |
| 19.7% | 0.0999% | 0.00404 | linear interpolation |
| 19.8% | 0.0999% | 0.00409 | linear interpolation |
| 19.9% | 0.0999% | 0.00415 | linear interpolation |
| 20.0% | 0.0999% | 0.00420 | estimate from Buckman et al. (2015) using the NCI method |
| 20.1% | 0.0999% | 0.00426 | linear interpolation |
| 20.2% | 0.0999% | 0.00432 | linear interpolation |
| 20.3% | 0.0999% | 0.00438 | linear interpolation |
| 20.4% | 0.0999% | 0.00444 | linear interpolation |
| 20.5% | 0.0999% | 0.00450 | linear interpolation |
| 20.6% | 0.0999% | 0.00456 | linear interpolation |
| 20.7% | 0.0999% | 0.00462 | linear interpolation |
| 20.8% | 0.0999% | 0.00468 | linear interpolation |
| 20.9% | 0.0999% | 0.00474 | linear interpolation |
| 21.0% | 0.0999% | 0.00480 | estimate from Buckman et al. (2015) using the NCI method |
| 21.1% | 0.0999% | 0.00487 | linear interpolation |
| 21.2% | 0.0999% | 0.00493 | linear interpolation |
| 21.3% | 0.0999% | 0.00500 | linear interpolation |
| 21.4% | 0.0999% | 0.00506 | linear interpolation |
| 21.5% | 0.0999% | 0.00513 | linear interpolation |
| 21.6% | 0.0999% | 0.00519 | linear interpolation |
| 21.7% | 0.0999% | 0.00526 | linear interpolation |
| 21.8% | 0.0999% | 0.00532 | linear interpolation |
| 21.9% | 0.0999% | 0.00539 | linear interpolation |
| 22.0% | 0.0999% | 0.00545 | estimate from Buckman et al. (2015) using the NCI method |
| 22.1% | 0.0999% | 0.00553 | linear interpolation |
| 22.2% | 0.0999% | 0.00560 | linear interpolation |
| 22.3% | 0.0999% | 0.00567 | linear interpolation |
| 22.4% | 0.0999% | 0.00574 | linear interpolation |
| 22.5% | 0.0999% | 0.00582 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 22.6% | 0.0999% | 0.00589 | linear interpolation |
| 22.7% | 0.0999% | 0.00596 | linear interpolation |
| 22.8% | 0.0999% | 0.00603 | linear interpolation |
| 22.9% | 0.0999% | 0.00610 | linear interpolation |
| 23.0% | 0.0999% | 0.00618 | estimate from Buckman et al. (2015) using the NCI method |
| 23.1% | 0.0999% | 0.00626 | linear interpolation |
| 23.2% | 0.0999% | 0.00634 | linear interpolation |
| 23.3% | 0.0999% | 0.00642 | linear interpolation |
| 23.4% | 0.0999% | 0.00651 | linear interpolation |
| 23.5% | 0.0999% | 0.00659 | linear interpolation |
| 23.6% | 0.0999% | 0.00667 | linear interpolation |
| 23.7% | 0.0999% | 0.00675 | linear interpolation |
| 23.8% | 0.0999% | 0.00684 | linear interpolation |
| 23.9% | 0.0999% | 0.00692 | linear interpolation |
| 24.0% | 0.0999% | 0.00700 | estimate from Buckman et al. (2015) using the NCI method |
| 24.1% | 0.0999% | 0.00709 | linear interpolation |
| 24.2% | 0.0999% | 0.00718 | linear interpolation |
| 24.3% | 0.0999% | 0.00727 | linear interpolation |
| 24.4% | 0.0999% | 0.00736 | linear interpolation |
| 24.5% | 0.0999% | 0.00746 | linear interpolation |
| 24.6% | 0.0999% | 0.00755 | linear interpolation |
| 24.7% | 0.0999% | 0.00764 | linear interpolation |
| 24.8% | 0.0999% | 0.00773 | linear interpolation |
| 24.9% | 0.0999% | 0.00782 | linear interpolation |
| 25.0% | 0.0999% | 0.00791 | estimate from Buckman et al. (2015) using the NCI method |
| 25.1% | 0.0999% | 0.00801 | linear interpolation |
| 25.2% | 0.0999% | 0.00811 | linear interpolation |
| 25.3% | 0.0999% | 0.00821 | linear interpolation |
| 25.4% | 0.0999% | 0.00831 | linear interpolation |
| 25.5% | 0.0999% | 0.00841 | linear interpolation |
| 25.6% | 0.0999% | 0.00851 | linear interpolation |
| 25.7% | 0.0999% | 0.00861 | linear interpolation |
| 25.8% | 0.0999% | 0.00871 | linear interpolation |
| 25.9% | 0.0999% | 0.00881 | linear interpolation |
| 26.0% | 0.0999% | 0.00891 | estimate from Buckman et al. (2015) using the NCI method |
| 26.1% | 0.0999% | 0.00902 | linear interpolation |
| 26.2% | 0.0999% | 0.00913 | linear interpolation |
| 26.3% | 0.0999% | 0.00924 | linear interpolation |
| 26.4% | 0.0999% | 0.00935 | linear interpolation |
| 26.5% | 0.0999% | 0.00946 | linear interpolation |
| 26.6% | 0.0999% | 0.00956 | linear interpolation |
| 26.7% | 0.0999% | 0.00967 | linear interpolation |
| 26.8% | 0.0999% | 0.00978 | linear interpolation |
| 26.9% | 0.0999% | 0.00989 | linear interpolation |
| 27.0% | 0.0999% | 0.0100 | estimate from Buckman et al. (2015) using the NCI method |
| 27.1% | 0.0999% | 0.0101 | linear interpolation |
| 27.2% | 0.0999% | 0.0102 | linear interpolation |
| 27.3% | 0.0999% | 0.0104 | linear interpolation |
| 27.4% | 0.0999% | 0.0105 | linear interpolation |
| 27.5% | 0.0999% | 0.0106 | linear interpolation |
| 27.6% | 0.0999% | 0.0107 | linear interpolation |
| 27.7% | 0.0999% | 0.0109 | linear interpolation |
| 27.8% | 0.0999% | 0.0110 | linear interpolation |
| 27.9% | 0.0999% | 0.0111 | linear interpolation |
| 28.0% | 0.0999% | 0.0112 | estimate from Buckman et al. (2015) using the NCI method |
| 28.1% | 0.0999% | 0.0114 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 28.2% | 0.0999% | 0.0115 | linear interpolation |
| 28.3% | 0.0999% | 0.0116 | linear interpolation |
| 28.4% | 0.0999% | 0.0118 | linear interpolation |
| 28.5% | 0.0999% | 0.0119 | linear interpolation |
| 28.6% | 0.0999% | 0.0120 | linear interpolation |
| 28.7% | 0.0999% | 0.0121 | linear interpolation |
| 28.8% | 0.0999% | 0.0123 | linear interpolation |
| 28.9% | 0.0999% | 0.0124 | linear interpolation |
| 29.0% | 0.0999% | 0.0125 | estimate from Buckman et al. (2015) using the NCI method |
| 29.1% | 0.0999% | 0.0127 | linear interpolation |
| 29.2% | 0.0999% | 0.0128 | linear interpolation |
| 29.3% | 0.0999% | 0.0130 | linear interpolation |
| 29.4% | 0.0999% | 0.0131 | linear interpolation |
| 29.5% | 0.0999% | 0.0133 | linear interpolation |
| 29.6% | 0.0999% | 0.0134 | linear interpolation |
| 29.7% | 0.0999% | 0.0136 | linear interpolation |
| 29.8% | 0.0999% | 0.0137 | linear interpolation |
| 29.9% | 0.0999% | 0.0139 | linear interpolation |
| 30.0% | 0.0999% | 0.0140 | estimate from Buckman et al. (2015) using the NCI method |
| 30.1% | 0.0999% | 0.0142 | linear interpolation |
| 30.2% | 0.0999% | 0.0143 | linear interpolation |
| 30.3% | 0.0999% | 0.0145 | linear interpolation |
| 30.4% | 0.0999% | 0.0146 | linear interpolation |
| 30.5% | 0.0999% | 0.0148 | linear interpolation |
| 30.6% | 0.0999% | 0.0149 | linear interpolation |
| 30.7% | 0.0999% | 0.0151 | linear interpolation |
| 30.8% | 0.0999% | 0.0152 | linear interpolation |
| 30.9% | 0.0999% | 0.0154 | linear interpolation |
| 31.0% | 0.0999% | 0.0156 | estimate from Buckman et al. (2015) using the NCI method |
| 31.1% | 0.0999% | 0.0157 | linear interpolation |
| 31.2% | 0.0999% | 0.0159 | linear interpolation |
| 31.3% | 0.0999% | 0.0161 | linear interpolation |
| 31.4% | 0.0999% | 0.0163 | linear interpolation |
| 31.5% | 0.0999% | 0.0164 | linear interpolation |
| 31.6% | 0.0999% | 0.0166 | linear interpolation |
| 31.7% | 0.0999% | 0.0168 | linear interpolation |
| 31.8% | 0.0999% | 0.0170 | linear interpolation |
| 31.9% | 0.0999% | 0.0171 | linear interpolation |
| 32.0% | 0.0999% | 0.0173 | estimate from Buckman et al. (2015) using the NCI method |
| 32.1% | 0.0999% | 0.0175 | linear interpolation |
| 32.2% | 0.0999% | 0.0177 | linear interpolation |
| 32.3% | 0.0999% | 0.0178 | linear interpolation |
| 32.4% | 0.0999% | 0.0180 | linear interpolation |
| 32.5% | 0.0999% | 0.0182 | linear interpolation |
| 32.6% | 0.0999% | 0.0184 | linear interpolation |
| 32.7% | 0.0999% | 0.0185 | linear interpolation |
| 32.8% | 0.0999% | 0.0187 | linear interpolation |
| 32.9% | 0.0999% | 0.0189 | linear interpolation |
| 33.0% | 0.0999% | 0.0191 | estimate from Buckman et al. (2015) using the NCI method |
| 33.1% | 0.0999% | 0.0193 | linear interpolation |
| 33.2% | 0.0999% | 0.0195 | linear interpolation |
| 33.3% | 0.0999% | 0.0197 | linear interpolation |
| 33.4% | 0.0999% | 0.0199 | linear interpolation |
| 33.5% | 0.0999% | 0.0201 | linear interpolation |
| 33.6% | 0.0999% | 0.0203 | linear interpolation |
| 33.7% | 0.0999% | 0.0206 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 33.8% | 0.0999% | 0.0208 | linear interpolation |
| 33.9% | 0.0999% | 0.0210 | linear interpolation |
| 34.0% | 0.0999% | 0.0212 | estimate from Buckman et al. (2015) using the NCI method |
| 34.1% | 0.0999% | 0.0214 | linear interpolation |
| 34.2% | 0.0999% | 0.0216 | linear interpolation |
| 34.3% | 0.0999% | 0.0219 | linear interpolation |
| 34.4% | 0.0999% | 0.0221 | linear interpolation |
| 34.5% | 0.0999% | 0.0223 | linear interpolation |
| 34.6% | 0.0999% | 0.0225 | linear interpolation |
| 34.7% | 0.0999% | 0.0227 | linear interpolation |
| 34.8% | 0.0999% | 0.0230 | linear interpolation |
| 34.9% | 0.0999% | 0.0232 | linear interpolation |
| 35.0% | 0.0999% | 0.0234 | estimate from Buckman et al. (2015) using the NCI method |
| 35.1% | 0.0999% | 0.0237 | linear interpolation |
| 35.2% | 0.0999% | 0.0239 | linear interpolation |
| 35.3% | 0.0999% | 0.0241 | linear interpolation |
| 35.4% | 0.0999% | 0.0244 | linear interpolation |
| 35.5% | 0.0999% | 0.0246 | linear interpolation |
| 35.6% | 0.0999% | 0.0248 | linear interpolation |
| 35.7% | 0.0999% | 0.0251 | linear interpolation |
| 35.8% | 0.0999% | 0.0253 | linear interpolation |
| 35.9% | 0.0999% | 0.0255 | linear interpolation |
| 36.0% | 0.0999% | 0.0258 | estimate from Buckman et al. (2015) using the NCI method |
| 36.1% | 0.0999% | 0.0261 | linear interpolation |
| 36.2% | 0.0999% | 0.0263 | linear interpolation |
| 36.3% | 0.0999% | 0.0266 | linear interpolation |
| 36.4% | 0.0999% | 0.0269 | linear interpolation |
| 36.5% | 0.0999% | 0.0271 | linear interpolation |
| 36.6% | 0.0999% | 0.0274 | linear interpolation |
| 36.7% | 0.0999% | 0.0277 | linear interpolation |
| 36.8% | 0.0999% | 0.0279 | linear interpolation |
| 36.9% | 0.0999% | 0.0282 | linear interpolation |
| 37.0% | 0.0999% | 0.0285 | estimate from Buckman et al. (2015) using the NCI method |
| 37.1% | 0.0999% | 0.0288 | linear interpolation |
| 37.2% | 0.0999% | 0.0291 | linear interpolation |
| 37.3% | 0.0999% | 0.0293 | linear interpolation |
| 37.4% | 0.0999% | 0.0296 | linear interpolation |
| 37.5% | 0.0999% | 0.0299 | linear interpolation |
| 37.6% | 0.0999% | 0.0302 | linear interpolation |
| 37.7% | 0.0999% | 0.0305 | linear interpolation |
| 37.8% | 0.0999% | 0.0308 | linear interpolation |
| 37.9% | 0.0999% | 0.0310 | linear interpolation |
| 38.0% | 0.0999% | 0.0313 | estimate from Buckman et al. (2015) using the NCI method |
| 38.1% | 0.0999% | 0.0316 | linear interpolation |
| 38.2% | 0.0999% | 0.0320 | linear interpolation |
| 38.3% | 0.0999% | 0.0323 | linear interpolation |
| 38.4% | 0.0999% | 0.0326 | linear interpolation |
| 38.5% | 0.0999% | 0.0329 | linear interpolation |
| 38.6% | 0.0999% | 0.0332 | linear interpolation |
| 38.7% | 0.0999% | 0.0335 | linear interpolation |
| 38.8% | 0.0999% | 0.0338 | linear interpolation |
| 38.9% | 0.0999% | 0.0342 | linear interpolation |
| 39.0% | 0.0999% | 0.0345 | estimate from Buckman et al. (2015) using the NCI method |
| 39.1% | 0.0999% | 0.0348 | linear interpolation |
| 39.2% | 0.0999% | 0.0352 | linear interpolation |
| 39.3% | 0.0999% | 0.0355 | linear interpolation |

### Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 39.4% | 0.0999% | 0.0358 | linear interpolation |
| 39.5% | 0.0999% | 0.0362 | linear interpolation |
| 39.6% | 0.0999% | 0.0365 | linear interpolation |
| 39.7% | 0.0999% | 0.0369 | linear interpolation |
| 39.8% | 0.0999% | 0.0372 | linear interpolation |
| 39.9% | 0.0999% | 0.0375 | linear interpolation |
| 40.0% | 0.0999% | 0.0379 | estimate from Buckman et al. (2015) using the NCI method |
| 40.1% | 0.0999% | 0.0382 | linear interpolation |
| 40.2% | 0.0999% | 0.0386 | linear interpolation |
| 40.3% | 0.0999% | 0.0390 | linear interpolation |
| 40.4% | 0.0999% | 0.0393 | linear interpolation |
| 40.5% | 0.0999% | 0.0397 | linear interpolation |
| 40.6% | 0.0999% | 0.0400 | linear interpolation |
| 40.7% | 0.0999% | 0.0404 | linear interpolation |
| 40.8% | 0.0999% | 0.0408 | linear interpolation |
| 40.9% | 0.0999% | 0.0411 | linear interpolation |
| 41.0% | 0.0999% | 0.0415 | estimate from Buckman et al. (2015) using the NCI method |
| 41.1% | 0.0999% | 0.0419 | linear interpolation |
| 41.2% | 0.0999% | 0.0423 | linear interpolation |
| 41.3% | 0.0999% | 0.0427 | linear interpolation |
| 41.4% | 0.0999% | 0.0431 | linear interpolation |
| 41.5% | 0.0999% | 0.0435 | linear interpolation |
| 41.6% | 0.0999% | 0.0439 | linear interpolation |
| 41.7% | 0.0999% | 0.0443 | linear interpolation |
| 41.8% | 0.0999% | 0.0447 | linear interpolation |
| 41.9% | 0.0999% | 0.0451 | linear interpolation |
| 42.0% | 0.0999% | 0.0455 | estimate from Buckman et al. (2015) using the NCI method |
| 42.1% | 0.0999% | 0.0460 | linear interpolation |
| 42.2% | 0.0999% | 0.0464 | linear interpolation |
| 42.3% | 0.0999% | 0.0469 | linear interpolation |
| 42.4% | 0.0999% | 0.0473 | linear interpolation |
| 42.5% | 0.0999% | 0.0477 | linear interpolation |
| 42.6% | 0.0999% | 0.0482 | linear interpolation |
| 42.7% | 0.0999% | 0.0486 | linear interpolation |
| 42.8% | 0.0999% | 0.0491 | linear interpolation |
| 42.9% | 0.0999% | 0.0495 | linear interpolation |
| 43.0% | 0.0999% | 0.0500 | estimate from Buckman et al. (2015) using the NCI method |
| 43.1% | 0.0999% | 0.0504 | linear interpolation |
| 43.2% | 0.0999% | 0.0509 | linear interpolation |
| 43.3% | 0.0999% | 0.0514 | linear interpolation |
| 43.4% | 0.0999% | 0.0518 | linear interpolation |
| 43.5% | 0.0999% | 0.0523 | linear interpolation |
| 43.6% | 0.0999% | 0.0528 | linear interpolation |
| 43.7% | 0.0999% | 0.0532 | linear interpolation |
| 43.8% | 0.0999% | 0.0537 | linear interpolation |
| 43.9% | 0.0999% | 0.0541 | linear interpolation |
| 44.0% | 0.0999% | 0.0546 | estimate from Buckman et al. (2015) using the NCI method |
| 44.1% | 0.0999% | 0.0551 | linear interpolation |
| 44.2% | 0.0999% | 0.0556 | linear interpolation |
| 44.3% | 0.0999% | 0.0561 | linear interpolation |
| 44.4% | 0.0999% | 0.0567 | linear interpolation |
| 44.5% | 0.0999% | 0.0572 | linear interpolation |
| 44.6% | 0.0999% | 0.0577 | linear interpolation |
| 44.7% | 0.0999% | 0.0582 | linear interpolation |
| 44.8% | 0.0999% | 0.0587 | linear interpolation |
| 44.9% | 0.0999% | 0.0592 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 45.0% | 0.0999% | 0.0597 | estimate from Buckman et al. (2015) using the NCI method |
| 45.1% | 0.0999% | 0.0603 | linear interpolation |
| 45.2% | 0.0999% | 0.0609 | linear interpolation |
| 45.3% | 0.0999% | 0.0614 | linear interpolation |
| 45.4% | 0.0999% | 0.0620 | linear interpolation |
| 45.5% | 0.0999% | 0.0625 | linear interpolation |
| 45.6% | 0.0999% | 0.0631 | linear interpolation |
| 45.7% | 0.0999% | 0.0636 | linear interpolation |
| 45.8% | 0.0999% | 0.0642 | linear interpolation |
| 45.9% | 0.0999% | 0.0647 | linear interpolation |
| 46.0% | 0.0999% | 0.0653 | estimate from Buckman et al. (2015) using the NCI method |
| 46.1% | 0.0999% | 0.0659 | linear interpolation |
| 46.2% | 0.0999% | 0.0665 | linear interpolation |
| 46.3% | 0.0999% | 0.0671 | linear interpolation |
| 46.4% | 0.0999% | 0.0677 | linear interpolation |
| 46.5% | 0.0999% | 0.0683 | linear interpolation |
| 46.6% | 0.0999% | 0.0689 | linear interpolation |
| 46.7% | 0.0999% | 0.0695 | linear interpolation |
| 46.8% | 0.0999% | 0.0702 | linear interpolation |
| 46.9% | 0.0999% | 0.0708 | linear interpolation |
| 47.0% | 0.0999% | 0.0714 | estimate from Buckman et al. (2015) using the NCI method |
| 47.1% | 0.0999% | 0.0720 | linear interpolation |
| 47.2% | 0.0999% | 0.0727 | linear interpolation |
| 47.3% | 0.0999% | 0.0734 | linear interpolation |
| 47.4% | 0.0999% | 0.0740 | linear interpolation |
| 47.5% | 0.0999% | 0.0747 | linear interpolation |
| 47.6% | 0.0999% | 0.0754 | linear interpolation |
| 47.7% | 0.0999% | 0.0760 | linear interpolation |
| 47.8% | 0.0999% | 0.0767 | linear interpolation |
| 47.9% | 0.0999% | 0.0774 | linear interpolation |
| 48.0% | 0.0999% | 0.0780 | estimate from Buckman et al. (2015) using the NCI method |
| 48.1% | 0.0999% | 0.0788 | linear interpolation |
| 48.2% | 0.0999% | 0.0795 | linear interpolation |
| 48.3% | 0.0999% | 0.0802 | linear interpolation |
| 48.4% | 0.0999% | 0.0809 | linear interpolation |
| 48.5% | 0.0999% | 0.0816 | linear interpolation |
| 48.6% | 0.0999% | 0.0823 | linear interpolation |
| 48.7% | 0.0999% | 0.0831 | linear interpolation |
| 48.8% | 0.0999% | 0.0838 | linear interpolation |
| 48.9% | 0.0999% | 0.0845 | linear interpolation |
| 49.0% | 0.0999% | 0.0852 | estimate from Buckman et al. (2015) using the NCI method |
| 49.1% | 0.0999% | 0.0860 | linear interpolation |
| 49.2% | 0.0999% | 0.0867 | linear interpolation |
| 49.3% | 0.0999% | 0.0875 | linear interpolation |
| 49.4% | 0.0999% | 0.0883 | linear interpolation |
| 49.5% | 0.0999% | 0.0890 | linear interpolation |
| 49.6% | 0.0999% | 0.0898 | linear interpolation |
| 49.7% | 0.0999% | 0.0905 | linear interpolation |
| 49.8% | 0.0999% | 0.0913 | linear interpolation |
| 49.9% | 0.0999% | 0.0921 | linear interpolation |
| 50.0% | 0.0999% | 0.0928 | estimate from Buckman et al. (2015) using the NCI method |
| 50.1% | 0.0999% | 0.0937 | linear interpolation |
| 50.2% | 0.0999% | 0.0945 | linear interpolation |
| 50.3% | 0.0999% | 0.0954 | linear interpolation |
| 50.4% | 0.0999% | 0.0963 | linear interpolation |
| 50.5% | 0.0999% | 0.0971 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 50.6% | 0.0999% | 0.0980 | linear interpolation |
| 50.7% | 0.0999% | 0.0988 | linear interpolation |
| 50.8% | 0.0999% | 0.0997 | linear interpolation |
| 50.9% | 0.0999% | 0.101 | linear interpolation |
| 51.0% | 0.0999% | 0.101 | estimate from Buckman et al. (2015) using the NCI method |
| 51.1% | 0.0999% | 0.102 | linear interpolation |
| 51.2% | 0.0999% | 0.103 | linear interpolation |
| 51.3% | 0.0999% | 0.104 | linear interpolation |
| 51.4% | 0.0999% | 0.105 | linear interpolation |
| 51.5% | 0.0999% | 0.106 | linear interpolation |
| 51.6% | 0.0999% | 0.107 | linear interpolation |
| 51.7% | 0.0999% | 0.108 | linear interpolation |
| 51.8% | 0.0999% | 0.109 | linear interpolation |
| 51.9% | 0.0999% | 0.110 | linear interpolation |
| 52.0% | 0.0999% | 0.111 | estimate from Buckman et al. (2015) using the NCI method |
| 52.1% | 0.0999% | 0.112 | linear interpolation |
| 52.2% | 0.0999% | 0.113 | linear interpolation |
| 52.3% | 0.0999% | 0.114 | linear interpolation |
| 52.4% | 0.0999% | 0.115 | linear interpolation |
| 52.5% | 0.0999% | 0.116 | linear interpolation |
| 52.6% | 0.0999% | 0.117 | linear interpolation |
| 52.7% | 0.0999% | 0.118 | linear interpolation |
| 52.8% | 0.0999% | 0.119 | linear interpolation |
| 52.9% | 0.0999% | 0.120 | linear interpolation |
| 53.0% | 0.0999% | 0.121 | estimate from Buckman et al. (2015) using the NCI method |
| 53.1% | 0.0999% | 0.122 | linear interpolation |
| 53.2% | 0.0999% | 0.123 | linear interpolation |
| 53.3% | 0.0999% | 0.124 | linear interpolation |
| 53.4% | 0.0999% | 0.125 | linear interpolation |
| 53.5% | 0.0999% | 0.126 | linear interpolation |
| 53.6% | 0.0999% | 0.127 | linear interpolation |
| 53.7% | 0.0999% | 0.128 | linear interpolation |
| 53.8% | 0.0999% | 0.129 | linear interpolation |
| 53.9% | 0.0999% | 0.130 | linear interpolation |
| 54.0% | 0.0999% | 0.131 | estimate from Buckman et al. (2015) using the NCI method |
| 54.1% | 0.0999% | 0.132 | linear interpolation |
| 54.2% | 0.0999% | 0.133 | linear interpolation |
| 54.3% | 0.0999% | 0.134 | linear interpolation |
| 54.4% | 0.0999% | 0.136 | linear interpolation |
| 54.5% | 0.0999% | 0.137 | linear interpolation |
| 54.6% | 0.0999% | 0.138 | linear interpolation |
| 54.7% | 0.0999% | 0.139 | linear interpolation |
| 54.8% | 0.0999% | 0.140 | linear interpolation |
| 54.9% | 0.0999% | 0.142 | linear interpolation |
| 55.0% | 0.0999% | 0.143 | estimate from Buckman et al. (2015) using the NCI method |
| 55.1% | 0.0999% | 0.144 | linear interpolation |
| 55.2% | 0.0999% | 0.145 | linear interpolation |
| 55.3% | 0.0999% | 0.147 | linear interpolation |
| 55.4% | 0.0999% | 0.148 | linear interpolation |
| 55.5% | 0.0999% | 0.149 | linear interpolation |
| 55.6% | 0.0999% | 0.151 | linear interpolation |
| 55.7% | 0.0999% | 0.152 | linear interpolation |
| 55.8% | 0.0999% | 0.153 | linear interpolation |
| 55.9% | 0.0999% | 0.155 | linear interpolation |
| 56.0% | 0.0999% | 0.156 | estimate from Buckman et al. (2015) using the NCI method |
| 56.1% | 0.0999% | 0.157 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 56.2% | 0.0999% | 0.159 | linear interpolation |
| 56.3% | 0.0999% | 0.160 | linear interpolation |
| 56.4% | 0.0999% | 0.161 | linear interpolation |
| 56.5% | 0.0999% | 0.163 | linear interpolation |
| 56.6% | 0.0999% | 0.164 | linear interpolation |
| 56.7% | 0.0999% | 0.166 | linear interpolation |
| 56.8% | 0.0999% | 0.167 | linear interpolation |
| 56.9% | 0.0999% | 0.168 | linear interpolation |
| 57.0% | 0.0999% | 0.170 | estimate from Buckman et al. (2015) using the NCI method |
| 57.1% | 0.0999% | 0.171 | linear interpolation |
| 57.2% | 0.0999% | 0.173 | linear interpolation |
| 57.3% | 0.0999% | 0.174 | linear interpolation |
| 57.4% | 0.0999% | 0.176 | linear interpolation |
| 57.5% | 0.0999% | 0.177 | linear interpolation |
| 57.6% | 0.0999% | 0.179 | linear interpolation |
| 57.7% | 0.0999% | 0.180 | linear interpolation |
| 57.8% | 0.0999% | 0.182 | linear interpolation |
| 57.9% | 0.0999% | 0.183 | linear interpolation |
| 58.0% | 0.0999% | 0.185 | estimate from Buckman et al. (2015) using the NCI method |
| 58.1% | 0.0999% | 0.186 | linear interpolation |
| 58.2% | 0.0999% | 0.188 | linear interpolation |
| 58.3% | 0.0999% | 0.190 | linear interpolation |
| 58.4% | 0.0999% | 0.192 | linear interpolation |
| 58.5% | 0.0999% | 0.193 | linear interpolation |
| 58.6% | 0.0999% | 0.195 | linear interpolation |
| 58.7% | 0.0999% | 0.197 | linear interpolation |
| 58.8% | 0.0999% | 0.198 | linear interpolation |
| 58.9% | 0.0999% | 0.200 | linear interpolation |
| 59.0% | 0.0999% | 0.202 | estimate from Buckman et al. (2015) using the NCI method |
| 59.1% | 0.0999% | 0.204 | linear interpolation |
| 59.2% | 0.0999% | 0.205 | linear interpolation |
| 59.3% | 0.0999% | 0.207 | linear interpolation |
| 59.4% | 0.0999% | 0.209 | linear interpolation |
| 59.5% | 0.0999% | 0.211 | linear interpolation |
| 59.6% | 0.0999% | 0.213 | linear interpolation |
| 59.7% | 0.0999% | 0.214 | linear interpolation |
| 59.8% | 0.0999% | 0.216 | linear interpolation |
| 59.9% | 0.0999% | 0.218 | linear interpolation |
| 60.0% | 0.0999% | 0.220 | estimate from Buckman et al. (2015) using the NCI method |
| 60.1% | 0.0999% | 0.222 | linear interpolation |
| 60.2% | 0.0999% | 0.224 | linear interpolation |
| 60.3% | 0.0999% | 0.226 | linear interpolation |
| 60.4% | 0.0999% | 0.228 | linear interpolation |
| 60.5% | 0.0999% | 0.229 | linear interpolation |
| 60.6% | 0.0999% | 0.231 | linear interpolation |
| 60.7% | 0.0999% | 0.233 | linear interpolation |
| 60.8% | 0.0999% | 0.235 | linear interpolation |
| 60.9% | 0.0999% | 0.237 | linear interpolation |
| 61.0% | 0.0999% | 0.239 | estimate from Buckman et al. (2015) using the NCI method |
| 61.1% | 0.0999% | 0.241 | linear interpolation |
| 61.2% | 0.0999% | 0.243 | linear interpolation |
| 61.3% | 0.0999% | 0.246 | linear interpolation |
| 61.4% | 0.0999% | 0.248 | linear interpolation |
| 61.5% | 0.0999% | 0.250 | linear interpolation |
| 61.6% | 0.0999% | 0.252 | linear interpolation |
| 61.7% | 0.0999% | 0.254 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 61.8% | 0.0999% | 0.256 | linear interpolation |
| 61.9% | 0.0999% | 0.258 | linear interpolation |
| 62.0% | 0.0999% | 0.261 | estimate from Buckman et al. (2015) using the NCI method |
| 62.1% | 0.0999% | 0.263 | linear interpolation |
| 62.2% | 0.0999% | 0.265 | linear interpolation |
| 62.3% | 0.0999% | 0.268 | linear interpolation |
| 62.4% | 0.0999% | 0.270 | linear interpolation |
| 62.5% | 0.0999% | 0.273 | linear interpolation |
| 62.6% | 0.0999% | 0.275 | linear interpolation |
| 62.7% | 0.0999% | 0.277 | linear interpolation |
| 62.8% | 0.0999% | 0.280 | linear interpolation |
| 62.9% | 0.0999% | 0.282 | linear interpolation |
| 63.0% | 0.0999% | 0.285 | estimate from Buckman et al. (2015) using the NCI method |
| 63.1% | 0.0999% | 0.287 | linear interpolation |
| 63.2% | 0.0999% | 0.290 | linear interpolation |
| 63.3% | 0.0999% | 0.292 | linear interpolation |
| 63.4% | 0.0999% | 0.295 | linear interpolation |
| 63.5% | 0.0999% | 0.297 | linear interpolation |
| 63.6% | 0.0999% | 0.300 | linear interpolation |
| 63.7% | 0.0999% | 0.303 | linear interpolation |
| 63.8% | 0.0999% | 0.305 | linear interpolation |
| 63.9% | 0.0999% | 0.308 | linear interpolation |
| 64.0% | 0.0999% | 0.310 | estimate from Buckman et al. (2015) using the NCI method |
| 64.1% | 0.0999% | 0.313 | linear interpolation |
| 64.2% | 0.0999% | 0.316 | linear interpolation |
| 64.3% | 0.0999% | 0.319 | linear interpolation |
| 64.4% | 0.0999% | 0.322 | linear interpolation |
| 64.5% | 0.0999% | 0.325 | linear interpolation |
| 64.6% | 0.0999% | 0.328 | linear interpolation |
| 64.7% | 0.0999% | 0.331 | linear interpolation |
| 64.8% | 0.0999% | 0.333 | linear interpolation |
| 64.9% | 0.0999% | 0.336 | linear interpolation |
| 65.0% | 0.0999% | 0.339 | estimate from Buckman et al. (2015) using the NCI method |
| 65.1% | 0.0999% | 0.342 | linear interpolation |
| 65.2% | 0.0999% | 0.345 | linear interpolation |
| 65.3% | 0.0999% | 0.348 | linear interpolation |
| 65.4% | 0.0999% | 0.352 | linear interpolation |
| 65.5% | 0.0999% | 0.355 | linear interpolation |
| 65.6% | 0.0999% | 0.358 | linear interpolation |
| 65.7% | 0.0999% | 0.361 | linear interpolation |
| 65.8% | 0.0999% | 0.364 | linear interpolation |
| 65.9% | 0.0999% | 0.367 | linear interpolation |
| 66.0% | 0.0999% | 0.370 | estimate from Buckman et al. (2015) using the NCI method |
| 66.1% | 0.0999% | 0.373 | linear interpolation |
| 66.2% | 0.0999% | 0.377 | linear interpolation |
| 66.3% | 0.0999% | 0.380 | linear interpolation |
| 66.4% | 0.0999% | 0.383 | linear interpolation |
| 66.5% | 0.0999% | 0.387 | linear interpolation |
| 66.6% | 0.0999% | 0.390 | linear interpolation |
| 66.7% | 0.0999% | 0.393 | linear interpolation |
| 66.8% | 0.0999% | 0.397 | linear interpolation |
| 66.9% | 0.0999% | 0.400 | linear interpolation |
| 67.0% | 0.0999% | 0.403 | estimate from Buckman et al. (2015) using the NCI method |
| 67.1% | 0.0999% | 0.407 | linear interpolation |
| 67.2% | 0.0999% | 0.411 | linear interpolation |
| 67.3% | 0.0999% | 0.415 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 67.4% | 0.0999% | 0.419 | linear interpolation |
| 67.5% | 0.0999% | 0.423 | linear interpolation |
| 67.6% | 0.0999% | 0.427 | linear interpolation |
| 67.7% | 0.0999% | 0.430 | linear interpolation |
| 67.8% | 0.0999% | 0.434 | linear interpolation |
| 67.9% | 0.0999% | 0.438 | linear interpolation |
| 68.0% | 0.0999% | 0.442 | estimate from Buckman et al. (2015) using the NCI method |
| 68.1% | 0.0999% | 0.446 | linear interpolation |
| 68.2% | 0.0999% | 0.450 | linear interpolation |
| 68.3% | 0.0999% | 0.454 | linear interpolation |
| 68.4% | 0.0999% | 0.459 | linear interpolation |
| 68.5% | 0.0999% | 0.463 | linear interpolation |
| 68.6% | 0.0999% | 0.467 | linear interpolation |
| 68.7% | 0.0999% | 0.471 | linear interpolation |
| 68.8% | 0.0999% | 0.475 | linear interpolation |
| 68.9% | 0.0999% | 0.479 | linear interpolation |
| 69.0% | 0.0999% | 0.483 | estimate from Buckman et al. (2015) using the NCI method |
| 69.1% | 0.0999% | 0.488 | linear interpolation |
| 69.2% | 0.0999% | 0.493 | linear interpolation |
| 69.3% | 0.0999% | 0.497 | linear interpolation |
| 69.4% | 0.0999% | 0.502 | linear interpolation |
| 69.5% | 0.0999% | 0.506 | linear interpolation |
| 69.6% | 0.0999% | 0.511 | linear interpolation |
| 69.7% | 0.0999% | 0.515 | linear interpolation |
| 69.8% | 0.0999% | 0.520 | linear interpolation |
| 69.9% | 0.0999% | 0.524 | linear interpolation |
| 70.0% | 0.0999% | 0.529 | estimate from Buckman et al. (2015) using the NCI method |
| 70.1% | 0.0999% | 0.534 | linear interpolation |
| 70.2% | 0.0999% | 0.539 | linear interpolation |
| 70.3% | 0.0999% | 0.544 | linear interpolation |
| 70.4% | 0.0999% | 0.549 | linear interpolation |
| 70.5% | 0.0999% | 0.554 | linear interpolation |
| 70.6% | 0.0999% | 0.559 | linear interpolation |
| 70.7% | 0.0999% | 0.564 | linear interpolation |
| 70.8% | 0.0999% | 0.570 | linear interpolation |
| 70.9% | 0.0999% | 0.575 | linear interpolation |
| 71.0% | 0.0999% | 0.580 | estimate from Buckman et al. (2015) using the NCI method |
| 71.1% | 0.0999% | 0.585 | linear interpolation |
| 71.2% | 0.0999% | 0.591 | linear interpolation |
| 71.3% | 0.0999% | 0.596 | linear interpolation |
| 71.4% | 0.0999% | 0.602 | linear interpolation |
| 71.5% | 0.0999% | 0.608 | linear interpolation |
| 71.6% | 0.0999% | 0.613 | linear interpolation |
| 71.7% | 0.0999% | 0.619 | linear interpolation |
| 71.8% | 0.0999% | 0.624 | linear interpolation |
| 71.9% | 0.0999% | 0.630 | linear interpolation |
| 72.0% | 0.0999% | 0.635 | estimate from Buckman et al. (2015) using the NCI method |
| 72.1% | 0.0999% | 0.642 | linear interpolation |
| 72.2% | 0.0999% | 0.648 | linear interpolation |
| 72.3% | 0.0999% | 0.654 | linear interpolation |
| 72.4% | 0.0999% | 0.660 | linear interpolation |
| 72.5% | 0.0999% | 0.667 | linear interpolation |
| 72.6% | 0.0999% | 0.673 | linear interpolation |
| 72.7% | 0.0999% | 0.679 | linear interpolation |
| 72.8% | 0.0999% | 0.685 | linear interpolation |
| 72.9% | 0.0999% | 0.692 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 73.0% | 0.0999% | 0.698 | estimate from Buckman et al. (2015) using the NCI method |
| 73.1% | 0.0999% | 0.705 | linear interpolation |
| 73.2% | 0.0999% | 0.711 | linear interpolation |
| 73.3% | 0.0999% | 0.718 | linear interpolation |
| 73.4% | 0.0999% | 0.725 | linear interpolation |
| 73.5% | 0.0999% | 0.731 | linear interpolation |
| 73.6% | 0.0999% | 0.738 | linear interpolation |
| 73.7% | 0.0999% | 0.745 | linear interpolation |
| 73.8% | 0.0999% | 0.751 | linear interpolation |
| 73.9% | 0.0999% | 0.758 | linear interpolation |
| 74.0% | 0.0999% | 0.765 | estimate from Buckman et al. (2015) using the NCI method |
| 74.1% | 0.0999% | 0.772 | linear interpolation |
| 74.2% | 0.0999% | 0.780 | linear interpolation |
| 74.3% | 0.0999% | 0.787 | linear interpolation |
| 74.4% | 0.0999% | 0.795 | linear interpolation |
| 74.5% | 0.0999% | 0.802 | linear interpolation |
| 74.6% | 0.0999% | 0.810 | linear interpolation |
| 74.7% | 0.0999% | 0.817 | linear interpolation |
| 74.8% | 0.0999% | 0.825 | linear interpolation |
| 74.9% | 0.0999% | 0.832 | linear interpolation |
| 75.0% | 0.0999% | 0.840 | estimate from Buckman et al. (2015) using the NCI method |
| 75.1% | 0.0999% | 0.848 | linear interpolation |
| 75.2% | 0.0999% | 0.857 | linear interpolation |
| 75.3% | 0.0999% | 0.865 | linear interpolation |
| 75.4% | 0.0999% | 0.873 | linear interpolation |
| 75.5% | 0.0999% | 0.882 | linear interpolation |
| 75.6% | 0.0999% | 0.890 | linear interpolation |
| 75.7% | 0.0999% | 0.898 | linear interpolation |
| 75.8% | 0.0999% | 0.906 | linear interpolation |
| 75.9% | 0.0999% | 0.915 | linear interpolation |
| 76.0% | 0.0999% | 0.923 | estimate from Buckman et al. (2015) using the NCI method |
| 76.1% | 0.0999% | 0.933 | linear interpolation |
| 76.2% | 0.0999% | 0.942 | linear interpolation |
| 76.3% | 0.0999% | 0.952 | linear interpolation |
| 76.4% | 0.0999% | 0.962 | linear interpolation |
| 76.5% | 0.0999% | 0.971 | linear interpolation |
| 76.6% | 0.0999% | 0.981 | linear interpolation |
| 76.7% | 0.0999% | 0.991 | linear interpolation |
| 76.8% | 0.0999% | 1.00 | linear interpolation |
| 76.9% | 0.0999% | 1.01 | linear interpolation |
| 77.0% | 0.0999% | 1.02 | estimate from Buckman et al. (2015) using the NCI method |
| 77.1% | 0.0999% | 1.03 | linear interpolation |
| 77.2% | 0.0999% | 1.04 | linear interpolation |
| 77.3% | 0.0999% | 1.05 | linear interpolation |
| 77.4% | 0.0999% | 1.06 | linear interpolation |
| 77.5% | 0.0999% | 1.07 | linear interpolation |
| 77.6% | 0.0999% | 1.08 | linear interpolation |
| 77.7% | 0.0999% | 1.09 | linear interpolation |
| 77.8% | 0.0999% | 1.10 | linear interpolation |
| 77.9% | 0.0999% | 1.11 | linear interpolation |
| 78.0% | 0.0999% | 1.12 | estimate from Buckman et al. (2015) using the NCI method |
| 78.1% | 0.0999% | 1.14 | linear interpolation |
| 78.2% | 0.0999% | 1.15 | linear interpolation |
| 78.3% | 0.0999% | 1.16 | linear interpolation |
| 78.4% | 0.0999% | 1.17 | linear interpolation |
| 78.5% | 0.0999% | 1.18 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 78.6% | 0.0999% | 1.20 | linear interpolation |
| 78.7% | 0.0999% | 1.21 | linear interpolation |
| 78.8% | 0.0999% | 1.22 | linear interpolation |
| 78.9% | 0.0999% | 1.23 | linear interpolation |
| 79.0% | 0.0999% | 1.24 | estimate from Buckman et al. (2015) using the NCI method |
| 79.1% | 0.0999% | 1.26 | linear interpolation |
| 79.2% | 0.0999% | 1.27 | linear interpolation |
| 79.3% | 0.0999% | 1.28 | linear interpolation |
| 79.4% | 0.0999% | 1.30 | linear interpolation |
| 79.5% | 0.0999% | 1.31 | linear interpolation |
| 79.6% | 0.0999% | 1.32 | linear interpolation |
| 79.7% | 0.0999% | 1.34 | linear interpolation |
| 79.8% | 0.0999% | 1.35 | linear interpolation |
| 79.9% | 0.0999% | 1.36 | linear interpolation |
| 80.0% | 0.0999% | 1.38 | estimate from Buckman et al. (2015) using the NCI method |
| 80.1% | 0.0999% | 1.39 | linear interpolation |
| 80.2% | 0.0999% | 1.41 | linear interpolation |
| 80.3% | 0.0999% | 1.42 | linear interpolation |
| 80.4% | 0.0999% | 1.44 | linear interpolation |
| 80.5% | 0.0999% | 1.45 | linear interpolation |
| 80.6% | 0.0999% | 1.47 | linear interpolation |
| 80.7% | 0.0999% | 1.48 | linear interpolation |
| 80.8% | 0.0999% | 1.50 | linear interpolation |
| 80.9% | 0.0999% | 1.51 | linear interpolation |
| 81.0% | 0.0999% | 1.53 | estimate from Buckman et al. (2015) using the NCI method |
| 81.1% | 0.0999% | 1.55 | linear interpolation |
| 81.2% | 0.0999% | 1.57 | linear interpolation |
| 81.3% | 0.0999% | 1.58 | linear interpolation |
| 81.4% | 0.0999% | 1.60 | linear interpolation |
| 81.5% | 0.0999% | 1.62 | linear interpolation |
| 81.6% | 0.0999% | 1.64 | linear interpolation |
| 81.7% | 0.0999% | 1.66 | linear interpolation |
| 81.8% | 0.0999% | 1.67 | linear interpolation |
| 81.9% | 0.0999% | 1.69 | linear interpolation |
| 82.0% | 0.0999% | 1.71 | estimate from Buckman et al. (2015) using the NCI method |
| 82.1% | 0.0999% | 1.73 | linear interpolation |
| 82.2% | 0.0999% | 1.75 | linear interpolation |
| 82.3% | 0.0999% | 1.77 | linear interpolation |
| 82.4% | 0.0999% | 1.79 | linear interpolation |
| 82.5% | 0.0999% | 1.81 | linear interpolation |
| 82.6% | 0.0999% | 1.83 | linear interpolation |
| 82.7% | 0.0999% | 1.85 | linear interpolation |
| 82.8% | 0.0999% | 1.87 | linear interpolation |
| 82.9% | 0.0999% | 1.89 | linear interpolation |
| 83.0% | 0.0999% | 1.91 | estimate from Buckman et al. (2015) using the NCI method |
| 83.1% | 0.0999% | 1.94 | linear interpolation |
| 83.2% | 0.0999% | 1.96 | linear interpolation |
| 83.3% | 0.0999% | 1.98 | linear interpolation |
| 83.4% | 0.0999% | 2.01 | linear interpolation |
| 83.5% | 0.0999% | 2.03 | linear interpolation |
| 83.6% | 0.0999% | 2.05 | linear interpolation |
| 83.7% | 0.0999% | 2.08 | linear interpolation |
| 83.8% | 0.0999% | 2.10 | linear interpolation |
| 83.9% | 0.0999% | 2.12 | linear interpolation |
| 84.0% | 0.0999% | 2.15 | estimate from Buckman et al. (2015) using the NCI method |
| 84.1% | 0.0999% | 2.17 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 84.2% | 0.0999% | 2.20 | linear interpolation |
| 84.3% | 0.0999% | 2.23 | linear interpolation |
| 84.4% | 0.0999% | 2.26 | linear interpolation |
| 84.5% | 0.0999% | 2.28 | linear interpolation |
| 84.6% | 0.0999% | 2.31 | linear interpolation |
| 84.7% | 0.0999% | 2.34 | linear interpolation |
| 84.8% | 0.0999% | 2.36 | linear interpolation |
| 84.9% | 0.0999% | 2.39 | linear interpolation |
| 85.0% | 0.0999% | 2.42 | estimate from Buckman et al. (2015) using the NCI method |
| 85.1% | 0.0999% | 2.45 | linear interpolation |
| 85.2% | 0.0999% | 2.48 | linear interpolation |
| 85.3% | 0.0999% | 2.51 | linear interpolation |
| 85.4% | 0.0999% | 2.55 | linear interpolation |
| 85.5% | 0.0999% | 2.58 | linear interpolation |
| 85.6% | 0.0999% | 2.61 | linear interpolation |
| 85.7% | 0.0999% | 2.64 | linear interpolation |
| 85.8% | 0.0999% | 2.67 | linear interpolation |
| 85.9% | 0.0999% | 2.70 | linear interpolation |
| 86.0% | 0.0999% | 2.74 | estimate from Buckman et al. (2015) using the NCI method |
| 86.1% | 0.0999% | 2.77 | linear interpolation |
| 86.2% | 0.0999% | 2.81 | linear interpolation |
| 86.3% | 0.0999% | 2.84 | linear interpolation |
| 86.4% | 0.0999% | 2.88 | linear interpolation |
| 86.5% | 0.0999% | 2.91 | linear interpolation |
| 86.6% | 0.0999% | 2.95 | linear interpolation |
| 86.7% | 0.0999% | 2.98 | linear interpolation |
| 86.8% | 0.0999% | 3.02 | linear interpolation |
| 86.9% | 0.0999% | 3.06 | linear interpolation |
| 87.0% | 0.0999% | 3.09 | estimate from Buckman et al. (2015) using the NCI method |
| 87.1% | 0.0999% | 3.13 | linear interpolation |
| 87.2% | 0.0999% | 3.18 | linear interpolation |
| 87.3% | 0.0999% | 3.22 | linear interpolation |
| 87.4% | 0.0999% | 3.27 | linear interpolation |
| 87.5% | 0.0999% | 3.31 | linear interpolation |
| 87.6% | 0.0999% | 3.35 | linear interpolation |
| 87.7% | 0.0999% | 3.40 | linear interpolation |
| 87.8% | 0.0999% | 3.44 | linear interpolation |
| 87.9% | 0.0999% | 3.48 | linear interpolation |
| 88.0% | 0.0999% | 3.53 | estimate from Buckman et al. (2015) using the NCI method |
| 88.1% | 0.0999% | 3.58 | linear interpolation |
| 88.2% | 0.0999% | 3.63 | linear interpolation |
| 88.3% | 0.0999% | 3.68 | linear interpolation |
| 88.4% | 0.0999% | 3.73 | linear interpolation |
| 88.5% | 0.0999% | 3.78 | linear interpolation |
| 88.6% | 0.0999% | 3.83 | linear interpolation |
| 88.7% | 0.0999% | 3.88 | linear interpolation |
| 88.8% | 0.0999% | 3.93 | linear interpolation |
| 88.9% | 0.0999% | 3.98 | linear interpolation |
| 89.0% | 0.0999% | 4.03 | estimate from Buckman et al. (2015) using the NCI method |
| 89.1% | 0.0999% | 4.10 | linear interpolation |
| 89.2% | 0.0999% | 4.16 | linear interpolation |
| 89.3% | 0.0999% | 4.22 | linear interpolation |
| 89.4% | 0.0999% | 4.28 | linear interpolation |
| 89.5% | 0.0999% | 4.35 | linear interpolation |
| 89.6% | 0.0999% | 4.41 | linear interpolation |
| 89.7% | 0.0999% | 4.47 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 89.8% | 0.0999% | 4.53 | linear interpolation |
| 89.9% | 0.0999% | 4.60 | linear interpolation |
| 90.0% | 0.0999% | 4.66 | estimate from Buckman et al. (2015) using the NCI method |
| 90.1% | 0.0999% | 4.73 | linear interpolation |
| 90.2% | 0.0999% | 4.81 | linear interpolation |
| 90.3% | 0.0999% | 4.89 | linear interpolation |
| 90.4% | 0.0999% | 4.96 | linear interpolation |
| 90.5% | 0.0999% | 5.04 | linear interpolation |
| 90.6% | 0.0999% | 5.11 | linear interpolation |
| 90.7% | 0.0999% | 5.19 | linear interpolation |
| 90.8% | 0.0999% | 5.27 | linear interpolation |
| 90.9% | 0.0999% | 5.34 | linear interpolation |
| 91.0% | 0.0999% | 5.42 | estimate from Buckman et al. (2015) using the NCI method |
| 91.1% | 0.0999% | 5.51 | linear interpolation |
| 91.2% | 0.0999% | 5.61 | linear interpolation |
| 91.3% | 0.0999% | 5.70 | linear interpolation |
| 91.4% | 0.0999% | 5.80 | linear interpolation |
| 91.5% | 0.0999% | 5.89 | linear interpolation |
| 91.6% | 0.0999% | 5.98 | linear interpolation |
| 91.7% | 0.0999% | 6.08 | linear interpolation |
| 91.8% | 0.0999% | 6.17 | linear interpolation |
| 91.9% | 0.0999% | 6.27 | linear interpolation |
| 92.0% | 0.0999% | 6.36 | estimate from Buckman et al. (2015) using the NCI method |
| 92.1% | 0.0999% | 6.48 | linear interpolation |
| 92.2% | 0.0999% | 6.60 | linear interpolation |
| 92.3% | 0.0999% | 6.71 | linear interpolation |
| 92.4% | 0.0999% | 6.83 | linear interpolation |
| 92.5% | 0.0999% | 6.94 | linear interpolation |
| 92.6% | 0.0999% | 7.06 | linear interpolation |
| 92.7% | 0.0999% | 7.18 | linear interpolation |
| 92.8% | 0.0999% | 7.29 | linear interpolation |
| 92.9% | 0.0999% | 7.41 | linear interpolation |
| 93.0% | 0.0999% | 7.53 | estimate from Buckman et al. (2015) using the NCI method |
| 93.1% | 0.0999% | 7.69 | linear interpolation |
| 93.2% | 0.0999% | 7.85 | linear interpolation |
| 93.3% | 0.0999% | 8.01 | linear interpolation |
| 93.4% | 0.0999% | 8.17 | linear interpolation |
| 93.5% | 0.0999% | 8.33 | linear interpolation |
| 93.6% | 0.0999% | 8.49 | linear interpolation |
| 93.7% | 0.0999% | 8.65 | linear interpolation |
| 93.8% | 0.0999% | 8.81 | linear interpolation |
| 93.9% | 0.0999% | 8.98 | linear interpolation |
| 94.0% | 0.0999% | 9.14 | estimate from Buckman et al. (2015) using the NCI method |
| 94.1% | 0.0999% | 9.35 | linear interpolation |
| 94.2% | 0.0999% | 9.56 | linear interpolation |
| 94.3% | 0.0999% | 9.77 | linear interpolation |
| 94.4% | 0.0999% | 9.98 | linear interpolation |
| 94.5% | 0.0999% | 10.2 | linear interpolation |
| 94.6% | 0.0999% | 10.4 | linear interpolation |
| 94.7% | 0.0999% | 10.6 | linear interpolation |
| 94.8% | 0.0999% | 10.8 | linear interpolation |
| 94.9% | 0.0999% | 11.0 | linear interpolation |
| 95.0% | 0.0999% | 11.2 | estimate from Buckman et al. (2015) using the NCI method |
| 95.1% | 0.0999% | 11.5 | linear interpolation |
| 95.2% | 0.0999% | 11.8 | linear interpolation |
| 95.3% | 0.0999% | 12.1 | linear interpolation |

**Table A1. IDEQ Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 95.4% | 0.0999% | 12.4 | linear interpolation |
| 95.5% | 0.0999% | 12.6 | linear interpolation |
| 95.6% | 0.0999% | 12.9 | linear interpolation |
| 95.7% | 0.0999% | 13.2 | linear interpolation |
| 95.8% | 0.0999% | 13.5 | linear interpolation |
| 95.9% | 0.0999% | 13.8 | linear interpolation |
| 96.0% | 0.0999% | 14.1 | estimate from Buckman et al. (2015) using the NCI method |
| 96.1% | 0.0999% | 14.5 | linear interpolation |
| 96.2% | 0.0999% | 14.9 | linear interpolation |
| 96.3% | 0.0999% | 15.3 | linear interpolation |
| 96.4% | 0.0999% | 15.7 | linear interpolation |
| 96.5% | 0.0999% | 16.1 | linear interpolation |
| 96.6% | 0.0999% | 16.6 | linear interpolation |
| 96.7% | 0.0999% | 17.0 | linear interpolation |
| 96.8% | 0.0999% | 17.4 | linear interpolation |
| 96.9% | 0.0999% | 17.8 | linear interpolation |
| 97.0% | 0.0999% | 18.2 | estimate from Buckman et al. (2015) using the NCI method |
| 97.1% | 0.0999% | 18.9 | linear interpolation |
| 97.2% | 0.0999% | 19.6 | linear interpolation |
| 97.3% | 0.0999% | 20.4 | linear interpolation |
| 97.4% | 0.0999% | 21.1 | linear interpolation |
| 97.5% | 0.0999% | 21.8 | linear interpolation |
| 97.6% | 0.0999% | 22.5 | linear interpolation |
| 97.7% | 0.0999% | 23.2 | linear interpolation |
| 97.8% | 0.0999% | 23.9 | linear interpolation |
| 97.9% | 0.0999% | 24.6 | linear interpolation |
| 98.0% | 0.0999% | 25.3 | estimate from Buckman et al. (2015) using the NCI method |
| 98.1% | 0.0999% | 26.9 | linear interpolation |
| 98.2% | 0.0999% | 28.4 | linear interpolation |
| 98.3% | 0.0999% | 29.9 | linear interpolation |
| 98.4% | 0.0999% | 31.4 | linear interpolation |
| 98.5% | 0.0999% | 32.9 | linear interpolation |
| 98.6% | 0.0999% | 34.5 | linear interpolation |
| 98.7% | 0.0999% | 36.0 | linear interpolation |
| 98.8% | 0.0999% | 37.5 | linear interpolation |
| 98.9% | 0.0999% | 39.0 | linear interpolation |
| 99.0% | 0.0999% | 40.5 | estimate from Buckman et al. (2015) using the NCI method |
| 99.1% | 0.0999% | 163 | linear interpolation |
| 99.2% | 0.0999% | 285 | linear interpolation |
| 99.3% | 0.0999% | 407 | linear interpolation |
| 99.4% | 0.0999% | 529 | linear interpolation |
| 99.5% | 0.0999% | 651 | linear interpolation |
| 99.6% | 0.0999% | 773 | linear interpolation |
| 99.7% | 0.0999% | 895 | linear interpolation |
| 99.8% | 0.0999% | 1017 | linear interpolation |
| 99.9% | 0.0999% | 1139 | linear interpolation |
| 100% | 0.0999% | 1261 | estimate from Buckman et al. (2015) using the NCI method |

### Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| Mean | -- | 5.81 | arithmetic mean of discrete distribution |
| 0% | 0.0999% | 0 | estimate from Buckman et al. (2015) using the NCI method |
| 0.1% | 0.0999% | 0.000000020 | logarithmic interpolation |
| 0.2% | 0.0999% | 0.00000004 | logarithmic interpolation |
| 0.3% | 0.0999% | 0.00000008 | logarithmic interpolation |
| 0.4% | 0.0999% | 0.00000015 | logarithmic interpolation |
| 0.5% | 0.0999% | 0.00000030 | logarithmic interpolation |
| 0.6% | 0.0999% | 0.00000060 | logarithmic interpolation |
| 0.7% | 0.0999% | 0.00000119 | logarithmic interpolation |
| 0.8% | 0.0999% | 0.00000235 | logarithmic interpolation |
| 0.9% | 0.0999% | 0.00000464 | logarithmic interpolation |
| 1.0% | 0.0999% | 0.00000918 | estimate from Buckman et al. (2015) using the NCI method |
| 1.1% | 0.0999% | 0.0000106 | logarithmic interpolation |
| 1.2% | 0.0999% | 0.0000122 | logarithmic interpolation |
| 1.3% | 0.0999% | 0.0000140 | logarithmic interpolation |
| 1.4% | 0.0999% | 0.0000161 | logarithmic interpolation |
| 1.5% | 0.0999% | 0.0000186 | logarithmic interpolation |
| 1.6% | 0.0999% | 0.0000214 | logarithmic interpolation |
| 1.7% | 0.0999% | 0.0000247 | logarithmic interpolation |
| 1.8% | 0.0999% | 0.0000284 | logarithmic interpolation |
| 1.9% | 0.0999% | 0.0000327 | logarithmic interpolation |
| 2.0% | 0.0999% | 0.0000377 | estimate from Buckman et al. (2015) using the NCI method |
| 2.1% | 0.0999% | 0.0000405 | logarithmic interpolation |
| 2.2% | 0.0999% | 0.0000436 | logarithmic interpolation |
| 2.3% | 0.0999% | 0.0000469 | logarithmic interpolation |
| 2.4% | 0.0999% | 0.0000504 | logarithmic interpolation |
| 2.5% | 0.0999% | 0.0000542 | logarithmic interpolation |
| 2.6% | 0.0999% | 0.0000583 | logarithmic interpolation |
| 2.7% | 0.0999% | 0.0000627 | logarithmic interpolation |
| 2.8% | 0.0999% | 0.0000675 | logarithmic interpolation |
| 2.9% | 0.0999% | 0.0000726 | logarithmic interpolation |
| 3.0% | 0.0999% | 0.0000780 | estimate from Buckman et al. (2015) using the NCI method |
| 3.1% | 0.0999% | 0.0000822 | logarithmic interpolation |
| 3.2% | 0.0999% | 0.0000866 | logarithmic interpolation |
| 3.3% | 0.0999% | 0.0000913 | logarithmic interpolation |
| 3.4% | 0.0999% | 0.0000961 | logarithmic interpolation |
| 3.5% | 0.0999% | 0.000101 | logarithmic interpolation |
| 3.6% | 0.0999% | 0.000107 | logarithmic interpolation |
| 3.7% | 0.0999% | 0.000112 | logarithmic interpolation |
| 3.8% | 0.0999% | 0.000118 | logarithmic interpolation |
| 3.9% | 0.0999% | 0.000125 | logarithmic interpolation |
| 4.0% | 0.0999% | 0.000131 | estimate from Buckman et al. (2015) using the NCI method |
| 4.1% | 0.0999% | 0.000137 | logarithmic interpolation |
| 4.2% | 0.0999% | 0.000142 | logarithmic interpolation |
| 4.3% | 0.0999% | 0.000148 | logarithmic interpolation |
| 4.4% | 0.0999% | 0.000154 | logarithmic interpolation |
| 4.5% | 0.0999% | 0.000160 | logarithmic interpolation |
| 4.6% | 0.0999% | 0.000167 | logarithmic interpolation |
| 4.7% | 0.0999% | 0.000174 | logarithmic interpolation |
| 4.8% | 0.0999% | 0.000181 | logarithmic interpolation |
| 4.9% | 0.0999% | 0.000188 | logarithmic interpolation |
| 5.0% | 0.0999% | 0.000196 | estimate from Buckman et al. (2015) using the NCI method |
| 5.1% | 0.0999% | 0.000203 | logarithmic interpolation |
| 5.2% | 0.0999% | 0.000210 | logarithmic interpolation |
| 5.3% | 0.0999% | 0.000217 | logarithmic interpolation |
| 5.4% | 0.0999% | 0.000225 | logarithmic interpolation |
| 5.5% | 0.0999% | 0.000233 | logarithmic interpolation |
| 5.6% | 0.0999% | 0.000241 | logarithmic interpolation |
| 5.7% | 0.0999% | 0.000250 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 5.8% | 0.0999% | 0.000258 | logarithmic interpolation |
| 5.9% | 0.0999% | 0.000268 | logarithmic interpolation |
| 6.0% | 0.0999% | 0.000277 | estimate from Buckman et al. (2015) using the NCI method |
| 6.1% | 0.0999% | 0.000285 | logarithmic interpolation |
| 6.2% | 0.0999% | 0.000294 | logarithmic interpolation |
| 6.3% | 0.0999% | 0.000302 | logarithmic interpolation |
| 6.4% | 0.0999% | 0.000311 | logarithmic interpolation |
| 6.5% | 0.0999% | 0.000321 | logarithmic interpolation |
| 6.6% | 0.0999% | 0.000330 | logarithmic interpolation |
| 6.7% | 0.0999% | 0.000340 | logarithmic interpolation |
| 6.8% | 0.0999% | 0.000350 | logarithmic interpolation |
| 6.9% | 0.0999% | 0.000360 | logarithmic interpolation |
| 7.0% | 0.0999% | 0.000371 | estimate from Buckman et al. (2015) using the NCI method |
| 7.1% | 0.0999% | 0.000381 | logarithmic interpolation |
| 7.2% | 0.0999% | 0.000391 | logarithmic interpolation |
| 7.3% | 0.0999% | 0.000402 | logarithmic interpolation |
| 7.4% | 0.0999% | 0.000413 | logarithmic interpolation |
| 7.5% | 0.0999% | 0.000424 | logarithmic interpolation |
| 7.6% | 0.0999% | 0.000435 | logarithmic interpolation |
| 7.7% | 0.0999% | 0.000447 | logarithmic interpolation |
| 7.8% | 0.0999% | 0.000459 | logarithmic interpolation |
| 7.9% | 0.0999% | 0.000471 | logarithmic interpolation |
| 8.0% | 0.0999% | 0.000484 | estimate from Buckman et al. (2015) using the NCI method |
| 8.1% | 0.0999% | 0.000496 | logarithmic interpolation |
| 8.2% | 0.0999% | 0.000508 | logarithmic interpolation |
| 8.3% | 0.0999% | 0.000521 | logarithmic interpolation |
| 8.4% | 0.0999% | 0.000533 | logarithmic interpolation |
| 8.5% | 0.0999% | 0.000546 | logarithmic interpolation |
| 8.6% | 0.0999% | 0.000560 | logarithmic interpolation |
| 8.7% | 0.0999% | 0.000574 | logarithmic interpolation |
| 8.8% | 0.0999% | 0.000588 | logarithmic interpolation |
| 8.9% | 0.0999% | 0.000602 | logarithmic interpolation |
| 9.0% | 0.0999% | 0.000617 | estimate from Buckman et al. (2015) using the NCI method |
| 9.1% | 0.0999% | 0.000630 | logarithmic interpolation |
| 9.2% | 0.0999% | 0.000644 | logarithmic interpolation |
| 9.3% | 0.0999% | 0.000658 | logarithmic interpolation |
| 9.4% | 0.0999% | 0.000673 | logarithmic interpolation |
| 9.5% | 0.0999% | 0.000687 | logarithmic interpolation |
| 9.6% | 0.0999% | 0.000703 | logarithmic interpolation |
| 9.7% | 0.0999% | 0.000718 | logarithmic interpolation |
| 9.8% | 0.0999% | 0.000734 | logarithmic interpolation |
| 9.9% | 0.0999% | 0.000750 | logarithmic interpolation |
| 10.0% | 0.0999% | 0.000766 | estimate from Buckman et al. (2015) using the NCI method |
| 10.1% | 0.0999% | 0.000783 | logarithmic interpolation |
| 10.2% | 0.0999% | 0.000800 | logarithmic interpolation |
| 10.3% | 0.0999% | 0.000817 | logarithmic interpolation |
| 10.4% | 0.0999% | 0.000835 | logarithmic interpolation |
| 10.5% | 0.0999% | 0.000854 | logarithmic interpolation |
| 10.6% | 0.0999% | 0.000872 | logarithmic interpolation |
| 10.7% | 0.0999% | 0.000891 | logarithmic interpolation |
| 10.8% | 0.0999% | 0.000911 | logarithmic interpolation |
| 10.9% | 0.0999% | 0.000931 | logarithmic interpolation |
| 11.0% | 0.0999% | 0.000951 | estimate from Buckman et al. (2015) using the NCI method |
| 11.1% | 0.0999% | 0.000970 | logarithmic interpolation |
| 11.2% | 0.0999% | 0.000990 | logarithmic interpolation |
| 11.3% | 0.0999% | 0.00101 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 11.4% | 0.0999% | 0.00103 | logarithmic interpolation |
| 11.5% | 0.0999% | 0.00105 | logarithmic interpolation |
| 11.6% | 0.0999% | 0.00107 | logarithmic interpolation |
| 11.7% | 0.0999% | 0.00109 | logarithmic interpolation |
| 11.8% | 0.0999% | 0.00112 | logarithmic interpolation |
| 11.9% | 0.0999% | 0.00114 | logarithmic interpolation |
| 12.0% | 0.0999% | 0.00116 | estimate from Buckman et al. (2015) using the NCI method |
| 12.1% | 0.0999% | 0.00118 | logarithmic interpolation |
| 12.2% | 0.0999% | 0.00121 | logarithmic interpolation |
| 12.3% | 0.0999% | 0.00123 | logarithmic interpolation |
| 12.4% | 0.0999% | 0.00125 | logarithmic interpolation |
| 12.5% | 0.0999% | 0.00128 | logarithmic interpolation |
| 12.6% | 0.0999% | 0.00130 | logarithmic interpolation |
| 12.7% | 0.0999% | 0.00132 | logarithmic interpolation |
| 12.8% | 0.0999% | 0.00135 | logarithmic interpolation |
| 12.9% | 0.0999% | 0.00137 | logarithmic interpolation |
| 13.0% | 0.0999% | 0.00140 | estimate from Buckman et al. (2015) using the NCI method |
| 13.1% | 0.0999% | 0.00143 | logarithmic interpolation |
| 13.2% | 0.0999% | 0.00145 | logarithmic interpolation |
| 13.3% | 0.0999% | 0.00148 | logarithmic interpolation |
| 13.4% | 0.0999% | 0.00150 | logarithmic interpolation |
| 13.5% | 0.0999% | 0.00153 | logarithmic interpolation |
| 13.6% | 0.0999% | 0.00156 | logarithmic interpolation |
| 13.7% | 0.0999% | 0.00159 | logarithmic interpolation |
| 13.8% | 0.0999% | 0.00162 | logarithmic interpolation |
| 13.9% | 0.0999% | 0.00164 | logarithmic interpolation |
| 14.0% | 0.0999% | 0.00167 | estimate from Buckman et al. (2015) using the NCI method |
| 14.1% | 0.0999% | 0.00170 | logarithmic interpolation |
| 14.2% | 0.0999% | 0.00173 | logarithmic interpolation |
| 14.3% | 0.0999% | 0.00176 | logarithmic interpolation |
| 14.4% | 0.0999% | 0.00179 | logarithmic interpolation |
| 14.5% | 0.0999% | 0.00182 | logarithmic interpolation |
| 14.6% | 0.0999% | 0.00185 | logarithmic interpolation |
| 14.7% | 0.0999% | 0.00189 | logarithmic interpolation |
| 14.8% | 0.0999% | 0.00192 | logarithmic interpolation |
| 14.9% | 0.0999% | 0.00195 | logarithmic interpolation |
| 15.0% | 0.0999% | 0.00199 | estimate from Buckman et al. (2015) using the NCI method |
| 15.1% | 0.0999% | 0.00202 | logarithmic interpolation |
| 15.2% | 0.0999% | 0.00205 | logarithmic interpolation |
| 15.3% | 0.0999% | 0.00209 | logarithmic interpolation |
| 15.4% | 0.0999% | 0.00212 | logarithmic interpolation |
| 15.5% | 0.0999% | 0.00216 | logarithmic interpolation |
| 15.6% | 0.0999% | 0.00219 | logarithmic interpolation |
| 15.7% | 0.0999% | 0.00223 | logarithmic interpolation |
| 15.8% | 0.0999% | 0.00226 | logarithmic interpolation |
| 15.9% | 0.0999% | 0.00230 | logarithmic interpolation |
| 16.0% | 0.0999% | 0.00234 | estimate from Buckman et al. (2015) using the NCI method |
| 16.1% | 0.0999% | 0.00238 | logarithmic interpolation |
| 16.2% | 0.0999% | 0.00241 | logarithmic interpolation |
| 16.3% | 0.0999% | 0.00245 | logarithmic interpolation |
| 16.4% | 0.0999% | 0.00249 | logarithmic interpolation |
| 16.5% | 0.0999% | 0.00253 | logarithmic interpolation |
| 16.6% | 0.0999% | 0.00257 | logarithmic interpolation |
| 16.7% | 0.0999% | 0.00261 | logarithmic interpolation |
| 16.8% | 0.0999% | 0.00265 | logarithmic interpolation |
| 16.9% | 0.0999% | 0.00269 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 17.0% | 0.0999% | 0.00273 | estimate from Buckman et al. (2015) using the NCI method |
| 17.1% | 0.0999% | 0.00277 | logarithmic interpolation |
| 17.2% | 0.0999% | 0.00282 | logarithmic interpolation |
| 17.3% | 0.0999% | 0.00286 | logarithmic interpolation |
| 17.4% | 0.0999% | 0.00290 | logarithmic interpolation |
| 17.5% | 0.0999% | 0.00294 | logarithmic interpolation |
| 17.6% | 0.0999% | 0.00299 | logarithmic interpolation |
| 17.7% | 0.0999% | 0.00303 | logarithmic interpolation |
| 17.8% | 0.0999% | 0.00308 | logarithmic interpolation |
| 17.9% | 0.0999% | 0.00312 | logarithmic interpolation |
| 18.0% | 0.0999% | 0.00317 | estimate from Buckman et al. (2015) using the NCI method |
| 18.1% | 0.0999% | 0.00321 | logarithmic interpolation |
| 18.2% | 0.0999% | 0.00326 | logarithmic interpolation |
| 18.3% | 0.0999% | 0.00331 | logarithmic interpolation |
| 18.4% | 0.0999% | 0.00335 | logarithmic interpolation |
| 18.5% | 0.0999% | 0.00340 | logarithmic interpolation |
| 18.6% | 0.0999% | 0.00345 | logarithmic interpolation |
| 18.7% | 0.0999% | 0.00350 | logarithmic interpolation |
| 18.8% | 0.0999% | 0.00355 | logarithmic interpolation |
| 18.9% | 0.0999% | 0.00360 | logarithmic interpolation |
| 19.0% | 0.0999% | 0.00366 | estimate from Buckman et al. (2015) using the NCI method |
| 19.1% | 0.0999% | 0.00371 | logarithmic interpolation |
| 19.2% | 0.0999% | 0.00376 | logarithmic interpolation |
| 19.3% | 0.0999% | 0.00381 | logarithmic interpolation |
| 19.4% | 0.0999% | 0.00387 | logarithmic interpolation |
| 19.5% | 0.0999% | 0.00392 | logarithmic interpolation |
| 19.6% | 0.0999% | 0.00398 | logarithmic interpolation |
| 19.7% | 0.0999% | 0.00403 | logarithmic interpolation |
| 19.8% | 0.0999% | 0.00409 | logarithmic interpolation |
| 19.9% | 0.0999% | 0.00415 | logarithmic interpolation |
| 20.0% | 0.0999% | 0.00420 | estimate from Buckman et al. (2015) using the NCI method |
| 20.1% | 0.0999% | 0.00426 | logarithmic interpolation |
| 20.2% | 0.0999% | 0.00432 | logarithmic interpolation |
| 20.3% | 0.0999% | 0.00437 | logarithmic interpolation |
| 20.4% | 0.0999% | 0.00443 | logarithmic interpolation |
| 20.5% | 0.0999% | 0.00449 | logarithmic interpolation |
| 20.6% | 0.0999% | 0.00455 | logarithmic interpolation |
| 20.7% | 0.0999% | 0.00461 | logarithmic interpolation |
| 20.8% | 0.0999% | 0.00468 | logarithmic interpolation |
| 20.9% | 0.0999% | 0.00474 | logarithmic interpolation |
| 21.0% | 0.0999% | 0.00480 | estimate from Buckman et al. (2015) using the NCI method |
| 21.1% | 0.0999% | 0.00486 | logarithmic interpolation |
| 21.2% | 0.0999% | 0.00493 | logarithmic interpolation |
| 21.3% | 0.0999% | 0.00499 | logarithmic interpolation |
| 21.4% | 0.0999% | 0.00505 | logarithmic interpolation |
| 21.5% | 0.0999% | 0.00512 | logarithmic interpolation |
| 21.6% | 0.0999% | 0.00518 | logarithmic interpolation |
| 21.7% | 0.0999% | 0.00525 | logarithmic interpolation |
| 21.8% | 0.0999% | 0.00532 | logarithmic interpolation |
| 21.9% | 0.0999% | 0.00538 | logarithmic interpolation |
| 22.0% | 0.0999% | 0.00545 | estimate from Buckman et al. (2015) using the NCI method |
| 22.1% | 0.0999% | 0.00552 | logarithmic interpolation |
| 22.2% | 0.0999% | 0.00559 | logarithmic interpolation |
| 22.3% | 0.0999% | 0.00566 | logarithmic interpolation |
| 22.4% | 0.0999% | 0.00573 | logarithmic interpolation |
| 22.5% | 0.0999% | 0.00580 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 22.6% | 0.0999% | 0.00588 | logarithmic interpolation |
| 22.7% | 0.0999% | 0.00595 | logarithmic interpolation |
| 22.8% | 0.0999% | 0.00603 | logarithmic interpolation |
| 22.9% | 0.0999% | 0.00610 | logarithmic interpolation |
| 23.0% | 0.0999% | 0.00618 | estimate from Buckman et al. (2015) using the NCI method |
| 23.1% | 0.0999% | 0.00625 | logarithmic interpolation |
| 23.2% | 0.0999% | 0.00633 | logarithmic interpolation |
| 23.3% | 0.0999% | 0.00641 | logarithmic interpolation |
| 23.4% | 0.0999% | 0.00649 | logarithmic interpolation |
| 23.5% | 0.0999% | 0.00658 | logarithmic interpolation |
| 23.6% | 0.0999% | 0.00666 | logarithmic interpolation |
| 23.7% | 0.0999% | 0.00674 | logarithmic interpolation |
| 23.8% | 0.0999% | 0.00683 | logarithmic interpolation |
| 23.9% | 0.0999% | 0.00691 | logarithmic interpolation |
| 24.0% | 0.0999% | 0.00700 | estimate from Buckman et al. (2015) using the NCI method |
| 24.1% | 0.0999% | 0.00709 | logarithmic interpolation |
| 24.2% | 0.0999% | 0.00717 | logarithmic interpolation |
| 24.3% | 0.0999% | 0.00726 | logarithmic interpolation |
| 24.4% | 0.0999% | 0.00735 | logarithmic interpolation |
| 24.5% | 0.0999% | 0.00744 | logarithmic interpolation |
| 24.6% | 0.0999% | 0.00753 | logarithmic interpolation |
| 24.7% | 0.0999% | 0.00763 | logarithmic interpolation |
| 24.8% | 0.0999% | 0.00772 | logarithmic interpolation |
| 24.9% | 0.0999% | 0.00781 | logarithmic interpolation |
| 25.0% | 0.0999% | 0.00791 | estimate from Buckman et al. (2015) using the NCI method |
| 25.1% | 0.0999% | 0.00800 | logarithmic interpolation |
| 25.2% | 0.0999% | 0.00810 | logarithmic interpolation |
| 25.3% | 0.0999% | 0.00820 | logarithmic interpolation |
| 25.4% | 0.0999% | 0.00830 | logarithmic interpolation |
| 25.5% | 0.0999% | 0.00840 | logarithmic interpolation |
| 25.6% | 0.0999% | 0.00850 | logarithmic interpolation |
| 25.7% | 0.0999% | 0.00860 | logarithmic interpolation |
| 25.8% | 0.0999% | 0.00870 | logarithmic interpolation |
| 25.9% | 0.0999% | 0.00880 | logarithmic interpolation |
| 26.0% | 0.0999% | 0.00891 | estimate from Buckman et al. (2015) using the NCI method |
| 26.1% | 0.0999% | 0.00901 | logarithmic interpolation |
| 26.2% | 0.0999% | 0.00912 | logarithmic interpolation |
| 26.3% | 0.0999% | 0.00922 | logarithmic interpolation |
| 26.4% | 0.0999% | 0.00933 | logarithmic interpolation |
| 26.5% | 0.0999% | 0.00944 | logarithmic interpolation |
| 26.6% | 0.0999% | 0.00955 | logarithmic interpolation |
| 26.7% | 0.0999% | 0.00966 | logarithmic interpolation |
| 26.8% | 0.0999% | 0.00977 | logarithmic interpolation |
| 26.9% | 0.0999% | 0.00989 | logarithmic interpolation |
| 27.0% | 0.0999% | 0.0100 | estimate from Buckman et al. (2015) using the NCI method |
| 27.1% | 0.0999% | 0.0101 | logarithmic interpolation |
| 27.2% | 0.0999% | 0.0102 | logarithmic interpolation |
| 27.3% | 0.0999% | 0.0104 | logarithmic interpolation |
| 27.4% | 0.0999% | 0.0105 | logarithmic interpolation |
| 27.5% | 0.0999% | 0.0106 | logarithmic interpolation |
| 27.6% | 0.0999% | 0.0107 | logarithmic interpolation |
| 27.7% | 0.0999% | 0.0108 | logarithmic interpolation |
| 27.8% | 0.0999% | 0.0110 | logarithmic interpolation |
| 27.9% | 0.0999% | 0.0111 | logarithmic interpolation |
| 28.0% | 0.0999% | 0.0112 | estimate from Buckman et al. (2015) using the NCI method |
| 28.1% | 0.0999% | 0.0114 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 28.2% | 0.0999% | 0.0115 | logarithmic interpolation |
| 28.3% | 0.0999% | 0.0116 | logarithmic interpolation |
| 28.4% | 0.0999% | 0.0117 | logarithmic interpolation |
| 28.5% | 0.0999% | 0.0119 | logarithmic interpolation |
| 28.6% | 0.0999% | 0.0120 | logarithmic interpolation |
| 28.7% | 0.0999% | 0.0121 | logarithmic interpolation |
| 28.8% | 0.0999% | 0.0123 | logarithmic interpolation |
| 28.9% | 0.0999% | 0.0124 | logarithmic interpolation |
| 29.0% | 0.0999% | 0.0125 | estimate from Buckman et al. (2015) using the NCI method |
| 29.1% | 0.0999% | 0.0127 | logarithmic interpolation |
| 29.2% | 0.0999% | 0.0128 | logarithmic interpolation |
| 29.3% | 0.0999% | 0.0130 | logarithmic interpolation |
| 29.4% | 0.0999% | 0.0131 | logarithmic interpolation |
| 29.5% | 0.0999% | 0.0132 | logarithmic interpolation |
| 29.6% | 0.0999% | 0.0134 | logarithmic interpolation |
| 29.7% | 0.0999% | 0.0135 | logarithmic interpolation |
| 29.8% | 0.0999% | 0.0137 | logarithmic interpolation |
| 29.9% | 0.0999% | 0.0138 | logarithmic interpolation |
| 30.0% | 0.0999% | 0.0140 | estimate from Buckman et al. (2015) using the NCI method |
| 30.1% | 0.0999% | 0.0141 | logarithmic interpolation |
| 30.2% | 0.0999% | 0.0143 | logarithmic interpolation |
| 30.3% | 0.0999% | 0.0145 | logarithmic interpolation |
| 30.4% | 0.0999% | 0.0146 | logarithmic interpolation |
| 30.5% | 0.0999% | 0.0148 | logarithmic interpolation |
| 30.6% | 0.0999% | 0.0149 | logarithmic interpolation |
| 30.7% | 0.0999% | 0.0151 | logarithmic interpolation |
| 30.8% | 0.0999% | 0.0152 | logarithmic interpolation |
| 30.9% | 0.0999% | 0.0154 | logarithmic interpolation |
| 31.0% | 0.0999% | 0.0156 | estimate from Buckman et al. (2015) using the NCI method |
| 31.1% | 0.0999% | 0.0157 | logarithmic interpolation |
| 31.2% | 0.0999% | 0.0159 | logarithmic interpolation |
| 31.3% | 0.0999% | 0.0161 | logarithmic interpolation |
| 31.4% | 0.0999% | 0.0162 | logarithmic interpolation |
| 31.5% | 0.0999% | 0.0164 | logarithmic interpolation |
| 31.6% | 0.0999% | 0.0166 | logarithmic interpolation |
| 31.7% | 0.0999% | 0.0168 | logarithmic interpolation |
| 31.8% | 0.0999% | 0.0169 | logarithmic interpolation |
| 31.9% | 0.0999% | 0.0171 | logarithmic interpolation |
| 32.0% | 0.0999% | 0.0173 | estimate from Buckman et al. (2015) using the NCI method |
| 32.1% | 0.0999% | 0.0175 | logarithmic interpolation |
| 32.2% | 0.0999% | 0.0176 | logarithmic interpolation |
| 32.3% | 0.0999% | 0.0178 | logarithmic interpolation |
| 32.4% | 0.0999% | 0.0180 | logarithmic interpolation |
| 32.5% | 0.0999% | 0.0182 | logarithmic interpolation |
| 32.6% | 0.0999% | 0.0183 | logarithmic interpolation |
| 32.7% | 0.0999% | 0.0185 | logarithmic interpolation |
| 32.8% | 0.0999% | 0.0187 | logarithmic interpolation |
| 32.9% | 0.0999% | 0.0189 | logarithmic interpolation |
| 33.0% | 0.0999% | 0.0191 | estimate from Buckman et al. (2015) using the NCI method |
| 33.1% | 0.0999% | 0.0193 | logarithmic interpolation |
| 33.2% | 0.0999% | 0.0195 | logarithmic interpolation |
| 33.3% | 0.0999% | 0.0197 | logarithmic interpolation |
| 33.4% | 0.0999% | 0.0199 | logarithmic interpolation |
| 33.5% | 0.0999% | 0.0201 | logarithmic interpolation |
| 33.6% | 0.0999% | 0.0203 | logarithmic interpolation |
| 33.7% | 0.0999% | 0.0205 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 33.8% | 0.0999% | 0.0207 | logarithmic interpolation |
| 33.9% | 0.0999% | 0.0210 | logarithmic interpolation |
| 34.0% | 0.0999% | 0.0212 | estimate from Buckman et al. (2015) using the NCI method |
| 34.1% | 0.0999% | 0.0214 | logarithmic interpolation |
| 34.2% | 0.0999% | 0.0216 | logarithmic interpolation |
| 34.3% | 0.0999% | 0.0218 | logarithmic interpolation |
| 34.4% | 0.0999% | 0.0220 | logarithmic interpolation |
| 34.5% | 0.0999% | 0.0223 | logarithmic interpolation |
| 34.6% | 0.0999% | 0.0225 | logarithmic interpolation |
| 34.7% | 0.0999% | 0.0227 | logarithmic interpolation |
| 34.8% | 0.0999% | 0.0230 | logarithmic interpolation |
| 34.9% | 0.0999% | 0.0232 | logarithmic interpolation |
| 35.0% | 0.0999% | 0.0234 | estimate from Buckman et al. (2015) using the NCI method |
| 35.1% | 0.0999% | 0.0236 | logarithmic interpolation |
| 35.2% | 0.0999% | 0.0239 | logarithmic interpolation |
| 35.3% | 0.0999% | 0.0241 | logarithmic interpolation |
| 35.4% | 0.0999% | 0.0243 | logarithmic interpolation |
| 35.5% | 0.0999% | 0.0246 | logarithmic interpolation |
| 35.6% | 0.0999% | 0.0248 | logarithmic interpolation |
| 35.7% | 0.0999% | 0.0250 | logarithmic interpolation |
| 35.8% | 0.0999% | 0.0253 | logarithmic interpolation |
| 35.9% | 0.0999% | 0.0255 | logarithmic interpolation |
| 36.0% | 0.0999% | 0.0258 | estimate from Buckman et al. (2015) using the NCI method |
| 36.1% | 0.0999% | 0.0260 | logarithmic interpolation |
| 36.2% | 0.0999% | 0.0263 | logarithmic interpolation |
| 36.3% | 0.0999% | 0.0266 | logarithmic interpolation |
| 36.4% | 0.0999% | 0.0268 | logarithmic interpolation |
| 36.5% | 0.0999% | 0.0271 | logarithmic interpolation |
| 36.6% | 0.0999% | 0.0274 | logarithmic interpolation |
| 36.7% | 0.0999% | 0.0276 | logarithmic interpolation |
| 36.8% | 0.0999% | 0.0279 | logarithmic interpolation |
| 36.9% | 0.0999% | 0.0282 | logarithmic interpolation |
| 37.0% | 0.0999% | 0.0285 | estimate from Buckman et al. (2015) using the NCI method |
| 37.1% | 0.0999% | 0.0288 | logarithmic interpolation |
| 37.2% | 0.0999% | 0.0290 | logarithmic interpolation |
| 37.3% | 0.0999% | 0.0293 | logarithmic interpolation |
| 37.4% | 0.0999% | 0.0296 | logarithmic interpolation |
| 37.5% | 0.0999% | 0.0299 | logarithmic interpolation |
| 37.6% | 0.0999% | 0.0302 | logarithmic interpolation |
| 37.7% | 0.0999% | 0.0304 | logarithmic interpolation |
| 37.8% | 0.0999% | 0.0307 | logarithmic interpolation |
| 37.9% | 0.0999% | 0.0310 | logarithmic interpolation |
| 38.0% | 0.0999% | 0.0313 | estimate from Buckman et al. (2015) using the NCI method |
| 38.1% | 0.0999% | 0.0316 | logarithmic interpolation |
| 38.2% | 0.0999% | 0.0319 | logarithmic interpolation |
| 38.3% | 0.0999% | 0.0322 | logarithmic interpolation |
| 38.4% | 0.0999% | 0.0325 | logarithmic interpolation |
| 38.5% | 0.0999% | 0.0329 | logarithmic interpolation |
| 38.6% | 0.0999% | 0.0332 | logarithmic interpolation |
| 38.7% | 0.0999% | 0.0335 | logarithmic interpolation |
| 38.8% | 0.0999% | 0.0338 | logarithmic interpolation |
| 38.9% | 0.0999% | 0.0341 | logarithmic interpolation |
| 39.0% | 0.0999% | 0.0345 | estimate from Buckman et al. (2015) using the NCI method |
| 39.1% | 0.0999% | 0.0348 | logarithmic interpolation |
| 39.2% | 0.0999% | 0.0351 | logarithmic interpolation |
| 39.3% | 0.0999% | 0.0355 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 39.4% | 0.0999% | 0.0358 | logarithmic interpolation |
| 39.5% | 0.0999% | 0.0361 | logarithmic interpolation |
| 39.6% | 0.0999% | 0.0365 | logarithmic interpolation |
| 39.7% | 0.0999% | 0.0368 | logarithmic interpolation |
| 39.8% | 0.0999% | 0.0372 | logarithmic interpolation |
| 39.9% | 0.0999% | 0.0375 | logarithmic interpolation |
| 40.0% | 0.0999% | 0.0379 | estimate from Buckman et al. (2015) using the NCI method |
| 40.1% | 0.0999% | 0.0382 | logarithmic interpolation |
| 40.2% | 0.0999% | 0.0386 | logarithmic interpolation |
| 40.3% | 0.0999% | 0.0389 | logarithmic interpolation |
| 40.4% | 0.0999% | 0.0393 | logarithmic interpolation |
| 40.5% | 0.0999% | 0.0396 | logarithmic interpolation |
| 40.6% | 0.0999% | 0.0400 | logarithmic interpolation |
| 40.7% | 0.0999% | 0.0404 | logarithmic interpolation |
| 40.8% | 0.0999% | 0.0407 | logarithmic interpolation |
| 40.9% | 0.0999% | 0.0411 | logarithmic interpolation |
| 41.0% | 0.0999% | 0.0415 | estimate from Buckman et al. (2015) using the NCI method |
| 41.1% | 0.0999% | 0.0419 | logarithmic interpolation |
| 41.2% | 0.0999% | 0.0423 | logarithmic interpolation |
| 41.3% | 0.0999% | 0.0427 | logarithmic interpolation |
| 41.4% | 0.0999% | 0.0431 | logarithmic interpolation |
| 41.5% | 0.0999% | 0.0435 | logarithmic interpolation |
| 41.6% | 0.0999% | 0.0439 | logarithmic interpolation |
| 41.7% | 0.0999% | 0.0443 | logarithmic interpolation |
| 41.8% | 0.0999% | 0.0447 | logarithmic interpolation |
| 41.9% | 0.0999% | 0.0451 | logarithmic interpolation |
| 42.0% | 0.0999% | 0.0455 | estimate from Buckman et al. (2015) using the NCI method |
| 42.1% | 0.0999% | 0.0460 | logarithmic interpolation |
| 42.2% | 0.0999% | 0.0464 | logarithmic interpolation |
| 42.3% | 0.0999% | 0.0468 | logarithmic interpolation |
| 42.4% | 0.0999% | 0.0473 | logarithmic interpolation |
| 42.5% | 0.0999% | 0.0477 | logarithmic interpolation |
| 42.6% | 0.0999% | 0.0481 | logarithmic interpolation |
| 42.7% | 0.0999% | 0.0486 | logarithmic interpolation |
| 42.8% | 0.0999% | 0.0490 | logarithmic interpolation |
| 42.9% | 0.0999% | 0.0495 | logarithmic interpolation |
| 43.0% | 0.0999% | 0.0500 | estimate from Buckman et al. (2015) using the NCI method |
| 43.1% | 0.0999% | 0.0504 | logarithmic interpolation |
| 43.2% | 0.0999% | 0.0509 | logarithmic interpolation |
| 43.3% | 0.0999% | 0.0513 | logarithmic interpolation |
| 43.4% | 0.0999% | 0.0518 | logarithmic interpolation |
| 43.5% | 0.0999% | 0.0522 | logarithmic interpolation |
| 43.6% | 0.0999% | 0.0527 | logarithmic interpolation |
| 43.7% | 0.0999% | 0.0532 | logarithmic interpolation |
| 43.8% | 0.0999% | 0.0536 | logarithmic interpolation |
| 43.9% | 0.0999% | 0.0541 | logarithmic interpolation |
| 44.0% | 0.0999% | 0.0546 | estimate from Buckman et al. (2015) using the NCI method |
| 44.1% | 0.0999% | 0.0551 | logarithmic interpolation |
| 44.2% | 0.0999% | 0.0556 | logarithmic interpolation |
| 44.3% | 0.0999% | 0.0561 | logarithmic interpolation |
| 44.4% | 0.0999% | 0.0566 | logarithmic interpolation |
| 44.5% | 0.0999% | 0.0571 | logarithmic interpolation |
| 44.6% | 0.0999% | 0.0576 | logarithmic interpolation |
| 44.7% | 0.0999% | 0.0582 | logarithmic interpolation |
| 44.8% | 0.0999% | 0.0587 | logarithmic interpolation |
| 44.9% | 0.0999% | 0.0592 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 45.0% | 0.0999% | 0.0597 | estimate from Buckman et al. (2015) using the NCI method |
| 45.1% | 0.0999% | 0.0603 | logarithmic interpolation |
| 45.2% | 0.0999% | 0.0608 | logarithmic interpolation |
| 45.3% | 0.0999% | 0.0614 | logarithmic interpolation |
| 45.4% | 0.0999% | 0.0619 | logarithmic interpolation |
| 45.5% | 0.0999% | 0.0625 | logarithmic interpolation |
| 45.6% | 0.0999% | 0.0630 | logarithmic interpolation |
| 45.7% | 0.0999% | 0.0636 | logarithmic interpolation |
| 45.8% | 0.0999% | 0.0641 | logarithmic interpolation |
| 45.9% | 0.0999% | 0.0647 | logarithmic interpolation |
| 46.0% | 0.0999% | 0.0653 | estimate from Buckman et al. (2015) using the NCI method |
| 46.1% | 0.0999% | 0.0659 | logarithmic interpolation |
| 46.2% | 0.0999% | 0.0665 | logarithmic interpolation |
| 46.3% | 0.0999% | 0.0671 | logarithmic interpolation |
| 46.4% | 0.0999% | 0.0677 | logarithmic interpolation |
| 46.5% | 0.0999% | 0.0683 | logarithmic interpolation |
| 46.6% | 0.0999% | 0.0689 | logarithmic interpolation |
| 46.7% | 0.0999% | 0.0695 | logarithmic interpolation |
| 46.8% | 0.0999% | 0.0701 | logarithmic interpolation |
| 46.9% | 0.0999% | 0.0707 | logarithmic interpolation |
| 47.0% | 0.0999% | 0.0714 | estimate from Buckman et al. (2015) using the NCI method |
| 47.1% | 0.0999% | 0.0720 | logarithmic interpolation |
| 47.2% | 0.0999% | 0.0727 | logarithmic interpolation |
| 47.3% | 0.0999% | 0.0733 | logarithmic interpolation |
| 47.4% | 0.0999% | 0.0740 | logarithmic interpolation |
| 47.5% | 0.0999% | 0.0746 | logarithmic interpolation |
| 47.6% | 0.0999% | 0.0753 | logarithmic interpolation |
| 47.7% | 0.0999% | 0.0760 | logarithmic interpolation |
| 47.8% | 0.0999% | 0.0767 | logarithmic interpolation |
| 47.9% | 0.0999% | 0.0773 | logarithmic interpolation |
| 48.0% | 0.0999% | 0.0780 | estimate from Buckman et al. (2015) using the NCI method |
| 48.1% | 0.0999% | 0.0787 | logarithmic interpolation |
| 48.2% | 0.0999% | 0.0794 | logarithmic interpolation |
| 48.3% | 0.0999% | 0.0801 | logarithmic interpolation |
| 48.4% | 0.0999% | 0.0808 | logarithmic interpolation |
| 48.5% | 0.0999% | 0.0815 | logarithmic interpolation |
| 48.6% | 0.0999% | 0.0823 | logarithmic interpolation |
| 48.7% | 0.0999% | 0.0830 | logarithmic interpolation |
| 48.8% | 0.0999% | 0.0837 | logarithmic interpolation |
| 48.9% | 0.0999% | 0.0845 | logarithmic interpolation |
| 49.0% | 0.0999% | 0.0852 | estimate from Buckman et al. (2015) using the NCI method |
| 49.1% | 0.0999% | 0.0859 | logarithmic interpolation |
| 49.2% | 0.0999% | 0.0867 | logarithmic interpolation |
| 49.3% | 0.0999% | 0.0874 | logarithmic interpolation |
| 49.4% | 0.0999% | 0.0882 | logarithmic interpolation |
| 49.5% | 0.0999% | 0.0889 | logarithmic interpolation |
| 49.6% | 0.0999% | 0.0897 | logarithmic interpolation |
| 49.7% | 0.0999% | 0.0905 | logarithmic interpolation |
| 49.8% | 0.0999% | 0.0913 | logarithmic interpolation |
| 49.9% | 0.0999% | 0.0920 | logarithmic interpolation |
| 50.0% | 0.0999% | 0.0928 | estimate from Buckman et al. (2015) using the NCI method |
| 50.1% | 0.0999% | 0.0937 | logarithmic interpolation |
| 50.2% | 0.0999% | 0.0945 | logarithmic interpolation |
| 50.3% | 0.0999% | 0.0953 | logarithmic interpolation |
| 50.4% | 0.0999% | 0.0962 | logarithmic interpolation |
| 50.5% | 0.0999% | 0.0970 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 50.6% | 0.0999% | 0.0979 | logarithmic interpolation |
| 50.7% | 0.0999% | 0.0987 | logarithmic interpolation |
| 50.8% | 0.0999% | 0.0996 | logarithmic interpolation |
| 50.9% | 0.0999% | 0.100 | logarithmic interpolation |
| 51.0% | 0.0999% | 0.101 | estimate from Buckman et al. (2015) using the NCI method |
| 51.1% | 0.0999% | 0.102 | logarithmic interpolation |
| 51.2% | 0.0999% | 0.103 | logarithmic interpolation |
| 51.3% | 0.0999% | 0.104 | logarithmic interpolation |
| 51.4% | 0.0999% | 0.105 | logarithmic interpolation |
| 51.5% | 0.0999% | 0.106 | logarithmic interpolation |
| 51.6% | 0.0999% | 0.107 | logarithmic interpolation |
| 51.7% | 0.0999% | 0.108 | logarithmic interpolation |
| 51.8% | 0.0999% | 0.109 | logarithmic interpolation |
| 51.9% | 0.0999% | 0.110 | logarithmic interpolation |
| 52.0% | 0.0999% | 0.111 | estimate from Buckman et al. (2015) using the NCI method |
| 52.1% | 0.0999% | 0.112 | logarithmic interpolation |
| 52.2% | 0.0999% | 0.113 | logarithmic interpolation |
| 52.3% | 0.0999% | 0.114 | logarithmic interpolation |
| 52.4% | 0.0999% | 0.115 | logarithmic interpolation |
| 52.5% | 0.0999% | 0.116 | logarithmic interpolation |
| 52.6% | 0.0999% | 0.117 | logarithmic interpolation |
| 52.7% | 0.0999% | 0.118 | logarithmic interpolation |
| 52.8% | 0.0999% | 0.119 | logarithmic interpolation |
| 52.9% | 0.0999% | 0.120 | logarithmic interpolation |
| 53.0% | 0.0999% | 0.121 | estimate from Buckman et al. (2015) using the NCI method |
| 53.1% | 0.0999% | 0.122 | logarithmic interpolation |
| 53.2% | 0.0999% | 0.123 | logarithmic interpolation |
| 53.3% | 0.0999% | 0.124 | logarithmic interpolation |
| 53.4% | 0.0999% | 0.125 | logarithmic interpolation |
| 53.5% | 0.0999% | 0.126 | logarithmic interpolation |
| 53.6% | 0.0999% | 0.127 | logarithmic interpolation |
| 53.7% | 0.0999% | 0.128 | logarithmic interpolation |
| 53.8% | 0.0999% | 0.129 | logarithmic interpolation |
| 53.9% | 0.0999% | 0.130 | logarithmic interpolation |
| 54.0% | 0.0999% | 0.131 | estimate from Buckman et al. (2015) using the NCI method |
| 54.1% | 0.0999% | 0.132 | logarithmic interpolation |
| 54.2% | 0.0999% | 0.133 | logarithmic interpolation |
| 54.3% | 0.0999% | 0.134 | logarithmic interpolation |
| 54.4% | 0.0999% | 0.136 | logarithmic interpolation |
| 54.5% | 0.0999% | 0.137 | logarithmic interpolation |
| 54.6% | 0.0999% | 0.138 | logarithmic interpolation |
| 54.7% | 0.0999% | 0.139 | logarithmic interpolation |
| 54.8% | 0.0999% | 0.140 | logarithmic interpolation |
| 54.9% | 0.0999% | 0.142 | logarithmic interpolation |
| 55.0% | 0.0999% | 0.143 | estimate from Buckman et al. (2015) using the NCI method |
| 55.1% | 0.0999% | 0.144 | logarithmic interpolation |
| 55.2% | 0.0999% | 0.145 | logarithmic interpolation |
| 55.3% | 0.0999% | 0.147 | logarithmic interpolation |
| 55.4% | 0.0999% | 0.148 | logarithmic interpolation |
| 55.5% | 0.0999% | 0.149 | logarithmic interpolation |
| 55.6% | 0.0999% | 0.151 | logarithmic interpolation |
| 55.7% | 0.0999% | 0.152 | logarithmic interpolation |
| 55.8% | 0.0999% | 0.153 | logarithmic interpolation |
| 55.9% | 0.0999% | 0.155 | logarithmic interpolation |
| 56.0% | 0.0999% | 0.156 | estimate from Buckman et al. (2015) using the NCI method |
| 56.1% | 0.0999% | 0.157 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 56.2% | 0.0999% | 0.159 | logarithmic interpolation |
| 56.3% | 0.0999% | 0.160 | logarithmic interpolation |
| 56.4% | 0.0999% | 0.161 | logarithmic interpolation |
| 56.5% | 0.0999% | 0.163 | logarithmic interpolation |
| 56.6% | 0.0999% | 0.164 | logarithmic interpolation |
| 56.7% | 0.0999% | 0.165 | logarithmic interpolation |
| 56.8% | 0.0999% | 0.167 | logarithmic interpolation |
| 56.9% | 0.0999% | 0.168 | logarithmic interpolation |
| 57.0% | 0.0999% | 0.170 | estimate from Buckman et al. (2015) using the NCI method |
| 57.1% | 0.0999% | 0.171 | logarithmic interpolation |
| 57.2% | 0.0999% | 0.173 | logarithmic interpolation |
| 57.3% | 0.0999% | 0.174 | logarithmic interpolation |
| 57.4% | 0.0999% | 0.176 | logarithmic interpolation |
| 57.5% | 0.0999% | 0.177 | logarithmic interpolation |
| 57.6% | 0.0999% | 0.179 | logarithmic interpolation |
| 57.7% | 0.0999% | 0.180 | logarithmic interpolation |
| 57.8% | 0.0999% | 0.182 | logarithmic interpolation |
| 57.9% | 0.0999% | 0.183 | logarithmic interpolation |
| 58.0% | 0.0999% | 0.185 | estimate from Buckman et al. (2015) using the NCI method |
| 58.1% | 0.0999% | 0.186 | logarithmic interpolation |
| 58.2% | 0.0999% | 0.188 | logarithmic interpolation |
| 58.3% | 0.0999% | 0.190 | logarithmic interpolation |
| 58.4% | 0.0999% | 0.191 | logarithmic interpolation |
| 58.5% | 0.0999% | 0.193 | logarithmic interpolation |
| 58.6% | 0.0999% | 0.195 | logarithmic interpolation |
| 58.7% | 0.0999% | 0.197 | logarithmic interpolation |
| 58.8% | 0.0999% | 0.198 | logarithmic interpolation |
| 58.9% | 0.0999% | 0.200 | logarithmic interpolation |
| 59.0% | 0.0999% | 0.202 | estimate from Buckman et al. (2015) using the NCI method |
| 59.1% | 0.0999% | 0.204 | logarithmic interpolation |
| 59.2% | 0.0999% | 0.205 | logarithmic interpolation |
| 59.3% | 0.0999% | 0.207 | logarithmic interpolation |
| 59.4% | 0.0999% | 0.209 | logarithmic interpolation |
| 59.5% | 0.0999% | 0.211 | logarithmic interpolation |
| 59.6% | 0.0999% | 0.212 | logarithmic interpolation |
| 59.7% | 0.0999% | 0.214 | logarithmic interpolation |
| 59.8% | 0.0999% | 0.216 | logarithmic interpolation |
| 59.9% | 0.0999% | 0.218 | logarithmic interpolation |
| 60.0% | 0.0999% | 0.220 | estimate from Buckman et al. (2015) using the NCI method |
| 60.1% | 0.0999% | 0.222 | logarithmic interpolation |
| 60.2% | 0.0999% | 0.224 | logarithmic interpolation |
| 60.3% | 0.0999% | 0.225 | logarithmic interpolation |
| 60.4% | 0.0999% | 0.227 | logarithmic interpolation |
| 60.5% | 0.0999% | 0.229 | logarithmic interpolation |
| 60.6% | 0.0999% | 0.231 | logarithmic interpolation |
| 60.7% | 0.0999% | 0.233 | logarithmic interpolation |
| 60.8% | 0.0999% | 0.235 | logarithmic interpolation |
| 60.9% | 0.0999% | 0.237 | logarithmic interpolation |
| 61.0% | 0.0999% | 0.239 | estimate from Buckman et al. (2015) using the NCI method |
| 61.1% | 0.0999% | 0.241 | logarithmic interpolation |
| 61.2% | 0.0999% | 0.243 | logarithmic interpolation |
| 61.3% | 0.0999% | 0.245 | logarithmic interpolation |
| 61.4% | 0.0999% | 0.247 | logarithmic interpolation |
| 61.5% | 0.0999% | 0.250 | logarithmic interpolation |
| 61.6% | 0.0999% | 0.252 | logarithmic interpolation |
| 61.7% | 0.0999% | 0.254 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 61.8% | 0.0999% | 0.256 | logarithmic interpolation |
| 61.9% | 0.0999% | 0.258 | logarithmic interpolation |
| 62.0% | 0.0999% | 0.261 | estimate from Buckman et al. (2015) using the NCI method |
| 62.1% | 0.0999% | 0.263 | logarithmic interpolation |
| 62.2% | 0.0999% | 0.265 | logarithmic interpolation |
| 62.3% | 0.0999% | 0.268 | logarithmic interpolation |
| 62.4% | 0.0999% | 0.270 | logarithmic interpolation |
| 62.5% | 0.0999% | 0.272 | logarithmic interpolation |
| 62.6% | 0.0999% | 0.275 | logarithmic interpolation |
| 62.7% | 0.0999% | 0.277 | logarithmic interpolation |
| 62.8% | 0.0999% | 0.280 | logarithmic interpolation |
| 62.9% | 0.0999% | 0.282 | logarithmic interpolation |
| 63.0% | 0.0999% | 0.285 | estimate from Buckman et al. (2015) using the NCI method |
| 63.1% | 0.0999% | 0.287 | logarithmic interpolation |
| 63.2% | 0.0999% | 0.290 | logarithmic interpolation |
| 63.3% | 0.0999% | 0.292 | logarithmic interpolation |
| 63.4% | 0.0999% | 0.295 | logarithmic interpolation |
| 63.5% | 0.0999% | 0.297 | logarithmic interpolation |
| 63.6% | 0.0999% | 0.300 | logarithmic interpolation |
| 63.7% | 0.0999% | 0.302 | logarithmic interpolation |
| 63.8% | 0.0999% | 0.305 | logarithmic interpolation |
| 63.9% | 0.0999% | 0.308 | logarithmic interpolation |
| 64.0% | 0.0999% | 0.310 | estimate from Buckman et al. (2015) using the NCI method |
| 64.1% | 0.0999% | 0.313 | logarithmic interpolation |
| 64.2% | 0.0999% | 0.316 | logarithmic interpolation |
| 64.3% | 0.0999% | 0.319 | logarithmic interpolation |
| 64.4% | 0.0999% | 0.322 | logarithmic interpolation |
| 64.5% | 0.0999% | 0.324 | logarithmic interpolation |
| 64.6% | 0.0999% | 0.327 | logarithmic interpolation |
| 64.7% | 0.0999% | 0.330 | logarithmic interpolation |
| 64.8% | 0.0999% | 0.333 | logarithmic interpolation |
| 64.9% | 0.0999% | 0.336 | logarithmic interpolation |
| 65.0% | 0.0999% | 0.339 | estimate from Buckman et al. (2015) using the NCI method |
| 65.1% | 0.0999% | 0.342 | logarithmic interpolation |
| 65.2% | 0.0999% | 0.345 | logarithmic interpolation |
| 65.3% | 0.0999% | 0.348 | logarithmic interpolation |
| 65.4% | 0.0999% | 0.351 | logarithmic interpolation |
| 65.5% | 0.0999% | 0.354 | logarithmic interpolation |
| 65.6% | 0.0999% | 0.357 | logarithmic interpolation |
| 65.7% | 0.0999% | 0.360 | logarithmic interpolation |
| 65.8% | 0.0999% | 0.364 | logarithmic interpolation |
| 65.9% | 0.0999% | 0.367 | logarithmic interpolation |
| 66.0% | 0.0999% | 0.370 | estimate from Buckman et al. (2015) using the NCI method |
| 66.1% | 0.0999% | 0.373 | logarithmic interpolation |
| 66.2% | 0.0999% | 0.376 | logarithmic interpolation |
| 66.3% | 0.0999% | 0.380 | logarithmic interpolation |
| 66.4% | 0.0999% | 0.383 | logarithmic interpolation |
| 66.5% | 0.0999% | 0.386 | logarithmic interpolation |
| 66.6% | 0.0999% | 0.390 | logarithmic interpolation |
| 66.7% | 0.0999% | 0.393 | logarithmic interpolation |
| 66.8% | 0.0999% | 0.396 | logarithmic interpolation |
| 66.9% | 0.0999% | 0.400 | logarithmic interpolation |
| 67.0% | 0.0999% | 0.403 | estimate from Buckman et al. (2015) using the NCI method |
| 67.1% | 0.0999% | 0.407 | logarithmic interpolation |
| 67.2% | 0.0999% | 0.411 | logarithmic interpolation |
| 67.3% | 0.0999% | 0.415 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 67.4% | 0.0999% | 0.418 | logarithmic interpolation |
| 67.5% | 0.0999% | 0.422 | logarithmic interpolation |
| 67.6% | 0.0999% | 0.426 | logarithmic interpolation |
| 67.7% | 0.0999% | 0.430 | logarithmic interpolation |
| 67.8% | 0.0999% | 0.434 | logarithmic interpolation |
| 67.9% | 0.0999% | 0.438 | logarithmic interpolation |
| 68.0% | 0.0999% | 0.442 | estimate from Buckman et al. (2015) using the NCI method |
| 68.1% | 0.0999% | 0.446 | logarithmic interpolation |
| 68.2% | 0.0999% | 0.450 | logarithmic interpolation |
| 68.3% | 0.0999% | 0.454 | logarithmic interpolation |
| 68.4% | 0.0999% | 0.458 | logarithmic interpolation |
| 68.5% | 0.0999% | 0.462 | logarithmic interpolation |
| 68.6% | 0.0999% | 0.466 | logarithmic interpolation |
| 68.7% | 0.0999% | 0.471 | logarithmic interpolation |
| 68.8% | 0.0999% | 0.475 | logarithmic interpolation |
| 68.9% | 0.0999% | 0.479 | logarithmic interpolation |
| 69.0% | 0.0999% | 0.483 | estimate from Buckman et al. (2015) using the NCI method |
| 69.1% | 0.0999% | 0.488 | logarithmic interpolation |
| 69.2% | 0.0999% | 0.492 | logarithmic interpolation |
| 69.3% | 0.0999% | 0.497 | logarithmic interpolation |
| 69.4% | 0.0999% | 0.501 | logarithmic interpolation |
| 69.5% | 0.0999% | 0.506 | logarithmic interpolation |
| 69.6% | 0.0999% | 0.510 | logarithmic interpolation |
| 69.7% | 0.0999% | 0.515 | logarithmic interpolation |
| 69.8% | 0.0999% | 0.520 | logarithmic interpolation |
| 69.9% | 0.0999% | 0.524 | logarithmic interpolation |
| 70.0% | 0.0999% | 0.529 | estimate from Buckman et al. (2015) using the NCI method |
| 70.1% | 0.0999% | 0.534 | logarithmic interpolation |
| 70.2% | 0.0999% | 0.539 | logarithmic interpolation |
| 70.3% | 0.0999% | 0.544 | logarithmic interpolation |
| 70.4% | 0.0999% | 0.549 | logarithmic interpolation |
| 70.5% | 0.0999% | 0.554 | logarithmic interpolation |
| 70.6% | 0.0999% | 0.559 | logarithmic interpolation |
| 70.7% | 0.0999% | 0.564 | logarithmic interpolation |
| 70.8% | 0.0999% | 0.569 | logarithmic interpolation |
| 70.9% | 0.0999% | 0.574 | logarithmic interpolation |
| 71.0% | 0.0999% | 0.580 | estimate from Buckman et al. (2015) using the NCI method |
| 71.1% | 0.0999% | 0.585 | logarithmic interpolation |
| 71.2% | 0.0999% | 0.590 | logarithmic interpolation |
| 71.3% | 0.0999% | 0.596 | logarithmic interpolation |
| 71.4% | 0.0999% | 0.601 | logarithmic interpolation |
| 71.5% | 0.0999% | 0.607 | logarithmic interpolation |
| 71.6% | 0.0999% | 0.613 | logarithmic interpolation |
| 71.7% | 0.0999% | 0.618 | logarithmic interpolation |
| 71.8% | 0.0999% | 0.624 | logarithmic interpolation |
| 71.9% | 0.0999% | 0.630 | logarithmic interpolation |
| 72.0% | 0.0999% | 0.635 | estimate from Buckman et al. (2015) using the NCI method |
| 72.1% | 0.0999% | 0.641 | logarithmic interpolation |
| 72.2% | 0.0999% | 0.647 | logarithmic interpolation |
| 72.3% | 0.0999% | 0.654 | logarithmic interpolation |
| 72.4% | 0.0999% | 0.660 | logarithmic interpolation |
| 72.5% | 0.0999% | 0.666 | logarithmic interpolation |
| 72.6% | 0.0999% | 0.672 | logarithmic interpolation |
| 72.7% | 0.0999% | 0.678 | logarithmic interpolation |
| 72.8% | 0.0999% | 0.685 | logarithmic interpolation |
| 72.9% | 0.0999% | 0.691 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 73.0% | 0.0999% | 0.698 | estimate from Buckman et al. (2015) using the NCI method |
| 73.1% | 0.0999% | 0.704 | logarithmic interpolation |
| 73.2% | 0.0999% | 0.711 | logarithmic interpolation |
| 73.3% | 0.0999% | 0.717 | logarithmic interpolation |
| 73.4% | 0.0999% | 0.724 | logarithmic interpolation |
| 73.5% | 0.0999% | 0.730 | logarithmic interpolation |
| 73.6% | 0.0999% | 0.737 | logarithmic interpolation |
| 73.7% | 0.0999% | 0.744 | logarithmic interpolation |
| 73.8% | 0.0999% | 0.751 | logarithmic interpolation |
| 73.9% | 0.0999% | 0.758 | logarithmic interpolation |
| 74.0% | 0.0999% | 0.765 | estimate from Buckman et al. (2015) using the NCI method |
| 74.1% | 0.0999% | 0.772 | logarithmic interpolation |
| 74.2% | 0.0999% | 0.779 | logarithmic interpolation |
| 74.3% | 0.0999% | 0.787 | logarithmic interpolation |
| 74.4% | 0.0999% | 0.794 | logarithmic interpolation |
| 74.5% | 0.0999% | 0.801 | logarithmic interpolation |
| 74.6% | 0.0999% | 0.809 | logarithmic interpolation |
| 74.7% | 0.0999% | 0.817 | logarithmic interpolation |
| 74.8% | 0.0999% | 0.824 | logarithmic interpolation |
| 74.9% | 0.0999% | 0.832 | logarithmic interpolation |
| 75.0% | 0.0999% | 0.840 | estimate from Buckman et al. (2015) using the NCI method |
| 75.1% | 0.0999% | 0.848 | logarithmic interpolation |
| 75.2% | 0.0999% | 0.856 | logarithmic interpolation |
| 75.3% | 0.0999% | 0.864 | logarithmic interpolation |
| 75.4% | 0.0999% | 0.872 | logarithmic interpolation |
| 75.5% | 0.0999% | 0.881 | logarithmic interpolation |
| 75.6% | 0.0999% | 0.889 | logarithmic interpolation |
| 75.7% | 0.0999% | 0.897 | logarithmic interpolation |
| 75.8% | 0.0999% | 0.906 | logarithmic interpolation |
| 75.9% | 0.0999% | 0.914 | logarithmic interpolation |
| 76.0% | 0.0999% | 0.923 | estimate from Buckman et al. (2015) using the NCI method |
| 76.1% | 0.0999% | 0.932 | logarithmic interpolation |
| 76.2% | 0.0999% | 0.942 | logarithmic interpolation |
| 76.3% | 0.0999% | 0.951 | logarithmic interpolation |
| 76.4% | 0.0999% | 0.961 | logarithmic interpolation |
| 76.5% | 0.0999% | 0.970 | logarithmic interpolation |
| 76.6% | 0.0999% | 0.980 | logarithmic interpolation |
| 76.7% | 0.0999% | 0.990 | logarithmic interpolation |
| 76.8% | 0.0999% | 1.00 | logarithmic interpolation |
| 76.9% | 0.0999% | 1.01 | logarithmic interpolation |
| 77.0% | 0.0999% | 1.02 | estimate from Buckman et al. (2015) using the NCI method |
| 77.1% | 0.0999% | 1.03 | logarithmic interpolation |
| 77.2% | 0.0999% | 1.04 | logarithmic interpolation |
| 77.3% | 0.0999% | 1.05 | logarithmic interpolation |
| 77.4% | 0.0999% | 1.06 | logarithmic interpolation |
| 77.5% | 0.0999% | 1.07 | logarithmic interpolation |
| 77.6% | 0.0999% | 1.08 | logarithmic interpolation |
| 77.7% | 0.0999% | 1.09 | logarithmic interpolation |
| 77.8% | 0.0999% | 1.10 | logarithmic interpolation |
| 77.9% | 0.0999% | 1.11 | logarithmic interpolation |
| 78.0% | 0.0999% | 1.12 | estimate from Buckman et al. (2015) using the NCI method |
| 78.1% | 0.0999% | 1.14 | logarithmic interpolation |
| 78.2% | 0.0999% | 1.15 | logarithmic interpolation |
| 78.3% | 0.0999% | 1.16 | logarithmic interpolation |
| 78.4% | 0.0999% | 1.17 | logarithmic interpolation |
| 78.5% | 0.0999% | 1.18 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 78.6% | 0.0999% | 1.19 | logarithmic interpolation |
| 78.7% | 0.0999% | 1.21 | logarithmic interpolation |
| 78.8% | 0.0999% | 1.22 | logarithmic interpolation |
| 78.9% | 0.0999% | 1.23 | logarithmic interpolation |
| 79.0% | 0.0999% | 1.24 | estimate from Buckman et al. (2015) using the NCI method |
| 79.1% | 0.0999% | 1.26 | logarithmic interpolation |
| 79.2% | 0.0999% | 1.27 | logarithmic interpolation |
| 79.3% | 0.0999% | 1.28 | logarithmic interpolation |
| 79.4% | 0.0999% | 1.30 | logarithmic interpolation |
| 79.5% | 0.0999% | 1.31 | logarithmic interpolation |
| 79.6% | 0.0999% | 1.32 | logarithmic interpolation |
| 79.7% | 0.0999% | 1.34 | logarithmic interpolation |
| 79.8% | 0.0999% | 1.35 | logarithmic interpolation |
| 79.9% | 0.0999% | 1.36 | logarithmic interpolation |
| 80.0% | 0.0999% | 1.38 | estimate from Buckman et al. (2015) using the NCI method |
| 80.1% | 0.0999% | 1.39 | logarithmic interpolation |
| 80.2% | 0.0999% | 1.41 | logarithmic interpolation |
| 80.3% | 0.0999% | 1.42 | logarithmic interpolation |
| 80.4% | 0.0999% | 1.44 | logarithmic interpolation |
| 80.5% | 0.0999% | 1.45 | logarithmic interpolation |
| 80.6% | 0.0999% | 1.47 | logarithmic interpolation |
| 80.7% | 0.0999% | 1.48 | logarithmic interpolation |
| 80.8% | 0.0999% | 1.50 | logarithmic interpolation |
| 80.9% | 0.0999% | 1.51 | logarithmic interpolation |
| 81.0% | 0.0999% | 1.53 | estimate from Buckman et al. (2015) using the NCI method |
| 81.1% | 0.0999% | 1.55 | logarithmic interpolation |
| 81.2% | 0.0999% | 1.56 | logarithmic interpolation |
| 81.3% | 0.0999% | 1.58 | logarithmic interpolation |
| 81.4% | 0.0999% | 1.60 | logarithmic interpolation |
| 81.5% | 0.0999% | 1.62 | logarithmic interpolation |
| 81.6% | 0.0999% | 1.63 | logarithmic interpolation |
| 81.7% | 0.0999% | 1.65 | logarithmic interpolation |
| 81.8% | 0.0999% | 1.67 | logarithmic interpolation |
| 81.9% | 0.0999% | 1.69 | logarithmic interpolation |
| 82.0% | 0.0999% | 1.71 | estimate from Buckman et al. (2015) using the NCI method |
| 82.1% | 0.0999% | 1.73 | logarithmic interpolation |
| 82.2% | 0.0999% | 1.75 | logarithmic interpolation |
| 82.3% | 0.0999% | 1.77 | logarithmic interpolation |
| 82.4% | 0.0999% | 1.79 | logarithmic interpolation |
| 82.5% | 0.0999% | 1.81 | logarithmic interpolation |
| 82.6% | 0.0999% | 1.83 | logarithmic interpolation |
| 82.7% | 0.0999% | 1.85 | logarithmic interpolation |
| 82.8% | 0.0999% | 1.87 | logarithmic interpolation |
| 82.9% | 0.0999% | 1.89 | logarithmic interpolation |
| 83.0% | 0.0999% | 1.91 | estimate from Buckman et al. (2015) using the NCI method |
| 83.1% | 0.0999% | 1.94 | logarithmic interpolation |
| 83.2% | 0.0999% | 1.96 | logarithmic interpolation |
| 83.3% | 0.0999% | 1.98 | logarithmic interpolation |
| 83.4% | 0.0999% | 2.00 | logarithmic interpolation |
| 83.5% | 0.0999% | 2.03 | logarithmic interpolation |
| 83.6% | 0.0999% | 2.05 | logarithmic interpolation |
| 83.7% | 0.0999% | 2.07 | logarithmic interpolation |
| 83.8% | 0.0999% | 2.10 | logarithmic interpolation |
| 83.9% | 0.0999% | 2.12 | logarithmic interpolation |
| 84.0% | 0.0999% | 2.15 | estimate from Buckman et al. (2015) using the NCI method |
| 84.1% | 0.0999% | 2.17 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 84.2% | 0.0999% | 2.20 | logarithmic interpolation |
| 84.3% | 0.0999% | 2.22 | logarithmic interpolation |
| 84.4% | 0.0999% | 2.25 | logarithmic interpolation |
| 84.5% | 0.0999% | 2.28 | logarithmic interpolation |
| 84.6% | 0.0999% | 2.31 | logarithmic interpolation |
| 84.7% | 0.0999% | 2.33 | logarithmic interpolation |
| 84.8% | 0.0999% | 2.36 | logarithmic interpolation |
| 84.9% | 0.0999% | 2.39 | logarithmic interpolation |
| 85.0% | 0.0999% | 2.42 | estimate from Buckman et al. (2015) using the NCI method |
| 85.1% | 0.0999% | 2.45 | logarithmic interpolation |
| 85.2% | 0.0999% | 2.48 | logarithmic interpolation |
| 85.3% | 0.0999% | 2.51 | logarithmic interpolation |
| 85.4% | 0.0999% | 2.54 | logarithmic interpolation |
| 85.5% | 0.0999% | 2.57 | logarithmic interpolation |
| 85.6% | 0.0999% | 2.60 | logarithmic interpolation |
| 85.7% | 0.0999% | 2.64 | logarithmic interpolation |
| 85.8% | 0.0999% | 2.67 | logarithmic interpolation |
| 85.9% | 0.0999% | 2.70 | logarithmic interpolation |
| 86.0% | 0.0999% | 2.74 | estimate from Buckman et al. (2015) using the NCI method |
| 86.1% | 0.0999% | 2.77 | logarithmic interpolation |
| 86.2% | 0.0999% | 2.80 | logarithmic interpolation |
| 86.3% | 0.0999% | 2.84 | logarithmic interpolation |
| 86.4% | 0.0999% | 2.87 | logarithmic interpolation |
| 86.5% | 0.0999% | 2.91 | logarithmic interpolation |
| 86.6% | 0.0999% | 2.94 | logarithmic interpolation |
| 86.7% | 0.0999% | 2.98 | logarithmic interpolation |
| 86.8% | 0.0999% | 3.02 | logarithmic interpolation |
| 86.9% | 0.0999% | 3.05 | logarithmic interpolation |
| 87.0% | 0.0999% | 3.09 | estimate from Buckman et al. (2015) using the NCI method |
| 87.1% | 0.0999% | 3.13 | logarithmic interpolation |
| 87.2% | 0.0999% | 3.17 | logarithmic interpolation |
| 87.3% | 0.0999% | 3.22 | logarithmic interpolation |
| 87.4% | 0.0999% | 3.26 | logarithmic interpolation |
| 87.5% | 0.0999% | 3.30 | logarithmic interpolation |
| 87.6% | 0.0999% | 3.35 | logarithmic interpolation |
| 87.7% | 0.0999% | 3.39 | logarithmic interpolation |
| 87.8% | 0.0999% | 3.44 | logarithmic interpolation |
| 87.9% | 0.0999% | 3.48 | logarithmic interpolation |
| 88.0% | 0.0999% | 3.53 | estimate from Buckman et al. (2015) using the NCI method |
| 88.1% | 0.0999% | 3.58 | logarithmic interpolation |
| 88.2% | 0.0999% | 3.62 | logarithmic interpolation |
| 88.3% | 0.0999% | 3.67 | logarithmic interpolation |
| 88.4% | 0.0999% | 3.72 | logarithmic interpolation |
| 88.5% | 0.0999% | 3.77 | logarithmic interpolation |
| 88.6% | 0.0999% | 3.82 | logarithmic interpolation |
| 88.7% | 0.0999% | 3.88 | logarithmic interpolation |
| 88.8% | 0.0999% | 3.93 | logarithmic interpolation |
| 88.9% | 0.0999% | 3.98 | logarithmic interpolation |
| 89.0% | 0.0999% | 4.03 | estimate from Buckman et al. (2015) using the NCI method |
| 89.1% | 0.0999% | 4.09 | logarithmic interpolation |
| 89.2% | 0.0999% | 4.15 | logarithmic interpolation |
| 89.3% | 0.0999% | 4.21 | logarithmic interpolation |
| 89.4% | 0.0999% | 4.27 | logarithmic interpolation |
| 89.5% | 0.0999% | 4.33 | logarithmic interpolation |
| 89.6% | 0.0999% | 4.40 | logarithmic interpolation |
| 89.7% | 0.0999% | 4.46 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 89.8% | 0.0999% | 4.53 | logarithmic interpolation |
| 89.9% | 0.0999% | 4.59 | logarithmic interpolation |
| 90.0% | 0.0999% | 4.66 | estimate from Buckman et al. (2015) using the NCI method |
| 90.1% | 0.0999% | 4.73 | logarithmic interpolation |
| 90.2% | 0.0999% | 4.80 | logarithmic interpolation |
| 90.3% | 0.0999% | 4.87 | logarithmic interpolation |
| 90.4% | 0.0999% | 4.95 | logarithmic interpolation |
| 90.5% | 0.0999% | 5.02 | logarithmic interpolation |
| 90.6% | 0.0999% | 5.10 | logarithmic interpolation |
| 90.7% | 0.0999% | 5.18 | logarithmic interpolation |
| 90.8% | 0.0999% | 5.26 | logarithmic interpolation |
| 90.9% | 0.0999% | 5.34 | logarithmic interpolation |
| 91.0% | 0.0999% | 5.42 | estimate from Buckman et al. (2015) using the NCI method |
| 91.1% | 0.0999% | 5.51 | logarithmic interpolation |
| 91.2% | 0.0999% | 5.59 | logarithmic interpolation |
| 91.3% | 0.0999% | 5.69 | logarithmic interpolation |
| 91.4% | 0.0999% | 5.78 | logarithmic interpolation |
| 91.5% | 0.0999% | 5.87 | logarithmic interpolation |
| 91.6% | 0.0999% | 5.97 | logarithmic interpolation |
| 91.7% | 0.0999% | 6.06 | logarithmic interpolation |
| 91.8% | 0.0999% | 6.16 | logarithmic interpolation |
| 91.9% | 0.0999% | 6.26 | logarithmic interpolation |
| 92.0% | 0.0999% | 6.36 | estimate from Buckman et al. (2015) using the NCI method |
| 92.1% | 0.0999% | 6.47 | logarithmic interpolation |
| 92.2% | 0.0999% | 6.58 | logarithmic interpolation |
| 92.3% | 0.0999% | 6.69 | logarithmic interpolation |
| 92.4% | 0.0999% | 6.80 | logarithmic interpolation |
| 92.5% | 0.0999% | 6.92 | logarithmic interpolation |
| 92.6% | 0.0999% | 7.04 | logarithmic interpolation |
| 92.7% | 0.0999% | 7.16 | logarithmic interpolation |
| 92.8% | 0.0999% | 7.28 | logarithmic interpolation |
| 92.9% | 0.0999% | 7.40 | logarithmic interpolation |
| 93.0% | 0.0999% | 7.53 | estimate from Buckman et al. (2015) using the NCI method |
| 93.1% | 0.0999% | 7.67 | logarithmic interpolation |
| 93.2% | 0.0999% | 7.82 | logarithmic interpolation |
| 93.3% | 0.0999% | 7.98 | logarithmic interpolation |
| 93.4% | 0.0999% | 8.13 | logarithmic interpolation |
| 93.5% | 0.0999% | 8.29 | logarithmic interpolation |
| 93.6% | 0.0999% | 8.45 | logarithmic interpolation |
| 93.7% | 0.0999% | 8.62 | logarithmic interpolation |
| 93.8% | 0.0999% | 8.79 | logarithmic interpolation |
| 93.9% | 0.0999% | 8.96 | logarithmic interpolation |
| 94.0% | 0.0999% | 9.14 | estimate from Buckman et al. (2015) using the NCI method |
| 94.1% | 0.0999% | 9.33 | logarithmic interpolation |
| 94.2% | 0.0999% | 9.52 | logarithmic interpolation |
| 94.3% | 0.0999% | 9.72 | logarithmic interpolation |
| 94.4% | 0.0999% | 9.93 | logarithmic interpolation |
| 94.5% | 0.0999% | 10.1 | logarithmic interpolation |
| 94.6% | 0.0999% | 10.3 | logarithmic interpolation |
| 94.7% | 0.0999% | 10.6 | logarithmic interpolation |
| 94.8% | 0.0999% | 10.8 | logarithmic interpolation |
| 94.9% | 0.0999% | 11.0 | logarithmic interpolation |
| 95.0% | 0.0999% | 11.2 | estimate from Buckman et al. (2015) using the NCI method |
| 95.1% | 0.0999% | 11.5 | logarithmic interpolation |
| 95.2% | 0.0999% | 11.8 | logarithmic interpolation |
| 95.3% | 0.0999% | 12.0 | logarithmic interpolation |

**Table A2. Alternate Interpolated Idaho Fish Consumption Distribution for the General Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 95.4% | 0.0999% | 12.3 | logarithmic interpolation |
| 95.5% | 0.0999% | 12.6 | logarithmic interpolation |
| 95.6% | 0.0999% | 12.9 | logarithmic interpolation |
| 95.7% | 0.0999% | 13.1 | logarithmic interpolation |
| 95.8% | 0.0999% | 13.4 | logarithmic interpolation |
| 95.9% | 0.0999% | 13.7 | logarithmic interpolation |
| 96.0% | 0.0999% | 14.1 | estimate from Buckman et al. (2015) using the NCI method |
| 96.1% | 0.0999% | 14.4 | logarithmic interpolation |
| 96.2% | 0.0999% | 14.8 | logarithmic interpolation |
| 96.3% | 0.0999% | 15.2 | logarithmic interpolation |
| 96.4% | 0.0999% | 15.6 | logarithmic interpolation |
| 96.5% | 0.0999% | 16.0 | logarithmic interpolation |
| 96.6% | 0.0999% | 16.4 | logarithmic interpolation |
| 96.7% | 0.0999% | 16.9 | logarithmic interpolation |
| 96.8% | 0.0999% | 17.3 | logarithmic interpolation |
| 96.9% | 0.0999% | 17.8 | logarithmic interpolation |
| 97.0% | 0.0999% | 18.2 | estimate from Buckman et al. (2015) using the NCI method |
| 97.1% | 0.0999% | 18.8 | logarithmic interpolation |
| 97.2% | 0.0999% | 19.5 | logarithmic interpolation |
| 97.3% | 0.0999% | 20.1 | logarithmic interpolation |
| 97.4% | 0.0999% | 20.8 | logarithmic interpolation |
| 97.5% | 0.0999% | 21.5 | logarithmic interpolation |
| 97.6% | 0.0999% | 22.2 | logarithmic interpolation |
| 97.7% | 0.0999% | 23.0 | logarithmic interpolation |
| 97.8% | 0.0999% | 23.7 | logarithmic interpolation |
| 97.9% | 0.0999% | 24.5 | logarithmic interpolation |
| 98.0% | 0.0999% | 25.3 | estimate from Buckman et al. (2015) using the NCI method |
| 98.1% | 0.0999% | 26.6 | logarithmic interpolation |
| 98.2% | 0.0999% | 27.8 | logarithmic interpolation |
| 98.3% | 0.0999% | 29.2 | logarithmic interpolation |
| 98.4% | 0.0999% | 30.6 | logarithmic interpolation |
| 98.5% | 0.0999% | 32.0 | logarithmic interpolation |
| 98.6% | 0.0999% | 33.6 | logarithmic interpolation |
| 98.7% | 0.0999% | 35.2 | logarithmic interpolation |
| 98.8% | 0.0999% | 36.9 | logarithmic interpolation |
| 98.9% | 0.0999% | 38.7 | logarithmic interpolation |
| 99.0% | 0.0999% | 40.5 | estimate from Buckman et al. (2015) using the NCI method |
| 99.1% | 0.0999% | 57 | logarithmic interpolation |
| 99.2% | 0.0999% | 81 | logarithmic interpolation |
| 99.3% | 0.0999% | 114 | logarithmic interpolation |
| 99.4% | 0.0999% | 160 | logarithmic interpolation |
| 99.5% | 0.0999% | 226 | logarithmic interpolation |
| 99.6% | 0.0999% | 319 | logarithmic interpolation |
| 99.7% | 0.0999% | 450 | logarithmic interpolation |
| 99.8% | 0.0999% | 634 | logarithmic interpolation |
| 99.9% | 0.0999% | 895 | logarithmic interpolation |
| 100% | 0.0999% | 1261 | estimate from Buckman et al. (2015) using the NCI method |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| Mean | -- | 19.2 | arithmetic mean of discrete distribution |
| 0% | 0.0999% | 0.992 | set equal to the 5th percentile value |
| 0.1% | 0.0999% | 0.992 | linear interpolation |
| 0.2% | 0.0999% | 0.992 | linear interpolation |
| 0.3% | 0.0999% | 0.992 | linear interpolation |
| 0.4% | 0.0999% | 0.992 | linear interpolation |
| 0.5% | 0.0999% | 0.992 | linear interpolation |
| 0.6% | 0.0999% | 0.992 | linear interpolation |
| 0.7% | 0.0999% | 0.992 | linear interpolation |
| 0.8% | 0.0999% | 0.992 | linear interpolation |
| 0.9% | 0.0999% | 0.992 | linear interpolation |
| 1.0% | 0.0999% | 0.992 | linear interpolation |
| 1.1% | 0.0999% | 0.992 | linear interpolation |
| 1.2% | 0.0999% | 0.992 | linear interpolation |
| 1.3% | 0.0999% | 0.992 | linear interpolation |
| 1.4% | 0.0999% | 0.992 | linear interpolation |
| 1.5% | 0.0999% | 0.992 | linear interpolation |
| 1.6% | 0.0999% | 0.992 | linear interpolation |
| 1.7% | 0.0999% | 0.992 | linear interpolation |
| 1.8% | 0.0999% | 0.992 | linear interpolation |
| 1.9% | 0.0999% | 0.992 | linear interpolation |
| 2.0% | 0.0999% | 0.992 | linear interpolation |
| 2.1% | 0.0999% | 0.992 | linear interpolation |
| 2.2% | 0.0999% | 0.992 | linear interpolation |
| 2.3% | 0.0999% | 0.992 | linear interpolation |
| 2.4% | 0.0999% | 0.992 | linear interpolation |
| 2.5% | 0.0999% | 0.992 | linear interpolation |
| 2.6% | 0.0999% | 0.992 | linear interpolation |
| 2.7% | 0.0999% | 0.992 | linear interpolation |
| 2.8% | 0.0999% | 0.992 | linear interpolation |
| 2.9% | 0.0999% | 0.992 | linear interpolation |
| 3.0% | 0.0999% | 0.992 | linear interpolation |
| 3.1% | 0.0999% | 0.992 | linear interpolation |
| 3.2% | 0.0999% | 0.992 | linear interpolation |
| 3.3% | 0.0999% | 0.992 | linear interpolation |
| 3.4% | 0.0999% | 0.992 | linear interpolation |
| 3.5% | 0.0999% | 0.992 | linear interpolation |
| 3.6% | 0.0999% | 0.992 | linear interpolation |
| 3.7% | 0.0999% | 0.992 | linear interpolation |
| 3.8% | 0.0999% | 0.992 | linear interpolation |
| 3.9% | 0.0999% | 0.992 | linear interpolation |
| 4.0% | 0.0999% | 0.992 | linear interpolation |
| 4.1% | 0.0999% | 0.992 | linear interpolation |
| 4.2% | 0.0999% | 0.992 | linear interpolation |
| 4.3% | 0.0999% | 0.992 | linear interpolation |
| 4.4% | 0.0999% | 0.992 | linear interpolation |
| 4.5% | 0.0999% | 0.992 | linear interpolation |
| 4.6% | 0.0999% | 0.992 | linear interpolation |
| 4.7% | 0.0999% | 0.992 | linear interpolation |
| 4.8% | 0.0999% | 0.992 | linear interpolation |
| 4.9% | 0.0999% | 0.992 | linear interpolation |
| 5.0% | 0.0999% | 0.992 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 5.1% | 0.0999% | 1.01 | linear interpolation |
| 5.2% | 0.0999% | 1.02 | linear interpolation |
| 5.3% | 0.0999% | 1.03 | linear interpolation |
| 5.4% | 0.0999% | 1.04 | linear interpolation |
| 5.5% | 0.0999% | 1.06 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 5.6% | 0.0999% | 1.07 | linear interpolation |
| 5.7% | 0.0999% | 1.08 | linear interpolation |
| 5.8% | 0.0999% | 1.10 | linear interpolation |
| 5.9% | 0.0999% | 1.11 | linear interpolation |
| 6.0% | 0.0999% | 1.12 | linear interpolation |
| 6.1% | 0.0999% | 1.14 | linear interpolation |
| 6.2% | 0.0999% | 1.15 | linear interpolation |
| 6.3% | 0.0999% | 1.16 | linear interpolation |
| 6.4% | 0.0999% | 1.18 | linear interpolation |
| 6.5% | 0.0999% | 1.19 | linear interpolation |
| 6.6% | 0.0999% | 1.20 | linear interpolation |
| 6.7% | 0.0999% | 1.21 | linear interpolation |
| 6.8% | 0.0999% | 1.23 | linear interpolation |
| 6.9% | 0.0999% | 1.24 | linear interpolation |
| 7.0% | 0.0999% | 1.25 | linear interpolation |
| 7.1% | 0.0999% | 1.27 | linear interpolation |
| 7.2% | 0.0999% | 1.28 | linear interpolation |
| 7.3% | 0.0999% | 1.29 | linear interpolation |
| 7.4% | 0.0999% | 1.31 | linear interpolation |
| 7.5% | 0.0999% | 1.32 | linear interpolation |
| 7.6% | 0.0999% | 1.33 | linear interpolation |
| 7.7% | 0.0999% | 1.35 | linear interpolation |
| 7.8% | 0.0999% | 1.36 | linear interpolation |
| 7.9% | 0.0999% | 1.37 | linear interpolation |
| 8.0% | 0.0999% | 1.38 | linear interpolation |
| 8.1% | 0.0999% | 1.40 | linear interpolation |
| 8.2% | 0.0999% | 1.41 | linear interpolation |
| 8.3% | 0.0999% | 1.42 | linear interpolation |
| 8.4% | 0.0999% | 1.44 | linear interpolation |
| 8.5% | 0.0999% | 1.45 | linear interpolation |
| 8.6% | 0.0999% | 1.46 | linear interpolation |
| 8.7% | 0.0999% | 1.48 | linear interpolation |
| 8.8% | 0.0999% | 1.49 | linear interpolation |
| 8.9% | 0.0999% | 1.50 | linear interpolation |
| 9.0% | 0.0999% | 1.51 | linear interpolation |
| 9.1% | 0.0999% | 1.53 | linear interpolation |
| 9.2% | 0.0999% | 1.54 | linear interpolation |
| 9.3% | 0.0999% | 1.55 | linear interpolation |
| 9.4% | 0.0999% | 1.57 | linear interpolation |
| 9.5% | 0.0999% | 1.58 | linear interpolation |
| 9.6% | 0.0999% | 1.59 | linear interpolation |
| 9.7% | 0.0999% | 1.61 | linear interpolation |
| 9.8% | 0.0999% | 1.62 | linear interpolation |
| 9.9% | 0.0999% | 1.63 | linear interpolation |
| 10.0% | 0.0999% | 1.65 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 10.1% | 0.0999% | 1.66 | linear interpolation |
| 10.2% | 0.0999% | 1.67 | linear interpolation |
| 10.3% | 0.0999% | 1.68 | linear interpolation |
| 10.4% | 0.0999% | 1.70 | linear interpolation |
| 10.5% | 0.0999% | 1.71 | linear interpolation |
| 10.6% | 0.0999% | 1.72 | linear interpolation |
| 10.7% | 0.0999% | 1.73 | linear interpolation |
| 10.8% | 0.0999% | 1.75 | linear interpolation |
| 10.9% | 0.0999% | 1.76 | linear interpolation |
| 11.0% | 0.0999% | 1.77 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 11.1% | 0.0999% | 1.78 | linear interpolation |
| 11.2% | 0.0999% | 1.80 | linear interpolation |
| 11.3% | 0.0999% | 1.81 | linear interpolation |
| 11.4% | 0.0999% | 1.82 | linear interpolation |
| 11.5% | 0.0999% | 1.83 | linear interpolation |
| 11.6% | 0.0999% | 1.85 | linear interpolation |
| 11.7% | 0.0999% | 1.86 | linear interpolation |
| 11.8% | 0.0999% | 1.87 | linear interpolation |
| 11.9% | 0.0999% | 1.88 | linear interpolation |
| 12.0% | 0.0999% | 1.90 | linear interpolation |
| 12.1% | 0.0999% | 1.91 | linear interpolation |
| 12.2% | 0.0999% | 1.92 | linear interpolation |
| 12.3% | 0.0999% | 1.94 | linear interpolation |
| 12.4% | 0.0999% | 1.95 | linear interpolation |
| 12.5% | 0.0999% | 1.96 | linear interpolation |
| 12.6% | 0.0999% | 1.97 | linear interpolation |
| 12.7% | 0.0999% | 1.99 | linear interpolation |
| 12.8% | 0.0999% | 2.00 | linear interpolation |
| 12.9% | 0.0999% | 2.01 | linear interpolation |
| 13.0% | 0.0999% | 2.02 | linear interpolation |
| 13.1% | 0.0999% | 2.04 | linear interpolation |
| 13.2% | 0.0999% | 2.05 | linear interpolation |
| 13.3% | 0.0999% | 2.06 | linear interpolation |
| 13.4% | 0.0999% | 2.07 | linear interpolation |
| 13.5% | 0.0999% | 2.09 | linear interpolation |
| 13.6% | 0.0999% | 2.10 | linear interpolation |
| 13.7% | 0.0999% | 2.11 | linear interpolation |
| 13.8% | 0.0999% | 2.12 | linear interpolation |
| 13.9% | 0.0999% | 2.14 | linear interpolation |
| 14.0% | 0.0999% | 2.15 | linear interpolation |
| 14.1% | 0.0999% | 2.16 | linear interpolation |
| 14.2% | 0.0999% | 2.17 | linear interpolation |
| 14.3% | 0.0999% | 2.19 | linear interpolation |
| 14.4% | 0.0999% | 2.20 | linear interpolation |
| 14.5% | 0.0999% | 2.21 | linear interpolation |
| 14.6% | 0.0999% | 2.22 | linear interpolation |
| 14.7% | 0.0999% | 2.24 | linear interpolation |
| 14.8% | 0.0999% | 2.25 | linear interpolation |
| 14.9% | 0.0999% | 2.26 | linear interpolation |
| 15.0% | 0.0999% | 2.27 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 15.1% | 0.0999% | 2.29 | linear interpolation |
| 15.2% | 0.0999% | 2.30 | linear interpolation |
| 15.3% | 0.0999% | 2.32 | linear interpolation |
| 15.4% | 0.0999% | 2.33 | linear interpolation |
| 15.5% | 0.0999% | 2.34 | linear interpolation |
| 15.6% | 0.0999% | 2.36 | linear interpolation |
| 15.7% | 0.0999% | 2.37 | linear interpolation |
| 15.8% | 0.0999% | 2.38 | linear interpolation |
| 15.9% | 0.0999% | 2.40 | linear interpolation |
| 16.0% | 0.0999% | 2.41 | linear interpolation |
| 16.1% | 0.0999% | 2.42 | linear interpolation |
| 16.2% | 0.0999% | 2.44 | linear interpolation |
| 16.3% | 0.0999% | 2.45 | linear interpolation |
| 16.4% | 0.0999% | 2.46 | linear interpolation |
| 16.5% | 0.0999% | 2.48 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 16.6% | 0.0999% | 2.49 | linear interpolation |
| 16.7% | 0.0999% | 2.51 | linear interpolation |
| 16.8% | 0.0999% | 2.52 | linear interpolation |
| 16.9% | 0.0999% | 2.53 | linear interpolation |
| 17.0% | 0.0999% | 2.55 | linear interpolation |
| 17.1% | 0.0999% | 2.56 | linear interpolation |
| 17.2% | 0.0999% | 2.57 | linear interpolation |
| 17.3% | 0.0999% | 2.59 | linear interpolation |
| 17.4% | 0.0999% | 2.60 | linear interpolation |
| 17.5% | 0.0999% | 2.61 | linear interpolation |
| 17.6% | 0.0999% | 2.63 | linear interpolation |
| 17.7% | 0.0999% | 2.64 | linear interpolation |
| 17.8% | 0.0999% | 2.65 | linear interpolation |
| 17.9% | 0.0999% | 2.67 | linear interpolation |
| 18.0% | 0.0999% | 2.68 | linear interpolation |
| 18.1% | 0.0999% | 2.69 | linear interpolation |
| 18.2% | 0.0999% | 2.71 | linear interpolation |
| 18.3% | 0.0999% | 2.72 | linear interpolation |
| 18.4% | 0.0999% | 2.74 | linear interpolation |
| 18.5% | 0.0999% | 2.75 | linear interpolation |
| 18.6% | 0.0999% | 2.76 | linear interpolation |
| 18.7% | 0.0999% | 2.78 | linear interpolation |
| 18.8% | 0.0999% | 2.79 | linear interpolation |
| 18.9% | 0.0999% | 2.80 | linear interpolation |
| 19.0% | 0.0999% | 2.82 | linear interpolation |
| 19.1% | 0.0999% | 2.83 | linear interpolation |
| 19.2% | 0.0999% | 2.84 | linear interpolation |
| 19.3% | 0.0999% | 2.86 | linear interpolation |
| 19.4% | 0.0999% | 2.87 | linear interpolation |
| 19.5% | 0.0999% | 2.88 | linear interpolation |
| 19.6% | 0.0999% | 2.90 | linear interpolation |
| 19.7% | 0.0999% | 2.91 | linear interpolation |
| 19.8% | 0.0999% | 2.93 | linear interpolation |
| 19.9% | 0.0999% | 2.94 | linear interpolation |
| 20.0% | 0.0999% | 2.95 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 20.1% | 0.0999% | 2.97 | linear interpolation |
| 20.2% | 0.0999% | 2.98 | linear interpolation |
| 20.3% | 0.0999% | 2.99 | linear interpolation |
| 20.4% | 0.0999% | 3.01 | linear interpolation |
| 20.5% | 0.0999% | 3.02 | linear interpolation |
| 20.6% | 0.0999% | 3.04 | linear interpolation |
| 20.7% | 0.0999% | 3.05 | linear interpolation |
| 20.8% | 0.0999% | 3.06 | linear interpolation |
| 20.9% | 0.0999% | 3.08 | linear interpolation |
| 21.0% | 0.0999% | 3.09 | linear interpolation |
| 21.1% | 0.0999% | 3.11 | linear interpolation |
| 21.2% | 0.0999% | 3.12 | linear interpolation |
| 21.3% | 0.0999% | 3.13 | linear interpolation |
| 21.4% | 0.0999% | 3.15 | linear interpolation |
| 21.5% | 0.0999% | 3.16 | linear interpolation |
| 21.6% | 0.0999% | 3.18 | linear interpolation |
| 21.7% | 0.0999% | 3.19 | linear interpolation |
| 21.8% | 0.0999% | 3.21 | linear interpolation |
| 21.9% | 0.0999% | 3.22 | linear interpolation |
| 22.0% | 0.0999% | 3.23 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 22.1% | 0.0999% | 3.25 | linear interpolation |
| 22.2% | 0.0999% | 3.26 | linear interpolation |
| 22.3% | 0.0999% | 3.28 | linear interpolation |
| 22.4% | 0.0999% | 3.29 | linear interpolation |
| 22.5% | 0.0999% | 3.30 | linear interpolation |
| 22.6% | 0.0999% | 3.32 | linear interpolation |
| 22.7% | 0.0999% | 3.33 | linear interpolation |
| 22.8% | 0.0999% | 3.35 | linear interpolation |
| 22.9% | 0.0999% | 3.36 | linear interpolation |
| 23.0% | 0.0999% | 3.37 | linear interpolation |
| 23.1% | 0.0999% | 3.39 | linear interpolation |
| 23.2% | 0.0999% | 3.40 | linear interpolation |
| 23.3% | 0.0999% | 3.42 | linear interpolation |
| 23.4% | 0.0999% | 3.43 | linear interpolation |
| 23.5% | 0.0999% | 3.44 | linear interpolation |
| 23.6% | 0.0999% | 3.46 | linear interpolation |
| 23.7% | 0.0999% | 3.47 | linear interpolation |
| 23.8% | 0.0999% | 3.49 | linear interpolation |
| 23.9% | 0.0999% | 3.50 | linear interpolation |
| 24.0% | 0.0999% | 3.51 | linear interpolation |
| 24.1% | 0.0999% | 3.53 | linear interpolation |
| 24.2% | 0.0999% | 3.54 | linear interpolation |
| 24.3% | 0.0999% | 3.56 | linear interpolation |
| 24.4% | 0.0999% | 3.57 | linear interpolation |
| 24.5% | 0.0999% | 3.58 | linear interpolation |
| 24.6% | 0.0999% | 3.60 | linear interpolation |
| 24.7% | 0.0999% | 3.61 | linear interpolation |
| 24.8% | 0.0999% | 3.63 | linear interpolation |
| 24.9% | 0.0999% | 3.64 | linear interpolation |
| 25.0% | 0.0999% | 3.65 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 25.1% | 0.0999% | 3.67 | linear interpolation |
| 25.2% | 0.0999% | 3.69 | linear interpolation |
| 25.3% | 0.0999% | 3.70 | linear interpolation |
| 25.4% | 0.0999% | 3.72 | linear interpolation |
| 25.5% | 0.0999% | 3.73 | linear interpolation |
| 25.6% | 0.0999% | 3.75 | linear interpolation |
| 25.7% | 0.0999% | 3.76 | linear interpolation |
| 25.8% | 0.0999% | 3.78 | linear interpolation |
| 25.9% | 0.0999% | 3.79 | linear interpolation |
| 26.0% | 0.0999% | 3.81 | linear interpolation |
| 26.1% | 0.0999% | 3.82 | linear interpolation |
| 26.2% | 0.0999% | 3.84 | linear interpolation |
| 26.3% | 0.0999% | 3.86 | linear interpolation |
| 26.4% | 0.0999% | 3.87 | linear interpolation |
| 26.5% | 0.0999% | 3.89 | linear interpolation |
| 26.6% | 0.0999% | 3.90 | linear interpolation |
| 26.7% | 0.0999% | 3.92 | linear interpolation |
| 26.8% | 0.0999% | 3.93 | linear interpolation |
| 26.9% | 0.0999% | 3.95 | linear interpolation |
| 27.0% | 0.0999% | 3.96 | linear interpolation |
| 27.1% | 0.0999% | 3.98 | linear interpolation |
| 27.2% | 0.0999% | 3.99 | linear interpolation |
| 27.3% | 0.0999% | 4.01 | linear interpolation |
| 27.4% | 0.0999% | 4.03 | linear interpolation |
| 27.5% | 0.0999% | 4.04 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 27.6% | 0.0999% | 4.06 | linear interpolation |
| 27.7% | 0.0999% | 4.07 | linear interpolation |
| 27.8% | 0.0999% | 4.09 | linear interpolation |
| 27.9% | 0.0999% | 4.10 | linear interpolation |
| 28.0% | 0.0999% | 4.12 | linear interpolation |
| 28.1% | 0.0999% | 4.13 | linear interpolation |
| 28.2% | 0.0999% | 4.15 | linear interpolation |
| 28.3% | 0.0999% | 4.17 | linear interpolation |
| 28.4% | 0.0999% | 4.18 | linear interpolation |
| 28.5% | 0.0999% | 4.20 | linear interpolation |
| 28.6% | 0.0999% | 4.21 | linear interpolation |
| 28.7% | 0.0999% | 4.23 | linear interpolation |
| 28.8% | 0.0999% | 4.24 | linear interpolation |
| 28.9% | 0.0999% | 4.26 | linear interpolation |
| 29.0% | 0.0999% | 4.27 | linear interpolation |
| 29.1% | 0.0999% | 4.29 | linear interpolation |
| 29.2% | 0.0999% | 4.30 | linear interpolation |
| 29.3% | 0.0999% | 4.32 | linear interpolation |
| 29.4% | 0.0999% | 4.34 | linear interpolation |
| 29.5% | 0.0999% | 4.35 | linear interpolation |
| 29.6% | 0.0999% | 4.37 | linear interpolation |
| 29.7% | 0.0999% | 4.38 | linear interpolation |
| 29.8% | 0.0999% | 4.40 | linear interpolation |
| 29.9% | 0.0999% | 4.41 | linear interpolation |
| 30.0% | 0.0999% | 4.43 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 30.1% | 0.0999% | 4.45 | linear interpolation |
| 30.2% | 0.0999% | 4.46 | linear interpolation |
| 30.3% | 0.0999% | 4.48 | linear interpolation |
| 30.4% | 0.0999% | 4.50 | linear interpolation |
| 30.5% | 0.0999% | 4.52 | linear interpolation |
| 30.6% | 0.0999% | 4.53 | linear interpolation |
| 30.7% | 0.0999% | 4.55 | linear interpolation |
| 30.8% | 0.0999% | 4.57 | linear interpolation |
| 30.9% | 0.0999% | 4.59 | linear interpolation |
| 31.0% | 0.0999% | 4.60 | linear interpolation |
| 31.1% | 0.0999% | 4.62 | linear interpolation |
| 31.2% | 0.0999% | 4.64 | linear interpolation |
| 31.3% | 0.0999% | 4.66 | linear interpolation |
| 31.4% | 0.0999% | 4.67 | linear interpolation |
| 31.5% | 0.0999% | 4.69 | linear interpolation |
| 31.6% | 0.0999% | 4.71 | linear interpolation |
| 31.7% | 0.0999% | 4.72 | linear interpolation |
| 31.8% | 0.0999% | 4.74 | linear interpolation |
| 31.9% | 0.0999% | 4.76 | linear interpolation |
| 32.0% | 0.0999% | 4.78 | linear interpolation |
| 32.1% | 0.0999% | 4.79 | linear interpolation |
| 32.2% | 0.0999% | 4.81 | linear interpolation |
| 32.3% | 0.0999% | 4.83 | linear interpolation |
| 32.4% | 0.0999% | 4.85 | linear interpolation |
| 32.5% | 0.0999% | 4.86 | linear interpolation |
| 32.6% | 0.0999% | 4.88 | linear interpolation |
| 32.7% | 0.0999% | 4.90 | linear interpolation |
| 32.8% | 0.0999% | 4.92 | linear interpolation |
| 32.9% | 0.0999% | 4.93 | linear interpolation |
| 33.0% | 0.0999% | 4.95 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 33.1% | 0.0999% | 4.97 | linear interpolation |
| 33.2% | 0.0999% | 4.99 | linear interpolation |
| 33.3% | 0.0999% | 5.00 | linear interpolation |
| 33.4% | 0.0999% | 5.02 | linear interpolation |
| 33.5% | 0.0999% | 5.04 | linear interpolation |
| 33.6% | 0.0999% | 5.06 | linear interpolation |
| 33.7% | 0.0999% | 5.07 | linear interpolation |
| 33.8% | 0.0999% | 5.09 | linear interpolation |
| 33.9% | 0.0999% | 5.11 | linear interpolation |
| 34.0% | 0.0999% | 5.13 | linear interpolation |
| 34.1% | 0.0999% | 5.14 | linear interpolation |
| 34.2% | 0.0999% | 5.16 | linear interpolation |
| 34.3% | 0.0999% | 5.18 | linear interpolation |
| 34.4% | 0.0999% | 5.20 | linear interpolation |
| 34.5% | 0.0999% | 5.21 | linear interpolation |
| 34.6% | 0.0999% | 5.23 | linear interpolation |
| 34.7% | 0.0999% | 5.25 | linear interpolation |
| 34.8% | 0.0999% | 5.26 | linear interpolation |
| 34.9% | 0.0999% | 5.28 | linear interpolation |
| 35.0% | 0.0999% | 5.30 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 35.1% | 0.0999% | 5.32 | linear interpolation |
| 35.2% | 0.0999% | 5.34 | linear interpolation |
| 35.3% | 0.0999% | 5.36 | linear interpolation |
| 35.4% | 0.0999% | 5.38 | linear interpolation |
| 35.5% | 0.0999% | 5.40 | linear interpolation |
| 35.6% | 0.0999% | 5.42 | linear interpolation |
| 35.7% | 0.0999% | 5.44 | linear interpolation |
| 35.8% | 0.0999% | 5.46 | linear interpolation |
| 35.9% | 0.0999% | 5.48 | linear interpolation |
| 36.0% | 0.0999% | 5.50 | linear interpolation |
| 36.1% | 0.0999% | 5.52 | linear interpolation |
| 36.2% | 0.0999% | 5.54 | linear interpolation |
| 36.3% | 0.0999% | 5.56 | linear interpolation |
| 36.4% | 0.0999% | 5.58 | linear interpolation |
| 36.5% | 0.0999% | 5.60 | linear interpolation |
| 36.6% | 0.0999% | 5.63 | linear interpolation |
| 36.7% | 0.0999% | 5.65 | linear interpolation |
| 36.8% | 0.0999% | 5.67 | linear interpolation |
| 36.9% | 0.0999% | 5.69 | linear interpolation |
| 37.0% | 0.0999% | 5.71 | linear interpolation |
| 37.1% | 0.0999% | 5.73 | linear interpolation |
| 37.2% | 0.0999% | 5.75 | linear interpolation |
| 37.3% | 0.0999% | 5.77 | linear interpolation |
| 37.4% | 0.0999% | 5.79 | linear interpolation |
| 37.5% | 0.0999% | 5.81 | linear interpolation |
| 37.6% | 0.0999% | 5.83 | linear interpolation |
| 37.7% | 0.0999% | 5.85 | linear interpolation |
| 37.8% | 0.0999% | 5.87 | linear interpolation |
| 37.9% | 0.0999% | 5.89 | linear interpolation |
| 38.0% | 0.0999% | 5.91 | linear interpolation |
| 38.1% | 0.0999% | 5.93 | linear interpolation |
| 38.2% | 0.0999% | 5.95 | linear interpolation |
| 38.3% | 0.0999% | 5.97 | linear interpolation |
| 38.4% | 0.0999% | 5.99 | linear interpolation |
| 38.5% | 0.0999% | 6.01 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 38.6% | 0.0999% | 6.03 | linear interpolation |
| 38.7% | 0.0999% | 6.05 | linear interpolation |
| 38.8% | 0.0999% | 6.07 | linear interpolation |
| 38.9% | 0.0999% | 6.09 | linear interpolation |
| 39.0% | 0.0999% | 6.11 | linear interpolation |
| 39.1% | 0.0999% | 6.13 | linear interpolation |
| 39.2% | 0.0999% | 6.15 | linear interpolation |
| 39.3% | 0.0999% | 6.17 | linear interpolation |
| 39.4% | 0.0999% | 6.19 | linear interpolation |
| 39.5% | 0.0999% | 6.21 | linear interpolation |
| 39.6% | 0.0999% | 6.23 | linear interpolation |
| 39.7% | 0.0999% | 6.26 | linear interpolation |
| 39.8% | 0.0999% | 6.28 | linear interpolation |
| 39.9% | 0.0999% | 6.30 | linear interpolation |
| 40.0% | 0.0999% | 6.32 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 40.1% | 0.0999% | 6.34 | linear interpolation |
| 40.2% | 0.0999% | 6.36 | linear interpolation |
| 40.3% | 0.0999% | 6.38 | linear interpolation |
| 40.4% | 0.0999% | 6.41 | linear interpolation |
| 40.5% | 0.0999% | 6.43 | linear interpolation |
| 40.6% | 0.0999% | 6.45 | linear interpolation |
| 40.7% | 0.0999% | 6.48 | linear interpolation |
| 40.8% | 0.0999% | 6.50 | linear interpolation |
| 40.9% | 0.0999% | 6.52 | linear interpolation |
| 41.0% | 0.0999% | 6.54 | linear interpolation |
| 41.1% | 0.0999% | 6.57 | linear interpolation |
| 41.2% | 0.0999% | 6.59 | linear interpolation |
| 41.3% | 0.0999% | 6.61 | linear interpolation |
| 41.4% | 0.0999% | 6.63 | linear interpolation |
| 41.5% | 0.0999% | 6.66 | linear interpolation |
| 41.6% | 0.0999% | 6.68 | linear interpolation |
| 41.7% | 0.0999% | 6.70 | linear interpolation |
| 41.8% | 0.0999% | 6.73 | linear interpolation |
| 41.9% | 0.0999% | 6.75 | linear interpolation |
| 42.0% | 0.0999% | 6.77 | linear interpolation |
| 42.1% | 0.0999% | 6.79 | linear interpolation |
| 42.2% | 0.0999% | 6.82 | linear interpolation |
| 42.3% | 0.0999% | 6.84 | linear interpolation |
| 42.4% | 0.0999% | 6.86 | linear interpolation |
| 42.5% | 0.0999% | 6.88 | linear interpolation |
| 42.6% | 0.0999% | 6.91 | linear interpolation |
| 42.7% | 0.0999% | 6.93 | linear interpolation |
| 42.8% | 0.0999% | 6.95 | linear interpolation |
| 42.9% | 0.0999% | 6.98 | linear interpolation |
| 43.0% | 0.0999% | 7.00 | linear interpolation |
| 43.1% | 0.0999% | 7.02 | linear interpolation |
| 43.2% | 0.0999% | 7.04 | linear interpolation |
| 43.3% | 0.0999% | 7.07 | linear interpolation |
| 43.4% | 0.0999% | 7.09 | linear interpolation |
| 43.5% | 0.0999% | 7.11 | linear interpolation |
| 43.6% | 0.0999% | 7.14 | linear interpolation |
| 43.7% | 0.0999% | 7.16 | linear interpolation |
| 43.8% | 0.0999% | 7.18 | linear interpolation |
| 43.9% | 0.0999% | 7.20 | linear interpolation |
| 44.0% | 0.0999% | 7.23 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 44.1% | 0.0999% | 7.25 | linear interpolation |
| 44.2% | 0.0999% | 7.27 | linear interpolation |
| 44.3% | 0.0999% | 7.29 | linear interpolation |
| 44.4% | 0.0999% | 7.32 | linear interpolation |
| 44.5% | 0.0999% | 7.34 | linear interpolation |
| 44.6% | 0.0999% | 7.36 | linear interpolation |
| 44.7% | 0.0999% | 7.39 | linear interpolation |
| 44.8% | 0.0999% | 7.41 | linear interpolation |
| 44.9% | 0.0999% | 7.43 | linear interpolation |
| 45.0% | 0.0999% | 7.45 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 45.1% | 0.0999% | 7.48 | linear interpolation |
| 45.2% | 0.0999% | 7.50 | linear interpolation |
| 45.3% | 0.0999% | 7.53 | linear interpolation |
| 45.4% | 0.0999% | 7.55 | linear interpolation |
| 45.5% | 0.0999% | 7.58 | linear interpolation |
| 45.6% | 0.0999% | 7.60 | linear interpolation |
| 45.7% | 0.0999% | 7.63 | linear interpolation |
| 45.8% | 0.0999% | 7.65 | linear interpolation |
| 45.9% | 0.0999% | 7.68 | linear interpolation |
| 46.0% | 0.0999% | 7.71 | linear interpolation |
| 46.1% | 0.0999% | 7.73 | linear interpolation |
| 46.2% | 0.0999% | 7.76 | linear interpolation |
| 46.3% | 0.0999% | 7.78 | linear interpolation |
| 46.4% | 0.0999% | 7.81 | linear interpolation |
| 46.5% | 0.0999% | 7.83 | linear interpolation |
| 46.6% | 0.0999% | 7.86 | linear interpolation |
| 46.7% | 0.0999% | 7.88 | linear interpolation |
| 46.8% | 0.0999% | 7.91 | linear interpolation |
| 46.9% | 0.0999% | 7.93 | linear interpolation |
| 47.0% | 0.0999% | 7.96 | linear interpolation |
| 47.1% | 0.0999% | 7.98 | linear interpolation |
| 47.2% | 0.0999% | 8.01 | linear interpolation |
| 47.3% | 0.0999% | 8.03 | linear interpolation |
| 47.4% | 0.0999% | 8.06 | linear interpolation |
| 47.5% | 0.0999% | 8.08 | linear interpolation |
| 47.6% | 0.0999% | 8.11 | linear interpolation |
| 47.7% | 0.0999% | 8.13 | linear interpolation |
| 47.8% | 0.0999% | 8.16 | linear interpolation |
| 47.9% | 0.0999% | 8.18 | linear interpolation |
| 48.0% | 0.0999% | 8.21 | linear interpolation |
| 48.1% | 0.0999% | 8.23 | linear interpolation |
| 48.2% | 0.0999% | 8.26 | linear interpolation |
| 48.3% | 0.0999% | 8.28 | linear interpolation |
| 48.4% | 0.0999% | 8.31 | linear interpolation |
| 48.5% | 0.0999% | 8.33 | linear interpolation |
| 48.6% | 0.0999% | 8.36 | linear interpolation |
| 48.7% | 0.0999% | 8.38 | linear interpolation |
| 48.8% | 0.0999% | 8.41 | linear interpolation |
| 48.9% | 0.0999% | 8.44 | linear interpolation |
| 49.0% | 0.0999% | 8.46 | linear interpolation |
| 49.1% | 0.0999% | 8.49 | linear interpolation |
| 49.2% | 0.0999% | 8.51 | linear interpolation |
| 49.3% | 0.0999% | 8.54 | linear interpolation |
| 49.4% | 0.0999% | 8.56 | linear interpolation |
| 49.5% | 0.0999% | 8.59 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 49.6% | 0.0999% | 8.61 | linear interpolation |
| 49.7% | 0.0999% | 8.64 | linear interpolation |
| 49.8% | 0.0999% | 8.66 | linear interpolation |
| 49.9% | 0.0999% | 8.69 | linear interpolation |
| 50.0% | 0.0999% | 8.71 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 50.1% | 0.0999% | 8.74 | linear interpolation |
| 50.2% | 0.0999% | 8.77 | linear interpolation |
| 50.3% | 0.0999% | 8.80 | linear interpolation |
| 50.4% | 0.0999% | 8.83 | linear interpolation |
| 50.5% | 0.0999% | 8.86 | linear interpolation |
| 50.6% | 0.0999% | 8.89 | linear interpolation |
| 50.7% | 0.0999% | 8.92 | linear interpolation |
| 50.8% | 0.0999% | 8.95 | linear interpolation |
| 50.9% | 0.0999% | 8.98 | linear interpolation |
| 51.0% | 0.0999% | 9.01 | linear interpolation |
| 51.1% | 0.0999% | 9.04 | linear interpolation |
| 51.2% | 0.0999% | 9.07 | linear interpolation |
| 51.3% | 0.0999% | 9.10 | linear interpolation |
| 51.4% | 0.0999% | 9.13 | linear interpolation |
| 51.5% | 0.0999% | 9.15 | linear interpolation |
| 51.6% | 0.0999% | 9.18 | linear interpolation |
| 51.7% | 0.0999% | 9.21 | linear interpolation |
| 51.8% | 0.0999% | 9.24 | linear interpolation |
| 51.9% | 0.0999% | 9.27 | linear interpolation |
| 52.0% | 0.0999% | 9.30 | linear interpolation |
| 52.1% | 0.0999% | 9.33 | linear interpolation |
| 52.2% | 0.0999% | 9.36 | linear interpolation |
| 52.3% | 0.0999% | 9.39 | linear interpolation |
| 52.4% | 0.0999% | 9.42 | linear interpolation |
| 52.5% | 0.0999% | 9.45 | linear interpolation |
| 52.6% | 0.0999% | 9.48 | linear interpolation |
| 52.7% | 0.0999% | 9.51 | linear interpolation |
| 52.8% | 0.0999% | 9.54 | linear interpolation |
| 52.9% | 0.0999% | 9.57 | linear interpolation |
| 53.0% | 0.0999% | 9.60 | linear interpolation |
| 53.1% | 0.0999% | 9.63 | linear interpolation |
| 53.2% | 0.0999% | 9.66 | linear interpolation |
| 53.3% | 0.0999% | 9.69 | linear interpolation |
| 53.4% | 0.0999% | 9.72 | linear interpolation |
| 53.5% | 0.0999% | 9.75 | linear interpolation |
| 53.6% | 0.0999% | 9.77 | linear interpolation |
| 53.7% | 0.0999% | 9.80 | linear interpolation |
| 53.8% | 0.0999% | 9.83 | linear interpolation |
| 53.9% | 0.0999% | 9.86 | linear interpolation |
| 54.0% | 0.0999% | 9.89 | linear interpolation |
| 54.1% | 0.0999% | 9.92 | linear interpolation |
| 54.2% | 0.0999% | 9.95 | linear interpolation |
| 54.3% | 0.0999% | 9.98 | linear interpolation |
| 54.4% | 0.0999% | 10.0 | linear interpolation |
| 54.5% | 0.0999% | 10.0 | linear interpolation |
| 54.6% | 0.0999% | 10.1 | linear interpolation |
| 54.7% | 0.0999% | 10.1 | linear interpolation |
| 54.8% | 0.0999% | 10.1 | linear interpolation |
| 54.9% | 0.0999% | 10.2 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 55.0% | 0.0999% | 10.2 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 55.1% | 0.0999% | 10.2 | linear interpolation |
| 55.2% | 0.0999% | 10.3 | linear interpolation |
| 55.3% | 0.0999% | 10.3 | linear interpolation |
| 55.4% | 0.0999% | 10.3 | linear interpolation |
| 55.5% | 0.0999% | 10.4 | linear interpolation |
| 55.6% | 0.0999% | 10.4 | linear interpolation |
| 55.7% | 0.0999% | 10.4 | linear interpolation |
| 55.8% | 0.0999% | 10.5 | linear interpolation |
| 55.9% | 0.0999% | 10.5 | linear interpolation |
| 56.0% | 0.0999% | 10.5 | linear interpolation |
| 56.1% | 0.0999% | 10.6 | linear interpolation |
| 56.2% | 0.0999% | 10.6 | linear interpolation |
| 56.3% | 0.0999% | 10.7 | linear interpolation |
| 56.4% | 0.0999% | 10.7 | linear interpolation |
| 56.5% | 0.0999% | 10.7 | linear interpolation |
| 56.6% | 0.0999% | 10.8 | linear interpolation |
| 56.7% | 0.0999% | 10.8 | linear interpolation |
| 56.8% | 0.0999% | 10.8 | linear interpolation |
| 56.9% | 0.0999% | 10.9 | linear interpolation |
| 57.0% | 0.0999% | 10.9 | linear interpolation |
| 57.1% | 0.0999% | 10.9 | linear interpolation |
| 57.2% | 0.0999% | 11.0 | linear interpolation |
| 57.3% | 0.0999% | 11.0 | linear interpolation |
| 57.4% | 0.0999% | 11.0 | linear interpolation |
| 57.5% | 0.0999% | 11.1 | linear interpolation |
| 57.6% | 0.0999% | 11.1 | linear interpolation |
| 57.7% | 0.0999% | 11.2 | linear interpolation |
| 57.8% | 0.0999% | 11.2 | linear interpolation |
| 57.9% | 0.0999% | 11.2 | linear interpolation |
| 58.0% | 0.0999% | 11.3 | linear interpolation |
| 58.1% | 0.0999% | 11.3 | linear interpolation |
| 58.2% | 0.0999% | 11.3 | linear interpolation |
| 58.3% | 0.0999% | 11.4 | linear interpolation |
| 58.4% | 0.0999% | 11.4 | linear interpolation |
| 58.5% | 0.0999% | 11.4 | linear interpolation |
| 58.6% | 0.0999% | 11.5 | linear interpolation |
| 58.7% | 0.0999% | 11.5 | linear interpolation |
| 58.8% | 0.0999% | 11.5 | linear interpolation |
| 58.9% | 0.0999% | 11.6 | linear interpolation |
| 59.0% | 0.0999% | 11.6 | linear interpolation |
| 59.1% | 0.0999% | 11.7 | linear interpolation |
| 59.2% | 0.0999% | 11.7 | linear interpolation |
| 59.3% | 0.0999% | 11.7 | linear interpolation |
| 59.4% | 0.0999% | 11.8 | linear interpolation |
| 59.5% | 0.0999% | 11.8 | linear interpolation |
| 59.6% | 0.0999% | 11.8 | linear interpolation |
| 59.7% | 0.0999% | 11.9 | linear interpolation |
| 59.8% | 0.0999% | 11.9 | linear interpolation |
| 59.9% | 0.0999% | 11.9 | linear interpolation |
| 60.0% | 0.0999% | 12.0 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 60.1% | 0.0999% | 12.0 | linear interpolation |
| 60.2% | 0.0999% | 12.1 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 60.3% | 0.0999% | 12.1 | linear interpolation |
| 60.4% | 0.0999% | 12.1 | linear interpolation |
| 60.5% | 0.0999% | 12.2 | linear interpolation |
| 60.6% | 0.0999% | 12.2 | linear interpolation |
| 60.7% | 0.0999% | 12.3 | linear interpolation |
| 60.8% | 0.0999% | 12.3 | linear interpolation |
| 60.9% | 0.0999% | 12.3 | linear interpolation |
| 61.0% | 0.0999% | 12.4 | linear interpolation |
| 61.1% | 0.0999% | 12.4 | linear interpolation |
| 61.2% | 0.0999% | 12.5 | linear interpolation |
| 61.3% | 0.0999% | 12.5 | linear interpolation |
| 61.4% | 0.0999% | 12.6 | linear interpolation |
| 61.5% | 0.0999% | 12.6 | linear interpolation |
| 61.6% | 0.0999% | 12.6 | linear interpolation |
| 61.7% | 0.0999% | 12.7 | linear interpolation |
| 61.8% | 0.0999% | 12.7 | linear interpolation |
| 61.9% | 0.0999% | 12.8 | linear interpolation |
| 62.0% | 0.0999% | 12.8 | linear interpolation |
| 62.1% | 0.0999% | 12.8 | linear interpolation |
| 62.2% | 0.0999% | 12.9 | linear interpolation |
| 62.3% | 0.0999% | 12.9 | linear interpolation |
| 62.4% | 0.0999% | 13.0 | linear interpolation |
| 62.5% | 0.0999% | 13.0 | linear interpolation |
| 62.6% | 0.0999% | 13.0 | linear interpolation |
| 62.7% | 0.0999% | 13.1 | linear interpolation |
| 62.8% | 0.0999% | 13.1 | linear interpolation |
| 62.9% | 0.0999% | 13.2 | linear interpolation |
| 63.0% | 0.0999% | 13.2 | linear interpolation |
| 63.1% | 0.0999% | 13.3 | linear interpolation |
| 63.2% | 0.0999% | 13.3 | linear interpolation |
| 63.3% | 0.0999% | 13.3 | linear interpolation |
| 63.4% | 0.0999% | 13.4 | linear interpolation |
| 63.5% | 0.0999% | 13.4 | linear interpolation |
| 63.6% | 0.0999% | 13.5 | linear interpolation |
| 63.7% | 0.0999% | 13.5 | linear interpolation |
| 63.8% | 0.0999% | 13.5 | linear interpolation |
| 63.9% | 0.0999% | 13.6 | linear interpolation |
| 64.0% | 0.0999% | 13.6 | linear interpolation |
| 64.1% | 0.0999% | 13.7 | linear interpolation |
| 64.2% | 0.0999% | 13.7 | linear interpolation |
| 64.3% | 0.0999% | 13.7 | linear interpolation |
| 64.4% | 0.0999% | 13.8 | linear interpolation |
| 64.5% | 0.0999% | 13.8 | linear interpolation |
| 64.6% | 0.0999% | 13.9 | linear interpolation |
| 64.7% | 0.0999% | 13.9 | linear interpolation |
| 64.8% | 0.0999% | 14.0 | linear interpolation |
| 64.9% | 0.0999% | 14.0 | linear interpolation |
| 65.0% | 0.0999% | 14.0 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 65.1% | 0.0999% | 14.1 | linear interpolation |
| 65.2% | 0.0999% | 14.1 | linear interpolation |
| 65.3% | 0.0999% | 14.2 | linear interpolation |
| 65.4% | 0.0999% | 14.2 | linear interpolation |
| 65.5% | 0.0999% | 14.3 | linear interpolation |
| 65.6% | 0.0999% | 14.3 | linear interpolation |
| 65.7% | 0.0999% | 14.4 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 65.8% | 0.0999% | 14.5 | linear interpolation |
| 65.9% | 0.0999% | 14.5 | linear interpolation |
| 66.0% | 0.0999% | 14.6 | linear interpolation |
| 66.1% | 0.0999% | 14.6 | linear interpolation |
| 66.2% | 0.0999% | 14.7 | linear interpolation |
| 66.3% | 0.0999% | 14.7 | linear interpolation |
| 66.4% | 0.0999% | 14.8 | linear interpolation |
| 66.5% | 0.0999% | 14.8 | linear interpolation |
| 66.6% | 0.0999% | 14.9 | linear interpolation |
| 66.7% | 0.0999% | 14.9 | linear interpolation |
| 66.8% | 0.0999% | 15.0 | linear interpolation |
| 66.9% | 0.0999% | 15.0 | linear interpolation |
| 67.0% | 0.0999% | 15.1 | linear interpolation |
| 67.1% | 0.0999% | 15.1 | linear interpolation |
| 67.2% | 0.0999% | 15.2 | linear interpolation |
| 67.3% | 0.0999% | 15.2 | linear interpolation |
| 67.4% | 0.0999% | 15.3 | linear interpolation |
| 67.5% | 0.0999% | 15.3 | linear interpolation |
| 67.6% | 0.0999% | 15.4 | linear interpolation |
| 67.7% | 0.0999% | 15.4 | linear interpolation |
| 67.8% | 0.0999% | 15.5 | linear interpolation |
| 67.9% | 0.0999% | 15.5 | linear interpolation |
| 68.0% | 0.0999% | 15.6 | linear interpolation |
| 68.1% | 0.0999% | 15.6 | linear interpolation |
| 68.2% | 0.0999% | 15.7 | linear interpolation |
| 68.3% | 0.0999% | 15.7 | linear interpolation |
| 68.4% | 0.0999% | 15.8 | linear interpolation |
| 68.5% | 0.0999% | 15.8 | linear interpolation |
| 68.6% | 0.0999% | 15.9 | linear interpolation |
| 68.7% | 0.0999% | 16.0 | linear interpolation |
| 68.8% | 0.0999% | 16.0 | linear interpolation |
| 68.9% | 0.0999% | 16.1 | linear interpolation |
| 69.0% | 0.0999% | 16.1 | linear interpolation |
| 69.1% | 0.0999% | 16.2 | linear interpolation |
| 69.2% | 0.0999% | 16.2 | linear interpolation |
| 69.3% | 0.0999% | 16.3 | linear interpolation |
| 69.4% | 0.0999% | 16.3 | linear interpolation |
| 69.5% | 0.0999% | 16.4 | linear interpolation |
| 69.6% | 0.0999% | 16.4 | linear interpolation |
| 69.7% | 0.0999% | 16.5 | linear interpolation |
| 69.8% | 0.0999% | 16.5 | linear interpolation |
| 69.9% | 0.0999% | 16.6 | linear interpolation |
| 70.0% | 0.0999% | 16.6 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 70.1% | 0.0999% | 16.7 | linear interpolation |
| 70.2% | 0.0999% | 16.8 | linear interpolation |
| 70.3% | 0.0999% | 16.8 | linear interpolation |
| 70.4% | 0.0999% | 16.9 | linear interpolation |
| 70.5% | 0.0999% | 16.9 | linear interpolation |
| 70.6% | 0.0999% | 17.0 | linear interpolation |
| 70.7% | 0.0999% | 17.1 | linear interpolation |
| 70.8% | 0.0999% | 17.1 | linear interpolation |
| 70.9% | 0.0999% | 17.2 | linear interpolation |
| 71.0% | 0.0999% | 17.3 | linear interpolation |
| 71.1% | 0.0999% | 17.3 | linear interpolation |
| 71.2% | 0.0999% | 17.4 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 71.3% | 0.0999% | 17.4 | linear interpolation |
| 71.4% | 0.0999% | 17.5 | linear interpolation |
| 71.5% | 0.0999% | 17.6 | linear interpolation |
| 71.6% | 0.0999% | 17.6 | linear interpolation |
| 71.7% | 0.0999% | 17.7 | linear interpolation |
| 71.8% | 0.0999% | 17.8 | linear interpolation |
| 71.9% | 0.0999% | 17.8 | linear interpolation |
| 72.0% | 0.0999% | 17.9 | linear interpolation |
| 72.1% | 0.0999% | 17.9 | linear interpolation |
| 72.2% | 0.0999% | 18.0 | linear interpolation |
| 72.3% | 0.0999% | 18.1 | linear interpolation |
| 72.4% | 0.0999% | 18.1 | linear interpolation |
| 72.5% | 0.0999% | 18.2 | linear interpolation |
| 72.6% | 0.0999% | 18.3 | linear interpolation |
| 72.7% | 0.0999% | 18.3 | linear interpolation |
| 72.8% | 0.0999% | 18.4 | linear interpolation |
| 72.9% | 0.0999% | 18.5 | linear interpolation |
| 73.0% | 0.0999% | 18.5 | linear interpolation |
| 73.1% | 0.0999% | 18.6 | linear interpolation |
| 73.2% | 0.0999% | 18.6 | linear interpolation |
| 73.3% | 0.0999% | 18.7 | linear interpolation |
| 73.4% | 0.0999% | 18.8 | linear interpolation |
| 73.5% | 0.0999% | 18.8 | linear interpolation |
| 73.6% | 0.0999% | 18.9 | linear interpolation |
| 73.7% | 0.0999% | 19.0 | linear interpolation |
| 73.8% | 0.0999% | 19.0 | linear interpolation |
| 73.9% | 0.0999% | 19.1 | linear interpolation |
| 74.0% | 0.0999% | 19.1 | linear interpolation |
| 74.1% | 0.0999% | 19.2 | linear interpolation |
| 74.2% | 0.0999% | 19.3 | linear interpolation |
| 74.3% | 0.0999% | 19.3 | linear interpolation |
| 74.4% | 0.0999% | 19.4 | linear interpolation |
| 74.5% | 0.0999% | 19.5 | linear interpolation |
| 74.6% | 0.0999% | 19.5 | linear interpolation |
| 74.7% | 0.0999% | 19.6 | linear interpolation |
| 74.8% | 0.0999% | 19.6 | linear interpolation |
| 74.9% | 0.0999% | 19.7 | linear interpolation |
| 75.0% | 0.0999% | 19.8 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 75.1% | 0.0999% | 19.9 | linear interpolation |
| 75.2% | 0.0999% | 19.9 | linear interpolation |
| 75.3% | 0.0999% | 20.0 | linear interpolation |
| 75.4% | 0.0999% | 20.1 | linear interpolation |
| 75.5% | 0.0999% | 20.2 | linear interpolation |
| 75.6% | 0.0999% | 20.3 | linear interpolation |
| 75.7% | 0.0999% | 20.3 | linear interpolation |
| 75.8% | 0.0999% | 20.4 | linear interpolation |
| 75.9% | 0.0999% | 20.5 | linear interpolation |
| 76.0% | 0.0999% | 20.6 | linear interpolation |
| 76.1% | 0.0999% | 20.6 | linear interpolation |
| 76.2% | 0.0999% | 20.7 | linear interpolation |
| 76.3% | 0.0999% | 20.8 | linear interpolation |
| 76.4% | 0.0999% | 20.9 | linear interpolation |
| 76.5% | 0.0999% | 21.0 | linear interpolation |
| 76.6% | 0.0999% | 21.0 | linear interpolation |
| 76.7% | 0.0999% | 21.1 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 76.8% | 0.0999% | 21.2 | linear interpolation |
| 76.9% | 0.0999% | 21.3 | linear interpolation |
| 77.0% | 0.0999% | 21.4 | linear interpolation |
| 77.1% | 0.0999% | 21.4 | linear interpolation |
| 77.2% | 0.0999% | 21.5 | linear interpolation |
| 77.3% | 0.0999% | 21.6 | linear interpolation |
| 77.4% | 0.0999% | 21.7 | linear interpolation |
| 77.5% | 0.0999% | 21.8 | linear interpolation |
| 77.6% | 0.0999% | 21.8 | linear interpolation |
| 77.7% | 0.0999% | 21.9 | linear interpolation |
| 77.8% | 0.0999% | 22.0 | linear interpolation |
| 77.9% | 0.0999% | 22.1 | linear interpolation |
| 78.0% | 0.0999% | 22.2 | linear interpolation |
| 78.1% | 0.0999% | 22.2 | linear interpolation |
| 78.2% | 0.0999% | 22.3 | linear interpolation |
| 78.3% | 0.0999% | 22.4 | linear interpolation |
| 78.4% | 0.0999% | 22.5 | linear interpolation |
| 78.5% | 0.0999% | 22.6 | linear interpolation |
| 78.6% | 0.0999% | 22.6 | linear interpolation |
| 78.7% | 0.0999% | 22.7 | linear interpolation |
| 78.8% | 0.0999% | 22.8 | linear interpolation |
| 78.9% | 0.0999% | 22.9 | linear interpolation |
| 79.0% | 0.0999% | 23.0 | linear interpolation |
| 79.1% | 0.0999% | 23.0 | linear interpolation |
| 79.2% | 0.0999% | 23.1 | linear interpolation |
| 79.3% | 0.0999% | 23.2 | linear interpolation |
| 79.4% | 0.0999% | 23.3 | linear interpolation |
| 79.5% | 0.0999% | 23.4 | linear interpolation |
| 79.6% | 0.0999% | 23.4 | linear interpolation |
| 79.7% | 0.0999% | 23.5 | linear interpolation |
| 79.8% | 0.0999% | 23.6 | linear interpolation |
| 79.9% | 0.0999% | 23.7 | linear interpolation |
| 80.0% | 0.0999% | 23.8 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 80.1% | 0.0999% | 23.9 | linear interpolation |
| 80.2% | 0.0999% | 24.0 | linear interpolation |
| 80.3% | 0.0999% | 24.1 | linear interpolation |
| 80.4% | 0.0999% | 24.2 | linear interpolation |
| 80.5% | 0.0999% | 24.3 | linear interpolation |
| 80.6% | 0.0999% | 24.4 | linear interpolation |
| 80.7% | 0.0999% | 24.6 | linear interpolation |
| 80.8% | 0.0999% | 24.7 | linear interpolation |
| 80.9% | 0.0999% | 24.8 | linear interpolation |
| 81.0% | 0.0999% | 24.9 | linear interpolation |
| 81.1% | 0.0999% | 25.0 | linear interpolation |
| 81.2% | 0.0999% | 25.1 | linear interpolation |
| 81.3% | 0.0999% | 25.2 | linear interpolation |
| 81.4% | 0.0999% | 25.4 | linear interpolation |
| 81.5% | 0.0999% | 25.5 | linear interpolation |
| 81.6% | 0.0999% | 25.6 | linear interpolation |
| 81.7% | 0.0999% | 25.7 | linear interpolation |
| 81.8% | 0.0999% | 25.8 | linear interpolation |
| 81.9% | 0.0999% | 25.9 | linear interpolation |
| 82.0% | 0.0999% | 26.0 | linear interpolation |
| 82.1% | 0.0999% | 26.2 | linear interpolation |
| 82.2% | 0.0999% | 26.3 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 82.3% | 0.0999% | 26.4 | linear interpolation |
| 82.4% | 0.0999% | 26.5 | linear interpolation |
| 82.5% | 0.0999% | 26.6 | linear interpolation |
| 82.6% | 0.0999% | 26.7 | linear interpolation |
| 82.7% | 0.0999% | 26.8 | linear interpolation |
| 82.8% | 0.0999% | 27.0 | linear interpolation |
| 82.9% | 0.0999% | 27.1 | linear interpolation |
| 83.0% | 0.0999% | 27.2 | linear interpolation |
| 83.1% | 0.0999% | 27.3 | linear interpolation |
| 83.2% | 0.0999% | 27.4 | linear interpolation |
| 83.3% | 0.0999% | 27.5 | linear interpolation |
| 83.4% | 0.0999% | 27.6 | linear interpolation |
| 83.5% | 0.0999% | 27.8 | linear interpolation |
| 83.6% | 0.0999% | 27.9 | linear interpolation |
| 83.7% | 0.0999% | 28.0 | linear interpolation |
| 83.8% | 0.0999% | 28.1 | linear interpolation |
| 83.9% | 0.0999% | 28.2 | linear interpolation |
| 84.0% | 0.0999% | 28.3 | linear interpolation |
| 84.1% | 0.0999% | 28.4 | linear interpolation |
| 84.2% | 0.0999% | 28.6 | linear interpolation |
| 84.3% | 0.0999% | 28.7 | linear interpolation |
| 84.4% | 0.0999% | 28.8 | linear interpolation |
| 84.5% | 0.0999% | 28.9 | linear interpolation |
| 84.6% | 0.0999% | 29.0 | linear interpolation |
| 84.7% | 0.0999% | 29.1 | linear interpolation |
| 84.8% | 0.0999% | 29.2 | linear interpolation |
| 84.9% | 0.0999% | 29.4 | linear interpolation |
| 85.0% | 0.0999% | 29.5 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 85.1% | 0.0999% | 29.7 | linear interpolation |
| 85.2% | 0.0999% | 29.8 | linear interpolation |
| 85.3% | 0.0999% | 30.0 | linear interpolation |
| 85.4% | 0.0999% | 30.2 | linear interpolation |
| 85.5% | 0.0999% | 30.4 | linear interpolation |
| 85.6% | 0.0999% | 30.6 | linear interpolation |
| 85.7% | 0.0999% | 30.7 | linear interpolation |
| 85.8% | 0.0999% | 30.9 | linear interpolation |
| 85.9% | 0.0999% | 31.1 | linear interpolation |
| 86.0% | 0.0999% | 31.3 | linear interpolation |
| 86.1% | 0.0999% | 31.5 | linear interpolation |
| 86.2% | 0.0999% | 31.7 | linear interpolation |
| 86.3% | 0.0999% | 31.8 | linear interpolation |
| 86.4% | 0.0999% | 32.0 | linear interpolation |
| 86.5% | 0.0999% | 32.2 | linear interpolation |
| 86.6% | 0.0999% | 32.4 | linear interpolation |
| 86.7% | 0.0999% | 32.6 | linear interpolation |
| 86.8% | 0.0999% | 32.8 | linear interpolation |
| 86.9% | 0.0999% | 32.9 | linear interpolation |
| 87.0% | 0.0999% | 33.1 | linear interpolation |
| 87.1% | 0.0999% | 33.3 | linear interpolation |
| 87.2% | 0.0999% | 33.5 | linear interpolation |
| 87.3% | 0.0999% | 33.7 | linear interpolation |
| 87.4% | 0.0999% | 33.8 | linear interpolation |
| 87.5% | 0.0999% | 34.0 | linear interpolation |
| 87.6% | 0.0999% | 34.2 | linear interpolation |
| 87.7% | 0.0999% | 34.4 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 87.8% | 0.0999% | 34.6 | linear interpolation |
| 87.9% | 0.0999% | 34.8 | linear interpolation |
| 88.0% | 0.0999% | 34.9 | linear interpolation |
| 88.1% | 0.0999% | 35.1 | linear interpolation |
| 88.2% | 0.0999% | 35.3 | linear interpolation |
| 88.3% | 0.0999% | 35.5 | linear interpolation |
| 88.4% | 0.0999% | 35.7 | linear interpolation |
| 88.5% | 0.0999% | 35.8 | linear interpolation |
| 88.6% | 0.0999% | 36.0 | linear interpolation |
| 88.7% | 0.0999% | 36.2 | linear interpolation |
| 88.8% | 0.0999% | 36.4 | linear interpolation |
| 88.9% | 0.0999% | 36.6 | linear interpolation |
| 89.0% | 0.0999% | 36.8 | linear interpolation |
| 89.1% | 0.0999% | 36.9 | linear interpolation |
| 89.2% | 0.0999% | 37.1 | linear interpolation |
| 89.3% | 0.0999% | 37.3 | linear interpolation |
| 89.4% | 0.0999% | 37.5 | linear interpolation |
| 89.5% | 0.0999% | 37.7 | linear interpolation |
| 89.6% | 0.0999% | 37.8 | linear interpolation |
| 89.7% | 0.0999% | 38.0 | linear interpolation |
| 89.8% | 0.0999% | 38.2 | linear interpolation |
| 89.9% | 0.0999% | 38.4 | linear interpolation |
| 90.0% | 0.0999% | 38.6 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 90.1% | 0.0999% | 38.9 | linear interpolation |
| 90.2% | 0.0999% | 39.3 | linear interpolation |
| 90.3% | 0.0999% | 39.7 | linear interpolation |
| 90.4% | 0.0999% | 40.0 | linear interpolation |
| 90.5% | 0.0999% | 40.4 | linear interpolation |
| 90.6% | 0.0999% | 40.7 | linear interpolation |
| 90.7% | 0.0999% | 41.1 | linear interpolation |
| 90.8% | 0.0999% | 41.5 | linear interpolation |
| 90.9% | 0.0999% | 41.8 | linear interpolation |
| 91.0% | 0.0999% | 42.2 | linear interpolation |
| 91.1% | 0.0999% | 42.5 | linear interpolation |
| 91.2% | 0.0999% | 42.9 | linear interpolation |
| 91.3% | 0.0999% | 43.3 | linear interpolation |
| 91.4% | 0.0999% | 43.6 | linear interpolation |
| 91.5% | 0.0999% | 44.0 | linear interpolation |
| 91.6% | 0.0999% | 44.3 | linear interpolation |
| 91.7% | 0.0999% | 44.7 | linear interpolation |
| 91.8% | 0.0999% | 45.1 | linear interpolation |
| 91.9% | 0.0999% | 45.4 | linear interpolation |
| 92.0% | 0.0999% | 45.8 | linear interpolation |
| 92.1% | 0.0999% | 46.1 | linear interpolation |
| 92.2% | 0.0999% | 46.5 | linear interpolation |
| 92.3% | 0.0999% | 46.9 | linear interpolation |
| 92.4% | 0.0999% | 47.2 | linear interpolation |
| 92.5% | 0.0999% | 47.6 | linear interpolation |
| 92.6% | 0.0999% | 47.9 | linear interpolation |
| 92.7% | 0.0999% | 48.3 | linear interpolation |
| 92.8% | 0.0999% | 48.7 | linear interpolation |
| 92.9% | 0.0999% | 49.0 | linear interpolation |
| 93.0% | 0.0999% | 49.4 | linear interpolation |
| 93.1% | 0.0999% | 49.8 | linear interpolation |
| 93.2% | 0.0999% | 50.1 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 93.3% | 0.0999% | 50.5 | linear interpolation |
| 93.4% | 0.0999% | 50.8 | linear interpolation |
| 93.5% | 0.0999% | 51.2 | linear interpolation |
| 93.6% | 0.0999% | 51.6 | linear interpolation |
| 93.7% | 0.0999% | 51.9 | linear interpolation |
| 93.8% | 0.0999% | 52.3 | linear interpolation |
| 93.9% | 0.0999% | 52.6 | linear interpolation |
| 94.0% | 0.0999% | 53.0 | linear interpolation |
| 94.1% | 0.0999% | 53.4 | linear interpolation |
| 94.2% | 0.0999% | 53.7 | linear interpolation |
| 94.3% | 0.0999% | 54.1 | linear interpolation |
| 94.4% | 0.0999% | 54.4 | linear interpolation |
| 94.5% | 0.0999% | 54.8 | linear interpolation |
| 94.6% | 0.0999% | 55.2 | linear interpolation |
| 94.7% | 0.0999% | 55.5 | linear interpolation |
| 94.8% | 0.0999% | 55.9 | linear interpolation |
| 94.9% | 0.0999% | 56.2 | linear interpolation |
| 95.0% | 0.0999% | 58.9 | estimate from Ridolfi and Pacific Market Research (2015) using the NCI method; adjusted by Idaho DEQ to account for exclusion of select species |
| 95.1% | 0.0999% | 60.4 | linear interpolation |
| 95.2% | 0.0999% | 62.0 | linear interpolation |
| 95.3% | 0.0999% | 63.6 | linear interpolation |
| 95.4% | 0.0999% | 65.3 | linear interpolation |
| 95.5% | 0.0999% | 67.1 | linear interpolation |
| 95.6% | 0.0999% | 69.0 | linear interpolation |
| 95.7% | 0.0999% | 71.0 | linear interpolation |
| 95.8% | 0.0999% | 73.1 | linear interpolation |
| 95.9% | 0.0999% | 75.3 | linear interpolation |
| 96.0% | 0.0999% | 77.5 | linear interpolation |
| 96.1% | 0.0999% | 79.9 | linear interpolation |
| 96.2% | 0.0999% | 82.4 | linear interpolation |
| 96.3% | 0.0999% | 85.0 | linear interpolation |
| 96.4% | 0.0999% | 87.8 | linear interpolation |
| 96.5% | 0.0999% | 90.6 | linear interpolation |
| 96.6% | 0.0999% | 93.6 | linear interpolation |
| 96.7% | 0.0999% | 96.7 | linear interpolation |
| 96.8% | 0.0999% | 99.9 | linear interpolation |
| 96.9% | 0.0999% | 103 | linear interpolation |
| 97.0% | 0.0999% | 107 | linear interpolation |
| 97.1% | 0.0999% | 110 | linear interpolation |
| 97.2% | 0.0999% | 114 | linear interpolation |
| 97.3% | 0.0999% | 118 | linear interpolation |
| 97.4% | 0.0999% | 122 | linear interpolation |
| 97.5% | 0.0999% | 127 | linear interpolation |
| 97.6% | 0.0999% | 131 | linear interpolation |
| 97.7% | 0.0999% | 136 | linear interpolation |
| 97.8% | 0.0999% | 141 | linear interpolation |
| 97.9% | 0.0999% | 146 | linear interpolation |
| 98.0% | 0.0999% | 151 | linear interpolation |
| 98.1% | 0.0999% | 156 | linear interpolation |
| 98.2% | 0.0999% | 162 | linear interpolation |
| 98.3% | 0.0999% | 168 | linear interpolation |
| 98.4% | 0.0999% | 174 | linear interpolation |
| 98.5% | 0.0999% | 180 | linear interpolation |
| 98.6% | 0.0999% | 187 | linear interpolation |
| 98.7% | 0.0999% | 193 | linear interpolation |

**Table A3. IDEQ Interpolated Idaho Fish Consumption Distribution for the Nez Perce Tribal Population**

| Percentile | Discrete Probability | FCR (g/day) | Basis |
|---|---|---|---|
| 98.8% | 0.0999% | 200 | linear interpolation |
| 98.9% | 0.0999% | 208 | linear interpolation |
| 99.0% | 0.0999% | 215 | linear interpolation |
| 99.1% | 0.0999% | 223 | linear interpolation |
| 99.2% | 0.0999% | 231 | linear interpolation |
| 99.3% | 0.0999% | 239 | linear interpolation |
| 99.4% | 0.0999% | 248 | linear interpolation |
| 99.5% | 0.0999% | 257 | linear interpolation |
| 99.6% | 0.0999% | 266 | linear interpolation |
| 99.7% | 0.0999% | 275 | linear interpolation |
| 99.8% | 0.0999% | 285 | linear interpolation |
| 99.9% | 0.0999% | 295 | linear interpolation |
| 100% | 0.0999% | 306 | estimated maximum value |

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# Appendix D:

# Alternative Risk Scenarios

# Appendix D

| Chemical Name | Idaho WQS Number | Water + Organism HHAWQC (ug/L) IDEQ Proposed | Alternative | Ratio Increase | Basis | Organism Only HHAWQC (ug/L) IDEQ Proposed | Alternative | Ratio Increase | Basis |
|---|---|---|---|---|---|---|---|---|---|
| Antimony | 1 | 3.2 | 3.3 | 1 | NP-NC | 640 | 700 | 1.1 | NP-NC |
| Nickel | 9 | 75 | 76 | 1 | G-NC | 330 | 370 | 1.1 | NP-NC |
| Selenium | 10 | 20 | 20 | 1 | NP-NC | 800 | 910 | 1.1 | NP-NC |
| Thallium | 12 | 0.038 | 0.035 | 0.92 | NP-NC | 0.075 | 0.083 | 1.1 | NP-NC |
| Zinc | 13 | 1100 | 1100 | 1 | G-NC | 4800 | 5600 | 1.2 | NP-NC |
| Cyanide | 14 | 2.4 | 2.5 | 1 | NP-NC | 460 | 530 | 1.2 | NP-NC |
| 2,3,7,8 TCDD | 16 | 0.0000000058 | 0.000000067 | 12 | NP-C | 0.0000000061 | 0.000000067 | 11 | NP-C |
| Acrolein | 17 | 2.0 | 2 | 1 | NP-NC | 400 | 440 | 1.1 | NP-NC |
| Acrylonitrile | 18 | 0.036 | 0.38 | 11 | NP-C | 7.000 | 81 | 12 | NP-C |
| Benzene low | 19 | 0.35 | 2 | 5.7 | NP-NC | 16 | 95 | 5.9 | NP-NC |
| Benzene high | 19 | 1.3 | 2 | 1.5 | NP-NC | 58 | 95 | 1.6 | NP-NC |
| Bromoform | 20 | 4.3 | 45 | 10 | NP-C | 110 | 1300 | 12 | NP-C |
| Carbon Tetrachloride | 21 | 0.28 | 2.9 | 10 | NP-C | 4.3 | 48 | 11 | NP-C |
| Chlorobenzene | 22 | 75 | 79 | 1.1 | NP-NC | 780 | 880 | 1.1 | NP-NC |
| Chlorodibromomethane | 23 | 0.48 | 5.1 | 11 | NP-C | 20 | 220 | 11 | NP-C |
| Chloroform | 26 | 39 | 41 | 1.1 | NP-NC | 2300 | 2500 | 1.1 | NP-NC |
| Dichlorobromomethane | 27 | 0.56 | 6 | 11 | NP-C | 26 | 290 | 11 | NP-C |
| 1,2-Dichloroethane | 29 | 6.2 | 62 | 10 | NP-C | 640 | 7400 | 12 | NP-C |
| 1,1-Dichloroethylene | 30 | 200 | 200 | 1 | NP-NC | 16000 | 18000 | 1.1 | NP-NC |
| 1,2-Dichloropropane | 31 | 0.56 | 5.7 | 10 | NP-C | 30 | 340 | 11 | NP-C |
| 1,3-Dichloropropene | 32 | 0.17 | 1.7 | 10 | NP-C | 11 | 130 | 12 | NP-C |
| Ethylbenzene | 33 | 70 | 66 | 0.94 | NP-NC | 120 | 140 | 1.2 | NP-NC |
| Methyl Bromide | 34 | 80 | 82 | 1 | NP-NC | 12000 | 13000 | 1.1 | NP-NC |
| Methylene Chloride | 36 | 1.0 | 24 | 24 | NP-NC | 1300 | 3500 | 2.7 | NP-NC |
| 1,1,2,2-Tetrachloroethane | 37 | 0.10 | 1 | 10 | NP-C | 2.5 | 29 | 12 | NP-C |
| Tetrachloroethylene (Perchloroethylene) | 38 | 8.6 | 22 | 2.6 | NP-NC | 28 | 77 | 2.8 | NP-NC |
| Toluene | 39 | 36 | 39 | 1.1 | NP-NC | 500 | 570 | 1.1 | NP-NC |
| trans-1,2-Dichloroethylene (DCE) | 40 | 81 | 81 | 1 | NP-NC | 3700 | 4100 | 1.1 | NP-NC |
| 1,1,1-Trichloroethane | 41 | 7800 | 8100 | 1 | NP-NC | 170000 | 190000 | 1.1 | NP-NC |
| 1,1,2-Trichloroethane | 42 | 0.34 | 3.5 | 10 | NP-C | 8.2 | 95 | 12 | NP-C |
| Trichloroethylene (TCE) | 43 | 0.39 | 2 | 5.1 | NP-NC | 6.7 | 37 | 5.5 | NP-NC |
| Vinyl Chloride | 44 | 0.013 | 0.14 | 11 | NP-C | 1.6 | 18 | 11 | NP-C |
| 2-Chlorophenol | 45 | 19 | 20 | 1.1 | NP-NC | 810 | 900 | 1.1 | NP-NC |
| 2,4-Dichlorophenol | 46 | 11 | 11 | 1 | G-NC | 55 | 61 | 1.1 | NP-NC |
| 2,4-Dimethylphenol | 47 | 80 | 81 | 1 | NP-NC | 2400 | 2700 | 1.1 | NP-NC |
| 2-Methyl-4,6-Dinitrophenol | 48 | 1.1 | 1.2 | 1.1 | NP-NC | 26 | 29 | 1.1 | NP-NC |
| 2,4-Dinitrophenol | 49 | 8.0 | 8.1 | 1 | NP-NC | 350 | 400 | 1.1 | NP-NC |
| 3-Methyl-4-Chlorophenol | 52 | 360 | 390 | 1.1 | NP-NC | 2200 | 2500 | 1.1 | NP-NC |
| Pentachlorophenol | 53 | 0.023 | 0.23 | 10 | NP-C | 0.027 | 0.3 | 11 | NP-C |
| Phenol | 54 | 2500 | 2400 | 0.96 | NP-NC | 270000 | 290000 | 1.1 | NP-NC |
| 2,4,6-Trichlorophenol | 55 | 1.5 | 3.1 | 2.1 | NP-NC | 2.6 | 6.7 | 2.6 | NP-NC |
| Acenaphthene | 56 | 78 | 86 | 1.1 | NP-NC | 94 | 100 | 1.1 | NP-NC |
| Anthracene | 58 | 340 | 370 | 1.1 | NP-NC | 370 | 430 | 1.2 | NP-NC |
| Benzidine | 59 | 0.000090 | 0.00089 | 9.9 | NP-C | 0.011 | 0.12 | 11 | NP-C |
| Benzo(a)anthracene | 60 | 0.0013 | 0.015 | 12 | NP-C | 0.0014 | 0.015 | 11 | NP-C |
| Benzo(a)pyrene | 61 | 0.00013 | 0.0015 | 12 | NP-C | 0.00014 | 0.0015 | 11 | NP-C |
| Benzo(b)fluoranthene | 62 | 0.0013 | 0.015 | 12 | NP-C | 0.0014 | 0.015 | 11 | NP-C |
| Benzo(k)fluoranthene | 64 | 0.013 | 0.15 | 12 | NP-C | 0.014 | 0.15 | 11 | NP-C |
| Bis(2-Chloroethyl) Ether | 66 | 0.019 | 0.19 | 10 | NP-C | 2.2 | 25 | 11 | NP-C |

# Appendix D

| Chemical Name | Idaho WQS Number | Water + Organism HHAWQC (ug/L) | | | | Organism Only HHAWQC (ug/L) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | IDEQ Proposed | Alternative | Ratio Increase | Basis | IDEQ Proposed | Alternative | Ratio Increase | Basis |
| Bis(2-Chloro-1-Methylethyl) Ether | 67 | 150 | 160 | 1.1 | NP-NC | 3500 | 3900 | 1.1 | NP-NC |
| Bis(2-Ethylhexyl) Phthalate | 68 | 0.36 | 3.9 | 11 | NP-C | 0.39 | 4.4 | 11 | NP-C |
| Butylbenzyl Phthalate | 70 | 0.11 | 1.2 | 11 | NP-C | 0.11 | 1.2 | 11 | NP-C |
| 2-Chloronaphthalene | 71 | 880 | 790 | 0.9 | NP-NC | 1100 | 1300 | 1.2 | NP-NC |
| Chrysene | 73 | 0.14 | 1.5 | 11 | NP-C | 0.14 | 1.5 | 11 | NP-C |
| Dibenzo(a,h)anthracene | 74 | 0.00013 | 0.0015 | 12 | NP-C | 0.00014 | 0.0015 | 11 | NP-C |
| 1,2-Dichlorobenzene | 75 | 1100 | 1100 | 1 | NP-NC | 3100 | 3600 | 1.2 | NP-NC |
| 1,3-Dichlorobenzene | 76 | 6.8 | 6 | 0.88 | NP-NC | 11 | 13 | 1.2 | NP-NC |
| 1,4-Dichlorobenzene | 77 | 250 | 250 | 1 | NP-NC | 810 | 890 | 1.1 | NP-NC |
| 3,3'-Dichlorobenzidine | 78 | 0.039 | 0.41 | 11 | NP-C | 0.14 | 1.6 | 11 | NP-C |
| Diethyl Phthalate | 79 | 620 | 700 | 1.1 | NP-NC | 700 | 760 | 1.1 | NP-NC |
| Dimethyl Phthalate | 80 | 2000 | 2200 | 1.1 | NP-NC | 2000 | 2200 | 1.1 | NP-NC |
| Di-n-Butyl Phthalate | 81 | 27 | 30 | 1.1 | NP-NC | 27 | 30 | 1.1 | NP-NC |
| 2,4-Dinitrotoluene | 82 | 0.030 | 0.31 | 10 | NP-C | 1.6 | 18 | 11 | NP-C |
| 1,2-Diphenylhydrazine | 85 | 0.023 | 0.25 | 11 | NP-C | 0.19 | 2.2 | 12 | NP-C |
| Fluoranthene | 86 | 20 | 22 | 1.1 | NP-NC | 20 | 23 | 1.2 | NP-NC |
| Fluorene | 87 | 51 | 54 | 1.1 | NP-NC | 58 | 64 | 1.1 | NP-NC |
| Hexachlorobenzene | 88 | 0.000060 | 0.00066 | 11 | NP-C | 0.000060 | 0.00066 | 11 | NP-C |
| Hexachlorobutadiene | 89 | 0.017 | 0.046 | 2.7 | NP-NC | 0.017 | 0.047 | 2.8 | NP-NC |
| Hexachlorocyclopentadiene | 90 | 3.7 | 4.1 | 1.1 | NP-NC | 3.9 | 4.4 | 1.1 | NP-NC |
| Hexachloroethane | 91 | 0.14 | 0.84 | 6 | NP-NC | 0.15 | 0.97 | 6.5 | NP-NC |
| Indeno(1,2,3-cd)pyrene | 92 | 0.0014 | 0.015 | 11 | NP-C | 0.0014 | 0.015 | 11 | NP-C |
| Isophorone | 93 | 22 | 210 | 9.5 | NP-C | 1700 | 20000 | 12 | NP-C |
| Nitrobenzene | 95 | 8.1 | 8.2 | 1 | NP-NC | 540 | 610 | 1.1 | NP-NC |
| N-nitrosodimethylamine | 96 | 0.00040 | 0.004 | 10 | NP-C | 2.8 | 33 | 12 | NP-C |
| N-Nitrosodi-n-Propylamine | 97 | 0.0030 | 0.029 | 9.7 | NP-C | 0.49 | 5.5 | 11 | NP-C |
| N-Nitrosodiphenylamine | 98 | 3.2 | 31 | 9.7 | NP-C | 5.8 | 66 | 11 | NP-C |
| Pyrene | 100 | 26 | 28 | 1.1 | NP-NC | 27 | 31 | 1.1 | NP-NC |
| 1,2,4-Trichlorobenzene | 101 | 0.11 | 1.2 | 11 | NP-C | 0.11 | 1.3 | 12 | NP-C |
| Aldrin | 102 | 0.00000051 | 0.0000059 | 12 | NP-C | 0.00000053 | 0.0000059 | 11 | NP-C |
| alpha-Hexachlorocyclohexane (HCH) | 103 | 0.00040 | 0.0044 | 11 | NP-C | 0.00042 | 0.0046 | 11 | NP-C |
| beta-Hexachlorocyclohexane (HCH) | 104 | 0.0084 | 0.079 | 9.4 | NP-C | 0.014 | 0.15 | 11 | NP-C |
| gamma- Hexachlorocyclohexane (HCH) | 105 | 3.9 | 4.5 | 1.2 | NP-NC | 4.2 | 4.7 | 1.1 | NP-NC |
| Chlordane | 107 | 0.00024 | 0.0027 | 11 | NP-C | 0.00024 | 0.0027 | 11 | NP-C |
| p,p'-Dichlorodiphenyltrichloroethane (DDT) | 108 | 0.000017 | 0.00019 | 11 | NP-C | 0.000017 | 0.00019 | 11 | NP-C |
| p,p'-Dichlorodiphenyldichloroethylene (DDE) | 109 | 0.000012 | 0.00013 | 11 | NP-C | 0.000012 | 0.00013 | 11 | NP-C |
| p,p'-Dichlorodiphenyldichloroethane (DDD) | 110 | 0.000094 | 0.0011 | 12 | NP-C | 0.000098 | 0.0011 | 11 | NP-C |
| Dieldrin | 111 | 0.00000088 | 0.0000098 | 11 | NP-C | 0.00000089 | 0.0000098 | 11 | NP-C |
| alpha-Endosulfan | 112 | 18 | 16 | 0.89 | NP-NC | 26 | 29 | 1.1 | NP-NC |
| beta-Endosulfan | 113 | 20 | 19 | 0.95 | NP-NC | 40 | 44 | 1.1 | NP-NC |
| Endosulfan Sulfate | 114 | 20 | 19 | 0.95 | NP-NC | 36 | 40 | 1.1 | NP-NC |
| Endrin | 115 | 0.026 | 0.029 | 1.1 | NP-NC | 0.026 | 0.029 | 1.1 | NP-NC |
| Endrin Aldehyde | 116 | 1.1 | 1.2 | 1.1 | NP-NC | 1.2 | 1.3 | 1.1 | NP-NC |
| Heptachlor | 117 | 0.0000042 | 0.000047 | 11 | NP-C | 0.0000041 | 0.000047 | 11 | NP-C |
| Heptachlor Epoxide | 118 | 0.000027 | 0.00029 | 11 | NP-C | 0.000026 | 0.0003 | 12 | NP-C |
| PCBs | 119 | 0.000061 | 0.0007 | 11 | NP-C | 0.000063 | 0.0007 | 11 | NP-C |
| Toxaphene | 120 | 0.00064 | 0.0072 | 11 | NP-C | 0.00067 | 0.0073 | 11 | NP-C |
| 1,2,4,5-Tetrachlorobenzene | none | 0.049 | 0.054 | 1.1 | NP-NC | 0.050 | 0.055 | 1.1 | NP-NC |
| 2,4,5-Trichlorophenol | none | 310 | 300 | 0.97 | NP-NC | 560 | 630 | 1.1 | NP-NC |

# Appendix D

| Chemical Name | Idaho WQS Number | Water + Organism HHAWQC (ug/L) | | | | Organism Only HHAWQC (ug/L) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | IDEQ Proposed | Alternative | Ratio Increase | Basis | IDEQ Proposed | Alternative | Ratio Increase | Basis |
| Bis(Chloromethyl) Ether | none | 0.000090 | 0.00093 | 10 | NP-C | 0.018 | 0.2 | 11 | NP-C |
| Chlorophenoxy Herbicide (2,4,5-TP) [Silvex] | none | 110 | 120 | 1.1 | G-NC | 420 | 480 | 1.1 | NP-NC |
| Chlorophenoxy Herbicide (2,4-D) | none | 800 | 840 | 1.1 | NP-NC | 13000 | 14000 | 1.1 | NP-NC |
| Dinitrophenols | none | 8.0 | 8.2 | 1 | NP-NC | 1000 | 1200 | 1.2 | NP-NC |
| Hexachlorocyclohexane (HCH)-Technical | none | 0.0075 | 0.067 | 8.9 | NP-C | 0.0096 | 0.11 | 11 | NP-C |
| Methoxychlor | none | 0.016 | 0.018 | 1.1 | NP-NC | 0.016 | 0.018 | 1.1 | NP-NC |
| Pentachlorobenzene | none | 0.085 | 0.095 | 1.1 | NP-NC | 0.089 | 0.096 | 1.1 | NP-NC |

**Notes:**

G-NC = general population, noncarcinogenic
G-C = general population, carcinogenic
HHAWQC = human health ambient water quality criteria
NP-NC = Nez Perce population, noncarcinogenic
NP-C = Nez Perce population, carcinogenic
WQS = water quality standards

Alternative #3 target risk levels:
General population 95th percentile at ELCR of $10^{-5}$ and HI of 1
Tribal population 95th percentile at ELCR of $10^{-5}$ and HI of 1

# Appendix E:

# Comparison of Fish Tissue Data with Water Column Values and Background Conditions

# APPENDIX C

# FISH TISSUE CONCENTRATIONS ALLOWED BY USEPA AMBIENT WATER QUALITY CRITERIA (AWQC): A COMPARISON WITH OTHER REGULATORY MECHANISMS CONTROLLING CHEMICALS IN FISH

**Kevin Connor And Paul Anderson, ARCADIS-US**

## 1.0 INTRODUCTION

For chemicals that are capable of concentrating in fish, Ambient Water Quality Criteria for the Protection of Human Health (HH-WQC) are derived based on the uptake of the chemical by edible fish and an assumed level of fish consumption by anglers (USEPA 2000). It follows that for these chemicals, there is an allowable fish tissue concentration corresponding with each HH-WQC. The associated allowable concentrations are risk-based benchmarks analogous to other risk-based thresholds applied to edible fish in other circumstances and, therefore, the comparison with the more formal screening levels or guidelines is of interest. This appendix first describes how these allowable fish tissue concentrations, which are an integral component of the HH-WQCs, are derived. Next, several comparisons are presented between these allowable fish tissue concentrations and existing fish concentration data, concentrations found in other foods, as well as other guidelines or risk-based levels used for regulating chemical concentrations in edible fish, such as fish consumption advisory (FCA) "trigger levels" issued by state and federal agencies, and U.S. Food and Drug Administration (USFDA) tolerances, illustrating the differences in these values.

These comparisons will focus on a short list of chemicals for which an HH-WQC has been established and for which fish tissue concentration data are likely to be available. This list is comprised of the following chemicals:

- arsenic
- methyl bromide
- mercury (total, inorganic and organic)
- PCBs (total)
- chlordane; and
- bis-(2-ethylhexyl)phthalate (DEHP)

These six chemicals were selected based on several considerations: 1) propensity for accumulating in fish; 2) inclusion in fish tissue monitoring programs; 3) inclusion in recent studies measuring chemicals in other foods; 4) inclusion in specific analyses estimating human (dietary) intake; and 5) subject of FCAs in at least one state. Not all of these criteria were satisfied for each of the six example chemicals; nor did the available data allow comparisons to be made for all six chemicals; however, in general, at least four of the six chemicals could be included in each of the comparisons that were undertaken as part of this analysis.

## 2.0 ALLOWABLE FISH TISSUE CONCENTRATIONS DERIVED FROM THE HH-WQCS

The HH-WQCs are established based on two exposure pathways: use of surface water as a source of drinking water; and the consumption of fish that may be caught and eaten from the surface water. The same algorithms that are used to calculate the HH-WQC can be rearranged to "back-calculate" an allowable fish tissue concentration.[11] Such values could be termed a water quality-based fish tissue concentration ($FTC_{WQ}$). These values are therefore a function of the same exposure assumptions, toxicity values and target risk level of 1 x $10^{-6}$ (for carcinogenic effects) used in calculating the HH-WQC.

The fish consumption rate (FCR) is an important factor in determining the HH-WQCs for chemicals having a moderate or high bioaccumulation potential. This analysis employs three different FCRs. As intended for the general population of fish consumers, we used the U.S. Environmental Protection Agency's (USEPA's) previously recommended default FCR of 6.5 grams/day or the current USEPA-recommended FCR of 17.5 grams/day. The choice between these two FCRs for each of the six chemicals was based on the derivation of the current HH-WQC, as published by USEPA. Specifically, the FCR used by USEPA to derive the current WQC for each chemical was selected for this analysis. For all but one chemical, this FCR was 17.5 grams/day. The exception was arsenic, where the HH-WQC is still based on an FCR of 6.5 grams/day. (The FTCs based on a FCR of 17.5 grams/day are referred to as the $FTC_{WQ-17.5}$ in the remainder of this appendix. Note that the recreational consumption rate FTC for arsenic is also referred to as $FTC_{WQ-17.5}$ despite being based on a FCR of 6.5 grams/day.)

Applying a FCR of 142.4 grams/day produced another set of $FTC_{WQ}$ (referred to as the $FTC_{WQ-142}$ in this appendix); this FCR represents a higher-end fish intake, which USEPA specifically recommends for subsistence anglers and is similar to the FCR recently adopted by the state of Oregon for state-wide ambient water quality criteria (Oregon DEQ 2011). The resulting $FTC_{WQ}$ for the six chemicals represent concentrations a regulatory agency might use to restrict consumption of fish in areas where there was reason to believe that subsistence fishing was known to occur. $FTC_{WQ}$ calculated for the six chemicals are summarized in Tables C1a (based on a FCR of 6.5 or 17.5 gram/day) and C1b (based on a FCR of 142 gram/day).

$FTC_{WQ}$ were derived from both the "water + organism" and the "organism only" HH-WQC. The former assumes that a surface water body is used as a source of drinking water and a source of fish consumption. The latter assumes that a surface water body is used only for consumption of fish. The influence of the drinking water consumption pathway is minor, or negligible for chemicals with a high bioconcentration factor (BCF), such as polychlorinated biphenyls (PCBs) and chlordane; however, it is important for chemicals with lower BCFs, such as methyl bromide, arsenic, and BEHP. For these chemicals, the use of the water and organism HH-WQC means that the allowable fish tissue concentration (i.e., $FTC_{WQ}$) will be substantially lower, because the target risk levels must be split between these pathways. However, the resulting $FTC_{WQ}$ would be assumed to be applicable in most areas because most states require that surface water bodies be protected for use as a source of drinking water.

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[11] Mathematically, this is the equivalent of multiplying the HH-WQC by the BCF, as long as a pathway-specific HH-WQC is used, i.e., based on the "organism only" or "water+organism" HH-WQC values.

**Table C1a** Allowable Fish Tissue Concentrations Derived from HH-WQC ($FTC_{WQ-17.5}$) for Six Chemicals: FCR = 17.5 g/day[1]

| | | HH-WQC Category[2] | | | |
|---|---|---|---|---|---|
| | | Water+Organism | | Organism Only | |
| Chemical | BCF (L/kg) | HH-WQC (µg/L, ppb) | $FTC_{WQ-17.5}$ (µg/kg, ppb) | HH-WQC (µg/L, ppb) | $FTC_{WQ-17.5}$ (µg/kg, ppb) |
| PCBs | 31,200 | 6.4E-05 | 2.0 | 6.4E-05 | 2.0 |
| Methyl bromide | 3.75 | 47 | 178 | 1,493 | 5,600 |
| Arsenic | 44 | 0.018 | 0.77[(1)] | 0.14 | 6.2 |
| Mercury | 7,343 | 0.054 | 394[(3)] | 0.054 | 400 |
| Chlordane | 14,100 | 8.0E-04 | 11.3 | 8.1E-04 | 11.4 |
| BEHP | 130 | 1.2 | 15 | 2.2 | 286 |

**Notes:**
[1] Tissue concentration for arsenic was calculated based on former FCR of 6.5 g/day, because current HH-WQC still uses this value.
[2] Assumed use of the surface water body
[3] USEPA has established a Fish Tissue WQC for methylmercury of 300 ppb, which would be expected to supersede this value.

Despite the limited applicability of "organism only" $FTC_{WQ}$ concentrations, they are still presented in some of the comparisons below because some regulatory agencies have derived FCA trigger levels based on fish consumption only or such triggers may be applied to waters not designated as a drinking water source (e.g., estuaries).

**Table C1b** Allowable Fish Tissue Concentrations Derived from HH-WQC ($FTC_{WQ-142}$) for Six Chemicals: FCR = 142 g/day

| | | HH-WQC Category[1] | | | |
|---|---|---|---|---|---|
| | | Water+Organism | | Organism Only | |
| Chemical | BCF (L/kg) | HH-WQC (µg/L, ppb) | $FTC_{WQ-142}$ (µg/kg, ppb) | HH-WQC (µg/L, ppb) | $FTC_{WQ-142}$ (µg/kg, ppb) |
| PCBs | 31,200 | 7.9E-6 | 0.25 | 7.9E-6 | 0.25 |
| Methyl bromide | 3.75 | 38.7 | 145 | 184 | 690 |
| Arsenic | 44 | 4.9E-3 | 0.21 | 6.4E-3 | 0.28 |
| Mercury | 7,343 | 6.7E-3 | 49.2[(2)] | 6.7E-3 | 49.3[(2)] |
| Chlordane | 14,100 | 1.0E-04 | 1.4 | 1.0E-04 | 1.4 |
| BEHP | 130 | 0.24 | 31.8 | 0.27 | 35.2 |

**Notes:**
[1] Assumed use of the surface water body
[2] USEPA has established a Fish Tissue WQC for methylmercury of 300 ppb; this value does not apply to subsistence levels of fish consumption, but the unique approach applied to mercury by USEPA could have an effect on these values.

## 3.0 MEASURED FISH TISSUE CONCENTRATIONS IN U.S. LAKES AND RESERVOIRS: COMPARISON WITH $FTC_{WQ}$

Several federal and state programs have provided data on the fish tissue concentrations of environmental chemicals in U.S. lakes and rivers. In addition to nationwide programs sponsored by USEPA, such as the National Study of Chemical Residues in Fish (USEPA 1992), some states have ongoing fish monitoring programs or have sponsored targeted studies. Many of these programs are focused on a particular set of compounds or a particular area.

The National Study of Chemical Residues in Lake Fish Tissue (or "National Lake Fish Tissue Study", or NLFTS) was a statistically-based study conducted by USEPA Office of Water, with an objective of assessing mean levels of selected bioaccumulative chemicals in fish on a national scale. The results represent concentrations throughout the U.S. based on samples collected from 500 lakes and reservoirs in 48 states (USEPA 2009; Stahl et al. 2009). The sampling phase was carried out from late 1999 through 2003. The focus on lakes and reservoirs, rather than rivers and streams, was based on the greater tendency of lakes for receiving and accumulating environmental chemicals. A *National Rivers and Streams Assessment*[12] is currently in progress, and it would be of interest to examine the fish tissue concentration data from this survey when the data become available. It is likely that any fresh water survey of a national scope, whether it included bound or flowing water bodies would find a broad range of fish tissue concentrations, with the concentrations being more highly influenced by the location and history of the water body.

The NLFTS included PCBs, dioxins, polycyclic aromatic hydrocarbons (PAHs), 46 pesticides, arsenic and mercury. Adult fish were collected from two categories: predator and bottom-dwelling, with the predatory fish comprised of largemouth bass (50%), walleye (10%) and northern pike (7%), and bottom-dwelling species comprised of common carp (26%), white sucker (20%) and channel catfish (16%). A summary of the results from this study is shown in Table C2a.

**Table C2a** Concentrations in Fish as Reported by the National Lake Fish Tissue Study (USEPA 2009)

| | Predator (Fillets) (µg/kg, ppb) | | | $FTC_{WQ}$ Water+Organism (µg/kg, ppb) | |
|---|---|---|---|---|---|
| Chemical | Mean | $50^{th}$ %ile | $90^{th}$ %ile | $FTC_{WQ-17.5}$ | $FTC_{WQ-142}$ |
| PCBs | 13.2 | 2.2 | 18.2 | 2.0 | 0.25 |
| Arsenic | ND[(2)] | ND[(2)] | ND[(2)] | 0.77 | 0.21 |
| Mercury | 352 | 285 | 562 | 394 | 49 |
| Chlordane | ND[(2)] | ND[(2)] | 3.6 | 11.3 | 1.4 |

**Notes:**

[1] National Lake Fish Tissue Study (NLFTS) (USEPA 2009); data from 486 predator fillet samples

[2] Infrequent detection in fish. Arsenic was detected at <1% of sampling locations, for predatory fish with a detection limit of 30 ppb. Chlordane was detected at 1-5% of sampling locations (for predatory fish) with a detection limits of 0.02 (alpha) and 0.49 (gamma) ppb. BEHP was detected at 1-5% of sampling locations (for predatory fish) and results are not provided by USEPA (2009).

[12] http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm

The NLFTS was not focused on areas specifically affected by industrial activities or historic releases. The water bodies included in this survey were selected at random with an objective of capturing typical levels of the chemicals analyzed. In fact, many lakes were included that could be regarded as pristine, likely to have been affected by only minimal human activity. Therefore, the resulting data could be representative of 'background' concentrations, which are from unavoidable depositional inputs of the chemicals of interest. However, because many of the water bodies included the NLFTS may have been affected by specific discharges or historic releases, we refer to the resulting data being only representative of typical levels for U.S. lakes. For simplicity, only the data representing predatory fish were included in this analysis, because these are the species likely to be targeted by anglers. The bottom-dwelling fish, which were included in the NLFTS to represent ecological (wildlife) exposures, contained substantially higher concentrations of PCBs (6 times greater at the median) and chlordane (1.7 ppb vs. ND), but lower concentrations of mercury ( 4 times lower at the median).

As shown in Table C2a, this study provided data for PCBs and mercury, as well as for arsenic and chlordane. Arsenic and chlordane were reported at very low frequencies of detection making quantitative comparisons between fish concentrations and FTCs challenging. Nevertheless, because the detection limits for chlordane (0.02 ppb for alpha and 0.5 ppb for gama) are less than the $FTC_{WQ-17.5}$ (11.3 ppb), and the $90^{th}$ percentile of the distribution of chlordane concentrations is roughly 3 times lower than the $FTC_{WQ-17.5}$, NLFTS data do demonstrate that chlordane concentrations in predatory fish from the large majority of U.S. surface waters are below the $FTC_{WQ-17.5}$. This also suggests that current concentrations of chlordane in most U.S. surface waters are unlikely to be above the HH-WQC derived based on the consumption rate of recreational anglers.

A similar evaluation could not be conducted for arsenic. The reported arsenic detection limits was above the $FTC_{WQ-17.5}$ derived from the HH-WQC, precluding a comparison with the $FTC_{WQ-17.5}$ absent making assumptions about the concentration of arsenic in fish samples with non-detectable concentrations. As a specific example, the NLFTS reported a method detection limit (MDL) for inorganic arsenic of 30 ppb, even using a state-of-the-art analysis, Method 1632A for the speciation of arsenic. Given that the $FTC_{WQ-17.5}$ for arsenic is 0.77 ppb, it is not possible to determine whether concentrations in predator fillets are above or below that $FTC_{WQ}$. Assuming detection limits for arsenic cannot be easily refined, this comparison does suggest that it is not possible to demonstrate compliance with the arsenic $FTC_{WQ-17.5}$.

For PCBs, the NLFTS data indicate that a substantial portion of predatory fish from U.S. lakes exceed the $FTC_{WQ-17.5}$ for PCBs (2 ppb). The extent of this exceedance depends on whether the data are represented by the mean concentration (13.2 ppb), which exceeds the $FTC_{WQ-17.5}$ by a factor of about 6x, or the median (i.e., $50^{th}$ percentile) concentration (2.3 ppb), which is nearly equivalent to the $FTC_{WQ-17.5}$. While this comparison indicates the average concentration of PCBs in fish throughout the U.S. is substantially higher than the $FTC_{WQ-17.5}$, it does not follow that fish in most surface waters of the U.S. have PCB concentrations greater than both of the $FTC_{WQ}$s. The difference between the mean and median concentration comparisons for this data set likely arises because the data are skewed, with the majority of samples having relatively low concentrations. As noted above, the $50^{th}$ percentile of the distribution of PCB concentrations in predatory fish from U.S. lakes is approximately equal to the $FTC_{WQ-17.5}$. Assuming the BCF accurately reflects the relationship between the PCB concentration in fish and water, the comparison of the $FTC_{WQ-17.5}$ to the $50^{th}$ percentile indicates that roughly half of sampled U.S. waters had PCB concentrations that met or were below the HH-WQC derived based on the consumption of recreational anglers. .

The mean mercury concentration of the NLFTS data (352 ppb) is slightly lower than the $FTC_{WQ-17.5}$ for mercury (394 ppb). The percentile data provided by USEPA (2009) indicate the distribution of mercury concentrations in predatory fish is also skewed, though a smaller proportion of the samples (approximately 25%) exceed the mercury $FTC_{WQ-17.5}$ than exceeded the PCB $FTC_{WQ-17.5}$.

The results of parallel comparisons with FTCs derived based on subsistence anglers (i.e., $FTC_{WQ-142}$) lead to a different conclusion for three for the four compounds (chlordane, PCBs and mercury). The arsenic $FTC_{WQ-142}$ is about four times lower than the $FTC_{WQ-17.5}$ and is also below the typical detection limits for inorganic arsenic, precluding any meaningful quantitative comparisons with the $FTC_{WQ-142}$.

The detection limit for alpha chlordane is slightly above the $FTC_{WQ-142}$ and the detection limit for gamma is slightly below (see footnotes to Table C2a). Additionally, the 90$^{th}$ percentile of the distribution of chlordane concentrations is only about 2.5 times higher than the $FTC_{WQ-142}$. These comparisons suggest that typical concentrations of chlordane may be similar to or less than the $FTC_{WQ-142}$ in many U.S. surface waters, though the upper percentiles of the distribution do exceed the $FTC_{WQ-142}$, in some cases, substantially (Table C2a).

The $FTC_{WQ-142}$ is about 10 times lower than the $FTC_{WQ-17.5}$ for PCBs and mercury (Table C2a). With the increase in FCR, the average fish tissue concentration exceeds the $FTC_{WQ-142}$ by approximately 50x and 7x for PCBs and mercury, respectively (Table C2a). Additionally, the majority of the distribution of PCB and mercury concentrations is above the $FTC_{WQ-142}$. For both chemicals, the concentration at the 5$^{th}$ percentile of the distribution exceeds the $FTC_{WQ-142}$. These comparisons indicate that if HH-WQC were to be revised using an FCR of 142 grams/day, assumed to be representative of subsistence anglers, the concentrations of PCBs and mercury in fish from virtually all surface waters in the U.S. would exceed the allowable fish concentration associated with such an HH-WQC.

Several state programs have surveyed fish tissue concentrations, often including PCBs, metals and/or pesticides. The state data assembled for our analyses included surveys conducted by Washington State Department of Ecology (WA-DOE) and by the Florida St. Johns River Water Management District (SJRWMD). Overall, the state programs include more recent data (through 2011) than those presented in the NLFTS (through 2003). These are much more limited data sets compared to the data from the NLFTS. Additionally, the number of observations from each state varies by chemical and in some instances all the data points are from a single state (e.g., all PCB data are from Washington).

**Table C2b** Measured Concentrations in Fish Samples from Washington and Florida

| | Data from State Programs (µg/kg, ppb) | | | $FTC_{WQ}$[1] (µg/kg, ppb) | |
|---|---|---|---|---|---|
| Chemical | Mean[2] | 50$^{th}$ %ile | 90$^{th}$ %ile | $FTC_{WQ-17.5}$ | $FTC_{WQ-142}$ |
| PCBs | 27.4 | 22.1 | 49.8 | 2.0 | 0.25 |
| Mercury | 191 | 120 | 408 | 394 | 49 |
| Chlordane | 1.4 | 0.62 | 2.8 | 11.3 | 1.4 |

**Notes:**

Based on data provided by J. Beebe (NCASI) and comprised of data from Washington State WA-DOE (2011), WA-EIMS, http://www.ecy.wa.gov/eim), and St. Johns River Water Management District (SJRWMD), Florida (http://sjr.state.fl.us).

[1] $FTC_{WQ}$ derived from water and organism HH-WQC.

[2] Data included: for PCBs, 45 samples from WA-EIMS; for mercury, 1598 samples from WA-EIMS and SJRWMD; and for chlordane, 382 samples from SJRWMD.

The mean concentration of PCBs in predatory fish (27.4 ppb), is about 14 times and 100 times higher than the $FTC_{WQ-17.5}$ and $FTC_{WQ-142}$, respectively. In fact, both $FTC_{WQ}$s are well below the minimum reported concentration (9.7 ppb) from this data set. Assuming these data were collected from waters potentially affected by PCB releases suggests that meeting the HH-WQC, based on either the recreational of subsistence FCR, in such waters is likely to be a challenge. To the extent these data are only from Washington, this finding may only apply to waters of that state.

The mean concentrations of mercury and chlordane from state programs are below their respective $FTC_{WQ-17.5}$ by approximately 2x- and 8x-, respectively (Table 4-2b) suggesting that a substantial portion of the surface waters in these states would meet an HH-WQC derived based on an FCR assumed to be representative of a recreational angler. The mean concentration of chlordane is equal to the $FTC_{WQ-142}$. If the chlordane distribution from these two states has a similar "shape" to the distribution in the national survey, this comparison suggests that a substantial portion of surface waters in these two states would meet an HH-WQC based on an FCR representative of a subsistence angler. Fewer waters are likely to meet such an HH-WQC for mercury, given that the mean concentration exceeds the $FTC_{WQ-142}$ by approximately 4x.

Arsenic was included in several of the state databases, however, inorganic arsenic was not detected at measurable concentrations. As discussed above for the NLFTS data, meaningful comparison of inorganic arsenic concentrations to FTCs is precluded because MDLs are greater than the FTCs.

## 4.0 COMPARISON OF $FTC_{WQ}$ TO FCA TRIGGER LEVELS ESTABLISHED BY STATE OR OTHER PUBLIC HEALTH AGENCIES

Most states and various federal agencies have programs for the protection of anglers who may eat fish containing trace amounts of chemicals. These programs are responsible for issuing FCAs for lakes and reservoirs where particular chemicals have been detected at levels in fish that exceed some risk-based "trigger level." While the approach to setting FCAs may differ, most programs use a risk-based approach to develop guidelines that are intended to be protective of the health of the angler communities with a wide margin of safety. USEPA (2000) issued guidance that could be used to establish some uniformity in the methods used to derive FCAs, but most states are maintaining programs and guidelines that have served them for many years. A common feature of both federal and state guidelines is the movement away from a single trigger level and towards a progression of trigger levels, each associated with an increasing level of restricted intake for the fish (and chemical) in question. Despite this increased complexity, USEPA (2000) also provided screening values (SV) based on moderate (recreational) and high (subsistence) levels of fish consumption, termed SVrec and SVsub, respectively, and shown in Table 4-3 for PCBs, arsenic, chlordane, and mercury.

Also shown in Table 4-3 are examples of FCA trigger levels from state programs that publish numerical benchmarks for this purpose. For states that have adopted a series of trigger levels, this analysis presents the levels based on either a "no more than 2 meal per month" restriction (noted as "L2" in Table 4-3), or a 'do not eat' advisory (complete restriction, notes as "R" in Table 4-3). Two 8-ounce (227 g) meals per month is assumed to be comparable to the 17.5 gram/day FCR applied by USEPA to the derivation of HH-WQC.[13]

[13] The guidelines from WI-DNR and MI-DCH, however, only included a one meal per month advisory level, and the concentrations accompanying this advisory level are shown for these two agencies (noted as "L1" in Table 4-3).

**Table C3** USEPA Screening Values for Fish and FCA Trigger Levels Used by Select State Agencies[1]

| | Federal USEPA (2000)[2] (µg/kg, ppb) | | Select State Programs (µg/kg, ppb) | | | $FTC_{WQ}$ Organism Only Values (µg/kg, ppb) | |
|---|---|---|---|---|---|---|---|
| Chemical | SV(rec)[3] | SV(sub)[3] | WI-DNR | MI-DCH | WV-DHHS | $FTC_{WQ-17.5}$ | $FTC_{WQ-142}$ |
| PCBs | 20 | 2.5 | 220 (L1)<br>2,000 (R) | 200 (L1)<br>2,000 (R) | 150 (L2)<br>1,340 (R) | 2.0 | 0.25 |
| Arsenic | 26 | 3.3 | -- | NA | 140 (L2)<br>1,250 (R) | 6.2 | 0.28 |
| Mercury | 400 | 50 | 500-1000 (NS) | 500 (L)<br>1,500 (R) | 220 (L2)<br>1,880 (R) | 400 | 49 |
| Chlordane | 114 | 14 | 660 (L1)<br>5,620 (R) | 300 (NS) | 880 (L2)<br>7,660 (R) | 2.2 | 1.4 |

**Notes:**

R: Restricted, referring to 'do not eat' advisory.

L: Limited, or a limited amount of consumption is advised.

L1: Limited to 1 meal per month.

L2: Limited to 2 meals per month.

NS: Not stated whether the value represents a restriction or a limit.

[1] Wisconsin Department of Natural Resources (WI-DNR), 2007, 2011; Michigan Department of Community Health (MI-DCH), 2008; West Virginia Department of Health and Human Services (WV-DHHS).

[2] USEPA, 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1.

[3] Screening values (SV) for the recreational and subsistence angler.

When compared to these FCA trigger levels, the $FTC_{WQ-17.5}$ for PCBs, arsenic and chlordane are 20-4,000 times lower (more stringent) (Table C3). For mercury, the $FTC_{WQ-17.5}$ is comparable to the trigger levels prompting some restriction on fish consumption, but is as much as 4x lower than the level where a 'do not eat' advisory is prompted. $FTC_{WQ-142}$ are between 200-8,000 times lower than the FCA trigger levels for PCBs, arsenic, and chlordane, and 4 to 40 times lower than the trigger levels for mercury (Table C3).

As shown in Table C3, the USEPA SVs are either similar or 10x higher than the $FTC_{WQ}$ derived from the HH-WQC. Because these USEPA values are intended to be generic screening-level benchmarks, they are very conservative compared to the trigger levels used by the most state programs (discussed further below).

Comparing the USEPA SVs to $FTC_{WQ}$ for chemicals for which noncancer endpoints are the driver, such as mercury, SVs are the same as the $FTC_{WQ}$s. For the other three constituents, for which the cancer endpoint is most sensitive, the SVs are approximately 10 times higher, because SVs are derived based on a $1x10^{-5}$ target risk level, rather than a $1x10^{-6}$ target risk level.

In contrast, fish advisory trigger levels used by public health agencies in Wisconsin, Michigan, and West Virginia (Table C3) are less stringent, and in general, would require substantially higher concentrations of arsenic, chlordane and PCBs than allowed by the HH-WQC before issuing even a moderate restriction on fish consumption. Based on our survey of state "trigger levels" and recent reviews comparing the FCAs between states (IWG-ACA, 2008; Scherer et al. 2008), we believe that the FCAs from Wisconsin, Michigan, and West Virginia are likely to be representative of the FCAs from many state programs. Scherer et al. (2008) found the FCAs among states to be quite similar, despite some variation in the methods used to develop the FCAs. Many state programs rely on less-stringent food tolerance levels as the basis for their trigger levels; this choice is consistent with the desire by States to consider the value of their recreational fisheries and the benefits of fish consumption, while protecting the public from potential chemical risks. The difference in the State vs. EPA trigger levels is due to several factors. As noted previously, state guidelines are typically based on a series of FCA trigger levels, giving the States the ability to partially restrict fish consumption at many concentration levels. Further, the ability to issue consumption limits for specific target fish species also permits states to allow higher fish tissue concentrations. Lastly, state agencies are more likely to apply lower assumed fish consumption rates based on local or regional surveys conducted within the state.

A key illustration of the conservative nature of the FTCs is provided by a comparison of the proportion of samples in the NLFTS data set that exceed an $FTC_{WQ}$ to the proportion of waters in the U.S. that have a fish consumption advisory. As described above approximately 50% of fish samples have PCB concentrations that exceed the $FTC_{WQ-17.5}$ and over 95% exceed the $FTC_{WQ-142}$. Yet, only about 15% of the nation's lakes are subject to a fish consumption advisory (USEPA 2009). Given that a goal of both an HH-WQC and an FCA is protection of the health of anglers, the much larger proportion of waters estimated to potentially pose an unacceptable risk when an HH-WQC is used than measured by the posting of an FCA, suggests that the derivation of HH-WQC by USEPA is substantially more conservative than the derivation of FCAs by state agencies.

## 5.0 COMPARISON OF $FTC_{WQ}$S TO HEALTH-BASED LIMITS FOR FISH OR OTHER FOODS

Other federal and global agencies charged with protection of food safety have established guidelines for ensuring the safety of foods in commerce. The most notable examples in the U.S. are the food tolerances established by USFDA. These tolerances have been used as a guideline for assessing the safety of food, largely animal products, such as beef, chicken, fish, milk and eggs. These tolerances are typically less stringent than analogous values derived using USEPA methods for risk assessment. Unlike the USEPA, the USFDA must balance potential economic concerns with the potential benefits to public health; in other words, the USFDA must consider the consequences of its actions on the U.S food supply. USEPA exposure limits and screening levels may also be considered for their economic consequences, but this review is conducted outside of the Agency and only after the value has been derived. Regardless, USFDA tolerances are risk-based concentrations and many risk assessors and scientists support the idea that the tolerances are protective of the public health (Cordle et al. 1982; Maxim and Harrington 1984; Boyer et al. 1991). Due to recent incidents in Europe in which PCBs were accidentally introduced into animal feeds, the European Commission (EC) has set maximum levels for PCBs in foods and feedstuffs, including fish (EC, 2011). The limits were based on a report of the European Food Safety Authority (EFSA) deriving allowable exposure levels, and on monitoring data compiled throughout the European Union (EU). The EU considered both the public health protection and the feasibility of attaining these limits, based on current levels measured in foods.

$FTC_{WQ}$ derived from the HH-WQC are in all cases well below both the USFDA and EU food tolerance levels (Table C4). The USFDA tolerance for PCBs in fish of 2,000 ppb is 1,000 times higher than the $FTC_{WQ-17.5}$ and 8,000 times higher than the $FTC_{WQ-142}$.

**Table C4** Comparison of $FTC_{WQ}$ to Food Safety Guidelines for Chemical Concentrations in Fish

| | Food Safety Standards | | HH-WQC-Based Threshold for Fish | |
|---|---|---|---|---|
| Chemical | USFDA Tolerance for Fish[1] (µg/kg, ppb) | EU Limit for Fresh Fish[2] (µg/kg, ppb) | $FTC_{WQ}$ FCR = 17.5 (µg/kg, ppb) | $FTC_{WQ}$ FCR=142 (µg/kg, ppb) |
| PCBs | 1,000 (action level) 2,000 (limit) | 250[(3)] | 2.0 | 0.25 |
| Mercury | 1,000 (action limit) | -- | 394 | 49.2 |
| Chlordane | 300 | -- | 11.3 | 1.4 |

**Notes:**
[1] USFDA (1998, 2011); Values are based on wet weight.
[2] European Commission (EC) 2011. Commission Regulation No. 1259/2011.
[3] EC Limit for PCBs is 125 ng/g wet wt. for the sum of 6 'marker' congeners, which comprise about 50% of the PCBs in fish. Therefore, to be applicable to a measure of total PCBs, this value was multiplied by a factor of 2 (EC, 2011).

## 6.0 TYPICAL INTAKES OF THE CHEMICALS IN THE U.S. POPULATION: COMPARISON TO THE ALLOWABLE DAILY INTAKES DERIVED FROM THE HH-WQC

The goal of an HH-WQC is to limit exposure of the population to chemicals in water such that an allowable dose (or risk) is not exceeded. If the dominant exposure pathway for a chemical is direct contact or use of surface water, then compliance with the AWQC may, indeed, limit overall exposure to allowable levels. However, if other pathways also contribute to overall exposure and, in particular, if the other pathways represent larger exposures than surface water, then establishment and enforcement of a stringent surface water criterion may not provide a measurable public health benefit. This section compares exposures allowed by the HH-WQC to the potential exposures from a limited set of other exposure sources or pathways for five chemicals.

One of the key assumptions used to derive $FTC_{WQ}$ is an allowable daily intake of each constituent in question. This allowable daily intake is a toxicologically-derived value and is represented by a reference dose (RfD) (for noncancer endpoints) or a risk-specific dose (RSD) (when cancer is the endpoint). The RSD is equal to the target risk level (typically $1 \times 10^{-6}$) divided by the cancer slope factor (CSF) for a particular constituent.

As shown in Table C5, the RfDs and RSDs for the six chemicals evaluated in this appendix range from 0.35 µg/day for PCBs to 98 µg/day for methyl bromide.[14] These are the toxicity values chosen by USEPA for the derivation of HH-WQC.

Another way to estimate the allowable daily dose associated with the HH-WQC, and the $FTC_{WQ}$ in particular, is to multiply the allowable fish tissue concentrations (i.e., the $FTC_{WQ}$) by the assumed FCR of 17.5 grams/day. The results, as shown in Table C5 as "Fish Dose", represent the dose of each chemical that someone would receive who ate fish containing chemicals at concentrations equal to the $FTC_{WQ}$.

[14] Traditional units of dose in mg/kg-day are converted to units of intake (µg/day) by multiplying by an adult body weight of 70 kg and a conversion factor of 1000 µg/mg.

For PCBs, mercury and arsenic, very low, but measurable daily intakes by the U.S. population are based on releases of these substances into the environment and their presence in trace quantities in the food supply. Arsenic occurs naturally in soils and groundwater and, therefore, there is a normal daily intake that varies by region. For BEHP, the presence of trace amounts in food stems from its use in plastic food packaging materials (Fromme et al. 2007). A summary of the data used to provide an estimate of the typical daily intake of each chemical is presented below.

PCBs: The intake of PCBs through foods, mainly animal products, has declined dramatically in the last 30 years. However, Schecter et al. (2010) recently carried out a market-basket survey of several types of foods and found measurable levels in enough foods to propose a daily intake of about 0.1 µg/day for a typical resident of the U.S. Other studies in Europe have proposed slightly higher intake levels (as high as 0.8 µg/day), but overall, corroborate the findings of Schecter et al. (2010). This range of typical dietary intakes of PCBs is 3 times to as much as 20 times greater than the risk-specific dose (RSD) used to derive the HH-WQC (0.035 µg/day) (Table C5). Thus, the HH-WQC is based on an exposure limit for PCBs that is routinely exceeded by the typical PCB intake that occurs through dietary exposures.

BEHP: Considerable effort has been made to estimate the human exposure to phthalate esters, which arises from food packaging materials, e.g., plastic food wraps. A German study by Fromme et al. (2007) provides the most reliable estimates of intake, based on a study using both samples of dietary items and biomonitoring data. Because phthalate ester exposures are derived from plastic packaging/wrapping that is sold across the globe, intakes estimated by this study for a German population are likely to be comparable to those in U.S. The authors report a median BEHP intake of 2.4 µg/kg-day (162 µg/day) which is approximately 30 times greater than the RSD used by the HH-WQC (Table C5). Thus, the HH-WQC is based on an exposure limit for BEHP that is routinely exceeded by the typical intake that occurs through dietary exposures.

**Table C5** Allowable vs. Actual Daily Intakes for Select Chemicals

| | Allowable Daily Intakes Used as the Basis for the HH-WQCs | | Measured or Estimated Average Daily Intakes Derived from Food | | |
|---|---|---|---|---|---|
| | Value [RfD or RSD] (μg/day) | Fish Dose[1] (μg/day) | Intake (μg/day) | Group | Note |
| PCBs | 0.035 [RSD] | 0.035 | 0.1-0.8 | all | (a) |
| Methyl bromide | 98 [RfD] | 3.1 | 6.5 (mean); 310 (95th %ile) | male | (b) |
| | | | 10 (mean); 350 (95th %ile) | female | |
| Arsenic | 0.04 [RSD] | 0.014 | 3.6 / 2.7 (avg.); 9.4 (90th %ile) | male | (c) |
| | | | 2.8 / 2.4 (avg.); 11.4 (90th %ile) | female | |
| Mercury | 7 [RfD] | 7 | 8.6 (mean); 166 (90th %ile) | male | (d) |
| | | | 8.2 (avg.); 204 (90th %ile) | female | |
| BEHP | 5 [RSD] | 0.26 | 162 (median); 309 (95th %ile) | all | (e) |

**Notes:**

RfD, Reference Dose; RSD, Risk-Specific Dose

[1] Computed as $FTC_{WQ}$ [from Table C1a] x FCR [17.5 g/day]

(a) Range is based on the results of several studies (Darnerud et al. 2006; Arnich et al. 2009; Roosens et al. 2010; Schecter et al. 2010).

(b) Cal-EPA 2002; assumed body weight of 70 kg for adults.

(c) Meacher et al. 2002; assumed body weight of 70 kg for adults.

(d) MacIntosh et al. 1996.

(e) Fromme et al. 2007.

Arsenic: A study by Meacher et al. (2002) represents a comprehensive evaluation of total inorganic arsenic exposure in the U.S. population. The authors discuss other studies with a similar aim and conclude that the average daily intake, primarily from food and drinking water, is in the range of 1 to 10 μg/day. Estimates of average daily intakes are 60 to 90 times greater than the RSD. Thus, the HH-WQC is based on an exposure limit for arsenic that is exceeded by a wide margin, by typical dietary intakes of arsenic.

Methyl bromide: The concentrations detected in foods are mainly in animal products, such as milk, which makes estimates of a one-time exposure as high as 4-5 μg/kg-day, but with average daily exposures likely to be less than 1 μg/kg-day, according to a study by Cal-EPA (2002). While 95th percentile values (310-350 μg/day) are more than 40 times higher that the mean intake estimates, it can be concluded that typical methyl bromide intakes based on diet are likely to be below the RfD of 98 μg/day. Thus, for methyl bromide, dietary intakes would not appear to hinder the objective of limiting the exposures based on fish consumption.

Mercury: The predominant human intake is from concentrations in predatory and deep-sea fish such as tuna. Average daily intakes are estimated to be about 8 μg/day (MacIntosh et al. 1996) and are comparable to the RfD of 7 μg/day (Table C5). Thus, for mercury, it is not uncommon for the consumption of store-bought tuna to provide an intake equivalent to the RfD; achieving this level of exposure would at least appear to be an achievable public health objective.

In summary, estimated daily intakes for five of the six chemicals could be obtained from the literature (Table C5). For PCBs, arsenic and BEHP, the chemicals for which potential cancer risk is the most sensitive endpoint, the estimated daily intake for the U.S. population is between 3 times to 90 times greater than the RSD. In surface waters with fish that have concentrations that are no more than a 2-times lower than the FTC, based on the comparisons shown in Table C5, decreasing exposures to the levels associated with HH-WQC would be likely to have no discernible effect on the intake of these chemicals in the community.

## 7.0 SUMMARY AND CONCLUSIONS

This paper described the derivation of allowable fish tissue concentrations (referred to as $FTC_{WQ}$) associated with HH-WQC for a select group of chemicals. $FTC_{WQ}$ are based on the same exposure and toxicity factors used to derive the HH-WQC. Separate $FTC_{WQ}$ were derived for USEPA's recommended fish consumption rate for recreational anglers (17.5 grams/day, $FTC_{WQ\text{-}17.5}$) and subsistence anglers (142 grams/day, $FTC_{WQ\text{-}142}$). Given the nearly 10x higher consumption rate assumed for subsistence anglers compared to recreational anglers, $FTC_{WQ\text{-}142}$ were lower than the $FTC_{WQ\text{-}17.5}$ for every chemical by about 10x. $FTC_{WQ}$ were compared to: (1) concentrations measured in fish from U.S. water bodies; (2) trigger levels used by State agencies to set fish consumption advisories; and (3) allowable concentrations set by other US and international health agencies. Additionally, ADIs used to derive $FTC_{WQ}$ were compared to estimated daily dietary intakes from all sources.

PCB concentrations in about half of the fish from the NLFTS exceeded the $FTC_{WQ\text{-}17.5}$ and PCB concentrations in essentially all fish from the NLFTS exceeded the $FTC_{WQ\text{-}142}$. (Additionally, all of the fish from two state-specific surveys had PCB concentrations above the $FTC_{WQ\text{-}17.5}$ and the $FTC_{WQ\text{-}142}$.) The mercury concentrations for the majority of fish in the NLFTS were below the $FTC_{WQ\text{-}17.5}$ but most fish had mercury concentrations above the $FTC_{WQ\text{-}142}$. Chlordane was not detected in the majority of NLFTS samples with detection limits below the $FTC_{WQ\text{-}17.5}$ and the $FTC_{WQ\text{-}142}$ suggesting the majority of fish have chlordane concentrations below either $FTC_{WQ}$. Arsenic was not detected in majority of NLFTS; however, unlike chlordane, the method detection limit for arsenic exceeds both the $FTC_{WQ\text{-}17.5}$ and the $FTC_{WQ\text{-}142}$ by more than 30x, precluding the possibility of determining whether arsenic concentrations meet the HH-WQC. Thus, whether nationwide fish tissue concentrations meet the $FTC_{WQ}$ depends upon the chemical of interest and whether recreational or subsistence angler consumption rates are used to derive the $FTC_{WQ}$. It does appear that if HH-WQC were to be revised using an FCR of 142 grams/day, the concentrations of PCBs and mercury in fish from virtually all surface waters in the U.S. would exceed the allowable fish concentration associated with such HH-WQC.

$FTC_{WQ\text{-}17.5}$ for PCBs, arsenic, and chlordane were 20 to 4,000 times lower (more stringent) than FCA trigger levels commonly used by state programs. For mercury, the $FTC_{WQ\text{-}17.5}$ was comparable to typical state trigger levels prompting some restriction on fish consumption, but it was as much as 4 times lower than the level where a 'do not eat' advisory is prompted. Again, the comparisons were much more remarkable using the $FTC_{WQ\text{-}142}$. $FTC_{WQ\text{-}142}$ were between 200 times and 8,000 times lower than the FCA trigger levels for PCBs, arsenic, and chlordane, and 4 times to 40 times lower than the state trigger levels for mercury. These comparisons were based on the guidelines from a select number of states, including Wisconsin, Michigan, and West Virginia; however, the FCA trigger levels were comparable among this small group of states, and based on our review of guidelines in many other states not included in this analysis, we believe that these states can be considered representative of many other state programs.

A comparison of FCAs to the NLFTS data provides another comparison that highlights the conservatism of the $FTC_{WQ}$ (and the HH-WQC from which they were derived). Approximately 50% of fish samples from the NLFTS had PCB concentrations that exceeded the $FTC_{WQ-17.5}$ and over 95% exceeded the $FTC_{WQ-142}$. However, only about 15% of the nation's lakes and reservoirs (on a surface area basis) are subject to a FCA based on PCBs (USEPA 2009). Thus, use of HH-WQC indicated that a much larger proportion of US surface waters pose an unacceptable risk than indicated by FCA postings. This comparison further illustrates that the assumptions used by USEPA to derive HH-WQC are more conservative than the assumptions used by state agencies to derive FCAs.

Various agencies, both Federal and international, have established concentration limits for fish as a food in commerce. The FDA food tolerances are the most notable example. $FTC_{WQ}$ were compared to FDA tolerance limits and a recently established EU limit for PCBs in fish. The $FTC_{WQ-17.5}$ for PCBs of 2 ppb is 500 times lower than the FDA action limit of 1,000 ppb and 125 times lower than an EU limit of 250 ppb. The $FTC_{WQ-142}$ is 1,000x and 4,000x lower than the EU and FDA action limits, respectively. The FDA tolerance of 300 ppb for chlordane is similarly much less stringent than either the $FTC_{WQ-17.5}$ (11.3 ppb) or the $FTC_{WQ-142}$ (1.4 ppb) for chlordane. The FDA action level for mercury of 1,000 ppb is similar to but still higher than either the $FTC_{WQ-17.5}$ (394 ppb) or the $FTC_{WQ-142}$ (49 ppb) for mercury. These comparisons indicate that HH-WQCs are limiting fish tissue concentrations to levels substantially below those considered to be without significant risk by public health agencies whose goal is to ensure the safety of edible fish.

Lastly, allowable daily intakes (RfDs for noncancer endpoints, RSDs for the cancer endpoint) assumed by the $FTC_{WQ}$ were compared to estimates of the daily intake of arsenic, BEHP, mercury and PCBs obtained from the open literature. Specifically, daily intakes were taken from studies that measured concentrations in various foodstuffs. Typical daily dietary intakes of arsenic, BEHP and PCBs exceeded the allowable daily intakes used to derive HH-WQC by a substantial margin. The typical daily dietary intake of mercury, mostly from tuna, is comparable to the RfD used to derive the HH-WQC. Thus, for those compounds whose daily dietary intake is greater than the intake associated with surface water and already exceeds the allowable daily intakes used to establish HH-WQC, the establishment and enforcement of a more stringent HH-WQC may not provide a measurable public health benefit.

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# Appendix F:

# Idaho Fish Advisory Analysis

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**MEMO**

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From:
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Date:
November 17, 2014

ARCADIS Project No.:
ME000168.0001

Subject:
Idaho Fish Consumption Advisories and Determinations

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This memorandum provides an overview and summary of the Idaho Fish Consumption Advisory Program (IFCAP) fish consumption advisories and listing methodology. This memorandum focuses on fish tissue data that have been collected by IFCAP specifically for use in development of fish consumption advisories for protection of human health and includes a summary of the fish consumption advisory determination process.

The tables that accompany this memorandum summarize the state fish consumption advisories. **Table 1** summarizes the fish consumption limits by water body. **Table 2** summarizes the IFCAP risk assessment assumptions. **Table 3** summarizes the chemical concentrations used to derive the Idaho fish consumption advisories. For some water bodies the specific data used for the setting of the consumption advisories were not available for review (approximately 20 percent of the consumption advisory listings). For those water bodies, available data obtained from other sources were included in **Table 3**. These data are potentially the same data used for the fish consumption limit determination, but the data may be incomplete or may not have been used by IFCAP. There is a potential delay in when fish consumption limits are set and when the data used for the calculation is released (IDHW 2014b), or in some instances the data may not have been released or could not be located in the references obtained for use in the preparation of this memorandum. Additionally, data may have been collected and assessed that did not lead to a fish consumption limit that may not have been released.

## 1. Existing Fish Consumption Advisories

The Idaho water bodies that currently have fish consumption advisories are summarized on the Idaho Department of Health and Welfare (IDHW) website (http://healthandwelfare.idaho.gov/Portals/0/Health/EnvironmentalHealth/FishGuide.pdf - IDHW 2014a) and **Table 1** of this memorandum. There is currently one State-wide advisory for bass consumption and

22 water body-specific advisories for consumption of various other species. All existing advisories are based on mercury, with the exception of Lake Coeur d'Alene, which has advisories based on arsenic and lead in addition to mercury.

Until recently, there was a temporary advisory based on selenium in fish tissue for East Mill Creek, a tributary to Blackfoot River in southeast Idaho. However, these data are not included in this memorandum because this advisory was removed in August 2013 following additional review of the data (IDHW 2013a). Screening values (SVs) were calculated for selenium in fish tissue of the streams of the upper Blackfoot River watershed by the Bureau of Environmental Health and Safety (BEHS), Division of Health, and IDHW for the protection of human health. These SVs were 6.2 mg/kg dry weight (dw) for the general population, 5.4 mg/kg dw for pregnant women, and 3.1 mg/kg dw for children under 7 years old. These values assume a reference dose of 0.005 mg/kg/day (BEHS 2003). Use of these screening values has not been continued by the state of Idaho.

## 2. Listing Methodology

Fish consumption advisories in Idaho are issued by the IFCAP, an interagency group supported primarily by the IDHW. Additional contributing agencies include the Idaho Department of Environmental Quality (IDEQ), Idaho Department of Fish and Game (IDFG), Idaho Department of Agriculture (IDA), US Geological Survey (USGS), and US Environmental Protection Agency (USEPA). The IFCAP guidance follows the fish advisory guidelines issued by the USEPA (i.e., USEPA 1994, 1995, 1996, 1999), with some Idaho-specific modifications intended to accommodate the specific needs of the State and the limited funding resources of the agencies contributing to the IFCAP program (IDHW 2013b). IFCAP targets water bodies and fish species of interest, conducts tissue sampling, and uses a risk assessment approach to issue consumption advisories based on the sampling results.

### *a. Sampling Guidelines*

IFCAP aims to assess one to five water bodies per year, with prioritization based on the potential contaminants present; frequency of fishing activities; availability of fish for consumption; and public interest in the water body. IFCAP targets popular game species for each water body assessed, with consideration of the size and abundance of the species as well as their potential to bioaccumulate contaminants. Tissue sampling is primarily conducted by the IDFG through the Water Quality Division and USGS. IDHW assesses the data collected and performs the risk assessment for potential exposures associated with fish consumption.

For most species, samples are prepared as fillets and analyzed for various selected metals, pesticides, polychlorinated biphenyls, and polybrominated diphenyl ethers depending on the water body and data needs. For fish known to be canned and eaten whole, fish to be analyzed are gutted and prepared as whole body carcasses. To achieve a target level of statistical confidence, IFCAP aims to collect and analyze 10 fish per target species per sampling location.

*b. Fish Advisory Consideration*

When there are insufficient samples to achieve statistical confidence (i.e., less than 10), a warning message or temporary advisory is considered and resampling is recommended when either (a) the maximum fish tissue concentration is three times greater than the action level or (b) the average fish tissue concentration is higher than the action level. When there are sufficient samples to achieve statistical confidence (i.e., 10 or more), an advisory will be issued when either (a) or (b) occurs and reevaluation will only occur when additional environmental information supports the need.

*c. Risk Assessment Procedure*

The IFCAP guidance states that a consumption advisory will be issued when it is not possible to follow the American Heart Association's recommendation to eat at least two fish meals a week or roughly 8.5 meals per month without consuming a dose exceeding a health-based screening level [e.g., reference dose (RfD)]. IFCAP (IDHW 2013b) uses the risk assessment assumptions summarized in **Table 2** and the following equations (USEPA 1994) to calculate the recommended meals per month. Consumption advisories in Idaho are risk-based and exist primarily for mercury with some limited advisories for lead and arsenic. Mercury and lead consumption limits are calculated by IDHW based on the non-carcinogenic endpoint, and arsenic limits are calculated on the carcinogenic endpoint.

- Calculation for non-carcinogens:

$$\frac{Meals}{Month} = \frac{\frac{RfD\ x\ BW}{Conc} x\ 30.44\ days/month}{MS}$$

- Calculation for carcinogens:

$$\frac{Meals}{Month} = \frac{\frac{TR\ x\ BW}{CSF\ x\ Conc} x\ 70\ years\ x\ 30.44\ days/month}{ED\ x\ MS}$$

- Where:

  RfD = Reference Dose (mg/kg-day)
  CSF = Cancer Slope Factor [$(mg/kg\text{-}day)^{-1}$]
  TR = Target Risk (unitless)
  BW = Body Weight (kg)
  ED = Exposure Duration (30 years)
  Conc = Fish Tissue Concentration (mg/kg)
  MS = Meal Size (kg)

For many waters the recommended consumption limits shown in **Table 1** cannot be replicated using the above equations and the exposure assumption inputs shown in **Table 2**. This is due in part to some additional risk management decisions the State makes once the limits based on those equations have been derived.

For example, based solely on the above equations and the exposure assumptions shown in **Table 2** (i.e., all other assumptions and risk management decisions being equal), consumption limits for the general population should be least restrictive. The mercury consumption limits for pregnant and nursing women should be about 10 percent more restrictive than the limits for the general population, and the consumption limits for children should be about two or six times more stringent than the consumption limits for the general population depending on the RfD that is used for children versus adults (see text that follows regarding the use of variable RfDs). However, review of **Table 1** indicates that for all waters (with the exception of Lake Coeur d'Alene), consumption limits based on mercury are the same for children and pregnant and nursing women and that the consumption limits for both of these receptor groups are about three to four times lower than the consumption limits for the general population rather than the two or six times lower as indicated by the equations cited.

The relative differences in consumption limits among the three receptor groups for Lake Coeur d'Alene differ depending upon lake, species, and tissue type. In some cases (arsenic in whole body Kokanee, **Table 1**) the relative differences between pregnant and nursing women, children, and the general population parallel the differences expected based on the relative intake differences from the assumptions shown in **Table 2** when using the same RfD – as is more generally practiced. In other cases, as with most other waters, the differences in some of the Lake Coeur d'Alene waters cannot be explained by the different assumptions shown in **Table 2** alone.

Based on correspondence with IDHW, when issuing final consumption limits for mercury, the State conservatively reduces the pregnant and nursing women meal consumption limits to equal the consumption limits derived for children (IDHW 2014b). This approach is taken for simplicity with the underlying assumption that the more sensitive population (i.e. children) should dictate meal choices for another sensitive subpopulation. Additionally, the State also employs an RfD for children that is lower (more conservative) than the RfD used for adults for mercury. The mercury RfD for children of 0.0001 milligrams of mercury per kilogram of body weight per day (mg/kg-day) is based on published USEPA data (USEPA 2014). The RfD used for an adult in the general population is a less conservative 0.0003 (mg/kg /day) based on Agency for Toxic Substances and Disease Registry data (ATSDR 2014). The practice of using different RfDs for different populations is a deviation from general practices because references doses are determined with consideration for all affected populations and as such are generally intended to be applied consistently across populations. The use of differing reference doses is not included in the Idaho Fish Consumption Advisory Protocol (IDHW 2013b). Based on the risk management decision to use different RfDs depending on population and have the consumption limits for pregnant and nursing women be identical to those derived for children, the consumption limits for pregnant and nursing women and children are inconsistently calculated and deviate from the assumptions included in **Table 2**. In addition, IDHW rounding results for the mercury limits may also be contributing to variability of the limit results (IDHW 2014b). Note that the arsenic and lead consumption advisory limits for Lake Coeur d'Alene were not calculated with these considerations.

## 3. Chemical Concentrations

The chemical concentrations in tissue collected by IFCAP that are used in development of the fish consumption advisories are summarized in **Table 3**. Specific sampling data could not be located for some of the water bodies where consumption limits are being applied. In some other instances the data used to support the consumption limits could not be located or may be only partially available; however, tissue data that were available from other sources for those water bodies are presented in the summary table for illustrative purposes. Such data are presumably available given the existence of a consumption advisory for such water bodies. IDHW (2014b) indicated that there may be a lag in when data are collected and when the data are published and available to the public via online resources.

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Tables

**Table 1. Idaho Fish Consumption Advisories**

| Water Body | | Species | Contaminant | Advisory Limit (Meals/Month) [a] | | |
|---|---|---|---|---|---|---|
| | | | | Women who are pregnant, planning to become pregnant, or nursing | Children under age 15 | General population |
| Statewide | | Bass | Mercury | 2 | 2 | 8 |
| American Falls Reservoir [e] | | Utah Sucker | Mercury | 2 | 2 | 8 |
| Bear River [f] | | Carp | Mercury | 4 | 4 | 14 |
| Boise River [e] | | Catfish | Mercury | 3 | 3 | 11 |
| Brownlee Reservoir | | Carp, Catfish, Perch | Mercury | 2 | 2 | 8 |
| | | Crappie | Mercury | 3 | 3 | 10 |
| Chesterfield Reservoir [f] | | Rainbow Trout | Mercury | 4 | 4 | 14 |
| CJ Strike Reservoir | | Bass | Mercury | 2 | 2 | 8 |
| Glendale Reservoir [e] | | Crappie, Perch | Mercury | 3 | 3 | 10 |
| | | Bluegill | Mercury | 4 | 4 | 14 |
| Grasmere Reservoir [f] | | Lahontan Cutthroat Trout | Mercury | 3 | 3 | 10 |
| Hells Canyon Reservoir [f] | | Carp, Catfish | Mercury | 2 | 2 | 8 |
| Jordan Creek [f] | | Redband Trout | Mercury | 2 | 2 | 8 |
| Lake Coeur d'Alene | All Lakes | Kokanee, Whole Body [b] | Arsenic | 10 | 6 | 12 |
| | | Kokanee, Fillet [b] | Arsenic, Mercury | 10 | 6 | 20 |
| | Northern Lake | Bullhead, Whole Body [c,d] | Lead | 4 | 3 | 20 |
| | | Bullhead, Fillet [c] | Arsenic, Mercury | 24 | 14 | 69 |
| | Central Lake | Bullhead, Whole Body [c,d] | Lead | 2 | 0 | 8 |
| | | Bullhead, Fillet [c] | Arsenic | 13 | 7 | 14 |
| | Southern Lake | Bullhead, Whole Body [c,d] | Lead | 13 | 8 | 33 |
| | | Bullhead, Fillet [c] | Arsenic, Mercury | 15 | 9 | 61 |
| Lake Lowell | | Sucker | Mercury | 3 | 3 | 10 |
| | | Carp | Mercury | 4 | 4 | 14 |
| Lake Pend Oreille | | Lake Trout | Mercury | 1 | 1 | 5 |
| | | Whitefish | Mercury | 4 | 4 | 14 |
| Oakley Reservoir [e] | | Yellow Perch | Mercury | 4 | 4 | 14 |
| | | Walleye | Mercury | 2 | 2 | 8 |
| Payette Lake [f] | | Lake Trout | Mercury | 2 | 2 | 7 |
| Payette River [f] | | Sucker | Mercury | 4 | 4 | 14 |
| Portneuf River [f] | | Cutthroat, Rainbow, and Brown Trout | Mercury | 3 | 3 | 10 |
| Priest Lake [f] | | Lake Trout | Mercury | 4 | 4 | 14 |
| Salmon Falls Creek Reservoir | | Perch | Mercury | 2 | 2 | 10 |
| | | Walleye (<16") | Mercury | 2 | 2 | 10 |
| | | Walleye (16-20") | Mercury | 0 | 0 | 6 |
| | | Walleye (>20") | Mercury | 0 | 0 | 2 |
| | | Bass | Mercury | 0 | 0 | 6 |
| | | Rainbow Trout | Mercury | 6 | 6 | 22 |
| Shoofly Reservoir [f] | | Lahontan Cutthroat Trout | Mercury | 2 | 2 | 8 |
| South Fork Snake River [f] | | Brown Trout | Mercury | 4 | 4 | 14 |
| Weston Reservoir [f] | | Yellow Perch | Mercury | 3 | 3 | 10 |

**Notes:**

[a] The amount of fish you can safely eat in a meal depends on your body weight. If you weigh 150 pounds, you can safely eat up to 8 ounces (precooked weight) of fish in a meal. To adjust the meal size for lighter or heavier weight, subtract or add 1 ounce of fish for every 20 pound difference in body weight.

[b] Kokanee are similar to many fish in the lake that were not tested. It is possible that these fish have high levels of arsenic and mercury, and the guidelines for Kokanee should be followed for these fish: Bluegill, Crappie and Perch less than 8 inches, Pumpkinseed, Rainbow Trout, Brook Trout, Cutthroat Trout & Tench.

[c] Bullhead are similar to many fish in the lake that were not tested. It is possible that these fish have high levels of lead, arsenic and mercury, and the guidelines for Bullhead should be followed for these fish: Channel Catfish and Suckers.

[d] People with increased blood lead levels or living in an area with high concentrations of lead in their yard soil or house dust should eat less whole Bullhead than suggested in this advisory. This is especially true for children and pregnant women.

[e] Data related to these consumption restrictions could not be located.

[f] Partial data sets for these water bodies was available for review as shown in Table 3; however, the consumption limits may be based on additional or different data that was not available.

**Table 2. IFCAP Risk Assessment Assumptions**

| Parameter | General Population | Pregnant Women [a] | Children [b] |
|---|---|---|---|
| Body Weight (kg) | 80 | 70 | 20 |
| Meal Size, Uncooked (oz) | 4 | 4 | 2.25 |
| Arsenic Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$ | 1.5 [c] | 1.5 [c] | 1.5 [c] |
| Lead Diet Slope Factor (ug/dL per ug Pb ingested per day) | 0.027 [d] | 0.034 [d] | 0.24 [d] |
| Mercury Reference Dose (mg/kg-day) | 0.0003 [e] | 0.0003 [e] | 0.0001 [f] |

**Notes:**

[a] Pregnant women, women planning to be pregnant, and nursing mothers

[b] Children 6 years old or younger

[c] Cancer slope factor from Agency for Toxic Substances and Disease Registry (ATSDR)

[d] Slope factor from ATSDR

[e] Reference dose for adults from ATSDR

[f] Reference dose for children from EPA Integrated Risk Information

**Table 3. Chemical Concentrations Driving Idaho Fish Consumption Advisories**

| Water Body | Species | Contaminant | Number Sampled | Concentration Range (ppm) | Mean Concentration (ppm) | Notes | Source |
|---|---|---|---|---|---|---|---|
| Bear River | Carp | Mercury | 10 | NA - 0.252 | 0.252 [a] | [k] | Essig [g] |
| Brownlee Reservoir | Carp, Catfish, Perch | Mercury | 76 | 0.17 - 0.67 | 0.35 [a] | 7.87 - 32.19 inches | USEPA [f] |
| | Crappie | Mercury | 58 | 0.08 - 0.95 | 0.36 [a] | 6.11 - 12.63 inches | USEPA [f] |
| Chesterfield Reservoir | Rainbow Trout | Mercury | 8 | NA - 0.227 | 0.227 [a] | [k] | Essig and Kosterman [h] |
| CJ Strike Reservoir | Bass | Mercury | 10 | 0.1 - 0.24 | 0.138 [a] | 10.23 - 13.38 inches | USEPA [f] |
| Grasmere Reservoir | Lahontan Cutthroat Trout | Mercury | 10 | NA - 0.319 | 0.319 [a] | [k] | Essig and Kosterman [h] |
| Hells Canyon Reservoir | Carp, Catfish | Mercury | 20 | 0.556 - 0.561 | 0.5585 [a] | [k] | Essig and Kosterman [h] |
| Jordan Creek | Redband Trout | Mercury | 9 | NA - 0.551 | 0.551 [a] | Rainbow Trout [k] | Dai and Ingham [i] |
| Lake Coeur d'Alene | Kokanee, Whole Body | Arsenic | 11 | NA - 0.194 | 0.145 [a] | Entire Lake | ATSDR 2003 [c] |
| | | Mercury | 11 | NA - 0.0853 | 0.0752 [a] | Entire Lake | ATSDR 2003 [c] |
| | Kokanee, Fillet | Arsenic | 10 | NA - 0.117 | 0.0831 [a] | Entire Lake | ATSDR 2003 [c] |
| | | Mercury | 10 | NA - 0.104 | 0.0917 [a] | Entire Lake | ATSDR 2003 [c] |
| | Bullhead, Whole Body | Arsenic | 10 | NA - 0.117 | 0.0831 [a] | Entire Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.104 | 0.0917 [a] | Entire Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.511 | 0.218 [a] | Center Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.11 | 0.0503 [a] | South Lake | ATSDR 2003 [c] |
| | | Lead | 30 | NA - 14.12 | 1.92 [a] | Entire Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 3.696 | 1.42 [a] | North Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 14.12 | 3.85 [a] | Center Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 1.353 | 0.479 [a] | South Lake | ATSDR 2003 [c] |
| | | Mercury | 30 | NA - 0.0752 | 0.0417 [a] | Entire Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.0512 | 0.0283 [a] | North Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.0752 | 0.0451 [a] | Center Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.0708 | 0.0518 [a] | South Lake | ATSDR 2003 [c] |
| | Bullhead, Fillet | Arsenic | 30 | NA - 0.328 | 0.056 [a] | Entire Lake | ATSDR 2003 [c] |
| | | | 10 | ND | ND [a] | North Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.328 | 0.116 [a] | Center Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.052 | 0.0276 [a] | South Lake | ATSDR 2003 [c] |
| | | Lead | 30 | NA - 1.494 | 0.0955 [a] | Entire Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.076 | 0.0288 [a] | North Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 1.494 | 0.232 [a] | Center Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.08 | 0.026 [a] | South Lake | ATSDR 2003 [c] |
| | | Mercury | 30 | NA - 0.138 | 0.0554 [a] | Entire Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.052 | 0.0385 [a] | North Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.138 | 0.0646 [a] | Center Lake | ATSDR 2003 [c] |
| | | | 10 | NA - 0.0721 | 0.0632 [a] | South Lake | ATSDR 2003 [c] |
| Lake Lowell | Sucker | Mercury | 40 | 0.027 - 0.515 | 0.171 [a] | NA | USEPA [f] |
| | Carp | Mercury | 38 | 0.042 - 0.363 | 0.165 [a] | NA | USEPA [f] |
| Lake Pend Oreille | Trout | Mercury | 14 | 0.285 - 0.93 | 0.421 [b] | 1.46 - 5.9 kg | IDHW 2005 [d] |
| | White Fish | | 15 | 0.163 - 0.354 | 0.264 [b] | 0.52 - 0.94 kg | IDHW 2005 [d] |
| Payette Lake | Lake Trout | Mercury | 10 | NA - 0.449 | 0.449 [a] | [k] | Essig and Kosterman [h] |
| Payette River | Sucker | Mercury | 27 | 0.186 - 0.276 | 0.232 [a] | [k] | Essig [g] |
| Portneuf River | Cutthroat, Rainbow, and Brown Trout | Mercury | [a] | 0.18 - 0.87 | 0.347 [a] | [k] | IDEQ 2007 [j] |
| Priest Lake | Lake Trout | Mercury | 10 | NA - 0.255 | 0.255 [a] | [k] | Essig and Kosterman [h] |
| Salmon Falls Creek | Rainbow Trout | Mercury | 10 | NA | 0.28 [b] | 15 - 18 inches | IDHW 2012 [e] |
| | Smallmouth Bass | | 10 | NA | 0.99 [b] | 11.5 - 14 inches | IDHW 2012 [e] |
| | Walleye (under 16 inches) | | 10 | NA | 0.64 [b] | 12 - 15.25 inches | IDHW 2012 [e] |
| | Walleye (16-20 inches) | | 4 | NA | 0.95 [b] | 16 - 19 inches | IDHW 2012 [e] |
| | Walleye (over 20 inches) | | 1 | NA | 1.98 [b] | 23.5 inches | IDHW 2012 [e] |
| | Yellow Perch | | 10 | NA | 0.69 [b] | 9.5 - 11 inches | IDHW 2012 [e] |
| Shoofly Reservoir | Lahontan Cutthroat Trout | Mercury | 10 | NA - 0.502 | 0.502 [a] | [k] | Essig and Kosterman [h] |
| South Fork Snake River | Brown Trout | Mercury | 10 | NA - 0.253 | 0.253 [a] | [k] | Essig [g] |
| Weston Reservoir | Yellow Perch | Mercury | 10 | NA - 0.339 | 0.339 [a] | [k] | Essig and Kosterman [h] |

**Notes:**

[a] Not specified

[b] Geometric mean

[c] Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Health Consultation: Evaluation of Metals in Bullhead, Bass, and Kokanee from Lake Coeur D'Alene. Available at: http://www.atsdr.cdc.gov/HAC/pha/PHA.asp?docid=1045&pg=0.

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[e] Idaho Department of Health and Welfare (IDHW). 2012. Health Consultation: Mercury in Fish from Salmon Falls Creek Reservoir, Rogerson, Idaho. Available at: http://www.healthandwelfare.idaho.gov/Portals/0/Health/EnvironmentalHealth/LHC%20SFCRFinal.pdf.

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[g] Essig. 2010. Arsenic, Mercury, and Selenium in Fish Tissue and Water from Idaho's Major Rivers: A Statewide Assessment. Arsenic, mercury, and selenium fish tissue data collected in 2008 from the major rivers of the state.

[h] Essig, D. and Kosterman, M. 2008. Arsenic, Mercury and Selenium in Fish Tissue from Idaho Lakes and Reservoirs: A Statewide Assessment. IDEQ. Arsenic, mercury, and selenium fish tissue data collected in 2007 from the lakes and reservoirs throughout the state.

[i] Dai, X. and Ingham, M. 2009. Analysis of Total Mercury Concentrations in Fish Samples from Jordan Creek and Non-Jordan Creek Sites. IDEQ. Mercury fish tissue data from a variety of fish species from Jordon Creek as well as East Fork, Flint, and Louise Creeks. Data were collected in 2005.

[j] IDEQ. 2007. Orofino Creek Mercury Monitoring Project. Mercury fish tissue data collected from salmonids in Orofino Creek. Data were collected in September 2007.

[k] Data obtained from sources possibly not directly related to fish consumption advisories. Data is provided here for illustrative purposes.

# Appendix G:

# Fish Consumption Suppression Review

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# Fish Consumption Suppression Review

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# Fish Consumption Suppression and Water Quality Criteria Rulemaking in Idaho

As part of a Negotiated Rulemaking for water quality standards, the Idaho Department of Environmental Quality (IDEQ) has convened a series of public meetings addressing critical issues for water criteria development. The October 2, 2014, meeting addressed the issue of fish consumption suppression and included presentations on this topic by the Shoshone Bannock Tribes (Shoshone Bannock 2014) and the Nez Perce Tribe (Nez Perce 2014). At the request of Clearwater Paper, Exponent reviewed these presentations and related information on fish consumption suppression; we provide comments below. These comments are not intended as a detailed review of fish consumption suppression, but rather to provide a discussion of important issues for evaluating suppression as it relates to water quality criteria development.

## Background

Fish consumption suppression is generally defined as a diminished rate of fish consumption compared to an appropriate baseline. In the context of regulatory decision-making and water quality criteria development, it is important to evaluate suppression not just on the basis of whether it exists, but also the causes. The definition is often expanded to describe an *artificially* diminished fish consumption rate *because* of a perception that the fish are contaminated (U.S. EPA 2000). However, suppression may occur as a natural consequence of social development and/or *because* of other reasons both related and unrelated to chemical impacts.

The two specific issues addressed in these comments are the potential causes of suppression and quantification of historical fish consumption rates.

## Issue: Evaluating Potential Causes of Suppression

Native American populations in the Pacific Northwest consume less fish than they did historically (Scholz et al. 1985; Harper and Harris 2008). It has been proposed that historical fish consumption patterns be used to establish an appropriate baseline to assess current suppression rates (Harper and Harris 2008). When evaluating whether to consider suppression in water quality criteria development, it is important to separate causes of suppression that are related to chemical impacts from those that are not. The table below lists potential causes of suppression, grouped by those related to chemical impacts to water and those that are not.

**Potential causes of suppressed fish consumption**

| Related to Chemical Impacts | Unrelated to Chemical Impacts |
|---|---|
| Fish population decline associated with chemical impacts | Fish population decline unrelated to chemical impacts |
| Fish advisories and other restrictions | Social changes in dietary patterns and choices |
| Perception of contamination | Changes in family/social structure |
| | Habitat loss |
| | Availability of alternative foods and economic resources to purchase them |

If suppression is primarily due to chemical impacts, then water quality criteria that quantitatively incorporate non-suppressed fish consumption rates could theoretically contribute to reversal of suppression and lead to higher fish consumption; this might suggest the need for more stringent water quality criteria in the future, if consumption changed to a higher level. However, if suppression is primarily due to factors unrelated to chemical impacts (e.g., societal changes, habitat loss), incorporating higher rates of fish consumption in water quality criteria based on historical practices would not likely lead to a higher rate of consumption in the future; in which case water quality criteria based on current consumption patterns would meet the goal of providing a high degree of public health protection, both currently and in the future.

Of the three potential causes of suppression related to chemical impacts listed above, fish population decline associated with chemical impacts is addressed in water quality criteria for the protection of aquatic life rather than human health. The other two potential causes associated with chemical impacts (i.e., recommended limits on fish consumption based on fish advisories or other restrictions and self-imposed limits based on real or perceived risks from chemical concentrations in fish) are associated with water quality criteria either directly or indirectly. However, it is unclear that either of these potential causes are actually significant reasons for diminished fish consumption relative to historical rates of consumption. Harper and Harris (2008) discuss reduced fish consumption from the Columbia River basin among the Confederated Tribes of the Umatilla Indian Reservation: "Many people have lost access to traditional fishing sites for a variety of reasons, while others lack time to fish, or have reduced fishing to avoid harassment which can be quite significant." In addition, the authors state that "due to the reduction in fish availability, all of these baseline [health] benefits have been adversely affected, even without contamination." Scholz and colleagues (1985) attribute significant declines in fish harvest related to dam construction from the late 1800s through the 1930s. Consistent with this, the presentation by the Shoshone Bannock (2014) indicates a steep decline in returning Columbia River salmon, from an estimated 17 million in 1855 to approximately 1.5 million in 1940, with populations hovering around that level to the present.

## Conclusion of Issue

The available information indicates that reductions in fish harvest and consumption occurred in the 1900s in association with development of hydroelectric plants, diminished fish resources, more limited access to fishing sites, and social changes. However, no scientific data are available to indicate suppression of fish consumption from historical levels is attributable to chemical impacts.

## Issue: Quantification of Historical Fish Consumption

The presentations at the IDEQ Negotiated Rulemaking public meeting on October 2, 2014 reported that fish harvest has declined significantly among Native American populations. As noted above, the presentation by the Shoshone Bannock (2014) reported a decline in returning Columbia River salmon from an estimated 17 million to 1.5 million between the late 1800s and the mid-1900s. Although a documented decline in fish population would not necessarily result in a decline in fish consumption if the remaining resource is not a limiting factor for harvest and consumption at the desired level, available information indicates a decrease in fish consumption that correlates with the timing of the declining resource (Scholz et al. 1985).

The available information about historical fish consumption patterns in the Columbia River basin is primarily anecdotal in nature, collected by ethnographers and historians (Scholz et al. 1985). The information is useful for understanding general shifts in cultural patterns in the context of changing resource levels; however, the methods used to collect the information do not provide adequate data to support quantitative estimates of fish consumption or specific changes in fish consumption over time. Minimum standards for method development, data collection and analysis, data quality assurance evaluation, and reporting are required by regulatory agencies for current studies to be adequate for use in regulatory decision-making. Historical information was not collected using standard dietary survey methods, nor was it subjected to the level of review that would be a requirement for studies evaluating current consumption patterns.

Retrospective surveys that ask respondents to recall consumption patterns from the distant past are unlikely to produce reliable, quantifiable estimates of fish consumption. Analyses indicate that retrospective diet history surveys, such as food frequency questionnaires that look back over even the limited timeframe of a year or longer, are more likely to overestimate actual consumption than surveys requiring short-term recall (e.g., 24-hour) (Rasanen 1979). Recall would suffer to an even greater degree for surveys that extend back further in time. In addition, the survey would be limited to older members of the population, whose fish consumption habits may differ substantially from younger members. Thus, any current study soliciting information about consumption patterns from the distant past may not be representative of current or likely future consumption patterns, independent of any chemical impacts.

One study conducted in Pacific Northwest by the Lummi Tribe collected information on "historical" fish consumption rates, asking respondents to report fish consumption information from 25 years prior (Lummi Nation 2012). The study was limited to adult male tribal members over 45 years of age (men at least 20 years old in 1985). The study authors briefly discussed in the report the uncertainties and limitations associated with long-term study designs such as this, and acknowledged the potential for recall bias, but did not provide a basis for establishing that recall bias did not impact the study results. In addition, as documented in the study, the focus was on a single year (1985) with a substantially higher harvest than all years after or at least five years before (the earliest reported in the study). Therefore, even if an accurate estimate of fish consumption in 1985 could be derived, it would likely overestimate long-term consumption patterns either before or after 1985.

Finally, the Lummi reservation is situated on Puget Sound, and Tribal members have far different fish resources and fish consumption habits from inland Tribes in Idaho (Exponent 2013). For these reasons, the Lummi Nation study does not provide adequate information to derive a reliable estimate of fish consumption in the past (1985), nor is it relevant to establishing fish consumption rates for residents in Idaho.

## Conclusion of Issue

Adequate data from studies conducted in historical times are not available to accurately quantify historical fish consumption rates. The one modern study conducted in the Pacific Northwest that specifically focused on collecting data on past fish consumption (25 years prior to the study) is not adequate for deriving a reliable fish consumption rate. More importantly, data collected for coastal populations (where fishing resources are abundant, and other resources may not be) are unlikely to provide a representative fish consumption rate for inland populations with more limited access to fish.

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# Exhibit H:

## IDAHO WATER QUALITY RULEMAKING ON TOXICS
## TRIBAL TREATY RIGHTS

This White Paper addresses an issue that has arisen in the negotiated rule making process under this docket. Specifically, it addresses the relationship between the rights and obligations assumed by the United States towards the Nez Perce Tribe in the Treaties between the two and the relationship between those Treaties and the obligation of the State to promulgate rules that are consistent with the requirement of the Clean Water Act. This White Paper establishes that the Treaties do not require any particular water quality standards, do not establish any levels of fish production or consumption by the Tribe, and do not impose any requirements on the State of Idaho in this rulemaking.

The Nez Perce Tribe and EPA in comments to Idaho DEQ during the negotiated rulemaking in Docket No. 58-0102-1201, appear to assert that the State of Idaho must establish water quality standards for fish consumption based upon the premise that the Treaties between the Nez Perce Tribe and the United States established a right to a particular quantity of harvestable fish and that this quantity of fish should be used as the basis for establishing Idaho water quality standards. This claim is not consistent with the actual terms of the Treaties between the United States and the Nez Perce Tribe and is not consistent with the court decisions interpreting the Treaties and the rights of the Tribe to harvest fish under the Treaties.

To the extent that any trust obligation arises from these Treaties with the Tribe, such would be an obligation that the United States Government would owe to the Tribe. No trust obligation is imposed on the State of Idaho or the people of the State of Idaho by these Treaties. The State is simply not a party to the Treaties.

Nor do the Treaties establish any level of harvest or water quality. If the United States wishes to provide a level of fish populations over and above what would be required under the Endangered Species Act to recover the species, any such measures would be the responsibility of the United States, not of the State of Idaho. Such voluntary undertaking by the United States is not something that the State of Idaho must consider in establishing state water quality standards. Idaho state water quality standards are guided by the Clean Water Act, and by the beneficial uses established by the State under State law, not by some separate and independent obligation that the United States owes the Tribe, real or imagined.

First, the 1855 and 1863 Treaties, and the 1893 Agreement with the Tribe make no mention of any particular quantity of fish or harvest levels. Nothing in the Treaties provides that the Nez Perce Tribe would live on fish and fish alone. To the contrary, the intent of the Treaties (as was well understood by the Tribe) was to convert the Tribal members to agriculturalists. Indeed, the Tribe was awarded a significant quantity of water for use for agricultural purposes on the reservation based on the reserved water right claims asserted by the Tribe in the Snake River Basin Adjudication (SRBA) claims made by the Tribe for irrigation water rights including water for future agricultural uses.

The 1855 Treaty contains language reserving to members of the Tribe the right to take fish at their "usual and accustomed" fishing places off the reservation. The meaning of the right to take fish at the "usual and accustomed" fishing places has been litigated many times over the years because several other Columbia Basin tribes had the same language in their treaties negotiated by the same treaty negotiator for the United States, Governor Isaac Stevens of the Washington territory. These "Stevens Treaties" include the Treaties with the Nez Perce Tribe.

In *Washington v. Passenger Vessel Fishing Association*, 433 U.S. 658 (1979), the United States Supreme Court held that this language in these Stevens Treaties was "unambiguous." The Supreme Court held that the meaning of this language was "to secure the Indians' right to take a share of each run of fish that passes through tribal areas." *Id.* at 668. In other words, "both sides have a right, secured by treaty, to take a fair *share* of the *available* fish." *Id.* at 669 (emphasis added). The Supreme Court also concluded that the percentage allocations for the fish run were maximums which could be regulated in response to changing circumstances. *Id*. at 687. The United States Supreme Court took up a Stevens Treaty in *Puyallup Tribe v. Department of Game of Washington*, 433 U.S. 173 (1977), and held there that the state can regulate the fishing right for conservation purposes.

The right to fish at "usual and accustomed" fishing places does not create a requirement that a certain quantity of fish be provided. *Nez Perce Tribe v. Idaho Power Company*, 847 F. Supp. 791, 808 (1994). There the Court held that the Nez Perce Tribe "do not have an absolute right to preservation of the fish runs in their original 1855 condition, free from all environmental damage, free from all environmental damage caused by the migration of increasing numbers of settlers and the resulting development of the land." *Id.* at 808. The Court specifically determined that the Stevens Treaties do not guarantee that development will not diminish or even eliminate the fish runs. *Id.* at 814. This same principal was recognized and upheld in litigation when the court rejected the federal reserved instream water right claims filed in the SRBA by the United States and the Tribe. *Consolidated Subcase* 03-10022 (Nez Perce Tribe Instream Flow Claims), *In Re SRBA*, (November 10, 1999).

There is no law requiring the maintenance of a quantity of fish consumption of a century and a half ago. Idaho water quality standards cannot therefore required to be based on the assumption that fish consumption levels of 1855 must be protected. Such a claim would find no support in the Treaties, established Court precedent, or under the Clean Water Act.

The Clean Water Act requires water quality standards are required by law to be established to meet existing beneficial uses. CWA § 303(c) provides that "revised or new water quality standard shall consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based on such uses." Nothing in the Clean Water Act imposes upon the State an obligation to establish water quality standards at a level that would meet some unknown past level of beneficial use, a more pristine quality, or pre-Columbian water quality conditions. Nothing in 40 CFR 131.6 requires the State to consider this factor. It is up to the State to establish and protect existing beneficial use. *Id.* The Clean Water Act does not require any state to set its water quality standards at pre-Columbian levels of uses or quality.

The Tribe and EPA appear to argue that the United States has a trust responsibility to ensure that state water quality standards are set at a level that allows the Tribe to harvest that amount of fish that the Tribes wishes to harvest, regardless of whether those fish are "available" or are projected to be available. The law of the United States is to the contrary. The trust obligation of the United States to the Tribe is to carry out the terms of its treaty. This Treaty contains not terms requiring e a certain quantity of fish. Instead the unambiguous meaning of the treaty is that it recognizes the right to take of a share of the "available fish." *Washington v. Passenger Vessel Fishing Association*, 433 U.S. 658 (1979). Second, as to off reservation activities, the United States' trust obligation to the Tribes is to follow the existing law. See *Nance v. EPA*, 645 F.2d 701 (9th Cir. 1981) (holding that EPA did not violate any trust responsibility in characterizing off-reservation land as Class I under the Clean Air Act);

In *Gross Ventre Tribe v. United States*, 469 F.3d 801 (9th Cir. 2006), the Ninth Circuit confirmed that a federal agency's obligations to an Indian Tribe, relative to off-reservation lands, are discharged through compliance with the existing law:

> [U]nless there is a specific duty that has been placed on the government with respect to Indians, this responsibility is discharged by the agency's compliance with general regulations and statutes not specifically aimed at protecting Indian tribes. This is the law of the circuit, and this is the law [the courts] must follow.

*Gross Ventre Tribe v. United States,* 469 F.3d 801, 812 (9th Cir. 2006), *cert. denied,* 522 U.S. 824 (2007); *Shoshone-Bannock Tribes v. Reno*, 56 F.3d 1476, 1482 (D.C. Cir. 1995) ("Without an unambiguous provision by Congress that clearly outlines a federal trust responsibility, courts must appreciate that whatever fiduciary responsibility exists, it is a limited one only").

No trust obligation of the United States allows or requires the United States to manipulate the Clean Water Act to force states or third parties to bear the responsibility that the United States believes is appropriate to carry out its own trust obligation to the Tribe. In fact, the United States just argued successfully in front of the United States Court of Appeals for the Federal Circuit that it had no trust obligation to endure adequate water quality on another tribal reservation. *Hopi Tribe v. United States*, 782 F.3d 662 (Fed Cir. 2015). There the Court stated that the trust doctrine does not impose obligations on the United States unless the United States specifically accepts those obligations by statute. Since the United States has no such trust obligation, surely it cannot impose an obligation on the States to perform what the United States does not have to perform.

The Treaties with the Nez Perce Tribe do not impose on the United States the obligation to maintain a particular level of fisheries. Nor does the Endangered Species Act, the Clean Water Act, or any other statute. As the Court stated in *Hopi Tribe v. United States*, "the sources of law relied on by the Hopi Tribe do not establish a specific fiduciary obligation on the United States to ensure adequate water quality on the Hopi Reservation." Where this trust obligation issue was directly in front of the Court, the Court found no obligation to establish a particular level of water quality for the Tribe. Here the Tribe and United States' claim of a trust obligation to the Tribe to establish particular levels of water quality is even more attenuated because the decisions of the United States Supreme Court interpreting the Stevens Treaties disclaim any responsibility to maintain a particular level of fish returns or consumption.

No water quality standard can be imposed upon the people of the State of Idaho by EPA or the Tribe based upon the claim that Idaho water quality standards must be set at a level to protect the right to harvest and consume a particular number of fish in the future that do not now exist.