

Sent via email to: paula.wilson@deg.idaho.gov

August 1, 2018

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

Dear Ms. Wilson:

The Department of Environmental Quality (the Department) has commenced a rulemaking to revise the arsenic human health water quality criteria. The Idaho Association of Commerce and Industry (IACI) is the leading trade association of Idaho businesses and represents hundreds of employer members of all sizes engaged in diverse commercial and industrial enterprises through the state. The arsenic water quality criteria values have a direct impact on requirements for water discharge or cleanups for a number of IACI members. Thus, IACI appreciates the opportunity to provide comments on this important rulemaking. These comments are focused on providing a framework for the Department to consider when the rulemaking process resumes in late November 2018.

1. Arsenic Human Health Water Quality: Toxicity and Criteria

1.A. The Toxicity of Inorganic Arsenic

The United States Environmental Protection Agency (EPA) utilizes the Integrated Risk Information System (IRIS) to provide scientifically credible toxicological information to form the basis of setting water quality standards for toxics. EPA has worked on updating the IRIS assessment for inorganic arsenic for many years and released an updated draft cancer assessment in 2010. Questions about the 2010 assessment led to a Congressional mandate that an independent peer review of the toxicological assessment of inorganic arsenic be done before EPA finalized the IRIS assessment. EPA withdrew the 2010 assessment and the National Research Council (NRC) began an independent review of the IRIS assessment process.¹

EPA's updated 2010 draft cancer assessment was widely criticized, which led to the Congressional mandate for an independent peer review. In an interim report issued by the NRC (NRC 2013), specific guidance and recommendations for improving the toxicological assessment of inorganic arsenic were provided.²

The NRC (2013) reviewed EPA's updated 2010 draft cancer assessment and identified several technical issues that precluded them from supporting EPA's conclusions. In response, the NRC

¹ This IRIS reassessment by EPA is now tied into the development of new human health water quality arsenic criteria for Idaho. EPA was sued in 2015 by Northwest Environmental Advocates (NWEA) for the June 21, 2010 approval of Idaho's arsenic human health criteria of 10 micrograms/liter (µg/L). In a June 7, 2016 settlement with NWEA, EPA agreed to take action which ultimately led to EPA reversing its approval of the 10 µg/L criterion. In a subsequent June 12, 2018 settlement with NWEA, EPA agreed to finalize the IRIS toxicological review of inorganic arsenic by the summer of 2021 and to finalize the human health arsenic criteria by November 15, 2023.

² National Research Council. 2013. Critical Aspects of EPA's IRIS Assessment of Inorganic Arsenic: Interim Report. The National Academies Press.

(2013) provided EPA with recommendations that would address these critical limitations. They included the need to:

- Expand dose-response analyses down to background concentrations using observed data for the “variety of health effects on which there is adequate epidemiological evidence”;
- Expand the dose-response analysis to include results from alternative models to evaluate how model-dependent the low-dose extrapolation results are;
- “Fit a general nonlinear model to observed data”, where the “nonlinear model can accommodate a linear fit if supported by the data”; and
- Incorporate meta-analytic procedures into dose-response modeling (using linear and non-linear methods) for epidemiological data.

1.B. Regulatory Approaches

Human health water quality criteria have to protect designated beneficial uses. For purposes of the arsenic criteria, the applicable designated beneficial uses are recreation and domestic water supply. These lead to the development of two criteria values:

- A criterion for the consumption of fish only (recreation beneficial use); and
- A second criterion for the consumption of fish and water (domestic water supply and recreation beneficial uses).

Often water quality criteria adopted by the states are based on EPA’s own Clean Water Act (CWA) section 304(a) recommended criteria. States can develop their own criteria as long as such criteria protect the designated use and are based on sound scientific rationale.³ EPA developed section 304(a) criteria for arsenic in 1992 (Table 1).

Table 1
EPA CWA § 304(a) Arsenic Criteria

	Criteria⁴ (µg/L)
Water and organisms	0.018
Organisms only	0.14

EPA’s section 304(A) recommended criteria for arsenic have been problematic for a couple reasons. First, as described earlier, there has been considerable debate on the scientific basis of the assumptions about the toxicity of inorganic arsenic used to develop EPA’s recommended criteria. Second, more than 25 years have passed since EPA developed the recommended criteria shown in Table 1. During that time new information affecting exposure assumptions used to develop the 1992 criteria has also become available. For example, new information about the bioaccumulation and speciation of arsenic in fish indicates EPA’s 1992 criteria overestimate bioaccumulation of inorganic arsenic in fish. Third, especially for Western states, arsenic is prevalent in the natural landscape. Thus, surface and groundwater often have concentrations greatly exceeding EPA’s recommended 304(a) criteria.

This has led to states developing a number of different approaches to setting arsenic human health water quality criteria. These approaches have included:

³ 40 CFR § 131.11(a).

⁴ Criteria assume an allowable excess lifetime cancer risk level of 1×10^{-6} . Assuming Idaho’s allowable risk level of 1×10^{-5} , the values would be 0.18 and 1.4 µg/L respectively.

- Derivation of a state specific criteria value using state specific values for parameters such as bioaccumulation factors (BAFs), speciation of arsenic in fish tissue, allowable risk, among other factors;
- Background or natural concentrations of arsenic; and
- Use of Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs).

As shown in Appendix A, Western states have a wide variety of arsenic water quality criteria. Six of the fourteen states listed have either a water and organism criteria or organism only criteria value that is 10 µg/L or higher. Four states have as criteria the EPA 304(a) values, one of which was imposed by EPA.⁵

1.C. Arsenic Criteria for Idaho

As alluded to earlier, arsenic commonly occurs naturally in soils and waters in the West, including Idaho. Studies conducted by DEQ have shown arsenic concentrations in surface water that range from less than 1 µg/L up to 17 µg/L (Appendix B).⁶ At 40 different sampling locations, only two sites had arsenic concentrations less than the EPA CWA 304(a) organism only criteria value of 0.14 µg/L; no sites had an arsenic concentration that met the water and organisms value of 0.018 µg/L. Clearly, the 304(a) criteria are inappropriate and unattainable for many major surface waters in Idaho.

2. Arsenic in Idaho Waters and Fish: Criteria and Implementation Implications

2.A. Assessing Toxicity and Idaho Specific Data

Determining the appropriate toxicity value(s) for use in calculating human health criteria for Idaho waters is difficult as evidenced by the controversy in the work done by EPA. As EPA undertakes its reassessment of the toxicity of inorganic arsenic, and there is further review and analysis by other credible organizations and researchers, the Department should carefully review such work. The work that is expected to occur in the next several years may provide information that can be used to evaluate alternative approaches to assessing toxicity of arsenic. Such work could possibly lead to a protective and achievable arsenic human health criterion in Idaho.

2.B. Utilization of Idaho Specific Water Concentration and Fish Tissue Data.

The data collected from Idaho waters and fish can also be used as provided in Idaho's water quality rules to develop criteria.

The rules do provide for the use of natural background conditions as criteria.⁷ However, in doing so, the Department should not use the "percentile" approach to establish background. It would mean that some portion of Idaho surface waters (the portion with concentrations above the selected percentile) would exceed the human health criteria due solely to naturally occurring arsenic concentrations. The arsenic criteria need to recognize the full range of naturally occurring background concentrations of arsenic in Idaho surface waters. All dischargers, regardless of whether present on low or high natural background receiving waters, should be treated equally with regard to consideration of background concentrations.

⁵ The State of Washington, like Idaho, finalized arsenic human health water quality criteria of 10 µg/L. EPA disapproved those criteria in 2016 and substituted the National Toxics Rule (NTR) criteria values, which for arsenic are the same as the Section 304(a) recommended criteria.

⁶ Essig, D. 2010. Arsenic, Mercury and Selenium in Fish Tissue and Water from Idaho's Major Rivers: A Statewide Assessment. Idaho Department of Environmental Quality. March 2010.

⁷ IDAPA 58.01.02.200.09

Also, the data collected so far can be used to establish an organism only arsenic criterion. An analysis of the data collected by the Department shows that an Idaho-specific BAF for inorganic arsenic is low. Looking at paired data, there is a strong indication that inorganic arsenic concentrations in fish are independent of inorganic arsenic concentrations in water. A 15 ug/L fish consumption only criteria can be derived using an Idaho-specific BAF of 0.53 L/kg combined with the Department's standard assumptions to derive human health criteria for fish consumption only. Those assumptions include consumption of 66.5 grams of Idaho fish by a person weighing 80 kilograms, for every day of the year, for every year of his or her entire lifetime, and an allowable risk of 1×10^{-5} . Using those assumptions and the current cancer slope factor for arsenic of $1.5 \text{ (mg/kg-day)}^{-1}$ results in a fish consumption only criteria of 15 ug/L for total arsenic (see Appendix C, Sections 3 and 4 for the calculations). A criterion of 15 ug/L is protective of human health, and achievable for the vast majority of Idaho's waters.

2.C. Implementation Tools

Idaho's water quality rules also have several "implementation tools" that might be of assistance to the regulated community in the implementation of any new arsenic criteria. Potential tools include variances, use attainability analysis and site-specific criteria. Of these tools, use attainability analysis offers the most practicable regulatory method to the regulated community.⁸ Variances would potentially be problematic. A variance (unless specifically described in the rules) would need to be re-issued in conjunction with a discharge permit renewal, which is typically every five (5) years. Because it is unlikely that arsenic concentrations in a receiving water would have changed during the term of a permit, the variance process would need to be repeated for every five (5) year permit renewal cycle. This repeated reissuance of variances is not practical.

3. Recommended Framework for Revising Idaho's Human Health Water Quality Criteria

IACI recognizes that the Department has already done a considerable amount of work in recent years relative to human health water quality standards. The Department has conducted state-wide water quality surveys on bioaccumulative metals and fish consumption rates. IACI recommends that the Department build upon this work with the actions listed below.

- A. Develop additional data on arsenic water quality and paired water arsenic/fish tissue values, including samples collected in undisturbed mineralized areas of the state. These data will be helpful in developing Idaho-specific BAFs, estimates of speciation of arsenic if fish tissue and surface water, and identifying Idaho waters where use of CWA implementation tools (such as use attainability analysis) might be warranted. The sampling plan for such a study should be made available for public review and comment.
- B. Evaluate alternative approaches to assessing the toxicity of arsenic, including use of Idaho-specific data.
- C. The data gathered and alternative approaches can potentially be used for:
 - a. The development of an Idaho specific arsenic criteria that uses state specific data (such as BAF, arsenic speciation, and fish consumption rate) and an alternative toxicity assessment approach;

⁸ IDAPA.58.01.02.102.d.

- b. Developing organism only criteria for water bodies that are not designated as drinking water supply. Preliminary calculations (shown in Appendix C) derive an Idaho-specific criterion of 15 µg/L; and
- c. Identification of water bodies where criteria would be based on natural background conditions or a use attainability analysis.

IACI believes that these recommendations will assist the State in deriving criteria based on the Idaho specific data (i.e., data reflecting actual Idaho water quality conditions) and best scientific methods, rather than conformance with a “one-size fits all” regulatory approach (i.e., such as the National Toxics Rule). IACI will continue to support the Department in this important work.

The consideration of these comments by the Department is appreciated.

Sincerely,



Alex LaBeau
President

cc: Alan Prouty, Chair
IACI Environment Committee

Appendix A

State	Effective Date	Drinking Water (µg/l)	Water and Organism (µg/l)	Organism only (µg/l)	Notes
Alaska	2008	10	--	--	Alaska drinking water criterion is based on the federal maximum contaminant level (Safe Drinking Water Act). The reference column in the Alaska Water Quality Criteria for Toxics and Other Deleterious Substances Table for arsenic human health refers to federal code 63 FR 10140, which states that EPA withdraws the applicability to Alaska's waters of the federal human health criteria for arsenic. Alaska does not appear to have established it's own state-specific human health surface water quality criteria for arsenic.
Oregon	2014	--	2.1	2.1 (freshwater) 1.0 (saltwater)	Oregon human health water criteria are given for consumption of water and organisms and consumption of organisms only. The organism only freshwater criterion is based on a risk level of approximately 1.1×10^{-5} , and the water and organism criterion is based on a risk level of 1×10^{-4} .
Washington	2016	--	0.018	0.14	EPA disapproved of Washington's proposed 2016 water quality criteria for consumption of water and organisms (10 µg/l) and organisms only (10 µg/l). Therefore, the Clean Water Act-effective criteria are those that EPA originally promulgated for Washington in the National Toxics Rule for consumption of water and organisms (0.018 µg/l) and organisms only (0.14 µg/l).
California	2008	10	0.018	0.14	California drinking water criterion is based on the federal maximum contaminant level (Safe Drinking Water Act). The human health surface water quality criteria for consumption of water and organisms and organisms only are based on the federal National Toxics Rule. We have not contacted California to understand how they apply the different criteria when setting permit limits.
Arizona	2016	10	--	80	Arizona human health water quality criterion is based on the federal maximum contaminant level (Safe Drinking Water Act) for drinking water (called "domestic water source" and defined as the use of a surface water as a source of potable water in Arizona administrative code). The fish consumption value of 80 µg/l is defined in Arizona administrative code as the use of a surface water by humans for harvesting aquatic organisms for consumption. Harvestable aquatic organisms include, but are not limited to, fish, clams, turtles, crayfish, and frogs.
Nevada	2018	50	--	--	Nevada water quality criterion is the maximum contaminant level (Safe Drinking Water Act) for drinking water and contact recreation uses. No values are given for consumption of water and organisms or consumption of organisms only. 50 µg/l is the federal maximum contaminant level for arsenic prior to 2001.
Utah	2016	10	10	10	Utah human health water quality criteria for drinking water, the consumption of water and organisms, and the consumption of organisms only are based on the federal maximum contaminant level (Safe Drinking Water Act) for drinking water (called "domestic source uses" in Utah administrative code).
New Mexico	2017	10	--	0.14	New Mexico drinking water criterion is based on the federal maximum contaminant level (Safe Drinking Water Act) for drinking water (called "domestic water supply" in New Mexico administrative code). No specific human health surface water criteria for consumption of water and organisms or consumption of organisms only are provided. New Mexico administrative code appears to state that if no state-specific human health surface water quality values are provided for the consumption of organisms only, then the federal Clean Water Act criteria for consumption of organisms only is in effect.
Texas	2014	--	10	--	Texas human health water quality criterion is for the consumption of water and organisms and is based on the federal maximum contaminant level (Safe Drinking Water Act) for drinking water. No separate value is given for consumption of organisms only.
Montana	2004	10	10	--	Montana drinking water and human health surface water quality criteria are based on the federal maximum contaminant level (Safe Drinking Water Act) for drinking water. Montana assumes that surface water criteria are for the consumption of water and organisms. No organism only criteria are provided.
Wyoming	2018	--	10	10	Wyoming human health surface water quality criteria for consumption of fish and organisms or consumption of organisms only are based on the federal maximum contaminant level (Safe Drinking Water Act).
Colorado	2018	0.02 - 10	0.02	7.6	The Colorado drinking water criterion (called "domestic water supply" in Colorado administrative code) is a range of values. The first number in the range is a strictly health-based value, based on the Colorado Water Quality Control Commission's established methodology for human health-based standards. The second number in the range is a maximum contaminant level, established under the federal Safe Drinking Water Act that has been determined to be an acceptable level of this chemical in public water supplies, taking treatability and laboratory detection limits into account. Human health surface water criteria are provided for consumption of water and organisms and consumption of organisms only.
South Dakota	2015	--	0.018	0.14	South Dakota human health surface water quality criteria for the consumption of water and organisms and consumption of organisms only are provided and based on the federal National Toxics Rule.
North Dakota	2014	--	10	--	North Dakota human health surface water quality criterion is for the consumption of water and organisms and is based on the federal maximum contaminant level (Safe Drinking Water Act) for drinking water. No separate value is given for consumption of organisms only.
Notes					
µg = micrograms					
l = liter					
EPA = United States Environmental Protection Agency					
-- = no specific numeric value is provided in state documentation or state administrative code					

Appendix B

Total and Inorganic Arsenic

No sample had an arsenic concentration that exceeded Idaho's water quality criteria for arsenic (the lowest of which is 50 µg/L to protect human health). Inorganic arsenic is thought to be the more toxic form of arsenic to humans and is the form specified in Idaho's 50 µg/L human health criterion.

The highest total arsenic concentration of 17 µg/L was in the sample from the Bruneau River. The highest inorganic arsenic concentration of 12 µg/L was also in the Bruneau River sample. This was the only sample to exceed 10 µg/L, which is the drinking water maximum contaminant level and also the inorganic arsenic concentration Idaho has proposed for adoption as a surface water human health criterion.

Only two of the sites monitored had samples with concentrations less than the EPA-recommended arsenic criterion⁸ of 0.14 µg/L, which is recommended for protection of human health, applicable to cases in which the only route of exposure is the consumption of fish. No water samples had arsenic levels less than the companion criterion of 0.018 µg/L, which is recommended for cases in which exposure is both from drinking water and consuming fish from the same water body. Figure 9 shows the range in total and inorganic arsenic concentrations among sites.

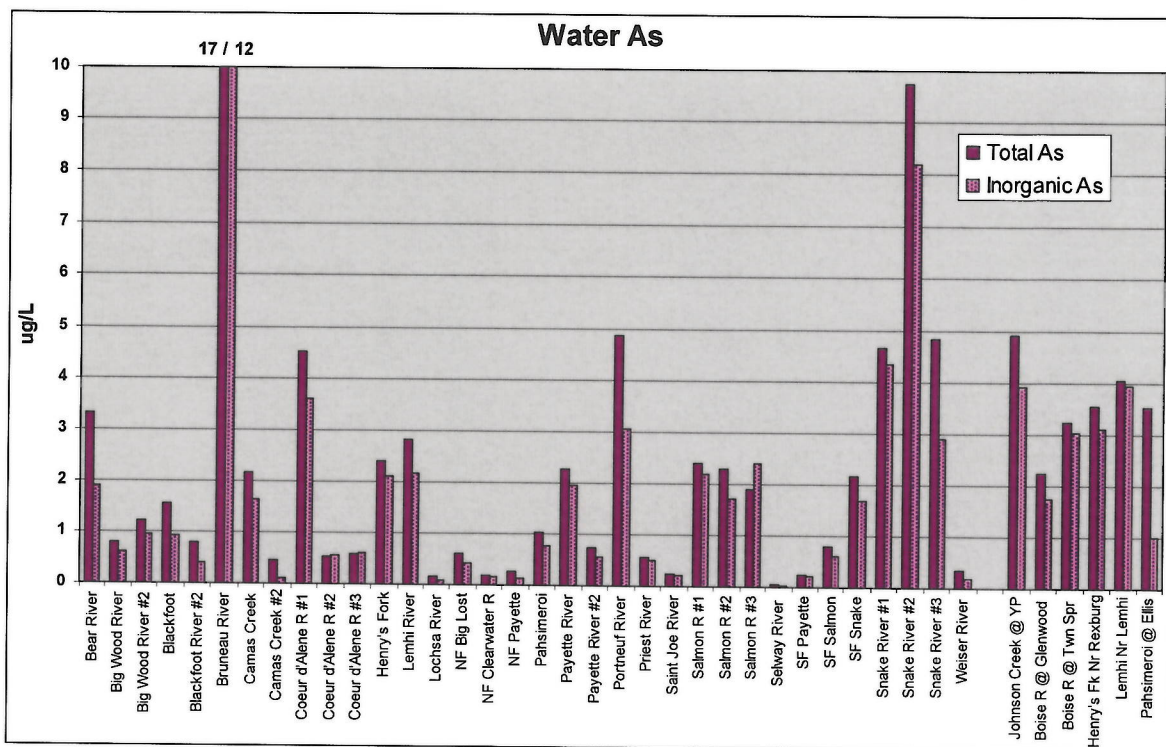


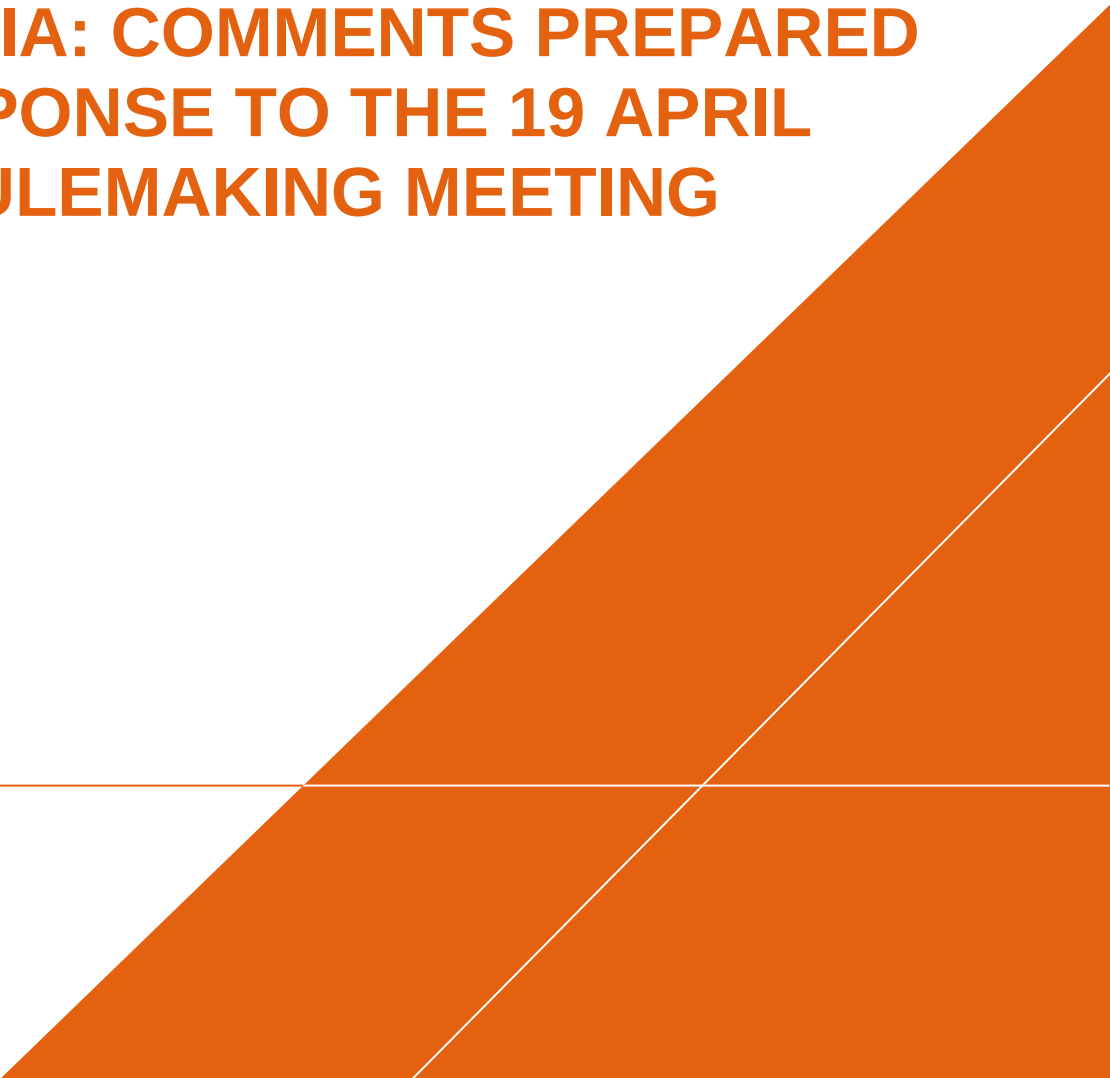
Figure 9. Total and Inorganic Arsenic (As) in Water (the first 34 sites shown are those that were planned for this study; the other six sites are those for which USGS provided samples)

⁸ See section 304(a) of the Clean Water Act. Note that the recommended criterion is for arsenic in water, not in fish, even though it relates to consumption of fish.

J.R. Simplot Company

IDAHO ARSENIC HUMAN HEALTH CRITERIA: COMMENTS PREPARED IN RESPONSE TO THE 19 APRIL 2018 RULEMAKING MEETING

April 2018

A large, solid orange geometric shape, resembling a stylized triangle or a section of a larger triangle, is positioned in the bottom right corner of the page. It is composed of two overlapping triangles, creating a complex, angular form. A thin white line runs diagonally through the shape, and a horizontal white line intersects it near the bottom.

IDAHO ARSENIC HUMAN HEALTH CRITERIA: COMMENTS PREPARED
IN RESPONSE TO THE 19 APRIL 2018 RULEMAKING MEETING

**IDAHO ARSENIC HUMAN
HEALTH CRITERIA:
COMMENTS PREPARED IN
RESPONSE TO THE
19 APRIL 2018
RULEMAKING MEETING**



Paul D. Anderson, Ph.D.
Senior Vice President/Principal Scientist



Emily Morrison
Environmental Scientist

Prepared for:
J.R. Simplot Company
One Capital Center
999 Main Street
P.O. Box 27
Boise, ID 83707

Prepared by:
Arcadis U.S., Inc.
1 Executive Drive
Suite 303
Chelmsford
Massachusetts 01824
Tel 978 937 9999
Fax

Our Ref.:
ME000366.0000

Date:
April 30, 2018

*This document is intended only for the use of
the individual or entity for which it was
prepared and may contain information that is
privileged, confidential and exempt from
disclosure under applicable law. Any
dissemination, distribution or copying of this
document is strictly prohibited.*

IDAHO ARSENIC HUMAN HEALTH CRITERIA: COMMENTS PREPARED
IN RESPONSE TO THE 19 APRIL 2018 RULEMAKING MEETING

CONTENTS

1	Introduction	1
2	BAF Derivation Background	1
3	Idaho-Specific BAFs for Arsenic.....	4
4	Idaho-Specific Fish Consumption Only HHC	8
5	Potential Risk Associated with Consumption of Idaho Fish	8
6	Idaho-Specific HHC Including Water Consumption.....	8
7	Implications of Relative Fish Consumption and Drinking Water Exposures	9
8	References	9

FIGURES

1a	Linear relationship between water and fish concentration.....	2
1b	No relationship between water and fish concentration	3
1c	Curvilinear relationship between water and fish concentration	3
2a	Plot of inorganic arsenic in paired samples of Idaho surface water and fish tissue	5
2b	Plot of inorganic arsenic in paired samples of Idaho surface water and fish tissue with superimposed line showing concentrations predicted by IDEQ (2010) BAF of 11 L/kg	5
3a	Plot of total arsenic in paired samples of Idaho surface water and fish tissue with regression equation (assumes concentration in non-detected fish tissue samples is equal to the detection limit).....	6
3b	Plot of total arsenic in paired samples of Idaho surface water and fish tissue with regression equation (non-detected fish tissue samples not included).....	7
4	Plot of total arsenic in paired samples of Idaho surface water and fish tissue with regression equation with superimposed line showing concentrations predicted by IDEQ (2010) BAF of 143 L/kg	7

APPENDICES

A	Summary of Total Arsenic Concentrations in Idaho Surface Waters Exceeding Two Hypothetical Alternative Human Health Criteria of 0.3 ug/L and 3.0 ug/L
---	--

1 INTRODUCTION

These preliminary comments are submitted in response to Idaho Department of Environmental Quality's (IDEQ's) request for comments during the 19 April 2018 arsenic human health criteria (HHC) rulemaking hearing. Given that IDEQ's request for comments was rather general, and not on a specific proposed approach or specific assumption used by a particular approach, these comments present some additional information on some of the topics discussed during the 19 April 2018 rulemaking meeting.

Specifically, the comments begin by reviewing approaches that can be used to develop a bioaccumulation factor (BAF) for arsenic in waters of Idaho and demonstrate that, based on available data, an Idaho-specific BAF for inorganic arsenic is likely to be quite low (less than 1 liter water per kilogram fish (L/kg)). That finding combined with available data on the concentration of inorganic arsenic in fish tissue from Idaho indicate that potential exposures to inorganic arsenic from consumption of fish is very small compared to potential exposures from use of surface water as a potable drinking water source. In fact, the fish consumption exposures are so small compared to potential drinking water exposures, that the focus of the arsenic HHC development process should be on drinking water consumption. The comments conclude by pointing out that the approach and assumptions used by IDEQ in 2016 to update HHC for other substances will lead to an arsenic HHC that is below naturally occurring background concentrations of arsenic in virtually all waters of Idaho. This finding suggests that the approach and assumptions used in 2016 for other substances is not appropriate for arsenic and that IDEQ will need to evaluate alternative approaches and assumptions to develop an HHC for arsenic that is protective of human health and is also pragmatic, achievable, and recognizes the naturally elevated levels of arsenic in Idaho's surface waters.

2 BAF DERIVATION BACKGROUND

The fundamental conceptual basis for establishing a BAF is that the concentration of a substance in water determines the concentration of that substance in fish. The BAF describes that relationship and allows one to predict fish concentrations from water concentration data.

Historically, BAFs are often calculated simply as the ratio of the concentration of a substance in fish to the concentration of that substance in water. Ideally, both the fish and water concentrations were collected from the same location and at the same time (i.e., are paired samples). If only a single paired sample was available, the fish to water concentration ratio from that sample was assumed to be the BAF. If more than one paired sample was available, an overall BAF was estimated by taking the average of all the BAFs calculated for each sample. That is what IDEQ did to estimate the total arsenic BAF of 143 L/kg (IDEQ 2010). However, even though a BAF can be calculated in this manner, it turns out that does not mean it is an accurate or appropriate predictor of bioaccumulation. A more representative and appropriate estimate of the BAF can be developed by plotting all of the paired data and conducting a regression analysis. The resulting regression equation represents the relationship between water and fish tissue concentration. When the regression is linear, the slope of the regression equation approximates the BAF.

Figures 1a-c provide three different hypothetical example relationships between the concentration of a substance in water and fish based on five paired samples. In Figure 1a, a linear relationship exists

IDAHO ARSENIC HUMAN HEALTH CRITERIA: COMMENTS PREPARED
IN RESPONSE TO THE 19 APRIL 2018 RULEMAKING MEETING

between water and fish concentration where the fish concentration is 1/10th the water concentration across the entire range of water concentrations. In that case the BAF is 0.1 L/kg for each sample and is equal to the slope of the regression equation, which is also 0.1. Note too that the average of the fish to water ratio across all five samples is also 0.1 L/kg. In this case, a BAF of 0.1 L/kg is an accurate predictor of fish concentrations.

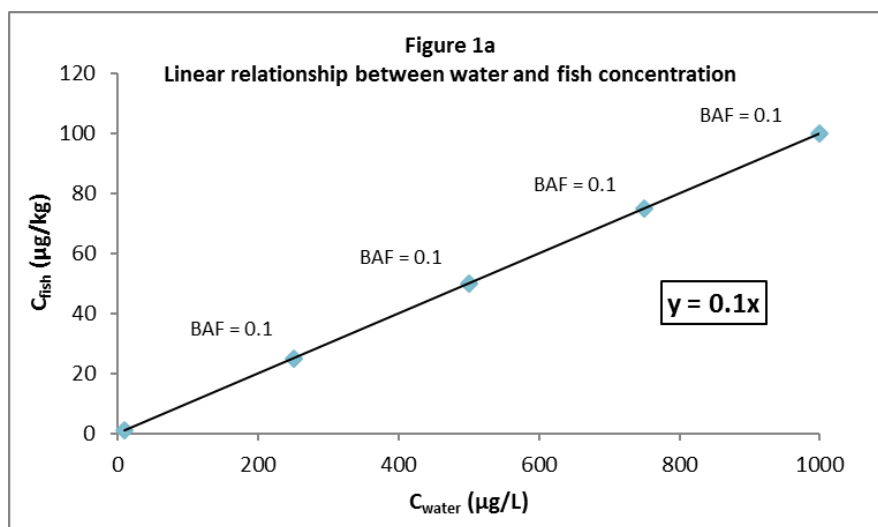


Figure 1b represents a hypothetical scenario where fish concentration is independent of water concentration. Even though water concentration varies by 1,000-fold (from 1 to 1,000 ug/l) the fish concentration remains constant at 5 ug/kg. Because there are five paired samples, a BAF can be calculated for each. Those BAFs range from 0.5 L/kg to 0.005 L/kg and have an arithmetic average BAF of 0.11 L/kg. However, that average BAF is not a good predictor of concentrations in fish. At low concentrations, for example 1 ug/L, the predicted fish concentration is 0.1 ug/kg, about 50 times lower than the measured concentration of 5 ug/kg. At high water concentrations, for example 500 ug/L, the predicted fish concentration is 55 ug/kg, about 10 times higher than the measured concentration. In this case, because fish concentration is independent of water concentration, it is not appropriate to use the average BAF from the five paired samples. The concentration in fish is constant regardless of water concentration.

IDAHO ARSENIC HUMAN HEALTH CRITERIA: COMMENTS PREPARED
IN RESPONSE TO THE 19 APRIL 2018 RULEMAKING MEETING

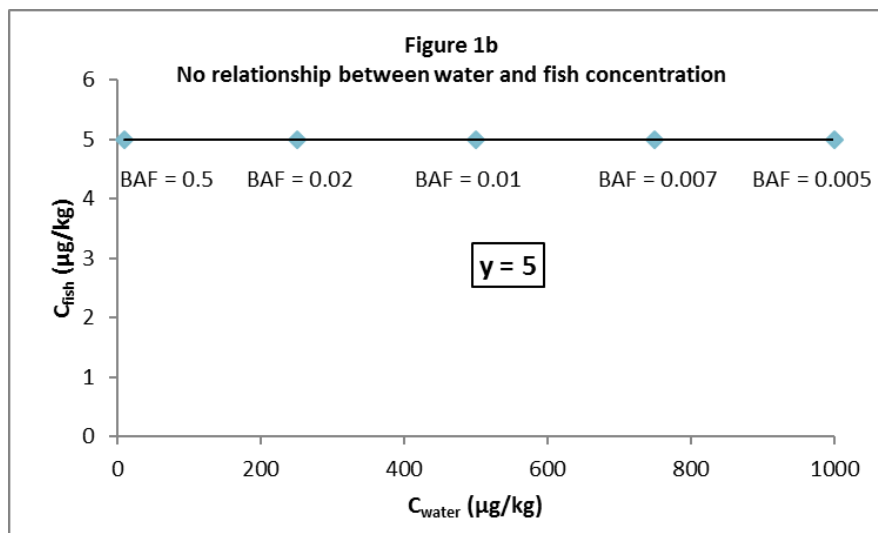
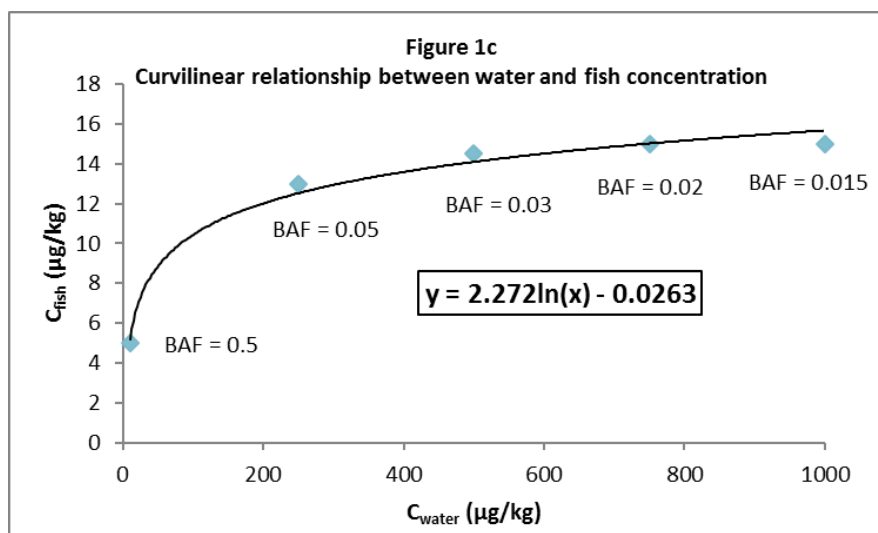


Figure 1c represents a scenario where fish concentration does depend on water concentration, but the relationship is not linear. Fish accumulate the substance at a rapid rate at low water concentrations but at a substantially lower rate at high concentrations. BAFs for the five paired samples range from 0.5 L/kg to 0.015 L/kg and have an arithmetic average BAF of 0.12 L/kg. However, that average BAF is not a good predictor of concentrations in fish. At low concentrations, for example 1 µg/L, the predicted fish concentration is 0.12 µg/kg, about 50 times lower than the measured concentration of 5 µg/kg. At intermediate and high water concentrations, for example 250 or 500 µg/L, the predicted fish concentrations are 30 and 60 µg/kg, about 2 and 4 times, respectively, higher than the measured concentration. Use of the arithmetic average BAF leads to accurate prediction of fish concentrations over a narrow range of water concentrations (between about 60 µg/L and 80 µg/L). As in the above example (Figure 1b) it is not appropriate to use the average BAF from the five paired samples. More accurate prediction over the entire range of concentrations is possible using the curvilinear regression equation shown on Figure 1c.



The key point from these three hypothetical scenarios is that all of the paired water and fish data need to be plotted to see if a relationship is apparent and, if one is, to conduct a regression analysis to quantify that relationship and determine its statistical significance. The next section of these comments presents such a preliminary evaluation of the 2008 IDEQ state-wide paired arsenic and fish data (IDEQ 2010).

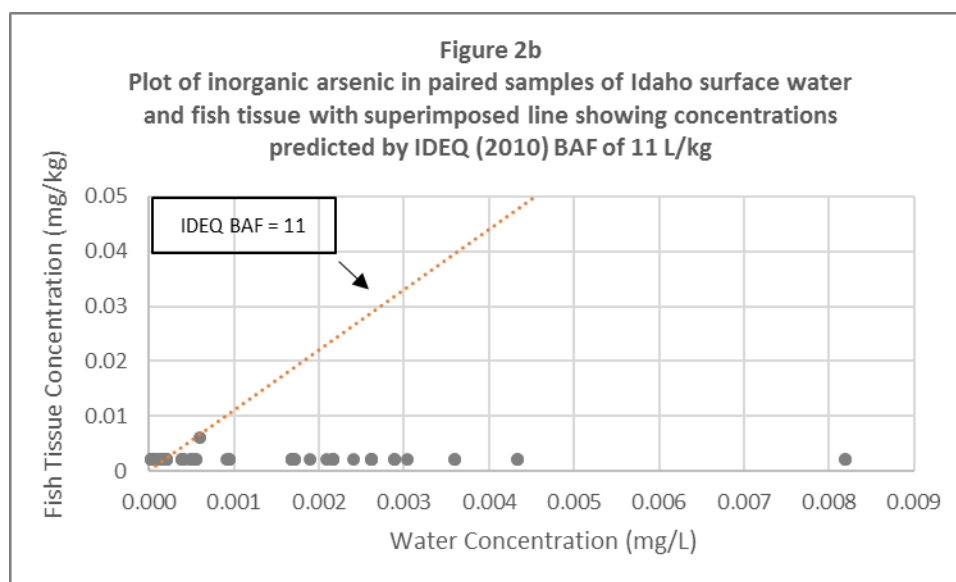
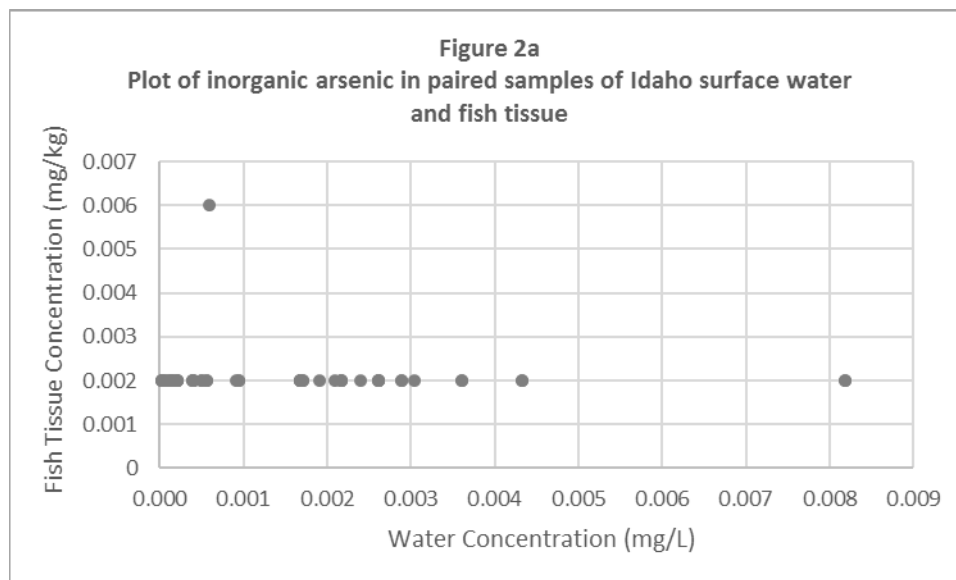
3 IDAHO-SPECIFIC BAFs FOR ARSENIC

Idaho is to be commended for having the foresight to collect arsenic background data in fish and water in 2008 (IDEQ 2010). Those data are robust and provide a good overview of the concentration of arsenic (total, inorganic, and organic) in fish tissue and surface water in Idaho. IDEQ used those data to estimate not just background concentrations in water and fish but also to develop a preliminary estimate of arsenic BAFs (IDEQ 2010). Those estimates were 143 L/kg for total As and less than 11 L/kg (<11 L/kg) for inorganic arsenic.

Figure 2a presents the 54 state-wide paired fish and surface water data for inorganic arsenic collected by IDEQ in 2008. With the exception of a single sample, the inorganic arsenic concentration in all fish was not detected at a detection limit of 0.002 mg/kg. This plot is very similar the hypothetical scenario presented in Figure 1b. The measured concentrations in fish (almost all of which are not detected) are identical regardless of whether the inorganic arsenic concentration in water is low (0.02 ug/L in the Selway River) or more than 200 times higher (8.2 ug/L in the Snake River). Given the available data at the current detection limit, a relationship between measured concentrations of inorganic arsenic in fish and Idaho surface water cannot be established using a regression approach.

As with the hypothetical example shown in Figure 1b, a BAF can be calculated for each of the 54 paired samples and an arithmetic mean BAF of <11 L/kg for inorganic arsenic can be estimated, but as with the hypothetical example, inorganic arsenic concentrations below the detection limit will be predicted at low concentrations and concentrations above the detection limit will be predicted at intermediate and higher water concentrations. For example, at a water concentration of 0.00002 mg/L of inorganic arsenic, the predicted concentration of inorganic arsenic in fish is 0.00022 mg/kg, about 10 times lower than the detection limit (Figure 2b). At a water concentration of 0.002 mg/L of inorganic arsenic, the predicted concentration of inorganic arsenic in fish is 0.022 mg/kg, or approximately 10 times above the detection limit (Figure 2b). The magnitude of overprediction continues to increase with increasing water concentration (Figure 2b). It is worth noting that a predicted concentration below the detection limit is consistent with the finding of no detected inorganic arsenic concentrations in virtually all fish. However, predicted inorganic concentrations above 0.002 mg/kg in fish tissue (the detection limit) are inconsistent with IDEQ's 2008 data (Figure 2b) and confirm that the arithmetic mean BAF of 11 L/kg is not appropriate to use to predict inorganic arsenic concentrations in fish in Idaho surface waters. That BAF will over predict fish tissue concentrations in surface water having more than approximately 0.00018 mg/L (0.18 ug/L) of inorganic arsenic; an inorganic arsenic concentration exceeded by approximately 90% of Idaho surface waters tested to date by IDEQ (IDEQ 2010).

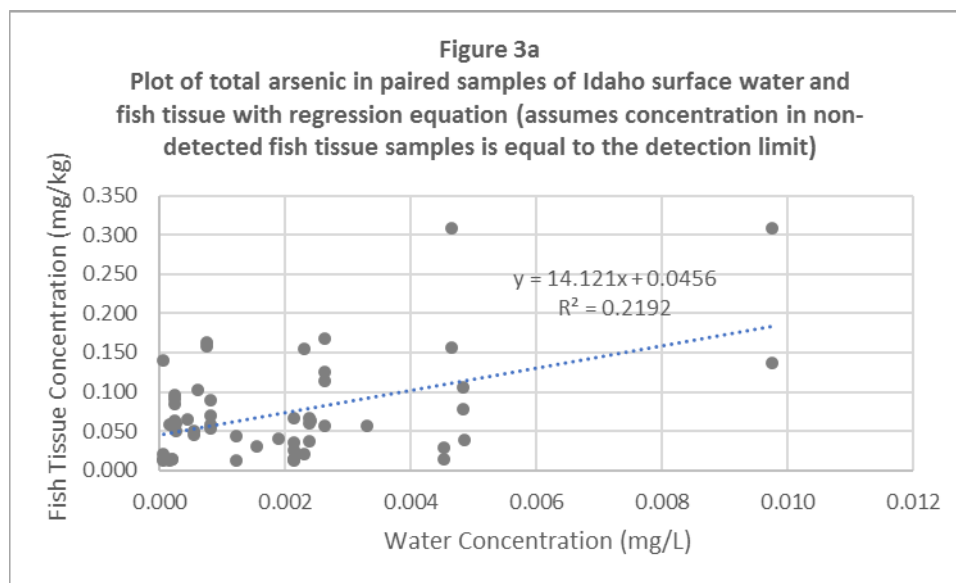
IDAHO ARSENIC HUMAN HEALTH CRITERIA: COMMENTS PREPARED
IN RESPONSE TO THE 19 APRIL 2018 RULEMAKING MEETING



It should be noted as well that the arithmetic mean BAF of 11 L/kg (or any of the individual BAFs developed based on non-detected concentrations of inorganic arsenic in fish) are upper bound estimates of the BAF. The actual BAF will be lower because the true fish concentration is below the current detection limit. For example, at a water concentration of 0.001 mg/L inorganic arsenic, a paired fish tissue sample at the current detection limit of 0.002 mg/kg results in an upper bound BAF of 2 L/kg. If the actual concentration in fish turned out to be 0.001 mg/kg, equal to one half the detection limit, the BAF would be 1 L/kg. If the actual concentration in fish turned out to be 0.0001 mg/kg, the BAF would be 0.1 L/kg. Thus, not only is use of the inorganic arsenic arithmetic mean BAF of 11 L/kg inappropriate to predict fish tissue concentrations, but for most waters of Idaho such predictions will be upper bounds. Actual concentrations would be expected to be lower.

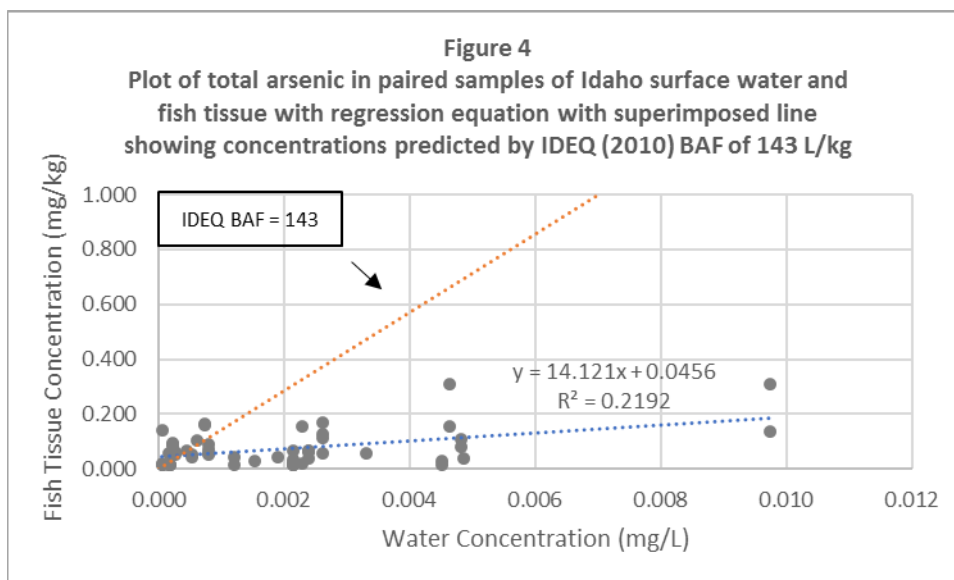
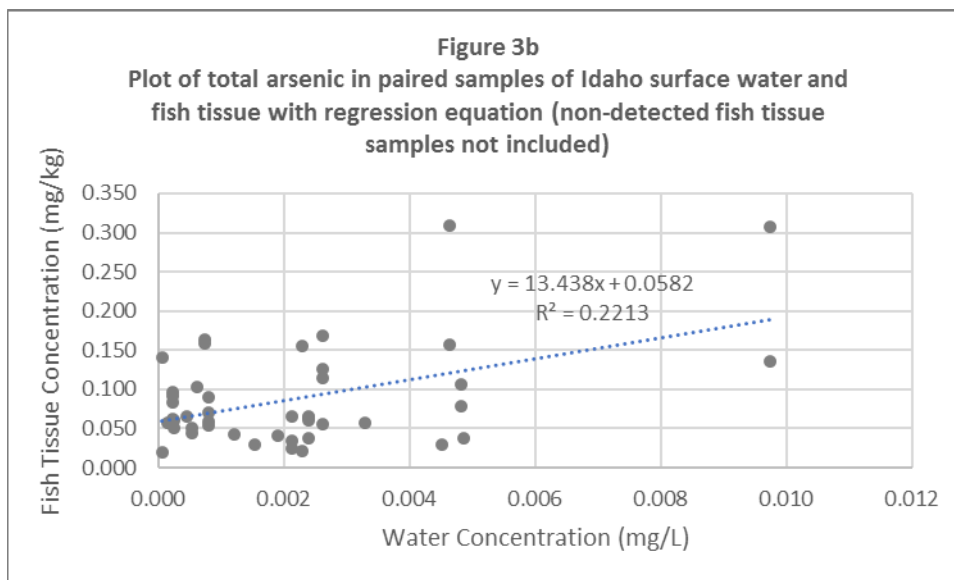
IDAHO ARSENIC HUMAN HEALTH CRITERIA: COMMENTS PREPARED
IN RESPONSE TO THE 19 APRIL 2018 RULEMAKING MEETING

IDEQ did find detectable concentrations of total arsenic in all surface water samples and most fish tissue samples. Those data can be used to develop an estimate of the BAF for total and inorganic arsenic in Idaho surface waters. Figure 3a presents the 54 state-wide paired fish and surface water data for total arsenic collected by IDEQ in 2008 and the equation that results from conducting a linear regression analysis using those data. The regression is statistically significant ($p=0.0003$) and indicates that water concentration explains about 22% of the variation observed in fish concentration ($R^2=0.22$). Ten of the sampling locations had non-detectable concentrations of total arsenic in fish (total arsenic was detected in all surface water samples). When the data are plotted excluding the locations with non-detected levels of total arsenic in fish, the regression remains statistically significant ($p=0.001$) and continues to explain approximately 22% of the variation observed in fish concentrations (Figure 3b). Both regression equations have slopes of approximately 14 (Figures 3a,b) which represents the state-wide BAF for total arsenic of approximately 14 L/kg.



The linear regression based BAF of 14 L/kg is a better predictor of total arsenic concentration in fish tissue than the arithmetic average BAF of 143 L/kg. Use of the latter results in predicted total arsenic concentrations in fish tissue that are substantially higher than the highest total arsenic concentrations measured in fish. For example, at a water concentration of 0.002 mg/L the highest measured concentration of total arsenic in fish tissue was about 0.15 mg/kg and most concentrations were less than 0.1 mg/kg. The predicted concentration using the arithmetic average BAF is 0.29 mg/kg, or about two times higher than the highest measured concentration (Figure 4). At the highest water concentration (0.009 mg/L) the predicted fish tissue concentration is 1.3 mg/kg, or about four times higher than the highest measured concentration (Figure 4). Thus, like the inorganic arsenic arithmetic mean BAF of 11 L/kg, the total arsenic mean BAF of 143 L/kg is inappropriate to use to predict total arsenic concentrations in Idaho fish. The regression-based BAF of 14 L/kg is a better predictor of total arsenic concentrations in fish than the arithmetic mean BAF.

IDAHO ARSENIC HUMAN HEALTH CRITERIA: COMMENTS PREPARED
IN RESPONSE TO THE 19 APRIL 2018 RULEMAKING MEETING



The paired total and inorganic arsenic tissue data collected by IDEQ in 2008 can be used to convert the regression based total arsenic BAF of 14 L/kg into a BAF that can be used to predict concentrations of inorganic arsenic in fish tissue from concentrations of total arsenic in surface water. IDEQ (2010) reports that less than 3.8% of the arsenic present in Idaho fish tissue is inorganic arsenic. That would mean that less than 3.8% of predicted total arsenic in fish tissue using the total arsenic BAF of 14 L/kg is inorganic arsenic. Combining the total arsenic BAF of 14 L/kg with the inorganic to total arsenic percentage in fish tissue of 3.8% results in a total arsenic in surface water to inorganic arsenic in fish tissue BAF of 0.53 L/kg (14 L/kg x 0.038). The actual total to inorganic arsenic BAF is lower because the estimate of 3.8% of inorganic arsenic in fish tissue is an upper bound. Given the above, the BAF of 0.53 L/kg is the best available, but still a conservative, estimate to predict inorganic arsenic concentrations in fish tissue.

4 IDAHO-SPECIFIC FISH CONSUMPTION ONLY HHC

The BAF of 0.53 L/kg can be combined with IDEQ's standard assumptions to derive HHC for fish consumption only. Those assumptions include consumption of 66.5 grams of Idaho fish by a person weighing 80 kilograms, for every day of the year, for every year of his or her entire lifetime, and an allowable risk of 1×10^{-5} . Using those assumptions and the current cancer slope factor for arsenic of $1.5 \text{ (mg/kg-day)}^{-1}$ results in a fish consumption only human health criterion of 15 ug/L for total arsenic. Based on the data collected by IDEQ in 2008 (IDEQ 2010), all surface waters with the exception of the Bruneau River have naturally occurring background concentrations of total arsenic lower than a fish consumption only HHC of 15 ug/L.

5 POTENTIAL RISK ASSOCIATED WITH CONSUMPTION OF IDAHO FISH

Further evidence of a minimal contribution of fish consumption to any potential risk associated with inorganic arsenic in Idaho surface waters is provided by combining the 2008 IDEQ fish tissue results with the above mentioned standard assumptions IDEQ used to derive the 2016 HHC (i.e., a fish consumption rate of 66.5 grams per person per day, 80 kilogram bodyweight, cancer slope factor of $1.5 \text{ (mg/kg-day)}^{-1}$). Assuming the concentration of inorganic arsenic in Idaho fish is equal to one half the detection limit used by Idaho in its 2008 fish tissue analysis (i.e., 0.001 mg/kg), results in a potential excess lifetime cancer risk of 1×10^{-6} . That is ten times lower than the allowable risk level used by Idaho to set the 2016 HHC and is at the low end of USEPA's range of allowable risk. Moreover, any actual risks would be lower because actual concentrations are likely to be lower, given that 53 of 54 fish tissue samples had non-detected inorganic arsenic concentrations.

6 IDAHO-SPECIFIC HHC INCLUDING WATER CONSUMPTION

The low potential exposures and risks associated with consumption of fish contrast with potential exposures from use of surface water as a drinking water source. Using the 2016 IDEQ standard assumptions for drinking water (2.4 liters per person per day) combined with the standard assumptions about fish consumption and the above BAF results in a fish consumption and drinking water ingestion HHC of 0.22 ug/L assuming all arsenic in surface water consumed as potable water is inorganic arsenic. IDEQ (2010) reported that on average, 73% of the total arsenic in surface water was in an inorganic form. Incorporating that percentage in the derivation results in a HHC of 0.3 ug/L. If fish consumption is excluded from the derivation (i.e., the criteria are for water consumption only) the criteria remain at 0.22 ug/L and 0.3 ug/L, respectively. Thus, including or excluding the fish consumption pathway has no meaningful effect on the resulting criteria.

7 IMPLICATIONS OF RELATIVE FISH CONSUMPTION AND DRINKING WATER EXPOSURES

The above evaluations indicate that fish consumption exposures make a negligible contribution to the exposure to inorganic arsenic in Idaho surface water. Virtually all of the potential exposure is associated with the assumption that surface water is used as a potable drinking water supply and that the water is consumed absent any treatment that would reduce the naturally present inorganic arsenic concentration. Combined with the absence of a strong relationship between inorganic arsenic concentrations in surface and fish suggests that potential risks associated with fish consumption can be excluded from the derivation of HHC, and further, that such exclusion will not adversely affect public health.

The evaluations also indicate that current concentrations of arsenic in virtually all Idaho surface waters measured to date exceed a human health criterion that includes potential exposures via drinking water consumption where those potential exposures are estimated using the assumptions and approach Idaho used in 2016 to update its HHC. (See Table A-1 in Appendix A.) It is notable that the exposure assumptions used to derive HHC protective of drinking water exposures (e.g., drinking water consumption rate, bodyweight) are generally accepted and are unlikely to undergo much Idaho-specific modification. The HHC derivation assumption most amenable to modification, and which Idaho has the flexibility to modify, is the allowable lifetime cancer risk level. However, even increasing allowable risk to 1×10^{-4} , equal to the same level used by Oregon for its arsenic human health criterion and approved by USEPA (IDEQ 2018), results in a potential criterion of 3 ug/L (assuming 73% of total arsenic in surface water is inorganic). Data collected to date by IDEQ (2010) suggest that naturally occurring total arsenic concentrations in approximately 30% of Idaho surface waters exceed such a criterion. (See Table A-1 in Appendix A.) The frequent exceedance of naturally occurring background raises important questions about the practicality of such a criterion and whether the typical approach and assumptions used by IDEQ and USEPA to derive HHC are appropriate and applicable to arsenic in Idaho surface waters. The naturally occurring background concentrations of arsenic in Idaho surface waters suggest that alternative approaches will need to be explored that account for the naturally occurring background concentrations.

8 REFERENCES

- IDEQ. 2010. Arsenic, Mercury, and Selenium in Fish Tissue and Water from Idaho's Major Rivers: A Statewide Assessment. Prepared by Don A. Essig. March 2010
- IDEQ. 2018. Rulemaking Docket 58-0102-1801 Arsenic Human Health Criteria Discussion Paper #1. April 2018.

APPENDIX A

Summary of Total Arsenic Concentrations in Idaho Surface Waters
Exceeding Two Hypothetical Alternative Human Health Criteria of 0.3
ug/L and 3.0 ug/L



Table 1 - Summary of Total Arsenic Concentrations in Idaho Surface Waters¹ Exceeding Two Hypothetical Alternative Human Health Criteria of 0.3 µg/L and 3.0 µg/L²

Sample ID	Site Name	Sample Date	Total Arsenic in Water (µg/L)
051	Bruneau River	8/14/2008	17.00
047	Snake River #2	8/19/2008	9.74
13313000	Johnson Creek @ YP	9/2/2008	4.92
085	Portneuf River	7/20/2008	4.86
095	Snake River #3	8/20/2008	4.83
083	Snake River #1	8/18/2008	4.64
030	Coeur d'Alene R #1	8/2/2008	4.52
13305000	Lemhi Nr Lemhi	9/10/2008	4.05
13056500	Henry's Fk Nr Rexburg	9/9/2008	3.55
13302005	Pahsimeroi @ Ellis	9/11/2008	3.52
017	Bear River	8/13/2008	3.30
13185000	Boise R @ Twn Spr	9/5/2008	3.23
094	Lemhi River	9/3/2008	2.82
077	Henry's Fork	7/17/2008	2.40
040	Salmon R #1	9/9/2008	2.39
028	Salmon R #2	9/10/2008	2.29
063	Payette River	8/21/2008	2.25
13206000	Boise R @ Glenwood	9/4/2008	2.22
061	Camas Creek	7/16/2008	2.15
097	SF Snake	7/18/2008	2.14
012	Salmon R #3	9/29/2008	1.90
005	Blackfoot	7/19/2008	1.54
091	Big Wood River #2	7/10/2008	1.21
044	Pahsimeroi	9/5/2008	1.03
011	Big Wood River	7/9/2008	0.80
037	Blackfoot River #2	8/12/2008	0.80
084	SF Salmon	8/27/2008	0.78
099	Payette River #2	8/25/2008	0.74
027	NF Big Lost	7/15/2008	0.61
054	Coeur d'Alene R #3	8/1/2008	0.59
050	Priest River	7/30/2008	0.54
038	Coeur d'Alene R #2	7/31/2008	0.53
068	Camas Creek #2	9/4/2008	0.45
031	Weiser River	8/26/2008	0.33
055	NF Payette	8/28/2008	0.26
087	SF Payette	9/2/2008	0.24
086	Saint Joe River	8/3/2008	0.24
026	NF Clearwater R	9/16/2008	0.19
074	Lochsa River	9/17/2008	0.16
088	Selway River	9/18/2008	0.06

Notes:

¹Total arsenic concentrations in Idaho surface waters reported in "Table E-1. Water Sample Results by Site" of *Arsenic, Mercury, and Selenium in Fish Tissue and Water from Idaho's Major Rivers: A Statewide Assessment. Prepared by Don A. Essig. March 2010.*

²The alternative hypothetical human health criterion of 0.3 µg/L is derived using the standard equation to derive human health criteria (see *IDEQ Rulemaking Docket 58-0102-1801 Arsenic Human Health Criteria Discussion Paper #1. April 2018*) and assumes a person weighs 80 kilograms, drinks 2.4 liters of water per day, eats 66.5 grams of fish per day, that arsenic has a cancer slope factor of 1.5 (mg/kg-day)⁻¹ and the acceptable excess lifetime cancer risk level is 1x10⁻⁵ (one in one hundred thousand). The alternative hypothetical human health criterion of 3 µg/L is derived using the same approach and assumptions except the acceptable excess lifetime cancer risk level is 1x10⁻⁴ (one in ten thousand).

unshaded - samples with total arsenic concentrations less than or equal to 0.3 µg/L

yellow shaded - samples with total arsenic concentrations greater than 0.3 µg/L and less than or equal to 3.0 µg/L

red shaded - samples with total arsenic concentrations greater than 3.0 µg/L

Arcadis U.S., Inc.

1 Executive Drive

Suite 303

Chelmsford, Massachusetts 01824

Tel 978 937 9999

Fax

www.arcadis.com

A decorative graphic consisting of three thin orange lines. One line is horizontal, extending from the left edge of the page towards the right. Two other lines are diagonal, starting from the bottom left and extending towards the top right, intersecting the horizontal line.