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September 18, 2020

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

Re: Docket No. 58-0102-1801 Update to Human Health Criteria for Arsenic – 7/15/2020 Stakeholder Meeting

Dear Ms. Wilson/Paula,

The Association of Idaho Cities (AIC) serves to advance the interests of the cities of Idaho through legislative advocacy, technical assistance, training, and research. Idaho cities and municipal drinking water utilities play important roles as primary providers of drinking water and implementers of the Clean Water Act. Idaho cities represent over 70% of all Idaho residents. These stakeholders have significant interests in the development of water quality standards, rules, and guidance related to the protection of human and aquatic life. AIC is actively engaged in water quality issues through the work of our Environment Committee, chaired by Boise City Council President Elaine Clegg and our Municipal Water Users Group.

AIC has reviewed the report and appendixes developed and submitted by the Idaho Association of Commerce and Industry (IACI) to the Idaho Department of Environmental Quality (IDEQ) on August 21,2020. We believe IACI's analysis and suggestions merit further consideration by the IDEQ, EPA, and stakeholders.

AIC appreciates the opportunity to participate in the update to Idaho's human health criteria for arsenic and looks forward to working with our State and partners in the development of these and other water quality standards.

Should you have questions concerning our attached comments, please feel free to contact me.

Sincerely,

Johanna Bell, Policy Analyst

ec: Kelley Packer, AIC Executive Director
Tom Jenkins, AIC President
Elaine Clegg, AIC Environment Committee Chair
AIC Municipal Water Users
AIC IPDES Task Force

August 21, 2020

Via email: paula.wilson@deq.idaho.gov

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

Dear Ms. Wilson:

The Idaho Association of Commerce & 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 clean-ups for several IACI members, and IACI appreciates this opportunity to provide comments on the Department of Environmental Quality's (the Department) rulemaking to revise the arsenic human health water quality criteria.

These criteria have been in flux for Idaho waters for over two decades and been subject to litigation and disagreement between the State of Idaho and EPA as to what criteria is protective of human health. As the Department is aware, arsenic naturally occurs in Idaho ground and surface waters that greatly exceed EPA's 304(a) recommended criteria. The Department is to be commended for the extensive studies done looking at arsenic concentrations in fish tissue and water.

These comments reflect a very thorough review of the data collected by the Department and discuss potential approaches to setting new arsenic human health water quality criteria for our great state. Your careful consideration of these comments would be appreciated.

Sincerely,

Alex LaBeau
President

cc: Alan Prouty, Chair
IACI Environment Committee

# Table of Contents

## 1. Introduction

The State of Idaho has wrestled for over three decades with reconciling the uncertainty in the science on the toxicity of arsenic, how to account for naturally occurring high concentrations of arsenic in Idaho groundwater and surface water, the utilization of that science in establishing appropriate regulatory (water quality) criteria, and conflict with the U.S Environmental Protection Agency (USEPA) over the appropriate criteria. This uncertainty and conflict continues today. Reconciling these issues was well illustrated in a 2007 letter from then Department of Environment Quality (Department) Director Hardesty in which she discussed the use of the Safe Drinking Water Act Maximum Contaminant Level (MCL) as a human health water quality criterion for arsenic:[1]

> "….Second was the concern for cities with a ground water based public water supply that exceeds 10 μg/L arsenic criterion and the associated arsenic concentration in the NPDES wastewater discharge, a situation not uncommon in Idaho. This is made even more difficult by the fact the efforts to treat water supplies to achieve the new drinking water requirement will likely leave even higher concentrations of arsenic to be discharged by public wastewater systems."

Idaho is now engaged in another rulemaking to determine appropriate arsenic human health water quality criteria. This rulemaking is the Department's fourth, starting in 1997 in establishing these criteria.

### 1.A. Arsenic in Idaho Waters

Arsenic occurs naturally in soils and waters in the West, including Idaho. The Idaho Department of Water Resources published a very comprehensive review of the geological origin of arsenic in Idaho.[2] This study includes data from measurements of arsenic in groundwater at 255 sites. 15% of the sites sampled had arsenic concentrations greater than 10 μg/L. Previous studies conducted by the Department have shown total arsenic ($As_{(total)}$) concentrations in surface water that range from less than 1 microgram per liter (μg/L) up to 17 μg/L (see Appendix A).[3] In recent years, the Department has conducted a targeted monitoring program begun in August 2019 of 40 different sampling locations has to date recorded arithmetic mean inorganic arsenic ($As_{(in)}$) concentrations ranging from 0.06 to 12 μg/L with an overall state-wide arithmetic

[1] Idaho DEQ. 2007. Idaho's Human Health Arsenic Water Quality Criteria, reply to ICL Letter of April 5, 2007.

[2] Idaho Department of Water Resources. 2002. Technical Summary Arsenic Results from the Statewide Program, 1991-2001.

[3] 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.

mean of 1.7 µg/L (Table 1). Geographic locations of the 40 targeted surface water monitoring stations are presented in Appendix B.

**Table 1**
**Summary of August 2019 to May 2020 $As_{(in)}$ Surface Water Monitoring Results**

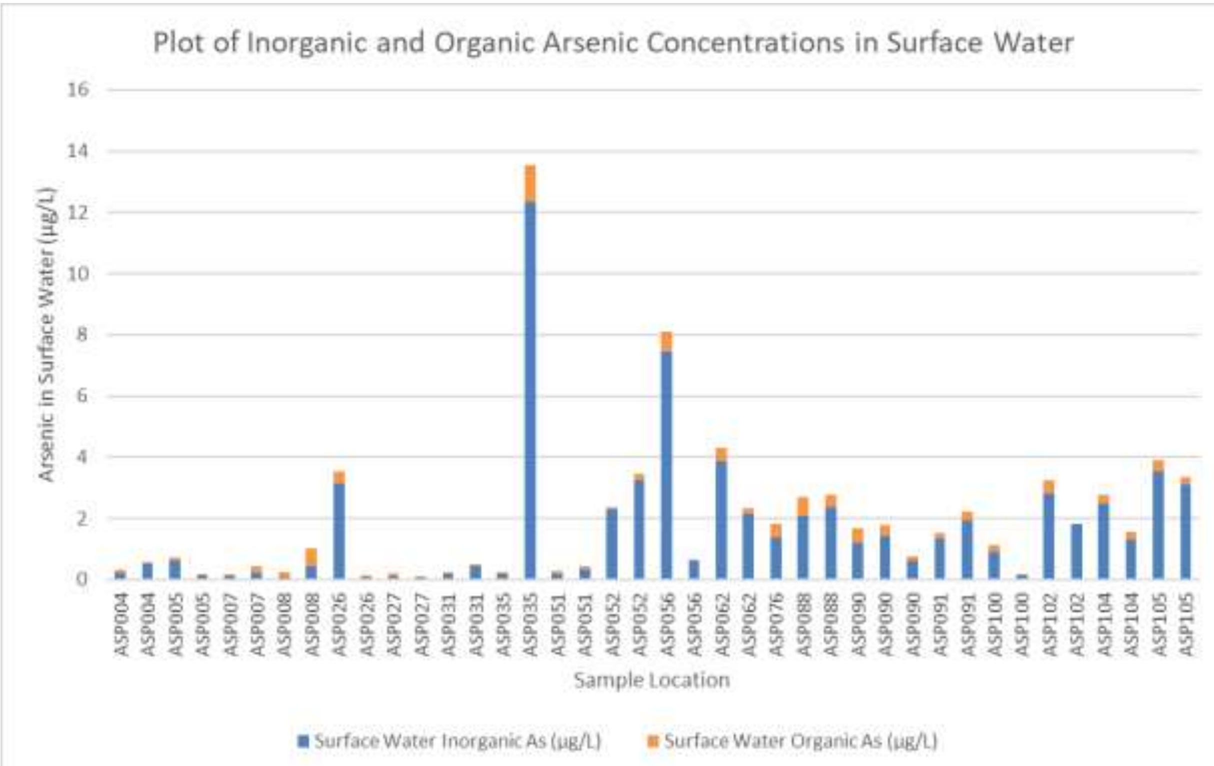
| Sample Location ID | Sample Size | Stream/River ID | Frequency of Detects (%) | Min Detect | Max Detect | Arithmetic Mean | Harmonic Mean | Median | 10th Percentile | 90th Percentile |
|---|---|---|---|---|---|---|---|---|---|---|
| AST001 | 8 | Kootenai River | 100 | 0.184 | 0.268 | 0.209 | 0.207 | 0.205 | 0.188 | 0.232 |
| AST002 | 8 | SF Coeur d'Alene River | 100 | 0.287 | 0.975 | 0.514 | 0.438 | 0.421 | 0.32 | 0.813 |
| AST003 | 8 | Priest River | 100 | 0.221 | 1.67 | 0.625 | 0.408 | 0.435 | 0.255 | 1.292 |
| AST004 | 8 | NF Coeur d'Alene River | 100 | 0.11 | 0.191 | 0.149 | 0.144 | 0.148 | 0.118 | 0.18 |
| AST005 | 8 | St. Maries River | 100 | 0.044 | 0.152 | 0.0943 | 0.079 | 0.095 | 0.0489 | 0.142 |
| AST006 | 8 | Palouse River | 100 | 0.141 | 0.39 | 0.221 | 0.201 | 0.193 | 0.158 | 0.32 |
| AST007 | 8 | Potlatch River | 87.5 | 0.047 | 0.143 | 0.079 | 0.066 | 0.077 | 0.0449 | 0.135 |
| AST008 | 8 | Paradise Creek | 100 | 0.18 | 1.11 | 0.438 | 0.328 | 0.38 | 0.198 | 0.712 |
| AST009 | 8 | Snake River | 100 | 1.18 | 3.55 | 3.125 | 2.750 | 3.45 | 2.496 | 3.508 |
| AST010 | 8 | MF Clearwater River | 62.5 | 0.044 | 0.089 | 0.055 | 0.051 | 0.064 | 0.04 | 0.0785 |
| AST011 | 8 | Threemile Creek | 100 | 0.05 | 0.215 | 0.0984 | 0.085 | 0.0825 | 0.0696 | 0.139 |
| AST012 | 8 | NF Payette River | 87.5 | 0.047 | 0.105 | 0.060 | 0.056 | 0.056 | 0.0449 | 0.0763 |
| AST013 | 8 | Little Salmon River | 100 | 0.089 | 0.257 | 0.183 | 0.162 | 0.186 | 0.117 | 0.251 |
| AST014 | 6 | Gold Fork River | 100 | 0.053 | 1.24 | 0.424 | 0.177 | 0.251 | 0.142 | 0.88 |
| AST015 | 8 | Weiser River | 100 | 0.049 | 0.314 | 0.187 | 0.128 | 0.207 | 0.0693 | 0.295 |
| AST016 | 8 | Mann Creek | 100 | 4.21 | 19.8 | 12.35 | 9.817 | 13.45 | 6.114 | 17.35 |
| AST017 | 8 | Squaw Creek | 100 | 0.087 | 0.379 | 0.16 | 0.134 | 0.127 | 0.104 | 0.252 |
| AST018 | 8 | Deadwood River | 100 | 0.192 | 0.408 | 0.332 | 0.308 | 0.373 | 0.209 | 0.395 |
| AST019 | 8 | MF Boise River | 100 | 1.49 | 3.03 | 2.281 | 2.203 | 2.23 | 1.952 | 2.666 |
| AST020 | 8 | Mores Creek | 100 | 1.65 | 3.7 | 3.226 | 3.024 | 3.49 | 2.539 | 3.679 |
| AST021 | 8 | Bruneau River | 100 | 2.34 | 11.9 | 7.426 | 5.993 | 7.295 | 4.734 | 10.21 |
| AST022 | 8 | Big Wood River | 100 | 0.512 | 0.689 | 0.597 | 0.590 | 0.592 | 0.518 | 0.674 |
| AST023 | 7 | Rock Creek | 100 | 2.39 | 4.82 | 3.867 | 3.680 | 4.08 | 2.906 | 4.706 |
| AST024 | 8 | Salmon River | 100 | 1.91 | 2.35 | 2.153 | 2.140 | 2.185 | 1.938 | 2.329 |
| AST025 | 8 | Salmon River | 100 | 0.934 | 2.33 | 1.388 | 1.242 | 1.2 | 0.935 | 2.232 |
| AST026 | 7 | Snake River | 100 | 1.34 | 3.53 | 2.057 | 1.841 | 1.75 | 1.412 | 3.02 |
| AST027 | 9 | Portneuf River | 100 | 1.52 | 2.77 | 2.352 | 2.282 | 2.45 | 1.984 | 2.746 |
| AST028 | 4 | Bear River | 100 | 0.507 | 2.25 | 1.201 | 0.904 | 1.024 | 0.612 | 1.932 |
| AST029 | 9 | Blackfoot River | 100 | 1.08 | 2.02 | 1.414 | 1.336 | 1.19 | 1.08 | 1.852 |
| AST030 | 8 | Bitch Creek | 100 | 0.101 | 1.08 | 0.626 | 0.380 | 0.686 | 0.311 | 0.904 |
| AST031 | 8 | Henrys Fork | 100 | 1.06 | 1.58 | 1.336 | 1.318 | 1.32 | 1.172 | 1.51 |

**Notes:**
All non-detects had a detection limit of 0.04 µg/L.
Arithmetic mean - calculated with ND=DL for non-detects

At virtually all targeted monitoring stations the majority of total arsenic in surface water is comprised of inorganic arsenic ($As_{(in)}$) (Figure 1). In contrast to the water column, in fish tissue, virtually all of the arsenic is present in organic forms and only a small portion is present as inorganic arsenic, the form which is potentially toxic to human health (Figure 2).

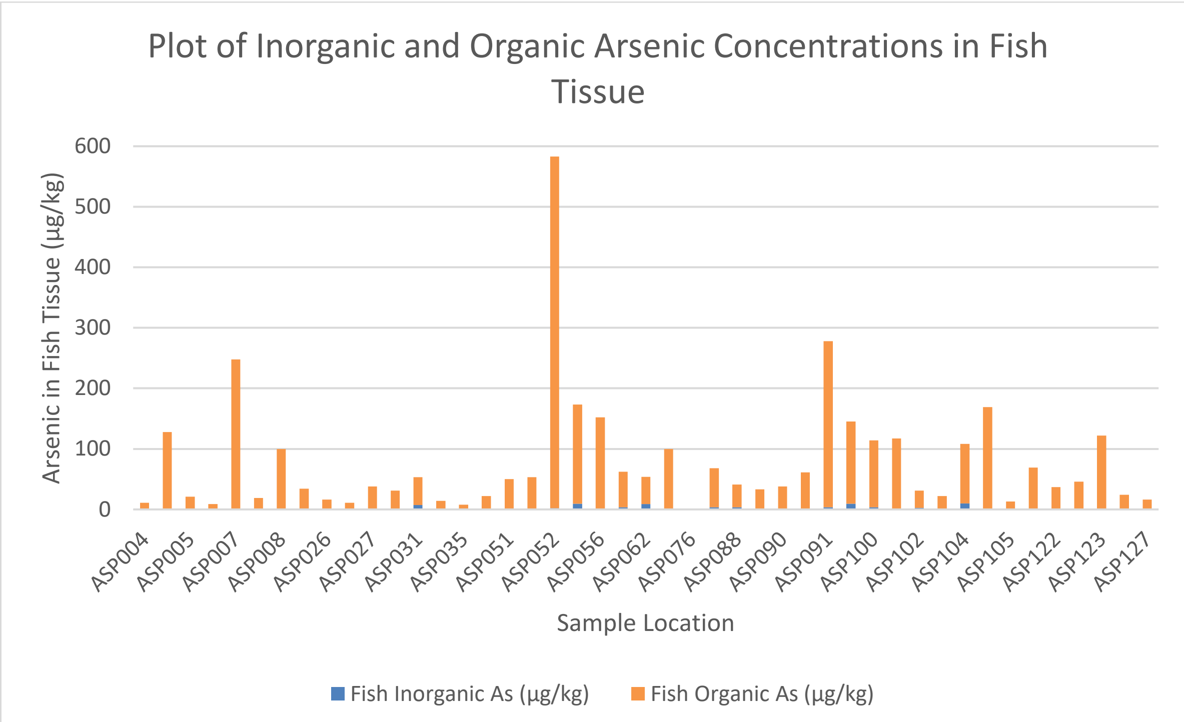
**Figure 1**

**Plot of Inorganic and Total Arsenic Concentrations in Surface Water**




**Notes:**
Arsenic concentrations averaged over eight sampling periods from August 2019 – May 2020.
Organic arsenic was estimated as the total arsenic concentration minus the inorganic arsenic concentration as reported by the laboratory.

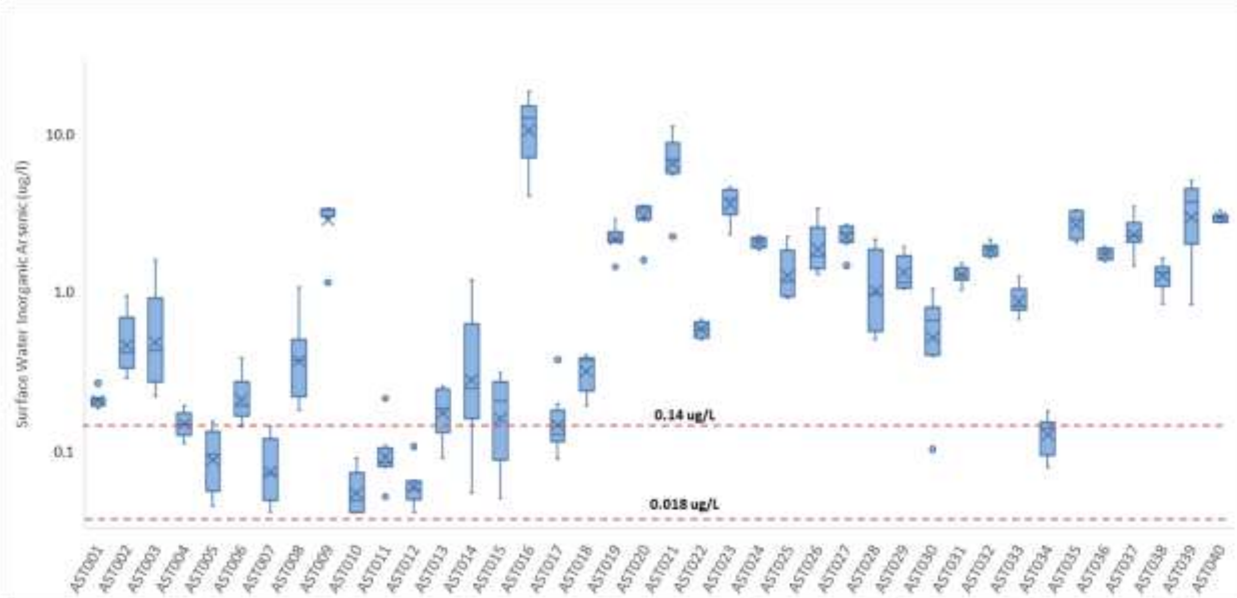
**Figure 2**
**Plot of Inorganic and Total Arsenic Concentrations in Fish Tissue**




Only six monitoring sites had $As_{(in)}$ concentrations less than the EPA CWA 304(a) human health (HH) organism only water quality criteria (WQC) of 0.14 µg/L $As_{(in)}$; no monitoring sites had an arsenic concentration that met the water and organism HH WQC of 0.018 µg/L $As_{(in)}$ (Figure 3).[4] It is doubtful that water with 18 parts per trillion (0.018 µg/L) can be found anywhere except in the laboratory. The conclusion from comparing concentrations of arsenic in Idaho waters shows that the 304(a) criteria are inappropriate and unattainable for all major surface waters sampled in Idaho and such criteria were derived using overly conservative assumptions. Additionally, the EPA WQC for HH did not consider the fact that arsenic is not DNA reactive, is not a direct carcinogen and has been shown to have a threshold for effects.[5]

[4] 40 CFR § 131.36(b)(1).
[5] Tsuji S.J. et al. 2019. Dose-response for assessing the cancer risk of inorganic arsenic in drinking water: the scientific basis for use of a threshold approach. Critical Reviews in Toxicology. 49(1), p. 36-84.

**Figure 3**
**August 2019 to May 2020 $As_{(in)}$ Surface Water Monitoring Results Compared to USEPA CWA § 304(a) Arsenic Criteria**




**Notes:**
0.14 µg/L = EPA CWA 304(a) HH WQC (organism only)
0.018 µg/L = EPA CWA 304(a) HH WQC (water + organism)
Middle line = median
X = arithmetic mean
Bottom line of the box represents the median of the bottom half or 1st quartile.
Top line of the box represents the median of the top half or 3rd quartile.
Whiskers = minimum and maximum values
Dots = outliers (a data point is considered an outlier if it exceeds a distance of 1.5 times the IQR below the 1st quartile or above the 3rd quartile)

## 1.B. Regulatory History

Idaho's history with the human health water quality standard for arsenic has been one of almost constant flux and disagreement with USEPA on appropriate values (see Table 2). When USEPA promulgated the National Toxics Rule (NTR) in 1992, it was made applicable to Idaho. Those values were 0.14 µg/L $As_{(in)}$ for consumption of fish only and 0.018 µg/L $As_{(in)}$ for fish and water consumption. In 1994, Idaho adopted the NTR by reference, however, the Idaho Legislature in 1995 revised the Idaho arsenic human health criteria. It is not clear that EPA ever acted on this legislative change. However, since Idaho had adopted the NTR by reference, EPA removed Idaho from the NTR in 1997.

In 1997, DEQ did initiate a new rulemaking on the human health water quality criteria for arsenic. The negotiated rulemaking value proposed to the Board of DEQ was 25 µg/L; the Board however adopted a temporary rule of 50 µg/L for both fish consumption and water and fish consumption. This change in the criteria was approved by the Idaho legislature in 1999. However, EPA took no immediate action on this new criterion.

In 2005, the Department commenced a new rulemaking on the arsenic human health water quality criteria. The focus of the rulemaking was to change the criteria to the new (2001) MCL value for arsenic of 10 μg/L. Due to a number of questions/issues raised, no change in the criteria was proposed.

In 2008, Advocates for the West, representing the Idaho Conservation League filed against USEPA a Notice of Intent to Sue over USEPA's failure to act on the 1999 submittal by Idaho. This led to another Idaho rulemaking in 2009 and resulted in arsenic human health criteria of 10 $\mu g/L_{(in)}$ (for both fish consumption and water and fish consumption). These criteria were approved by the Idaho legislature in 2010 and approved by USEPA later that year.

Northwest Environmental Advocates (NWEA) filed a complaint against USEPA in 2015 challenging USEPA's 2010 approval of Idaho's arsenic human health water quality criteria. The primary rationale for the complaint was that USEPA's approval of the MCL value (10 μg/L) was not consistent with EPA's own guidance that recommended that states *not* adopt Safe Drinking Water Act (SDWA) MCLs as human health water quality criteria for CWA purposes.

In 2016, USEPA reached an agreement with NWEA in which they agreed to a new action on Idaho's 2010 criteria submittal and they would essentially have new arsenic human health criteria in place for Idaho by July 15, 2019. USEPA's new action was reversing its prior approval of Idaho's 10 μg/L criteria; USEPA also disapproved the 50 μg/L criteria that had been submitted in 1999. The 10 μg/L criteria is still in place for purposes of the Clean Water Act.

The settlement agreement with NWEA was modified in 2018 to allow EPA to finish the Integrated Risk Information System (IRIS) Toxicological Review of Inorganic Arsenic in 2021. It is USEPA's intent that information from this review would be helpful in establishing a new arsenic human health water quality criterion for Idaho. The date for taking action on a new criterion for Idaho was moved to November 15, 2023.

The current rulemaking by the Department was initiated to utilize state specific information on inorganic arsenic concentrations in fish and state waters to develop new arsenic human health water quality criteria. The utilization of state specific information would allow the best science and most relevant environmental data to be used to develop arsenic water quality criteria for Idaho.

**Table 2**
**As Human Health Water Quality Criteria History**

| Year | Action | Standard: recreation (µg/L)$_{(in)}$ | Standard: recreation and water supply (µg/L)$_{(in)}$ | Notes |
|---|---|---|---|---|
| **1992** | EPA: NTR applicable to Idaho | 0.14 | 0.018 | |
| **1994** | Idaho: adopts NTR by reference | 0.14 | 0.018 | |
| **1995** | Idaho: Legislature revises criteria | 6.2 | 0.02 | It is not clear that EPA ever acted on these criteria. |
| **1997** | EPA: finalizes removing Idaho from NTR | 0.14 | 0.018 | |
| **1997/1999** | Idaho: DEQ Board approves temporary rule changing standard. Approved by legislature in 1999. | 50 | 50 | EPA did not act on this change till 2016, in which it was denied. |
| **2005** | Idaho: new negotiated rulemaking on As criteria; no consensus reached on changes to criteria. | | | |
| **2008** | ICL files intent to sue over EPA's failure to act on 1999 submittal. | | | |
| **2010** | Idaho: changes criteria to be consistent with MCL. | 10 | 10 | EPA approved these criteria in 2010. |
| **2015** | Northwest Environmental Advocates files complaint over EPA's 2010 approval of Idaho's | | | |
| **2016** | EPA: (a) settles complaint by agreeing to take *new* action and adopt replacement criteria by November 15, 2019. (b) disapproves both the 1999 and 2010 Idaho criteria. | | | |
| **2018** | EPA: reaches a modified agreement with plaintiffs; will adopt new Idaho criteria by November 15, 2023. | | | EPA also discusses finishing IRIS assessment for $As_{(in)}$ in 2021. |
| **2018** | Idaho: starts a new negotiated rulemaking on As criteria. | | | |

## 1.C. Regulatory Framework and Issue

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

- A criterion for the consumption of fish only (recreation use); and
- A second criterion for the consumption of fish and water (water supply and recreation 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.[6] EPA developed section 304(a) criteria for arsenic in 1992 (Table 2).

**Table 3**
**EPA CWA § 304(a) Arsenic$_{(in)}$ Criteria**

| | Criteria[7] (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, 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 3. 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:

- Derivation of state specific criteria values using state specific values for parameters such as bioaccumulation factors (BAFs), speciation of arsenic in fish tissue, and allowable risk, among other factors;
- Background or natural concentrations of arsenic; and

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[6] 40 CFR § 131.11(a).
[7] Criteria assume an allowable excess lifetime cancer risk level of $1x10^{-6}$. Assuming Idaho's allowable risk level of 1x10-5, the values would be 0,18 and 1.4 µg/L respectively.

- Use of Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs).

Western states have a wide variety of arsenic water quality criteria. Six of the fourteen states have either a water and organism criteria or organism only criteria value that is 10 µg/L or higher (Table 4). Four states have as criteria the EPA 304(a) values, one of which was imposed by EPA.[8] States in other areas of the country also have adopted a range of WQC for arsenic including the 10 µg/L MCL (Table 5). The values in Table 5 were obtained using a EPA's relatively new WQS Search Tool, which provides access to a compilation of state-specific water quality standards that are either approved by EPA or are otherwise in effect for Clean Water Act purposes (https://www.epa.gov/wqs-tech/state-specific-water-quality-standards-effective-under-clean-water-act-cwa).

[8] 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.

# Table 4
## Summary of Arsenic Water Quality Criteria - Western States

| 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)<br>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 $1.1 \times 10^{-5}$, and the water and organism criterion is based on a risk level of $1 \times 10^{-4}$. |
| 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. |
| 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. 10 µg/L is the new federal maximum contaminant level standard. |
| 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 drinking water only or 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:
The table contains three sets of HH WQC including Drinking Water, Water and Organism and Organism Only. Several states have a designated use of domestic (or drinking) water supply and have developed HH WQC for that designated use in addition to or instead of having HH WQC for Water and Organism and Organism Only. In many cases the Drinking Water HH WQC is equal to the Maximum Contaminant Level developed as part of the Safe Drinking Water Act.

## Table 5
## Summary of Arsenic Water Quality Criteria – Nation Wide

| State | Domestic Water Supply (µg/L) | Organism Only (µg/L) | Water and Organism (µg/L) |
|---|---|---|---|
| Alabama | -- | See equation | See equation |
| Connecticut | -- | 0.021 | 0.011 |
| Delaware | -- | -- | 10 |
| Florida | -- | 50 | 10 |
| Georgia | -- | 50 | 10 |
| Illinois | 50 | -- | -- |
| Iowa | -- | 50 | 0.18 |
| Kansas | 10 | -- | -- |
| Kentucky | 10 | -- | -- |
| Louisiana | 10 | -- | -- |
| Maine | -- | 0.028 | 0.012 |
| Maryland | -- | 1.4 | 0.18 |
| Massachusetts | -- | 0.14 | 0.018 |
| Minnesota | 10 | -- | -- |
| Mississippi | -- | 24 | 0.078 |
| Missouri | 50 | -- | -- |
| Nebraska | 0.18 | -- | -- |
| Nevada | 50 | -- | -- |
| New Hampshire | -- | 0.14 | 0.018 |
| New Jersey | -- | 12.9 (saltwater)<br>73.4 (freshwater) | 10 |
| New Mexico | -- | 9 | 10 |
| New York | 50 | -- | -- |
| North Carolina | -- | -- | 10 |
| Ohio | 10 | -- | -- |
| Oklahoma | 40 | 205 | -- |
| Pennsylvania | 10 | -- | -- |
| Rhode Island | -- | 1.4 | 0.18 |
| South Carolina | -- | 10 | 10 |
| Tennessee | -- | 10 | 10 |
| Texas | -- | -- | 10 |
| Vermont | -- | 1.5 | 0.02 |
| Virginia | -- | -- | 10 |
| Washington DC | -- | 0.14 | -- |
| West Virginia | -- | 10 | 10 |
| Wisconsin | 0.2 | -- | -- |

Notes:
The table contains three sets of HH WQC including Drinking Water, Water and Organism and Organism Only. Several states have a designated use of domestic (or drinking) water supply and have developed HH WQC for that designated use in addition to or instead of having HH WQC for Water and Organism and Organism Only. In many cases the Drinking Water HH WQC is equal to the Maximum Contaminant Level developed as part of the Safe Drinking Water Act.

As the 2018 negotiated rulemaking commenced, IACI made the following recommendations to the Department:[9]

1. "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 in 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.
2. Evaluate alternative approaches to assessing the toxicity of arsenic, including use of Idaho-specific data.
3. The data gathered and alternative approaches can potentially be used for:
    a. The development of Idaho specific arsenic criteria that use state specific data (such as BAF, arsenic speciation, and fish consumption rate) and an alternative toxicity assessment approach;
    b. Developing organism only criteria for water bodies that are not designated as drinking water supply. Preliminary calculations 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."

Since the time that IACI provided those comments and recommendations (in August 2018), the Department has gathered additional data and information relevant to the establishment of a new arsenic human health water quality criteria. The remainder of these comments provide: (a) a review and analysis of the data gathered; (b) the application of these data to new water quality criteria (c) discussion of several potential options for the establishment of new arsenic human health water quality criteria; and finally (d) recommendations for the Department to consider.

[9] Idaho Association of Commerce and Industry. 2018. Comments to the Idaho Department of Environmental Quality on Revising the Arsenic Human Health Water Quality Criteria.

## 2. The Science of Arsenic in Idaho Waters and Fish

### 2.A. Background Concentrations

Arsenic occurs naturally in the environment in several valences (e.g., arsenic III, arsenic V) and many forms (e.g., organic and inorganic). Inorganic arsenic ($As_{(in)}$) is acknowledged by the scientific community to be the most toxic form of arsenic. As a result, the Department's sampling and monitoring programs have focused on measuring concentrations of $As_{(in)}$ in surface water and fish tissue for the purpose of gathering data that could be used for the establishment of new arsenic human health water quality criteria.

The results collected to date from DEQ's targeted state-wide surface water monitoring program provide an excellent sense of the range of $As_{(in)}$ background concentrations in Idaho surface waters. Concentrations of $As_{(in)}$ range from non-detect with a detection limit of 0.04 µg/L to 19.8 µg/L (Table 1). Arithmetic mean concentrations of inorganic arsenic at the 40 targeted surface water monitoring locations range from 0.055 µg/L to 12.35 µg/L (Table 1, Figure 3). DEQ also collected inorganic arsenic surface water concentration data as part of the 2019 probabilistic fish tissue sampling program. The range of inorganic arsenic surface water concentrations from those 24 locations is similar to the ongoing monitoring program (Table 6) providing further evidence of the widespread presence of inorganic arsenic in Idaho surface waters.

**Table 6**
**Comparison of $As_{(in)}$ Surface Water Concentrations from the 2019 Targeted and Probabilistic Monitoring Programs**

| Dataset | Sample Size | Detects | Non-Detects | Minimum Detect | Maximum Detect | Arithmetic Mean | Harmonic Mean | Median | 10th Percentile | 90th Percentile |
|---|---|---|---|---|---|---|---|---|---|---|
| Targeted Surface Water (Aug 2019 - May 2020) | 309 | 304 | 5 | 0.044 | 19.8 | 1.68 | 0.25 | 1.01 | 0.08 | 3.5 |
| Probabilistic Surface Water/Fish Tissue (Aug - Oct 2019) | 48 | 46 | 2 | 0.076 | 8.1 | 1.53 | 0.31 | 1.01 | 0.13 | 4.2 |

**Notes:**
Detection limit= 0.04 µg/L

### 2.B. Bioaccumulation of Arsenic in Fish Tissue

The Department is to be commended for undertaking a comprehensive state-wide sampling program to better understand the relationship between concentrations of inorganic arsenic in surface water and concentrations of inorganic arsenic in fish tissue, the results of which can be used to inform development of a bioaccumulation factor (BAF) for use in establishing human health water quality criteria for arsenic in Idaho waters. The 2019 dataset is exceptionally robust and represents a one-of-a-kind study given the large number of sampling locations and their geographic coverage. Additional paired tissue/surface water data collected in the same manner are unlikely to change the 2019 findings. Moreover, the similarity of inorganic arsenic surface water concentrations in the probabilistic paired fish tissue/surface water sampling program and the more expansive targeted ongoing surface water monitoring program (Table 6) indicates that the inorganic arsenic fish tissue concentrations measured as part of the probabilistic fish tissue sampling program are representative of inorganic arsenic fish tissue concentrations in most Idaho surface waters.

Historically, BAFs have often been calculated simply as the ratio of the concentration of a substance in fish to the concentration of that substance in water. 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 mean of all the BAFs calculated for each sample, as DEQ did when developing the BAF of 1.18 L/kg presented during the 15 July 2020 rulemaking meeting. 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. Regression analysis represents a superior method to determine whether a relationship exists between water and fish tissue concentrations.[10] If a statistically significant relationship exists, that relationship represents the BAF. The absence of a statistically significant relationship, as is the case in Idaho, indicates that the concentration of a substance in fish tissue is not related to the concentration of the substance in surface water and therefore, a meaningful biologically-based BAF cannot be derived. Consequently, based on the existing data, a BAF should not be used to predict fish tissue concentrations based on surface water concentrations.

Three regression analyses were conducted using the 2019 paired fish tissue/surface water data collected by the Department. The analyses differed based on the treatment of surface water and fish tissue samples with non-detect inorganic arsenic concentrations. One regression analysis assumed non-detects have an inorganic arsenic concentration equal to the detection limit. Another assumed non-detects have an inorganic arsenic concentration equal to the one half the detection limit. The third regression analysis used only paired samples in which inorganic arsenic was detected in both surface water and fish tissue. All of the regression analyses confirmed the key finding presented by the Department.[11,12] Namely that a statistically significant relationship between the concentration of inorganic arsenic concentrations in surface water and the concentration of inorganic arsenic in fish tissue does not exist (Table 7, Figure 4). Previous work by Arcadis did not identify statistically significant relationships between the concentration of arsenic in surface water and fish tissue when accounting for fish species or size or speciation of arsenic (see Appendix C).[13]

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[10] Arcadis. 2018. Idaho Arsenic Human Health Criteria: Comments Prepared in Response to the April 19, 2018 Rulemaking Meeting. April 30, 2018.
[11] Idaho Department of Environmental Quality. 2020a. 2019 Arsenic Accumulation in Fish Tissue. Preliminary Monitoring Results. March.
[12] Idaho Department of Environmental Quality. 2020b. Revision of Idaho's Human Health Criteria for Arsenic. Docket No. 58-0102-1801. July 15, 2020. PowerPoint presentation by Jason Pappani.
[13] This paper looks at a number of relationships including inorganic arsenic fish tissue concentrations vs. surface water total arsenic concentrations; and BAF vs. total arsenic concentration in surface water. No statistically significant relationships were found.

**Table 7**
**Summary of $As_{(in)}$ Surface Water/Fish Tissue Regression Analyses with Varying Treatment of Non-detects**

| Treatment of Non-Detects | Sample Size | Regression Equation | $R^2$ | P-Value |
|---|---|---|---|---|
| Non-detects = Detection Limit | 48 | y = 0.1845x + 1.5487 | 0.013 | 0.44 |
| Non-detects = 1/2 Detection Limit | 48 | y = 0.1908x + 1.5069 | 0.014 | 0.42 |
| Non-detects Excluded | 34 | y = 0.0854x + 2.3312 | 0.003 | 0.77 |

**Figure 4.**
**Plot of Paired Surface Water/Fish Tissue Data with Regression and Geometric BAFs Shown.**

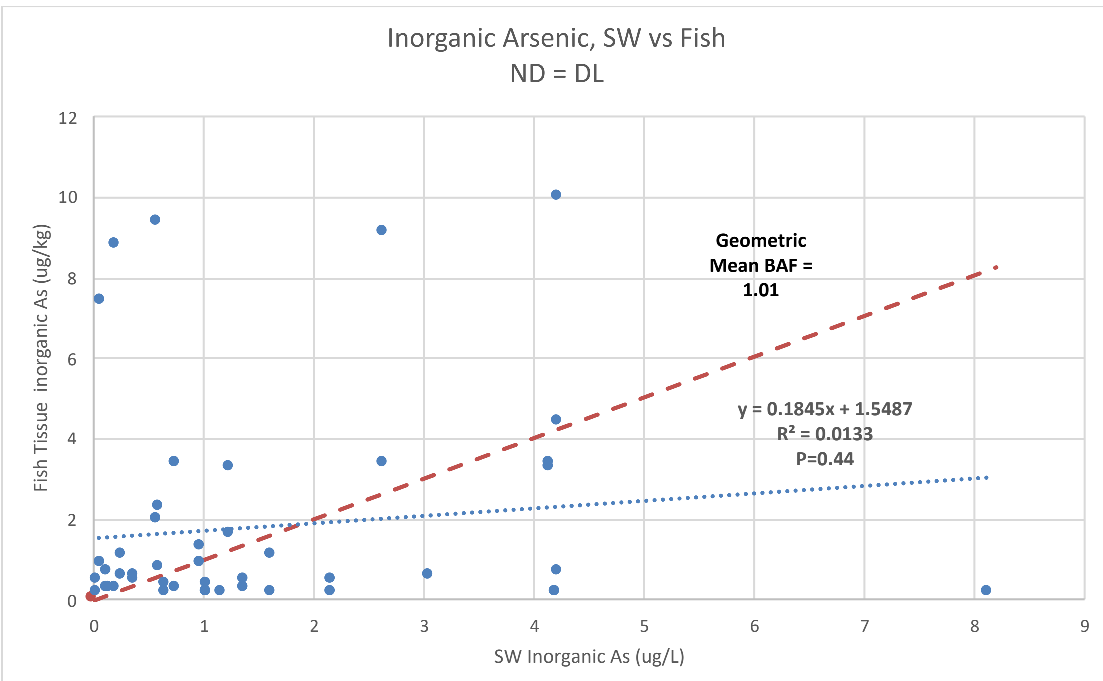


Figure 4 also presents a BAF derived using the geometric mean approach followed by the Department.[14] The geometric mean BAF shown on Figure 4 is 1.01 L/kg, slightly smaller than the BAF of 1.18 L/kg presented by DEQ during the July 15 Rulemaking meeting.[15] It does not represent a better "fit" to the 2019 dataset than any of numerous

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[14] Idaho Department of Environmental Quality. 2020b. See footnote number 10.

[15] Parallel to the regression analyses, three alternative geometric mean BAFs were calculated; they varied based on the treatment of non-detect samples and duplicates. In all cases the average of surface water duplicates was used to represent the surface water concentration when estimating the BAF at a location because the differences in $As_{(in)}$ surface water concentration were small. The relative percent

alternative lines that could be used to represent similarly derived BAFs. It under predicts inorganic arsenic tissue concentrations at low surface water concentrations and over predicts inorganic arsenic tissue concentrations at high surface water concentrations.

Thus, based on the state-wide 2019 dataset, the concentration of inorganic arsenic in fish tissue appears to be independent of the concentration of inorganic arsenic in surface water. As a result, a scientifically defensible BAF (defined as a BAF that can be used to predict fish tissue concentrations from a water concentration) cannot be established. That means in the "aggregate" regulating the inorganic arsenic concentration in surface water will not affect concentrations of inorganic arsenic in fish; for very specific site conditions such a relationship may exist but at this time a data set for such a site/conditions has not been found (developed). The state-wide data set shows that lower inorganic arsenic surface water concentrations do not lead to lower fish concentrations (and lower fish consumption exposures).[16] Though it does not preclude the possibility of specific sites where such a relationship does exist.

## 2.C. Potential Risk of Inorganic Arsenic Concentrations in Fish

As noted above, the geographic breadth (i.e., targeted state-wide sampling) and large size (i.e., 172 individual fish divided into 48 composites samples) of the 2019 Idaho-wide fish dataset makes it unique and robust. It can be used to evaluate the potential for fish in Idaho surface waters to pose a potential risk to human health associated with consumption of Idaho fish containing inorganic arsenic. To derive human heath water quality criteria for other substances, the Department has already identified the key assumptions necessary for deriving allowable concentrations of substances in surface water allowable fish tissue concentrations. Assuming a bodyweight of 80 kilograms, a fish consumption rate of 66.5 grams per day for a lifetime, an acceptable excess lifetime cancer risk of $1x10^{-5}$, and using the current USEPA cancer slope factor of 1.5 (mg/kg-day)$^{-1}$ for arsenic, the allowable <u>inorganic</u> arsenic fish tissue concentration is 8 micrograms per kilogram (μg/kg)[17].

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difference (RPD) of $As_{(in)}$ concentrations at the two sampling locations with surface water duplicates was 0% and 7%. In all cases, fish duplicates were treated as separate samples, each with its own unique BAF because detected $As_{(in)}$ concentrations varied substantially between fish tissue duplicate samples at two of three sampling stations with RPDs of 0%, 67%, and 78%. Depending upon whether non-detects were assumed to have $As_{(in)}$ concentrations equal to the detection limit, equal to half the detection limit, or non-detects were eliminated from the calculation, the geometric mean BAFs were 1.01 L/kg, 0.86 L/kg, and 1.37 L/kg. All of these are similar to but not identical to the geometric mean BAF of 1.18 L/kg developed by the Department (see footnote number 10)

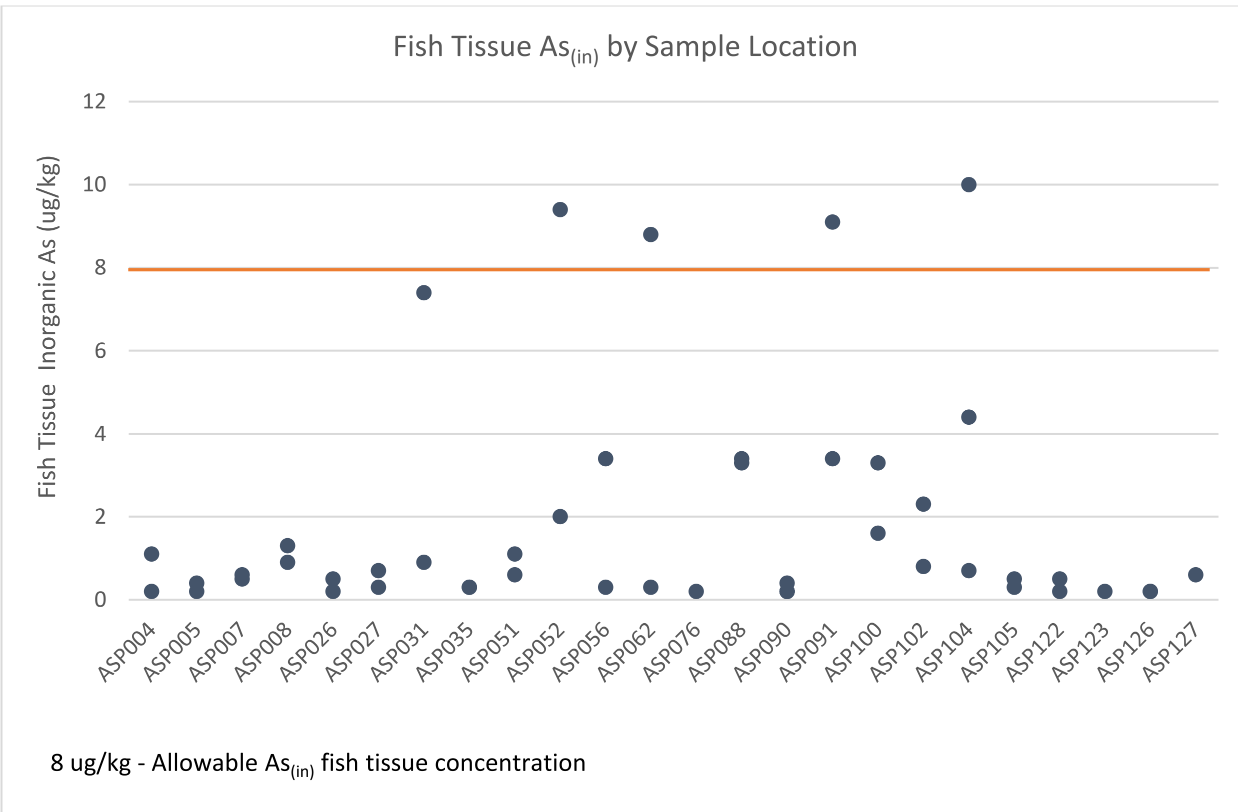
[16] The same conclusions exist for inorganic arsenic in fish tissue and total arsenic concentrations in surface water. See Appendix C.

[17] Allowable concentration (ug/kg) = (Allowable Risk ($1x10^{-5}$) x Bodyweight (80 kg/person)) ÷ (Fish consumption rate (0.0665 kg/person-day) x Cancer Slope Factor (1.5 kg-day/mg) x Conversion factor (1,000 ug/1 mg) = 8 ug/kg. Use of an allowable risk of $1x10^{-4}$ would result in a higher allowable concentration in fish tissue.

Based on the Department's 2019 data, 44 of 48 composite fish samples had inorganic arsenic concentrations below an allowable fish tissue concentration of 8 μg/kg (Figure 5). Only four of 48 tissue samples had an inorganic arsenic concentration slightly (no more than 25%) greater than 8 μg/kg (Figure 5). Because the exceedances of the allowable concentration are small and infrequent, the potential excess lifetime cancer risk associated with all four of these samples is $1x10^{-5}$. The comparison of measured inorganic As fish tissue concentrations to the allowable concentration indicates that potential excess lifetime cancer risks associated with daily consumption of fish from Idaho surface waters over a lifetime are at or below Idaho's allowable risk level and that the fish are safe to eat.

**Figure 5**

**Plot of 2019 Fish Tissue Data by Sampling Location with 8 ug/kg $As_{(in)}$ Allowable fish Tissue Concentration also Shown**



## 3. Application of the Arsenic Best Science to the Water Quality Regulatory Framework

As described in the introduction, the designated beneficial uses for which the arsenic human health water quality criteria are being developed are: recreational (fish consumption exposures only); and recreational and domestic water supply (fish consumption and potable water exposures). Approximately 96,490 stream miles are designated or presumed to have recreational use only. Approximately 22,957 stream miles are currently designated for domestic water supply and recreational use.[18] (IDEQ 2019)

Based on the finding that fish collected throughout Idaho have inorganic arsenic concentrations that are equal to or less than the allowable concentrations, water quality criteria derived to mitigate potential risks associated with fish consumption are not necessary given current concentrations. Moreover, given the absence of a biologically meaningful and statistically significant relationship between inorganic arsenic concentration in Idaho surface waters and fish tissue, the concept of a BAF is not applicable, and traditional numeric surface water-based water quality criteria that rely on a BAF is not defensible because requiring a lower inorganic arsenic surface water concentration won't lead to lower fish concentrations (and lower fish consumption exposures). If the inorganic arsenic concentration in fish tissue is determined to pose an unacceptable risk, exposure to such inorganic arsenic concentrations will need to be reduced through a mechanism other than numeric surface water quality criteria and dealt with on a site by site basis.

A mechanism by which to identify surface waters potentially needing evaluation of inorganic arsenic fish tissue concentrations is to use a water quality based value to trigger fish tissue sampling/monitoring. Though the basis for the surface water concentration that triggers the need for fish tissue monitoring could not rely on a relationship between fish tissue and water concentrations (i.e., a BAF) unless site-specific data justified such use.

As demonstrated at the July 15, 2020 rulemaking meeting, if default Department and USEPA assumptions are used to derive potential human health water quality criteria protective of drinking water exposures, (e.g., 0.22 µg/L $As_{(in)}$), it can be lower than the arithmetic mean[19] background inorganic arsenic concentrations in most Idaho surface waters monitored to date (Figure 6). Adoption and implementation of such potential water quality criteria creates numerous practical limitations, beyond the obvious

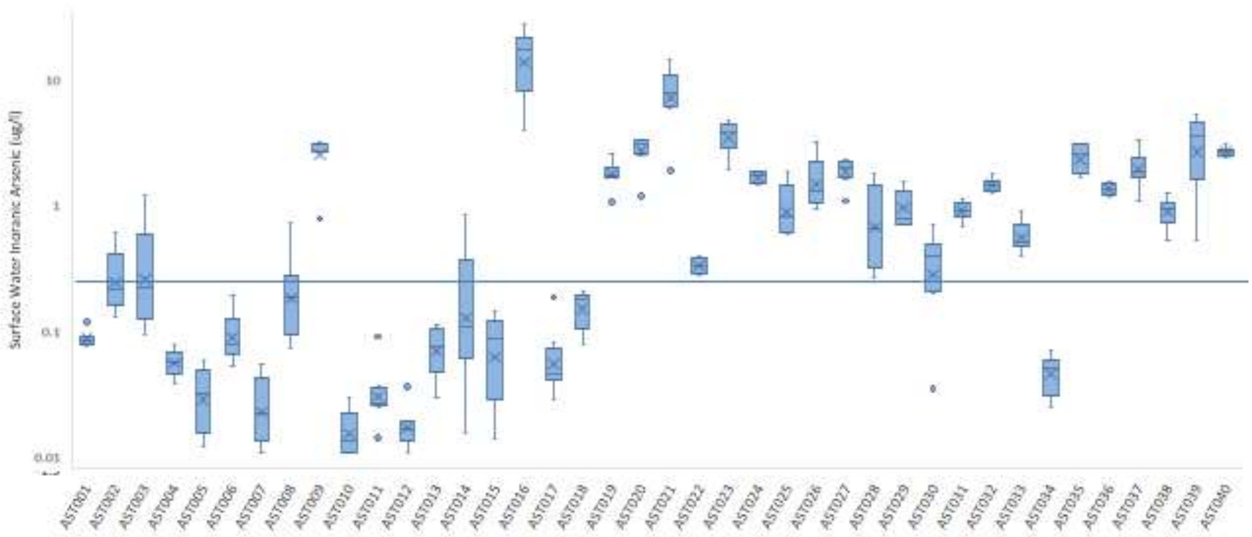
[18] Idaho Department of Environmental Quality. 2019. Docket No. 58-0102-1801. Revision of Idaho's Human Health Criteria for Arsenic. Negotiated Rulemaking. PowerPoint presentation by Jason Pappani. July 23, 2019.

[19] When comparing the receiving water concentration of a substance to a human health WQC based on chronic exposures, the arithmetic mean concentration, not the geometric or harmonic mean concentration, is the appropriate measure of central tendency to use in the comparison (Appendix E).

problem of promulgating an unattainable criteria. Two examples of such limitations are listed below.

**Figure 6**

**August 2019 to May 2020 $As_{(in)}$ Surface Water Monitoring Results Compared to Hypothetical $As_{(in)}$ Human Health Water Quality Criteria**




The first example consists of a hypothetical drinking water utility extracts groundwater with a natural occurring $As_{(in)}$ concentration of 1 μg/L. That groundwater concentration is greater than a hypothetical drinking water of 0.22 $As_{(in)}$ but meets the MCL of 10 μg/L $As_{(total)}$. Because the inorganic arsenic concentration is less than the MCL, the utility is able to distribute the groundwater without treatment for the inorganic arsenic concentration as potable water to the community it serves. Following use of the water by the community, the water is collected by the wastewater utility serving that community. The water continues to have an inorganic arsenic concentration of 1 μg/L because the community did not add any inorganic arsenic to the water during use. If Idaho were to adopt a hypothetical human health water quality criteria of 0.22 μg/L $As_{(in)}$, the wastewater utility might need to treat the water before discharging it to a surface water designated for drinking water use. Treatment might not be necessary if the $As_{(in)}$ receiving water concentration is less than the human health water quality criteria but would likely be required if the $As_{(in)}$ receiving water concentration is greater than the human health water quality criteria. In the first case where the background concentration in the receiving water is less than the human health water quality criteria, as long as the concentration of the receiving water remains below the water quality criteria following release of the wastewater utility's effluent, treatment would not be required. However, in the second case, where the $As_{(in)}$ background concentration in the receiving water exceeds the human health water quality criteria, treatment would likely be required such that the $As_{(in)}$ concentration in the receiving water does not exceed the naturally occurring $As_{(in)}$ concentration. Given the state-wide monitoring data collected to date, about two thirds of Idaho rivers will have a naturally occurring

$As_{(in)}$ background concentration higher than the hypothetical human health criteria used in this example.

The second hypothetical example of the practical implications of a human health water quality criteria that is lower than naturally occurring background inorganic arsenic concentrations consists of a drinking water utility that uses the receiving water as the source of potable water. The naturally occurring inorganic arsenic concentration in the receiving water is 1 μg/L. As in the above scenario, the drinking water utility can distribute that as potable water without treatment for arsenic because it meets the MCL of 10 μg/L $As_{(inl)}$. However, if consideration of naturally occurring background is not allowed, the wastewater utility will likely need to treat that water before discharging it because it exceeds the human health water quality criteria by nearly 10-fold. Because Idaho rules do allow use of naturally occurring background as the human health water quality criteria when the background concentration is higher than the human health water quality criteria, it may be possible for the wastewater utility to discharge its effluent without treatment. This assumes that the use of the water by the community did not add a measurable amount of arsenic to the wastewater. If the community were to add a measurable amount of arsenic to the wastewater stream, even if that amount is very small (e.g., 0.1 μg/L $As_{(in)}$, or 10% of the background), the wastewater utility would need to treat the water such that the receiving water does not exceed the natural background of 1 μg/L $As_{(in)}$.

Beyond the issue of community use of the water potentially causing a small increase in the inorganic arsenic concentration that would necessitate potentially expensive treatment, as the DEQ targeted monitoring data show, naturally occurring background concentration varies. Given that variation, establishing naturally occurring background on a site-specific basis has the potential to be a resource intensive process. Further, given that variation, a background-based human health water quality criteria would also need to have in place a process for determining whether an exceedance of naturally occurring background is the result of an addition by the community of inorganic arsenic to the wastewater stream or is simply, natural variation, unless the hypothetical inorganic arsenic human health water quality criteria allowed for a nominal exceedance of background.

Finally, from a public policy standpoint, the hypothetical drinking water criteria of 0.22 μg/L $As_{(in)}$ makes no sense in Idaho. According to the Department's website approximately 95% of Idaho's population obtain their drinking water from groundwater. Both the Department and EPA have determined that it is safe for Idaho citizens to consume drinking water with a concentration of arsenic that does not exceed 10 μg/L but presumably for the small percentage of people which consume their drinking water from surface water, the criteria must be orders of magnitude more stringent. Such an approach makes no sense even if EPA Guidance suggests such an irrational result.

## 4. Options for Establishing a New Human Health Arsenic Water Quality Criterion

This section presents two potential human health water quality options for waters whose designated use is recreation only (Table 8) and four potential options for whose designated use is water supply and recreation use (Table 9). Given that 2019 data indicate a statistically significant and biologically meaningful BAF is not applicable to surface waters and fish in Idaho, none of the options discussed below include use of a BAF to establish human health water quality criteria.

### 4.A. Recreational Use

1.) Fish tissue based human health "water quality" criterion of 8 µg/kg $As_{(in)}$ with no numeric surface water value. The criterion value is based on the current IRIS CSF of 1.5 kg-day/mg, $1x10^{-5}$ allowable risk, and DEQ fish consumption rate (66.5 g/d) and bodyweight (80 kg).

**Table 8**
**Summary of Recreation Use Only Human Health Water Quality Criteria Options**

| Option | Description | Criteria | Number of Stations/Samples Exceeding |
|---|---|---|---|
| **1** | Numeric Fish Tissue Value as the Water Quality Criteria | 8 µg/kg $As_{(in)}$ | 4 of 48 tissue samples |
| **2** | Narrative Criteria: Numeric Fish Tissue Value as the Water Quality Criteria with a Surface Water Screening Value | 8 µg/kg $As_{(in)}$ 2.2 µg/L $As_{(in)}$ is a "screening" value for triggering fish tissue monitoring | 11 of 40 monitoring stations would initiate fish tissue testing. |

**Note:**
For all recreational use only options presented in the Table 8, only an exceedance of the allowable fish tissue concentrations of 8 µg/kg can be used to demonstrate that the designated recreational use only is not being attained.

2.) A numeric surface water concentration of 2.2 µg/L $As_{(in)}$ is used as a screening value to initiate fish tissue sampling to determine if the inorganic arsenic fish tissue concentrations are above the tissue criterion value of 8 µg/kg $As_{(in)}$. The surface water screening concentration is derived using the assumptions the Department uses to derive human health water quality criteria for other substances in surface water but does not include the fish consumption contribution, the current USEPA cancer slope factor for arsenic and a $1x10^{-4}$ allowable risk level. As shown in Figure 4, the majority of the inorganic arsenic concentrations measured in fish tissue were less than 2 µg/kg and result in minimal exposure to inorganic arsenic compared to assumed surface water exposures. The water quality criterion should be clear that exceeding the 2.2 µg/L $As_{(in)}$ is not an exceedance of the water quality criterion (i.e., does not demonstrate impairment of the recreational only designated use). An exceedance in the surface water of the 2.2 µg/L $As_{(in)}$ concentration value only initiates fish tissue sampling to determine if the fish tissue criterion concentration of 8 μg/kg is exceeded. If 8 μg/kg As (inorganic) is not exceeded, then the waterbody is not impaired for recreational use and water quality based effluent limits for arsenic$_{(in)}$ would not be required to protect human health.

4.B. Recreational and Drinking Water Use

1.) Numeric surface water human health water quality criterion of 0.22 μg/L As$_{(in)}$. This is the hypothetical criterion value presented by the Department at the July 15, 2020 rulemaking meeting. This value is derived using the assumptions and allowable risk level that the Department uses to derive human health water quality criteria for other substances in surface water but does not include the fish consumption contribution. This assumes that the majority of the inorganic arsenic exposure would come from ingestion of surface water and not from fish consumption.[20] As shown in Figure 4, the majority of the inorganic arsenic concentrations measured in fish tissue were less than 2 μg/kg. The arithmetic mean background concentration of inorganic arsenic in surface water for 29 of 40 monitoring stations in the targeted sampling program (8/2019-5/2020 data) exceeds the value of 0.22 μg/L.

**Table 9**

**Summary of Water Supply and Recreation Use Human Health Water Quality Criteria Options**

| Option | Description | Criteria | Number of Stations Exceeding |
|---|---|---|---|
| **1** | Numeric Surface Water Criteria | 0.22 μg/L As$_{(in)}$ | 29 of 40 monitoring stations |
| **2** | Numeric Surface Water Criteria | 2.2 μg/L As$_{(in)}$ | 11 of 40 monitoring stations |
| **3** | Numeric Surface Water Criteria | 2.2 μg/L As$_{(in)}$ – 10 μg/L As$_{(in)}$ | 1 to 11 of 40 monitoring stations |
| **4** | Numeric Surface Water Criteria | 10 μg/L As$_{(in)}$ | 1 of 40 monitoring stations |

2.) Numeric surface water criterion of 2.2 μg/L As$_{(in)}$. This hypothetical criterion is derived using the same exposure and toxicity assumptions as used to derive the 0.22 hypothetical criterion value combined with an allowable excess life cancer risk level of $1x10^{-4}$. As with Option 1, this option assumes that the majority of the inorganic arsenic exposure would come from ingestion of surface water and not from fish consumption. This allowable cancer risk level is within

[20] As discussed above, a scientifically based BAF is not supported by the most recent paired fish tissue and surface water data collected by the Department. An alternative human health water quality criterion can be derived by using the assumptions and allowable risk level that the Department uses to derive human health water quality criteria for other substances in surface water but excluding the fish consumption rate and BAF assumptions. When those two assumptions are excluded, the inorganic As human health water quality criterion is 0.22 μg/L, the same value as when fish consumption and the BAF of 1.18 L/kg is included. Including or excluding fish consumption when the BAF is small, has little effect on the water quality criterion. This numeric criterion of 0.22 μg/L is derived without inclusion of fish consumption because the inorganic As concentration in fish is not affected by the inorganic As concentration in water.

the range of allowable cancer risk associated with MCLs. It is also the same allowable risk level approved by US EPA for Oregon's water and organism human health water quality criteria. The arithmetic mean background concentration of $As_{(in)}$ in 11 of 40 monthly monitored surface waters exceeds 2.2 μg/L (based on 8/2019-5/2020 data).

3.) Numeric surface water criterion of 2.2 μg/L $As_{(in)}$ to 10 μg/L $As_{(in)}$ to account for naturally high concentrations of arsenic in surface and ground waters. This criteria option is based on a range of arsenic water column concentrations, from the larger of either 2.2 μg/L $As_{(in)}$ or background, to 10 μg/L $As_{(in)}$. As with Option 1, this option assumes that the majority of the inorganic arsenic exposure would come from ingestion of surface water and not from fish consumption. When background is less than 2.2 μg/L $As_{(in)}$, the first concentration of 2.2 μg/L $As_{(in)}$ represents a strictly health-based criterion, based on the Department's established methodology for human health water quality criteria and assuming an allowable lifetime cancer risk level of $1x10^{-4}$. When background is greater than 2.2 μg/L $As_{(in)}$ the first number in the range is the background concentration and that value represents the criteria as established by Idaho rules when the criteria are less than background. The second number in the range is the MCL, (established under the federal Safe Drinking Water Act) that has been determined to be an acceptable concentration of $As_{(in)}$ as raw water for public water supplies, taking treatability and laboratory detection limits into account. Control requirements, such as discharge permit effluent limitations, shall be established using the first number in the range as the *ambient water quality target*, provided that no effluent limitation shall require an "end-of-pipe" discharge concentration more restrictive than the second number in the range. Water bodies will be considered in attainment of this standard, and not included on the Section 303(d) List, so long as the existing ambient quality does not exceed the second number in the range or naturally occurring background, whichever is greater.

4.) Numeric surface water criterion of 10 μg/L $As_{(in)}$. This is equal to the MCL of 10 μg/L $As_{(in)}$ as established by the Safe Drinking Water Act. It represents a concentration of arsenic in domestic drinking water that USEPA has determined is safe. Its adoption as the water and organism human health water quality criterion is not precedent setting in any way as 16 other states use the MCL of 10 μg/L $As_{(in)}$ as their water and organism human health water quality criteria. Thirteen other states have a domestic water supply designated beneficial use and use the MCL of 10 μg/L $As_{(in)}$ as the human health water quality criteria for those water bodies. [See Tables 4 and 5.]

An adoption of the arsenic MCL as the human heath water quality criteria would also meet Idaho's mixing zone provisions. Idaho allows mixing zones where the criteria may be exceeded in accordance with the terms of the mixing zone allowance, but (per IDAPA 58.02.060) the MCL is the criteria that must be met at the point of a drinking water system intake where treatment is presumed to occur.

> "Mixing zones, individually or in combination with other mixing zones, shall not cause unreasonable interference with, or danger to, beneficial uses. Unreasonable interference with, or danger to, beneficial uses includes, but is not limited to, the following: …. Concentrations of pollutants that exceed Maximum Contaminant Levels at drinking water intake structures."

As discussed in Section 1.B. of these comments, one of the reasons given in the complaint filed by NWEA of why EPA's approval of the 10 μg/L $As_{(in)}$ value as the human health criteria was invalid is that MCL values cannot be used as CWA human health water quality criteria per EPA guidance. EPA Region X, in reaching a settlement with NWEA agreed with that reason.[21] However, it is not clear that EPA's use of guidance as regulation is truly legal. Recent Executive Orders have been issued to address the use of "guidance" documents by agencies as regulations.[22] Moreover, it appears the main reason for this guidance/recommendation is that human health criteria for surface water need to consider not only drinking water consumption but "fish consumption and bioaccumulation".[23] As the Department's robust data set collected since EPA's disapproval has demonstrated, in the "aggregate" bioaccumulation and fish consumption are not influenced by inorganic arsenic concentrations in surface water. Concentrations of inorganic arsenic in fish tissue are most often below 2 μg/kg. Therefore, the incorporation of the 10 μg/L arsenic criteria still warrants serious discussion as the majority of the inorganic arsenic ingestion would come from surface water.

## 5. Recommendation & Implementation

Federal regulations require that water quality criteria be based upon the following:[24]

(1) Establish numerical values based on:
- (i) 304(a) Guidance or
- (ii) 304(a) Guidance modified to reflect site-specific conditions; or
- (iii) Other scientifically based defensible methods;

[21] During the Department's July 15, 2020 negotiated rulemaking meeting, EPA staff from headquarters and Region X restated this position.
[22] See the following Executive Orders issued on October 9, 2019: Executive Order on Promoting the Rule of Law Through Improved Agency Guidance Documents and Executive Order on Promoting the Rule of Law Through Transparency and Fairness in Civil Administrative Enforcement and Adjudication.
[23] See 65 Fed. Reg. 66444,66450.
[24] 40 CFR § 131.11.(b).

> (2) Establish narrative criteria or criteria based upon biomonitoring methods where numerical criteria cannot be established or to supplement numerical criteria.

As noted earlier in these comments, the 304(a) Guidance values do not reflect naturally occurring concentrations of arsenic in Idaho surface waters. Thus, any proposed criteria needs to (a) reflect site-specific conditions, (b) be based on scientifically defensible methods, or (c) be a narrative criteria that can utilize biomonitoring or supplemental numeral criteria. Based on the review and careful consideration of the robust and numerous available data from Idaho, the naturally occurring elevated concentrations of arsenic in Idaho surface waters, the following human health criteria are recommended.

<u>5.A. Recommendation</u>

*Recreation Use*

For waters designated for recreation use only, the recommended human health water quality criteria is a fish tissue concentration of 8 μg/kg $As_{(in)}$ with a screening water quality value of 2.2 μg/L $As_{(in)}$. The water column concentration of 2.2 μg/L is used as a screening value to determine if fish tissue monitoring is necessary in a water body. A water body with an inorganic arsenic concentration equal to or less than 2.2 μg/L will be considered to be in attainment of the recreational only designated use and fish tissue monitoring would not be required. Fish tissue monitoring would need to be undertaken in a water body with a water column inorganic arsenic concentration greater than 2.2 μg/L to determine if the water body attains the recreational only designated use. A water body with fish tissue concentrations equal to or less than the allowable fish tissue concentration of 8 μg/kg inorganic arsenic will be considered to be in attainment of the recreational only designated use.

This recommendation utilizes 304(a) guidance methodology for the calculation of human health water quality standards along with a narrative standard that incorporates biomonitoring.

*Water Supply and Recreation Uses*

For waters designated for water supply and recreation use, the recommended human health water quality criteria is based on a range of arsenic water column concentrations, where the low end of the range is the larger of either 2.2 μg/L $As_{(in)}$ or background (inorganic), and the high end of the range is 10 μg/L $As_{(in)}$. When the background concentration is less than 2.2 μg/L $As_{(in)}$, the low end of the range is 2.2 μg/L $As_{(in)}$ and represents a strictly health-based criterion. When background is greater than 2.2 μg/L $As_{(in)}$, the low end of the range is equal to the background concentration. The high end of the range is equal to the Maximum Contaminant Level, a concentration established under the federal Safe Drinking Water Act that has been determined to be an acceptable level of $As_{(in)}$ as raw water for public water supplies, taking treatability and laboratory detection limits into account.

Control requirements, such as discharge permit effluent limitations, shall be established using the low end of the range as the ambient water quality target, provided that no effluent limitation shall require an "end-of-pipe" discharge level more restrictive than the high end of the range. A water body will be considered in attainment of the domestic water supply and recreational designated use, so long as the existing ambient quality does not exceed the arsenic (total) concentration at the high end of range or background, whichever is greater.

This proposed criterion utilizes 304(a) guidance methodology for the calculation of a human health value and incorporates Idaho specific water quality conditions (high naturally occurring arsenic concentrations in surface and ground water) as a background adjustment per 40 CFR § 131.11(b)(ii and iii). *Also, it uses Idaho specific data that show on the aggregate there is not a relationship between surface water arsenic concentrations (both total arsenic and inorganic arsenic) and inorganic arsenic concentrations in fish tissue.* Furthermore, the extensive data set shows that the majority of the inorganic arsenic fish tissue concentrations are non-detect or below 2 μg/kg. Thus, this proposed criterion assumes that the majority of the inorganic arsenic exposure would come from ingestion of surface water and not from fish consumption. The use of the 10 μg/L value will not cause any waters designated as a drinking water supply to exceed the MCL value nor conflict with existing Water Quality Rules such as for mixing zones. Collectively, the use of Idaho specific surface water arsenic and fish tissue data to derive arsenic human health water quality criterion is appropriate as a "scientifically defensible method."

## 5.B. Implementation

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, intake credits, use attainability analysis and site-specific criteria. Of these tools, use attainability analysis offers the most practicable regulatory method to the regulated community.

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.

Intake credits, while helpful for discharges using the receiving water as a source water, may not be much help to dischargers who are using groundwater with naturally elevated groundwater concentrations as a source water. Naturally occurring arsenic concentrations in groundwater throughout much of Idaho exceed many of the possible domestic water supply human health water quality criteria that have been presented by the Department to date.

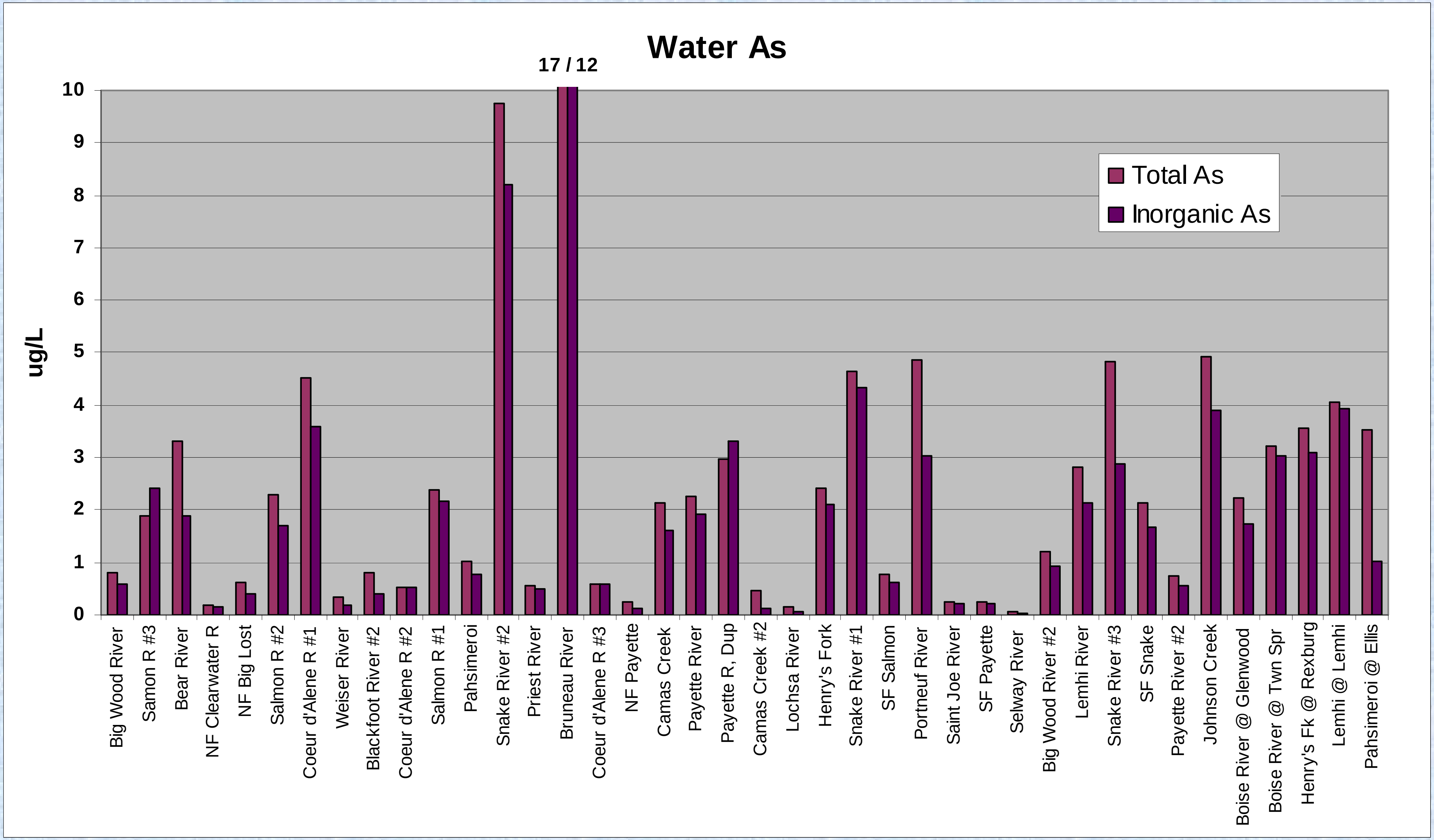
Natural background is recognized as a site-specific human health water quality criteria when natural background exceeds a numeric health based water quality criteria. However, as described by the second hypothetical example in the Application of Science section above, more specific implementation tools will need to be developed. At a minimum such tools would need to describe practical methods to establish site-specific background, take into account variability of naturally occurring concentrations, and allow for some de minimis increase in receiving water concentration downstream of the discharge.

The Use Attainability Analysis (UAA) process or development of a site-specific criteria (SSC) could also be utilized to revise the designated uses or criteria being applied to a specific water to more accurately reflect site conditions or account for elevated background concentrations in criteria. However, conducting a UAA or developing an SSC are time and data intensive processes ultimately requiring formal legislative and USEPA approval. These approaches are also impractical for application on a broad geographic scale. A streamlined or less intensive UAA or SSC development could be considered as part of implementation guidance to allow for consideration of site-specific conditions in application of criteria.

Idaho water quality rules already use fish tissue values as water quality criteria for two other pollutants (methyl mercury and selenium). Further procedures would need to be developed on how biomonitoring results are used to set discharge limits; though the recommended criteria do provide surface water concentrations that can be the starting place in regards to limits and monitoring that is needed.

# Appendix A

# 2008 Arsenic in Water from 40 Large River Sites



# Appendix B

## Location of Targeted Surface Water and Probabilistic Fish Tissue Monitoring Stations

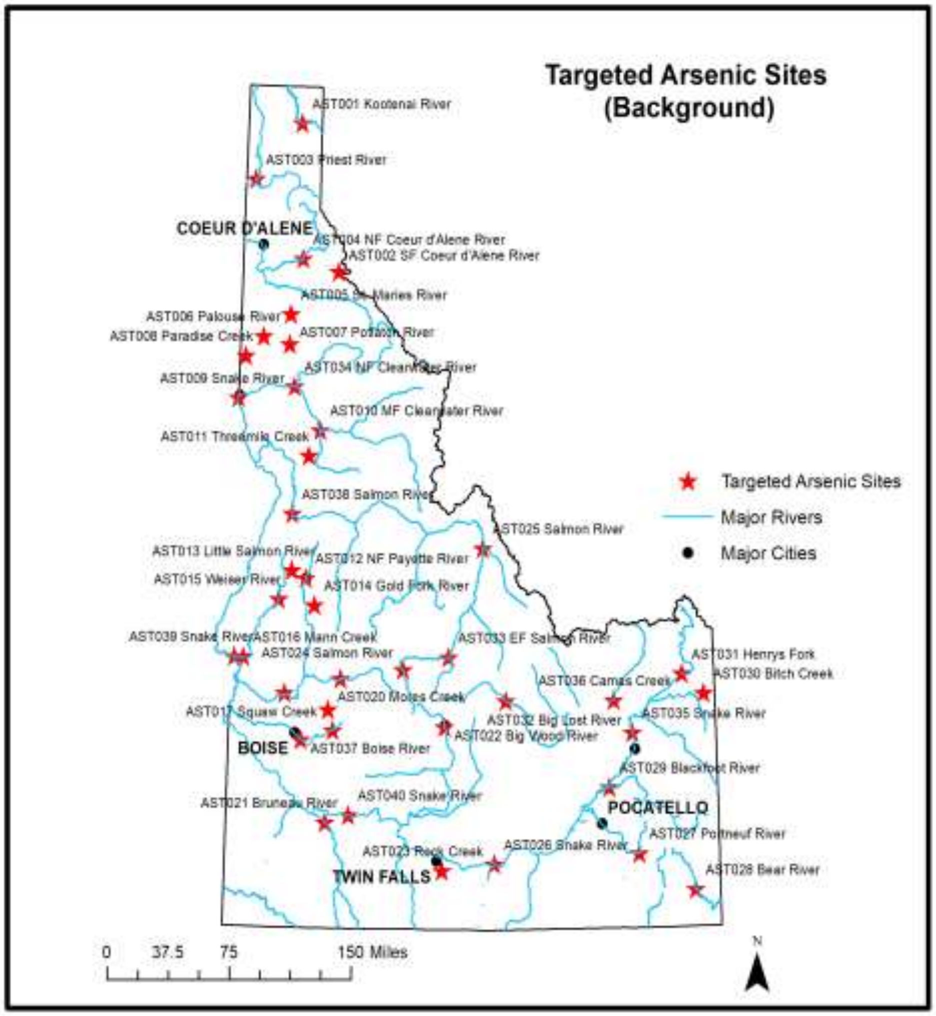
Table B-1 presents the identification number, drainage basin, and waterbody of each of the 40 targeted surface water monitoring stations. Figure B-1 shows the 40 stations on a map. Table B-2 presents the identification number and waterbody of each of the 24 probabilistic fish tissue sampling locations. Figure B-2 shows the 24 locations on a map.

**Table B-1**
**Location information for targeted surface water monitoring stations.**

| Sample Location ID | Stream/River ID | Basin Name | Nearby Municipalities | Longitude | Latitude |
|---|---|---|---|---|---|
| AST001 | Kootenai River | Panhandle | Bonners Ferry | -116.312039 | 48.699232 |
| AST002 | SF Coeur d'Alene River | Panhandle | Pinehurst, Kellogg, Osburn, Wallace | -115.785178 | 47.468986 |
| AST003 | Priest River | Panhandle | Priest River, Newport | -116.872210 | 48.284265 |
| AST004 | NF Coeur d'Alene River | Panhandle | Coeur d'Alene, Dalton Gardens, Hayden, Post Falls | -116.253050 | 47.569764 |
| AST005 | St. Maries River | Panhandle | Santa, Fernwood, St. Maries | -116.393277 | 47.105580 |
| AST006 | Palouse River | Clearwater | Harvard, Potlatch | -116.740897 | 46.915199 |
| AST007 | Potlatch River | Clearwater | Bovill, Deary, Kendrick, Juliaetta | -116.399840 | 46.857178 |
| AST008 | Paradise Creek | Clearwater | Moscow, Troy, Genesee | -116.962972 | 46.748297 |
| AST009 | Snake River | Salmon | Lewiston | -117.040041 | 46.395370 |
| AST010 | MF Clearwater River | Clearwater | Kooskia, Kamiah | -115.979384 | 46.146504 |
| AST011 | Threemile Creek | Clearwater | Grangeville, Winchester, Craigmont, Cottonwood | -116.117289 | 45.930786 |
| AST012 | NF Payette River | Southwest | McCall | -116.118594 | 44.912159 |
| AST013 | Little Salmon River | Salmon | New Meadows | -116.295267 | 44.973071 |
| AST014 | Gold Fork River | Southwest | Cascade | -116.052167 | 44.698826 |
| AST015 | Weiser River | Southwest | Council, Cambridge | -116.449595 | 44.731802 |
| AST016 | Mann Creek | Southwest | Weiser | -116.867454 | 44.241789 |
| AST017 | Squaw Creek | Southwest | Emmett, Fruitland, New Plymouth | -116.348164 | 43.951156 |
| AST018 | Deadwood River | Southwest | Garden Valley, Lowman, Horseshoe Bend | -115.659290 | 44.080173 |
| AST019 | MF Boise River | Southwest | Boise | -115.743884 | 43.649955 |
| AST020 | Mores Creek | Southwest | Idaho City, Robie Creek | -115.810086 | 43.821864 |
| AST021 | Bruneau River | Southwest | Bruneau | -115.817776 | 42.880298 |
| AST022 | Big Wood River | Upper Snake | Ketchum, Hailey, Bellevue, Sun Valley | -114.373205 | 43.687710 |
| AST023 | Rock Creek | Upper Snake | Twin Falls, Kimberly, Hansen, Jerome | -114.399756 | 42.489201 |
| AST024 | Salmon River | Salmon | Stanley | -114.886549 | 44.163196 |
| AST025 | Salmon River | Salmon | Salmon, Challis | -113.898119 | 45.177334 |
| AST026 | Snake River | Upper Snake | Burley, Ruperty, Paul, Declo | -113.761888 | 42.545283 |
| AST027 | Portneuf River | Upper Snake | Pocatello, Lava, Inkom, McCammon | -112.012207 | 42.620393 |
| AST028 | Bear River | Bear River | Montpelier, Paris, Grace, Soda Springs | -111.345377 | 42.308780 |
| AST029 | Blackfoot River | Upper Snake | Blackfoot, Pocatello, Shelley, Fort Hall | -112.359577 | 43.176103 |
| AST030 | Bitch Creek | Upper Snake | Rexburg, Driggs, Victor, Tetonia | -111.178947 | 43.939383 |
| AST031 | Henrys Fork | Upper Snake | Ashton, Island Part, St. Anthony | -111.446944 | 44.111396 |
| AST032 | Big Lost River | Upper Snake | Mackay, Arco, Carey | -113.617192 | 43.903079 |
| AST033 | EF Salmon River | Salmon | Challis, Stanley | -114.325582 | 44.267479 |
| AST034 | NF Clearwater River | Clearwater | Orofino, Pierce, Weippe | -116.321485 | 46.503872 |
| AST035 | Snake River | Upper Snake | Idaho Falls, Rigby, Ammon, Shelley, Menan | -112.067627 | 43.626237 |
| AST036 | Camas Creek | Upper Snake | Dubois, Mud Lake | -112.214341 | 44.014972 |
| AST037 | Boise River | Southwest | Boise, Eagle, Meridian, Star, Caldwell | -116.132432 | 43.565392 |
| AST038 | Salmon River | Salmon | Riggins | -116.311452 | 45.445100 |
| AST039 | Snake River | Southwest | Weiser, Payette | -116.981846 | 44.244351 |
| AST040 | Snake River | Southwest | Grand View, Glenns Ferry, Hagerman, Buhl, Bliss | -115.536420 | 42.943647 |

**Figure B-1**

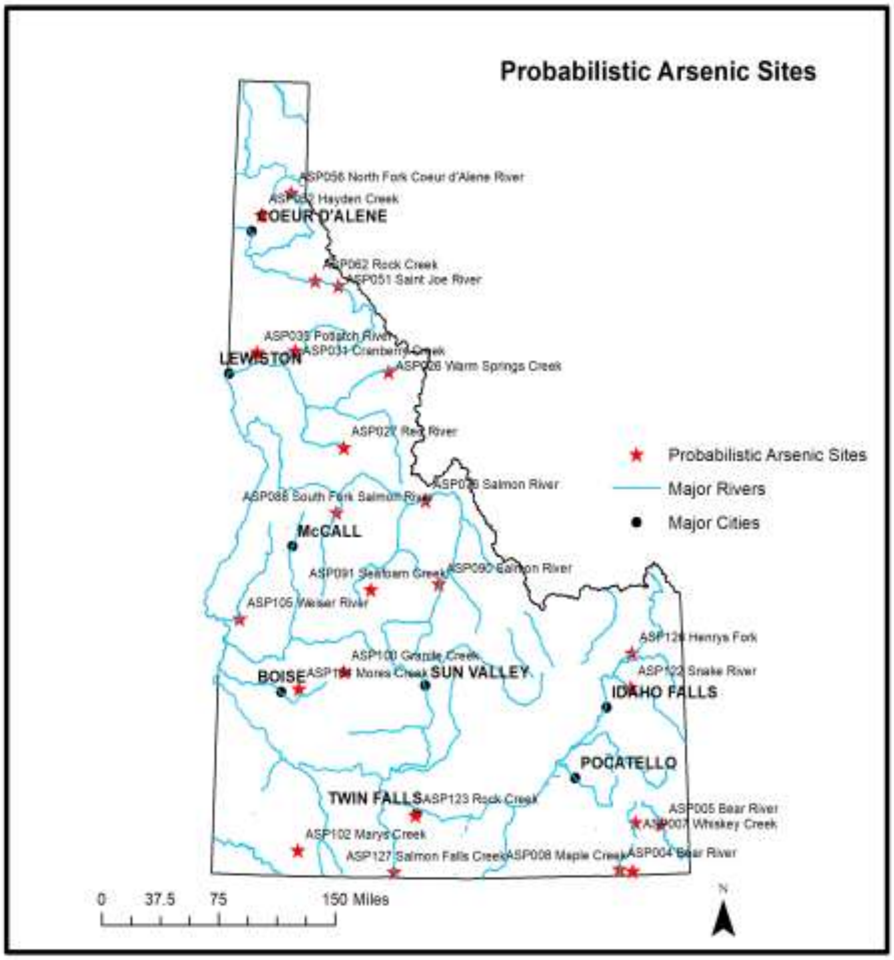
**Map of targeted surface water monitoring stations**



## Table B-2.
## Location information for probabilistic fish tissue sampling locations.

| Sample Location ID | Stream/River ID | Longitude | Latitude |
|---|---|---|---|
| ASP004 | Bear River | -111.919 | 42.058 |
| ASP005 | Bear River | -111.381 | 42.438 |
| ASP007 | Whiskey Creek | -111.709 | 42.465 |
| ASP008 | Maple Creek | -111.759 | 42.035 |
| ASP026 | Warm Springs Creek | -114.876 | 46.466 |
| ASP027 | Red River | -115.456 | 45.792 |
| ASP031 | Cranberry Creek | -116.14 | 46.635 |
| ASP035 | Potlatch River | -116.655 | 46.612 |
| ASP051 | Saint Joe River | -115.575 | 47.219 |
| ASP052 | Hayden Creek | -116.654 | 47.823 |
| ASP056 | North Fork Coeur d'Alene River | -116.252 | 48.026 |
| ASP062 | Rock Creek | -115.891 | 47.259 |
| ASP076 | Salmon River | -114.366 | 45.331 |
| ASP088 | South Fork Salmon River | -115.545 | 45.215 |
| ASP090 | Salmon River | -114.189 | 44.595 |
| ASP091 | Seafoam Creek | -115.078 | 44.542 |
| ASP100 | Granite Creek | -115.404 | 43.813 |
| ASP102 | Marys Creek | -115.949 | 42.227 |
| ASP104 | Mores Creek | -115.981 | 43.651 |
| ASP105 | Weiser River | -116.773 | 44.255 |
| ASP122 | Snake River | -111.723 | 43.661 |
| ASP123 | Rock Creek | -114.479 | 42.551 |
| ASP126 | Henrys Fork | -111.694 | 43.962 |
| ASP127 | Salmon Falls Creek | -114.741 | 42.049 |

**Figure B-2.**
**<u>Map of probabilistic fish tissue sampling locations</u>.**



# Appendix C

J.R. Simplot Company
Simplot Headquarters
1099 W. Front Street
Boise, Idaho 83702
P.O. Box 27
Boise, Idaho 83707

April 10, 2020

**Sent via email to: paula.wilson@deq.idaho.gov**
**Docket: 58-0102-1801**
**Human Health Water Quality Criteria for Arsenic**

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

Dear Ms. Wilson:

The Department of Environmental Quality (Department) is conducting a negotiated rulemaking to revise the arsenic human health water quality criteria. The J.R. Simplot Company (Simplot) has participated in past meetings on this rulemaking and retained Arcadis U.S. Inc. (Arcadis) to review and analyze technical information that have been gathered during this rulemaking.

The Department has undertaken a very robust program to characterize arsenic, including inorganic arsenic concentrations, in fish tissues and surface waters. The data gathered by the Department is very important so that the arsenic human health water quality criteria for Idaho reflects Idaho's natural environment.

Arcadis has reviewed the data gathered by the Department. Their analysis of the data is provided in the attached report. As this report shows, the existing data set (which is extensive) indicates that the inorganic arsenic concentration in fish tissue is independent of the total arsenic concentration in surface water. A similar non relationship exists with the inorganic arsenic concentration in surface water. The attached report does provide some thoughts for the Department to consider in the upcoming field system.

As to how this data should be utilized in the development of a "new" human health arsenic water quality criteria, the lack of a definitive relationship suggests that the ingestion of just water (no ingestion of fish tissues) might be the best technical approach to establish a human health arsenic water quality criteria.

We appreciate the ability to provide this analysis and input to the Department. Please contact me at (208) 780-7365 or the Arcadis staff if you have any questions.

Sincerely,

Alan L. Prouty
Vice President, Environmental & Regulatory Affairs

Attachment

| | |
|---|---|
| P. Anderson | Arcadis |
| A. LaBeau | IACI |
| B. Davenport | IMA |
| B. Adams | NAMC |

# TECHNICAL MEMO

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

To:

Alan Prouty
J.R. Simplot Company

Copies:

None

From:

Paul Anderson
Emily Morrison

Date:

April 10, 2020

Arcadis Project No.:

30039729

Subject:

IDEQ 2019 Preliminary Monitoring Findings

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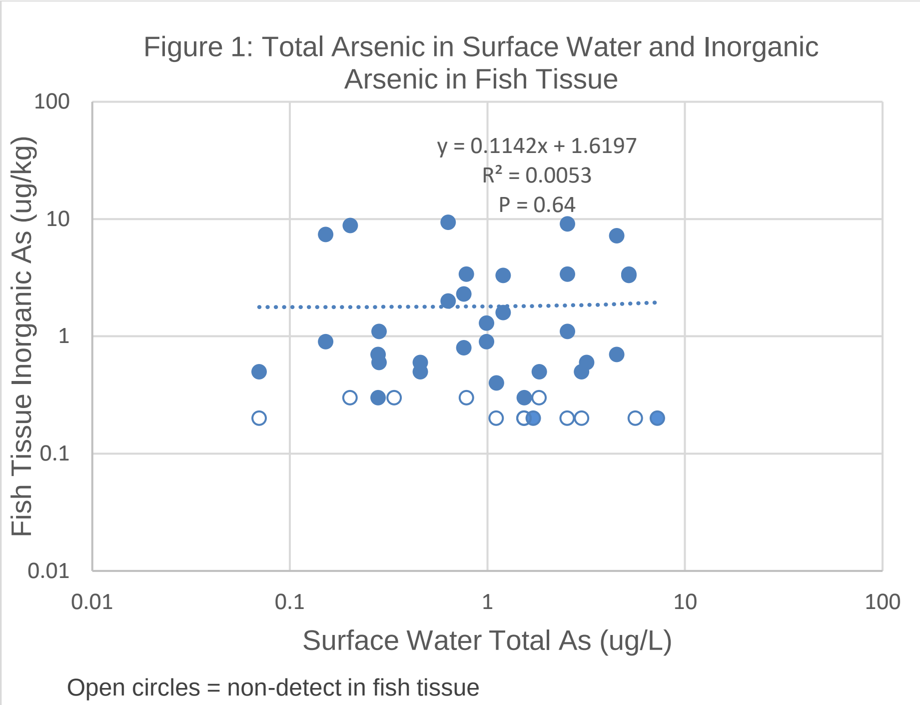
This technical memorandum provides an initial evaluation of the results of the Idaho Department of Environmental Quality (IDEQ) 2019 arsenic paired fish tissue and surface water sampling program summarized in 2019 Arsenic Accumulation in Fish Tissue Preliminary Monitoring Results dated March 2020 (IDEQ 2020) and how the results might be used to establish a bioaccumulation factor (BAF) for arsenic in Idaho surface waters.

IDEQ is to be commended for undertaking a comprehensive state-wide sampling program to better understand the relationship between concentrations of arsenic in surface water and concentrations of arsenic in fish tissue, the results of which can be used to inform development of a BAF for use in establishing water quality criteria (WQC) for arsenic in Idaho waters. The 2019 dataset is exceptionally robust and, to Arcadis' knowledge, represents a one-of-a-kind study given the large number of sampling locations and their geographic coverage. We focused our review on the interpretation of the 2019 results and not the sampling approach and methods as those were consistent with the approach and methods presented and discussed at previous rulemaking meetings.

Arcadis' confirmed the key finding presented by IDEQ (2020). Namely that that the concentration of inorganic arsenic (iAs) in fish tissue is not related to the concentration of iAs in surface water. We also confirmed that a relationship does not exist between total arsenic (tAs) in fish tissue and tAs in surface water (results not shown). More importantly, because our understanding is that the state-wide arsenic WQC that IDEQ is developing will be for tAs in surface water, Arcadis evaluated the relationship between iAs in fish tissue (the form of arsenic in fish tissue that is assumed to be toxic) and tAs in surface water. A direct relationship between iAs in fish tissue and tAs in surface water was also absent (Figure 1).



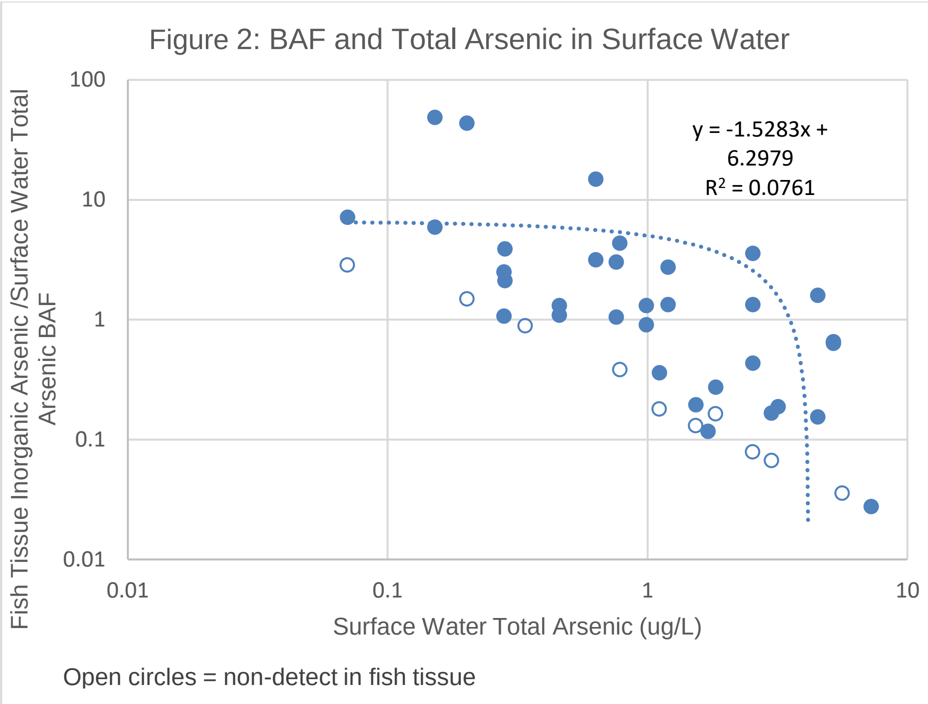

The absence of a direct relationship between the concentration of arsenic in water and fish tissue is a key finding. It indicates that the concept of a single state-wide BAF is not applicable to arsenic in Idaho surface waters. While it is true that a BAF can be calculated for every paired fish tissue and surface water sample (as summarized in Table 3 of IDEQ 2020) the large range of those iAs BAFs from 0.02 to 97 L/kg (nearly 5,000-fold)[1] reinforces that a meaningful relationship between the concentration of arsenic in water and fish tissue is absent.

Additionally, BAFs (calculated as the iAs fish tissue concentration divided by the tAs surface water concentration for each individual paired sample) tend to decrease with increasing surface water concentration (Figure 2) though the relationship is not statistically significant[2]. Such a trend is expected given the lack of a relationship between fish tissue and surface water concentrations; because fish tissue concentrations are essentially identical across the entire range of surface water concentrations, dividing a constant range of tissue concentrations by an increasing surface water concentration results in lower BAFs at higher surface water concentrations. Thus, the existing data set (which is extensive) indicates that the iAs concentration in fish tissue is independent of the tAs concentration in surface water.

---

[1] Inorganic arsenic in fish tissue to tAs in surface water BAFs range from 0.03 to 49 L/kg, about 1,700-fold (results not shown).

[2] A similar, but not statistically significant, trend of decreasing BAF with increasing iAs concentration in surface water also observed (results not shown).




Arcadis also investigated whether a relationship exists between arsenic in fish tissue and arsenic in water for individual species (Table 1). None of the relationships were statistically significant and no consistent trends were apparent. Tissue concentrations increase with increasing concentrations for some species and decrease for other species. Notably, in trout species, the concentration of iAs in tissue tended to decrease with increasing iAs or tAs concentration in water.

**Table 1. Summary of Surface Water to Fish Tissue Regression Results of Individual Species**

| Species | Sample Size | Regression Equation | $R^2$ | p |
|---|---|---|---|---|
| **Tissue iAs to Water tAs** | | | | |
| Brown Trout | 5 | iAs(ug/kg) = -0.08(tAs(ug/L)) + 0.65 | 0.48 | 0.2 |
| Cutthroat Trout | 9 | iAs(ug/kg) = -0.01(tAs(ug/L)) + 1.82 | 0.00 | 0.99 |
| Northern Pikeminnow | 5 | iAs(ug/kg) = 0.02(tAs(ug/L)) + 0.39 | 0.01 | 0.88 |
| Rainbow Trout | 6 | iAs(ug/kg) = -0.81(tAs(ug/L)) + 4.59 | 0.12 | 0.26 |
| Sculpin sp. | 7 | iAs(ug/kg) = 0.81(tAs(ug/L)) + 1.62 | 0.25 | 0.26 |
| **Tissue tAs to Water tAs** | | | | |
| Brown Trout | 5 | tAs(ug/kg) = 4.97(tAs(ug/L)) + 42.2 | 0.08 | 0.64 |
| Cutthroat Trout | 9 | tAs(ug/kg) = 66.7(tAs(ug/L)) + 47.4 | 0.28 | 0.14 |
| Northern Pikeminnow | 5 | tAs(ug/kg) = 0.66(tAs(ug/L)) + 20.6 | 0.001 | 0.96 |
| Rainbow Trout | 6 | tAs(ug/kg) = 21.3(tAs(ug/L)) + 79.3 | 0.33 | 0.23 |
| Sculpin sp. | 7 | tAs(ug/kg) = 6.81(tAs(ug/L)) + 53.3 | 0.06 | 0.59 |
| **Tissue iAs to Water iAs** | | | | |
| Brown Trout | 5 | iAs(ug/kg) = -0.06(iAs(ug/L)) + 0.56 | 0.31 | 0.33 |
| Cutthroat Trout | 9 | iAs(ug/kg) = 0.26(iAs(ug/L)) + 1.63 | 0.006 | 0.85 |
| Northern Pikeminnow | 5 | iAs(ug/kg) = 0.06(iAs(ug/L)) + 0.35 | 0.06 | 0.7 |
| Rainbow Trout | 6 | iAs(ug/kg) = -0.88(iAs(ug/L)) + 4.60 | 0.13 | 0.49 |
| Sculpin sp. | 7 | iAs(ug/kg) = 1.18(iAs(ug/L)) + 1.26 | 0.36 | 0.15 |

**Notes:**
Non-detects were equal to the detection limit.

As part of collecting fish tissue samples, IDEQ field teams recorded the length and weight of fish comprising each tissue sample. For all species combined there was a very slight, not statistically significant, trend for iAs concentration in fish tissue to decline with increasing weight of fish comprising the sample (Figure 3). This trend was observed in cutthroat trout, rainbow trout, northern pikeminnow and sculpin sp., while an increasing trend was observed in brown trout (Table 2). None of the relationships within individual species were statistically significant.

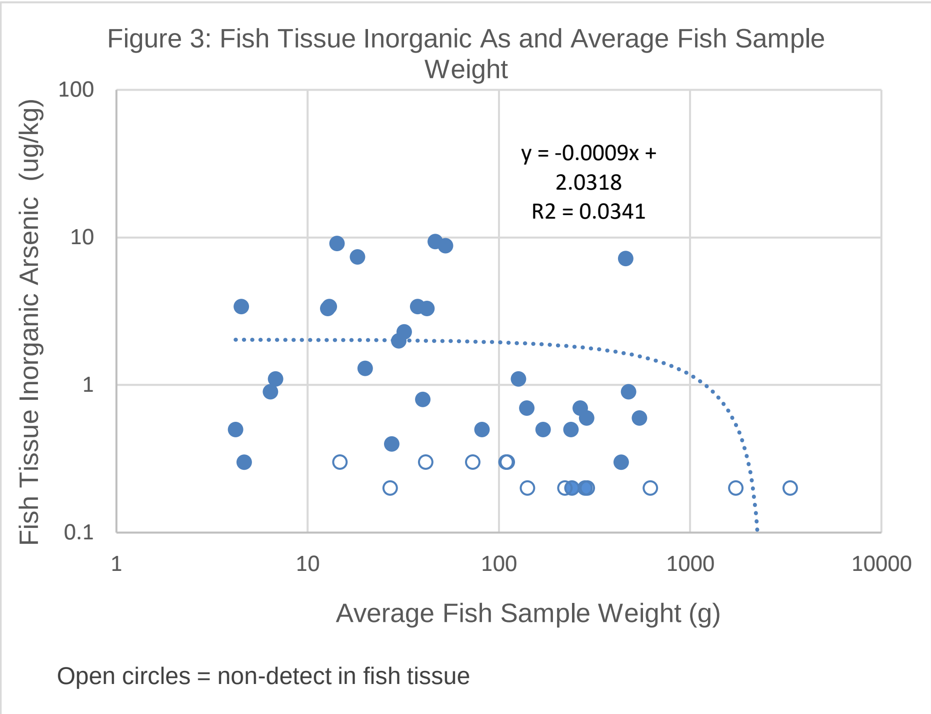



**Table 2. Summary of Inorganic Fish Tissue Concentration Regressions by Species**

| Species | Sample Size | Regression Equation | $R^2$ | p |
|---|---|---|---|---|
| Brown Trout | 5 | iAs(ug/kg) = -0.075(tAs(ug/L)) + 0.65 | 0.48 | 0.2 |
| Cutthroat Trout | 9 | iAs(ug/kg) = -0.011(tAs(ug/L)) + 1.82 | 0.00 | 0.99 |
| Northern Pikeminnow | 5 | iAs(ug/kg) = 0.022(tAs(ug/L)) + 0.39 | 0.008 | 0.88 |
| Rainbow Trout | 6 | iAs(ug/kg) = -0.813(tAs(ug/L)) + 4.59 | 0.12 | 0.5 |
| Sculpin sp. | 7 | iAs(ug/kg) = 0.805(tAs(ug/L)) + 1.62 | 0.24 | 0.26 |
| All Fish Combined[a] | 45 | iAs(ug/kg) = 0.039 (tAs(ug/L)) + 1.72 | 0 | 0.86 |

**Notes:**
Non-detects were equal to the detection limit
[a] Includes species other than those listed in the table

Given that fish move and may be exposed to surface water and habitats beyond the reach from which surface water samples were collected, we evaluated whether a relationship between fish tissue and surface water may be more evident in smaller size classes of fish, under the assumption that smaller fish may have more limited movement than larger fish. None of the regressions within specific size classes were statistically significant though a trend of increasing iAs concentration in fish tissue with increase tAs concentration in surface water was more apparent in small sized fish (0-20g and 20-50g) than in larger size fish (50-200g, 200-500g and >500g) (Figures 4a-4e).

Figure 4a: Total Arsenic in Surface Water and Inorganic Arsenic in Fish Tissue (Fish 0-20 g)

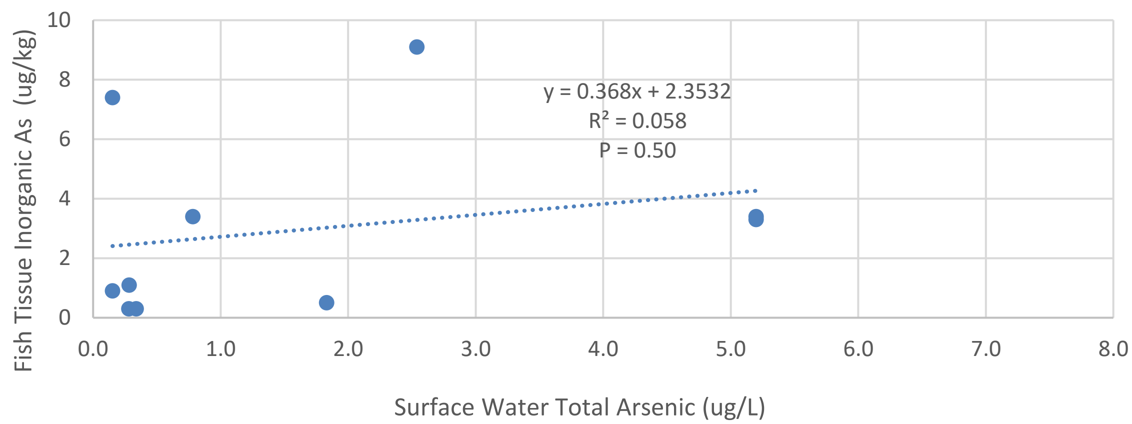



Figure 4b: Total Arsenic in Surface Water and Inorganic Arsenic in Fish Tissue (Fish 20-50 g)

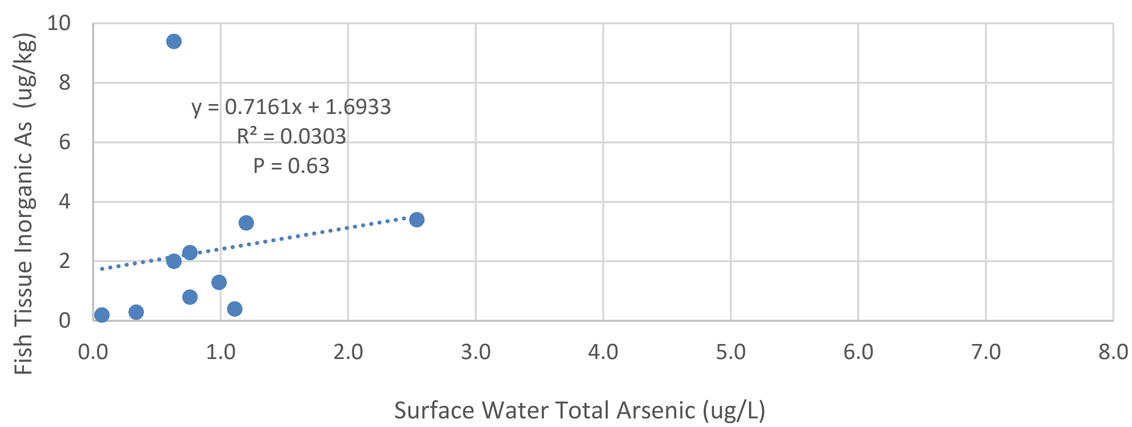


Figure 4c: Total Arsenic in Surface Water and Inorganic Arsenic in Fish Tissue (Fish 50-200 g)

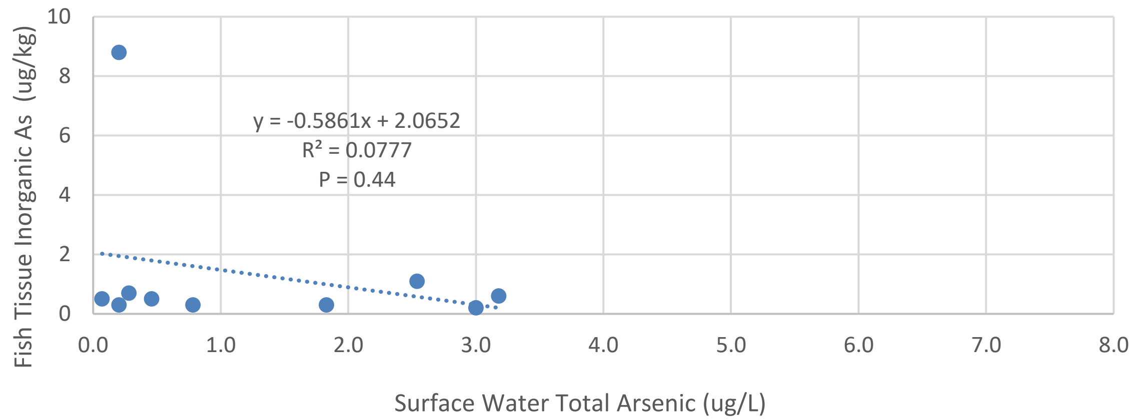



Figure 4d: Total Arsenic in Surface Water and Inorganic Arsenic in Fish Tissue (Fish 200-500 g)

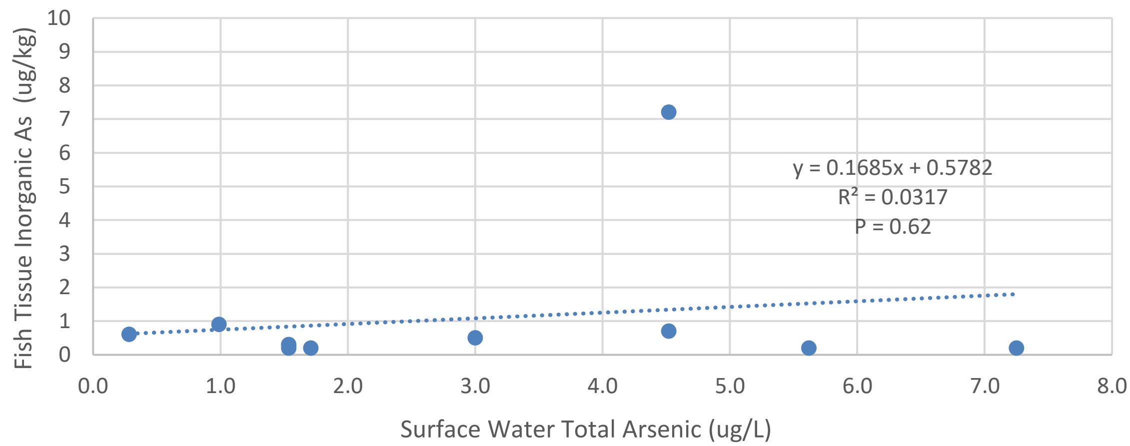
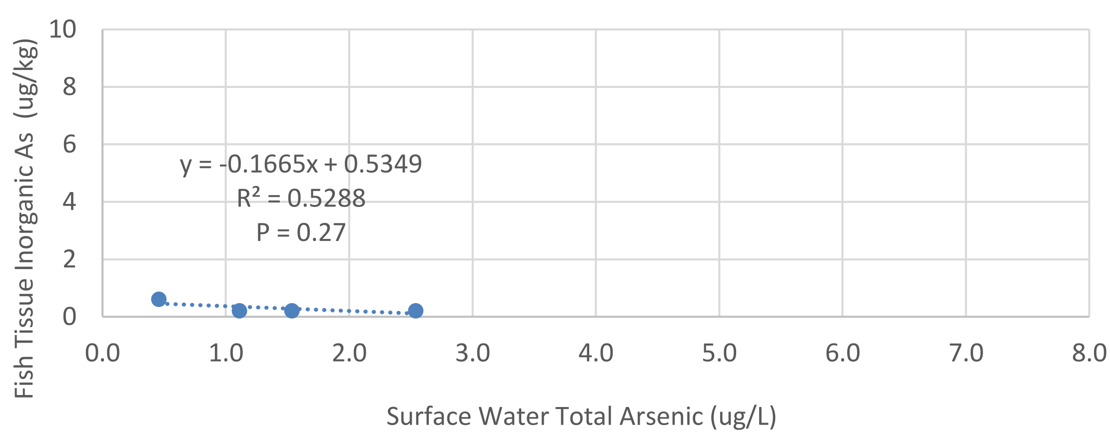



Figure 4e: Total Arsenic in Surface Water and Inorganic Arsenic in Fish Tissue (Fish >500 g)



Combined, these evaluations indicate that the concentration of iAs in fish tissue samples is independent of the concentration of arsenic in water and that the iAs concentrations measured in fish tissue collected in 2019 cannot be explained by, and are largely independent of, the various parameters measured by IDEQ during the 2019 field effort.

With regard to additional sampling in 2020, IDEQ (2020) lists four potential options. Which of those four options to undertake, or other option, would seem to depend upon the goal of the 2020 monitoring program. The 2019 sampling is very robust and indicates that a direct relationship between concentrations of arsenic in surface water and fish tissue is absent. Given the robustness of the 2019 sampling effort, it is not clear it needs to be repeated (i.e., the first of the listed options) unless the goal is to reinforce the likely absence of a relationship.

The second option is to target sites with more robust iAs water column data (IDEQ 2020). To the extent the arsenic concentration in surface water varies and is not well characterized by a one-time sample, collecting fish from the vicinity of the targeted monthly locations would help refine the concentration of arsenic in the water column. Review of the available 2019/2020 monthly monitoring data (posted on the Rulemaking Website on April 3, 2020) indicates that variation in water column concentration over the seven months of sampling (August 2019 through February 2020) is less than 2-fold at most sampling locations and is between 4- and 6-fold at only six of 40 locations. These results suggest that one-time surface water concentrations, like those collected as part of the 2019 paired surface water tissue sampling program, are likely to be reasonably representative of long-term concentrations at most sampling locations. Thus, it is not clear additional refinement of the water concentration will help explain the variation observed in fish concentrations. That said, we see no harm in collecting fish tissue samples at some of the monthly water column monitoring locations as it will help refine surface water concentrations, though IDEQ should not expect such refinement to greatly improve the relationship between arsenic concentration in fish tissue and surface water.

The third option is to target sampling locations with relatively high or low ambient iAs concentrations. Because ambient iAs concentrations in Idaho surface waters span a large range, it is not clear focusing on just the upper or lower end of that range will provide insight about tissue concentrations in the remaining waters. If a more focused approach to sampling is ultimately chosen, it will be important to collect data from the entire “cloud of 2019 points”, including the edges and corners, not just one portion of that “cloud”.

The fourth option is to collect individual fish rather than composites to better understand variability between fish species (IDEQ 2020). The fish tissue data collected in 2019 already provide strong indication that concentrations of iAs (and tAs) can be quite variable between species at a given sampling location and the duplicate results (Table 2 in IDEQ 2020) provide strong indication of substantial variability between individual fish within a species at a given sampling location. It is unclear how a finding of similar or greater variability between individual fish would be used when establishing a BAF for a WQC. Such data would seem to provide only further indication that the concentration of arsenic in fish tissue is independent of the arsenic concentration in water and that whatever factors determine the fish tissue concentration, the concentration in water plays a small, if any, part in that process.

An alternate goal of the 2020 sampling might be to collect information to help identify the causes of the large range of arsenic fish tissue concentrations observed in 2019. Such information would likely continue to include collection of paired fish tissue and water column samples but IDEQ might add collection of sediment and/or porewater samples, or of multiple species of different sizes at a single location to better understand if food web complexity is driving the observed differences between species and individuals, or perhaps, if sufficient mass can be collected, of components of the diet. Collecting other water quality and fish tissue parameters might also improve understanding of the causes of the iAs concentrations in fish tissue. For example, is there a parallel for arsenic to the role of organic carbon in sediments or lipid in fish when predicting fish tissue concentrations of non-ionized organic compounds. For organic compounds a relationship was typically evident from paired water and tissue samples; it was further refined using lipid and carbon data. The 2019 paired arsenic data are unique in the absence of any apparent relationship between tissue and surface water making it more difficult to identify which other parameters might need to be included in a sampling program.

With respect to selecting any (or several) of these 2020 monitoring options, the key question remains: how will IDEQ use the results when developing a WQC for arsenic? If the 2020 results reinforce the 2019 finding of no direct relationship between concentrations of arsenic in the water column and fish tissue, will a BAF and, therefore, fish consumption exposures, be excluded from the arsenic WQC? If the 2020 results confirm the 2019 findings, does this support continuing with the existing 10 micrograms per liter standard (which is based on consumption of water for drinking water purposes). If a BAF will continue to be included, what additional information is needed to inform selection of a state-wide BAF?

We are available to discuss the above results and other aspects of our initial review and evaluation at your convenience.

## References

IDEQ 2020. 2019 Arsenic Accumulation in Fish Tissue. Preliminary Monitoring Results. 14 pp. March.

# Appendix D

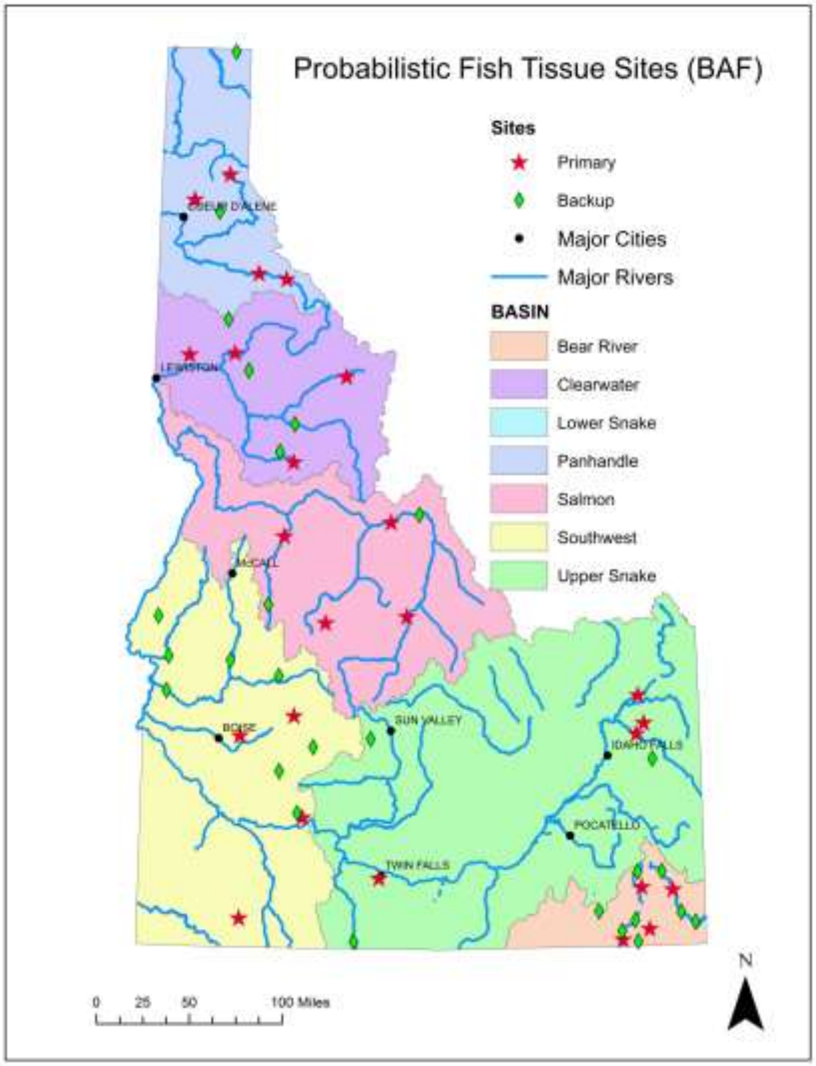
Summary of Inorganic and Total Arsenic Surface Water Concentrations by Basin

Background concentrations between basins vary substantially, where basins are defined as those used by DEQ to present the results of the probabilistic fish tissue monitoring program (Figure D-2). The arithmetic mean iAs concentration in the Clearwater basin is 0.18 ug/L while the arithmetic mean iAs concentration in the Southwest basin is 3.0 ug/L, more than ten times higher (Table D-1). Background concentrations also vary substantially within basins. The minimum detected concentrations range from about 2 to 60 times lower than the arithmetic mean concentration within a basin (Table D-1). The maximum detected concentrations range from about 2 to 6 times higher than the arithmetic mean concentration within a basin (Table D-1). The basin-specific data indicate that variation in iAs concentrations within a basin makes it challenging to establish a basin-specific background concentration, though it may be possible to do so with further refinement of the monitoring data taking into account information about the causes of the variation within a basin (e.g., varying geologic formations).

Table D-1. Summary of inorganic arsenic concentrations by basin.

| Basin | Sample Size | Detects | Non-Detects | Min Detected | Max Detected | Mean | Coefficient of Variation | 10th Percentile | 90th Percentile |
|---|---|---|---|---|---|---|---|---|---|
| Bear River | 4 | 4 | 0 | 0.507 | 2.25 | 1.201 | 0.627 | 0.612 | 1.932 |
| Clearwater | 48 | 44 | 4 | 0.044 | 1.11 | 0.182 | 1.008 | 0.0461 | 0.36 |
| Panhandle | 40 | 40 | 0 | 0.044 | 1.67 | 0.318 | 1.011 | 0.106 | 0.607 |
| Salmon | 48 | 48 | 0 | 0.089 | 3.55 | 1.514 | 0.675 | 0.223 | 3.37 |
| Southwest | 94 | 93 | 1 | 0.047 | 19.8 | 3.048 | 1.289 | 0.0807 | 7.693 |
| Upper Snake | 75 | 75 | 0 | 0.101 | 4.82 | 1.841 | 0.562 | 0.604 | 3.352 |

Figure D-2. Basins as defined by DEQ's probabilistic fish monitoring program



Probabilistic Fish Tissue Sites (BAF)
Sites
Primary
Backup
Major Cities
Major Rivers
BASIN
Bear River
Clearwater
Lower Snake
Panhandle
Salmon
Southwest
Upper Snake
BOISE
SUN VALLEY
POCATELLO
TWIN FALLS
0 25 50 100 Miles
N

## Appendix E

Use of Arithmetic and Harmonic Mean in Human Health Water Quality Criteria

Summary. Estimates of potential risk developed in human health risk assessments require estimating that arithmetic mean daily dose. When the concentration of a substance in a receiving water is known (e.g., measured concentrations are available as is the case for inorganic arsenic in Idaho surface waters) the arithmetic mean concentration, not the harmonic mean concentration, should be used to estimate exposures in a human health risk assessment. In situations where the concentration of a substance in a receiving water is unknown and needs to be predicted (e.g., and effluent discharging the substance to a receiving water), the harmonic mean of the receiving water flow, not the arithmetic mean flow, should be used. The example below demonstrates the difference.

Example. The example presented in the table below is hypothetical. It is based on a monthly flow regime that is typical of many rivers in the United States that receive runoff from spring snow melt. The example includes an effluent with a constant flow and a constant concentration of a substance discharging into the receiving water.

| Month | Receiving Water Flow (L/d) | Effluent Flow (L/d) | Effluent Concentration (mg/L) | Receiving Water Concentration (mg/L) | Water Exposure (mg/kg-day) |
|---|---|---|---|---|---|
| January | 20,000 | 2,000 | 1 | 0.100 | 0.0030 |
| February | 30,000 | 2,000 | 1 | 0.067 | 0.0020 |
| March | 20,000 | 2,000 | 1 | 0.100 | 0.0030 |
| April | 50,000 | 2,000 | 1 | 0.040 | 0.0012 |
| May | 100,000 | 2,000 | 1 | 0.020 | 0.0006 |
| June | 80,000 | 2,000 | 1 | 0.025 | 0.0008 |
| July | 50,000 | 2,000 | 1 | 0.040 | 0.0012 |
| August | 30,000 | 2,000 | 1 | 0.067 | 0.0020 |
| September | 20,000 | 2,000 | 1 | 0.100 | 0.0030 |
| October | 10,000 | 2,000 | 1 | 0.200 | 0.0060 |
| November | 40,000 | 2,000 | 1 | 0.050 | 0.0015 |
| December | 20,000 | 2,000 | 1 | 0.100 | 0.0030 |
| Arithmetic Mean | 39,167 | 2,000 | 1 | 0.076 | 0.0023 |
| Harmonic Mean | 26,422 | 2,000 | 1 | 0.051 | 0.0015 |

The first column of the table lists the month. The second column lists the receiving water flow rate for each month. For purposes of the example, flow is presented in units of liters per day (L/d). The third column is the effluent flow rate for each month also in L/d. The fourth column is the concentration of the substance in units of milligrams per liter (mg/L). The fifth column is the monthly concentration of the substance in the receiving water. The monthly concentration is estimated by multiplying the effluent concentration by the effluent flow and then dividing that product by the monthly receiving water flow (e.g., for January; 1 (mg/L) x 2,000 (L/d) ÷ 20,000 (L/d) = 0.1 (mg/L)). The sixth column in the daily exposure to the substance associated with use of the receiving water as drinking water. Drinking water exposure is estimated by multiplying the receiving water concentration by the drinking water consumption rate (2.4 liters per person per day) and dividing that product by bodyweight (80 kilograms per person). Using January as an example; 0.1 (mg/L) x 2.4 (L/d) ÷ 80 (kg) = 0.003 (mg/kg-d). The assumed drinking water consumption rate and bodyweight are identical to those used by IDEQ when setting water quality criteria protective of human health (WQC).

The last two rows of the table present the arithmetic mean and harmonic mean for each of the columns. For parameters that do not vary (e.g., the effluent flow and effluent concentration) the harmonic mean and arithmetic mean are identical. For all the other parameters, the harmonic mean is smaller than the arithmetic mean.

In human health risk assessment we are interested in the long-term daily exposure or dose. In non-cancer risk assessment that dose is referred to as the average daily dose (ADD). In cancer risk assessment it is referred to as the ifetime average daily dose (LADD). The relevant average turns out to be the arithmetic mean dose. Perhaps the best way to understand why it is the arithmetic mean dose and not some other mean dose (e.g., geometric or harmonic) is to consider how a person is exposed. In the above hypothetical example, a person is exposed to the substance every day through drinking water. His or her total lifetime exposure is the sum of each day's exposure. His or her lifetime average daily dose is equal to his or her total lifetime exposure divided by the days of his or her lifetime. That daily dose is equal to the arithmetic mean daily dose. In the case of the hypothetical example, assuming it represents monthly receiving water and effluent flows over a lifetime, the LADD is equal the arithmetic mean of the monthly exposures (0.0023 mg/kg/d) and is the relevant dose to use in risk assessment.

When receiving water concentration data are available for many months (as they are for inorganic arsenic in Idaho surface waters), the arithmetic mean concentration of the substance in receiving water, not the harmonic mean concentration, needs to be used to estimate the LADD. In the case of the hypothetical example, the arithmetic mean receiving water concentration is 0.076 mg/L. When that concentration is multiplied by a drinking water consumption rate of 2.4 L/d and divided by a bodyweight of 80 kg, the resulting LADD is equal to 0.0023 mg/kg-d, the same LADD estimated by taking the arithmetic mean of the monthly exposures. When the harmonic mean concentration of 0.051 mg/L is used, the resulting LADD (0.0015 mg/kg-d) is smaller than the LADD based on the arithmetic mean receiving water concentration.

The harmonic mean becomes relevant when receiving water concentrations need to be predicted based on receiving water and effluent flows and concentrations. Arithmetic mean annual flows are readily available for many receiving waters and have, in the past, been used to estimate the annual average concentration of substances in receiving water. However, when arithmetic mean flows are used to estimate the average concentration of a substance in receiving waters that has been discharged in an effluent, they underestimate the arithmetic mean of the daily concentration of the substance in the receiving water.

In the hypothetical example, the arithmetic mean annual flow is 39,167 L/d. When that annual mean flow is used to estimate a mean receiving water concentration, the resulting mean concentration is 0.051 mg/L (2,000 (L/d) x 1 (mg/L) ÷ 39,167 (L/d) = 0.051 (mg/L)). That mean concentration is lower than the arithmetic mean of monthly concentrations (i.e., 0.076 mg/L) and will lead to an underestimate of the LADD. When the harmonic mean annual flow is used to estimate a mean receiving water concentration, the resulting mean concentration is 0.076 mg/L (2,000 (L/d) x 1 (mg/L) ÷ 26,422 (L/d) = 0.076 (mg/L) which his equal to the arithmetic mean of monthly concentrations and leads to an appropriate estimate of the LADD.

In summary, the arithmetic mean of receiving water concentrations should be used for human health risk assessment and for comparison to WQC developed for the protection of human health from long-term exposures to substances in receiving waters. When long-term receiving water concentrations are unknown and need to be predicted, the harmonic mean flow should be used to estimate the average concentration of a substance in a receiving water.

# Appendix F

## CONTRIBUTORS

The Idaho Association of Commerce and Industry (IACI) is solely responsible for the content of these comments, but does want to acknowledge the following contributors to these comments:

Dr. Paul Anderson has over 30 years of experience in human health and ecological risk assessment. He has been involved in evaluating the potential effects of pharmaceuticals in the environment as well as constituents of emerging concern (CEC). Dr. Anderson has managed the development of a watershed based model that predicts environmental concentrations of pharmaceuticals and related compounds in United States surface waters. Dr. Anderson serves as one of seven national experts on a Science Advisory Panel established by the California State Water Resources Control Board to provide recommendations for monitoring of chemicals of emerging concern in recycled water and surface water. He has conducted human health and ecological risk assessments in support of the air and water permitting required for large industrial facilities and has prepared comments on the scientific basis of many Federal and State regulations including Ambient Water Quality Criteria. Dr. Anderson is also currently an Adjunct Assistant Professor in the Department of Earth and Environment at Boston University.

Mr. Ben Latham has over 25 years of experience in technical lead capacities on a diverse range of environmental and water resources projects both in the United States and internationally. He specializes in watershed and surface water hydrology, groundwater and surface water quality, contaminant loading and mitigation, geospatial analysis, and US Clean Water Act (CWA) related regulations. Mr. Latham has over 14 years of experience leading and implementing stream assessment projects including hydrologic and water quality analysis, stream surveys, sediment studies, and stream biologic analysis.

Dr. Emily Morrison is an Environmental Scientist at Arcadis, Inc. She has a PhD in biology from Michigan State University and 10 years of experience conducting ecological and human health risk assessments including the development of conceptual site models, data analyses, selection and development of toxicity reference values and exposure point concentrations, food web modeling, and evaluation of weight of evidence for risk assessment. She is experienced in the application of population ecology and probabilistic modeling approaches for natural resource damage assessments and risk assessments.

Mr. Alan Prouty has been involved in natural resource and environmental work for over 35 years. This work has included large scale river and regional stream studies on water quality and impacts from point and non-point sources. This work has included looking at biological transfer and toxicity of metals and organochlorine compounds to fish. He currently leads the Environmental and Regulatory Affairs organization for the J.R. Simplot Company.