

Revision of Idaho's Human Health Criteria for Arsenic

Docket No. 58-0102-1801
August 18, 2021



STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

Jason Pappani
Surface Water Bureau Chief

Outline

- Review Comments Received
- Review Draft Rule
- Discuss Criteria
- Implementation Principles
- Discussion
- Next Steps



Comments Received

- JR Simplot, IACI, AIC: Fish Tissue only criterion
- EPA and ICL: Water column criterion is necessary to ensure use is protected; do not support tissue criterion



Goal

- Submit criteria revision that will be approved, implementable, and practical



Fall/Winter 2021	Submit draft rule to post in March Bulletin
May 2022	Board of Environmental Quality
Early 2023	Legislative Review
Spring/Summer 2023	Submit to EPA

Rule Language

Draft Rule

Subsection 210.01

The following revisions are being proposed for the table headings for 210.01:

01. Criteria for Toxic Substances. The criteria of Section 210 apply to surface waters of the state as provided in Tables 1 and 2. Criteria for metals (arsenic through zinc) listed in Tables 1 and 2 are expressed as a dissolved fraction (i.e. passes through a 0.45 micron filter) unless otherwise noted.

a. Table 1 contains criteria ~~set for to~~ protection ~~of~~ aquatic life. ~~Criteria for metals (arsenic through zinc) are expressed as dissolved fraction unless otherwise noted. For purposes of these criteria, dissolved fraction means that which passes through a forty five hundredths (0.45) micron filter.~~

b. Table 2 contains criteria ~~set for to~~ protection ~~of~~ human health. The Water & Fish criteria apply to waters designated for domestic water supply use. The Fish Only criteria apply to waters designated for primary or secondary contact recreation use.

Subsection 210.01.b

Table 2. Criteria for Protection of Human Health (based on consumption of:)

Compound	^a CAS Number	Carcinogen?	Water & Fish ($\mu\text{g/L}$ <u>unless otherwise specified</u>)		Fish Only ($\mu\text{g/L}$ <u>unless otherwise specified</u>)	
Inorganic Compounds/Metals						
Arsenic ²	7440382	Y	10; 8.0 $\mu\text{g/kg}$ fish tissue	cdjk	104.3; 8.0 $\mu\text{g/kg}$ fish tissue	cdjl

Fish Only (Recreation)

I. For Fish Only exposure to inorganic arsenic, the human health criterion is:

<u>Fish Muscle/Fillet Tissue ($\mu\text{g}/\text{kg}$ wet-weight)</u>	<u>Water Column ($\mu\text{g}/\text{L}$)</u>
<u>8.0¹</u>	<u>4.3²</u>

¹Fish muscle (fillet) tissue supersedes water column element. ~~8 $\mu\text{g}/\text{kg}$ on a wet-weight basis.~~ Single measurement using sufficiently sensitive methods. ~~b~~ Based on an average or composite of a minimum of five (5) individual fish of the same species, collected from the same water body and within the same calendar year, where the smallest individual is no less than seventy-five percent (75%) of the total length (size) of the largest individual. Not to be exceeded; the Department will evaluate all representative fish tissue data to determine compliance with this criterion element.

²Water column values are based on total inorganic arsenic in water. Water column values are the applicable criterion element only in the absence of sufficient fish tissue data.

Water & Fish (Domestic Water Supply)

k. Human health criteria for Water & Fish exposure to inorganic arsenic are attained if fish tissue concentrations comply with the Fish Only criterion and water column concentrations meet the maximum contaminant level for inorganic arsenic provided in IDAPA 58.01.08, "Idaho Rules for Public Drinking Water Systems."—do not exceed 10 µg/L.

Subsection 210.03.d.ii

ii. Frequency and duration for human health toxics criteria. Criteria in Table 2 in Subsection 210.01 are not to be exceeded based on an annual **harmonic mean** concentration.

Subsection 210.05.b

ii. When using toxicity thresholds to derive water quality criteria to protect human health, a fish consumption rate representative of the population to be protected, a mean adult body weight, an adult 90th percentile water ingestion rate, a trophic level weighted BAF or BCF, and a hazard quotient of one (1) for non-carcinogens or a cancer risk level of 10^{-5} for carcinogens shall be utilized **for any compound not listed in Subsection 210.05.b.iii.**

iii. **Subsection 210.05.b.ii. does not apply to water quality criteria for arsenic.**

Criteria

Subsection 210.01.b

Table 2. Criteria for Protection of Human Health (based on consumption of:)

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Fish Only – Water Column

$$AWQC_{FO} = RSD * \left(\frac{BW}{(FI * BAF)} \right) * 1000 \mu\text{g}/\text{mg}$$

Equation 2. Equation for calculating Fish Only criterion.

Where:

AWQC_{FO} = ambient water quality criterion, fish only exposure;

RSD = risk-specific dose (mg/kg-day) derived from a cancer slope factor (chemical specific value) and a target incremental cancer risk;

BW = human body weight (kg);

FI = fish intake (kg/day);

BAF = bioaccumulation factor (L/kg); and

1000 μg/kg mg is a conversion factor to convert criteria in units of μg/L

Bioaccumulation Factor

- Calculated a BAF for each tissue sample

$$\text{BAF}_{\text{iAs}} = \left(\frac{[\text{iAs}]_{\text{Fish}}}{[\text{iAs}]_{\text{Water}}} \right)$$

Equation 4. Equation for calculating a bioaccumulation factor (BAF).

Where:

BAF_{iAs} is the sample BAF for inorganic Arsenic in L/kg;

$[\text{iAs}]_{\text{Fish}}$ is the concentration of inorganic Arsenic in fish in $\mu\text{g}/\text{kg}$; and

$[\text{iAs}]_{\text{Water}}$ is the concentration of inorganic Arsenic in water, in $\mu\text{g}/\text{L}$

Trophic Level

- Assigned each species to Trophic Level

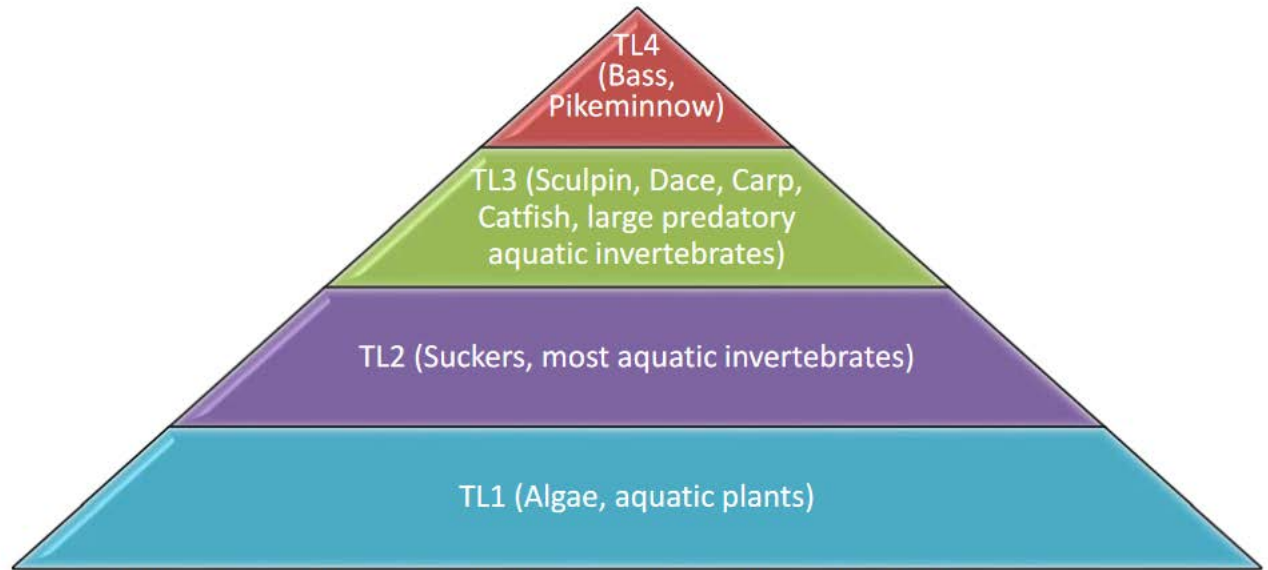


Figure 1. Illustration of the trophic level concept (from Alexander, 1999).

Bioaccumulation Factor

- Calculated geomean of BAFs by TL

Table 1. Trophic level assignments for calculation of a trophic level weighted bioaccumulation factor, and the geometric mean of calculated bioaccumulation factors (BAFs) by trophic level.

Trophic Level	Species	Rationale	Bioaccumulation Factor (L/kg)
2	Bridgelip Sucker	Herbivorous	2.99
3	Brook Trout, Channel Catfish, Common Carp, Cutthroat Trout, Longnose Dace, Mottled Sculpin, Mountain Whitefish, Rainbow Trout, Redside Shiner	Primarily invertivores, or opportunistic invertivore/piscivore where invertebrates make up a large component of diet	1.82
4	Brown Trout, Largemouth Bass, Northern Pike, Smallmouth Bass	Primarily piscivores, or diet composed mostly of large invertebrates and fishes	0.27

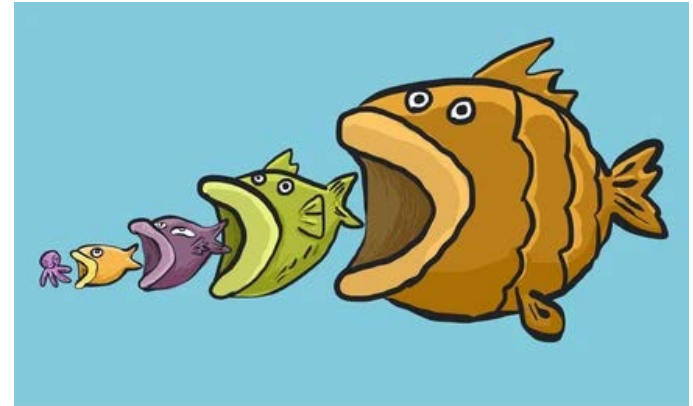
Bioaccumulation Factor

- Combine each TL-BAF with proportional consumption rate from National Survey

Table 2. Trophic level-specific consumption rates from the national fish consumption study.

Trophic Level	National Consumption rate, g/d	Proportion
2	7.6	0.36
3	8.6	0.40
4	5.1	0.24
Total	21.3	1.0

Source: EPA 2014. *Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations.*



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Bioaccumulation Factor

- Sum of the products produces TL-weighted BAF

$$\text{TL BAF} = [(\text{BAF}_{\text{TL2}})(\text{P}_{\text{TL2}}) + (\text{BAF}_{\text{TL3}})(\text{P}_{\text{TL3}}) + (\text{BAF}_{\text{TL4}})(\text{P}_{\text{TL4}})]$$

Equation 5. Equation for calculating a trophic level weighted bioaccumulation factor using TL-specific proportions from the national fish consumption rate.

$$\text{TL BAF} = 1.87 \text{ L/kg}$$

Where:

TL BAF is the trophic level weighted BAF;

BAF_{TLi} is the geometric mean of BAFs calculated for all samples for species assigned to TLi ; and

P_{TLi} is the proportion of national fish consumption rate for TLi fishes;

Fish Only – Water Column

4.3 µg/L

$$AWQC_{FO} = RSD * \left(\frac{BW}{(FI * BAF)} \right) * 1000 \mu\text{g}/\text{mg}$$

Equation 2. Equation for calculating Fish Only criterion.

Where:

AWQC_{FO} = ambient water quality criterion, fish only exposure;

RSD = risk-specific dose (mg/kg-day) derived from a cancer slope factor (chemical specific value) and a target incremental cancer risk;

BW = human body weight (kg);

FI = fish intake (kg/day);

BAF = bioaccumulation factor (L/kg); and

1000 µg/kg mg is a conversion factor to convert criteria in units of µg/L

Fish Only - Fish Tissue

8 µg/kg

$$AWQC_{\text{tissue}} = \text{RSD} \times \left(\frac{\text{BW}}{\text{FI}} \right) * 1000 \text{ } \mu\text{g}/\text{mg}$$

Equation 3. Fish tissue criterion equation.

Where:

$AWQC_{\text{tissue}}$ is the fish tissue criterion for inorganic arsenic in muscle, or fillet, tissue on a wet weight basis;

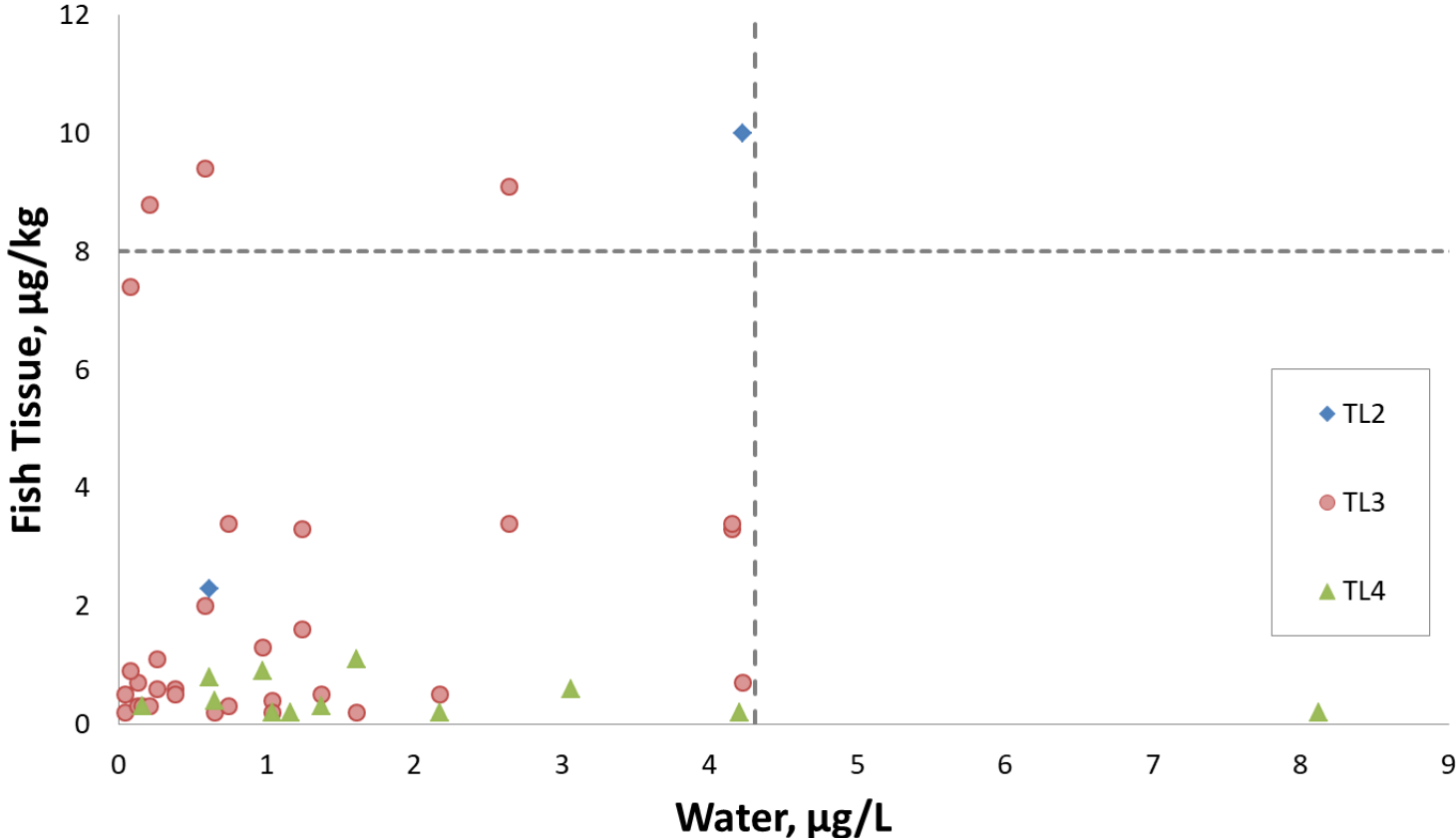
RSD is the risk-specific dose based on a target incremental cancer risk of 1×10^{-5} and a cancer slope factor for inorganic arsenic of $1.5 \text{ (mg/kg-day)}^{-1}$;

BW is the mean adult body weight of 80 kg;

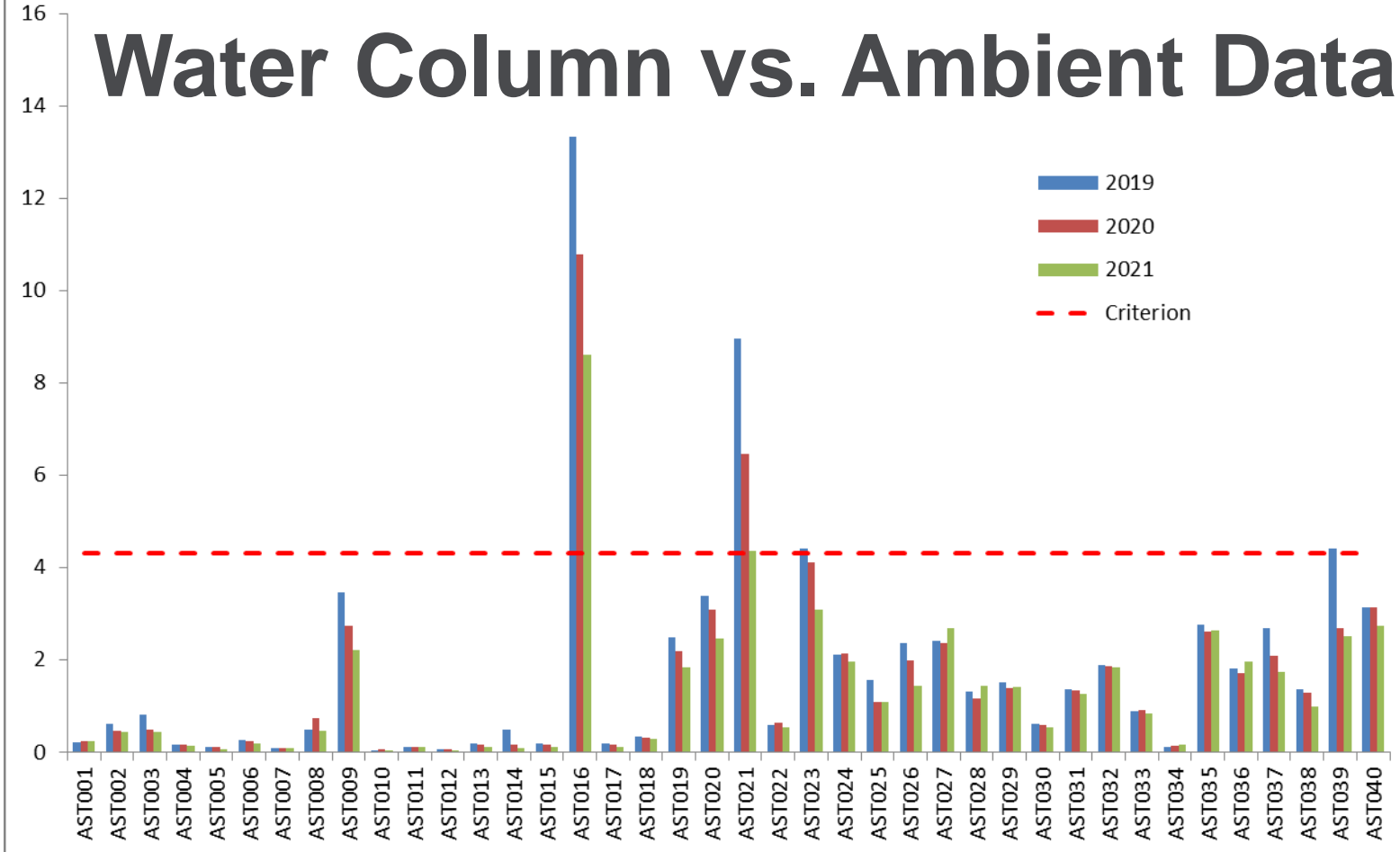
FI is the fish consumption rate of 0.0665 kg/day; and

1000 µg/kg mg is a conversion factor to convert criteria in units of µg/kg

Inorganic As, Water vs. Fish



Water Column vs. Ambient Data



Subsection 210.01.b

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Water & Fish

- Combined criteria approach – must meet both MCL and fish tissue criterion
- DWS use:
water quality appropriate for use as untreated raw water... for public drinking water



Implementation Principles



Fish Only

Fish Tissue: 8.0 µg/kg

- *Fish muscle (fillet) tissue supersedes water column element. Single measurement using sufficiently sensitive methods. Based on an average or composite of a minimum of 5 individual fish of the same species, collected from the same water body and within the same calendar year, where the smallest individual is no less than 75% of the total length of the largest individual. Not to be exceeded; the Department will evaluate all representative fish tissue data to determine compliance with this criterion element.*

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Fish Only

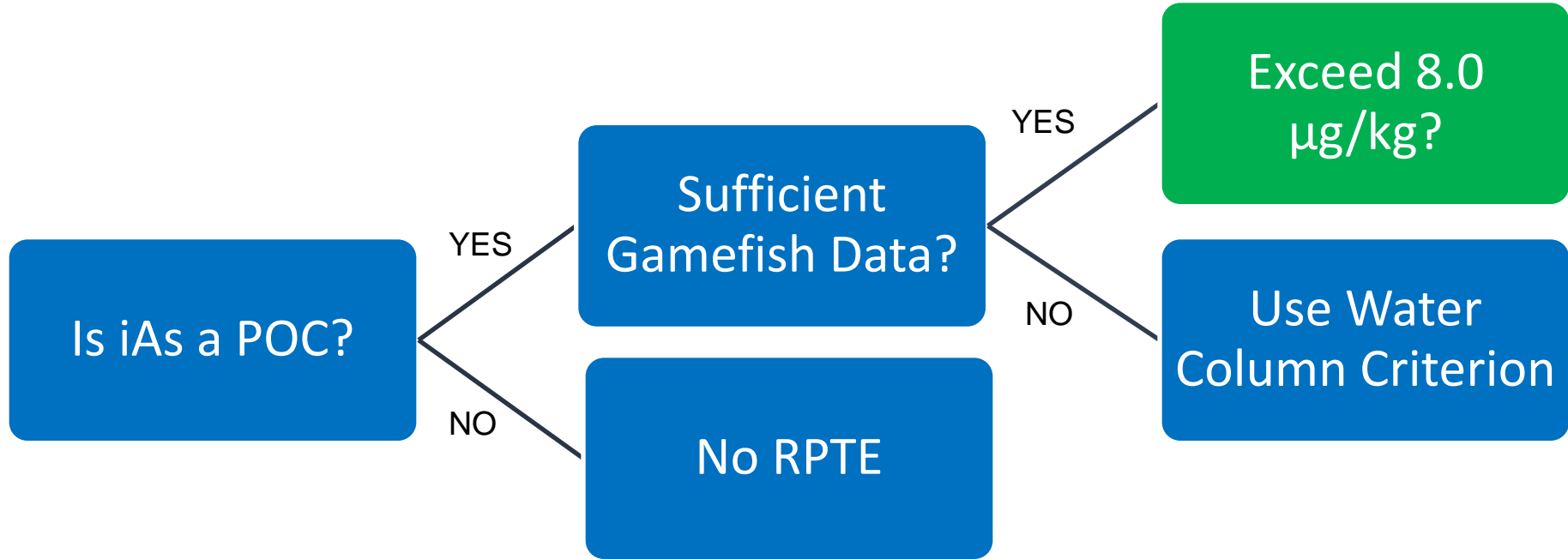
Water Column: 4.3 µg/L

- *Water column values are based on total inorganic arsenic in water. **Water column values are the applicable criterion element only in the absence of sufficient fish tissue data.***

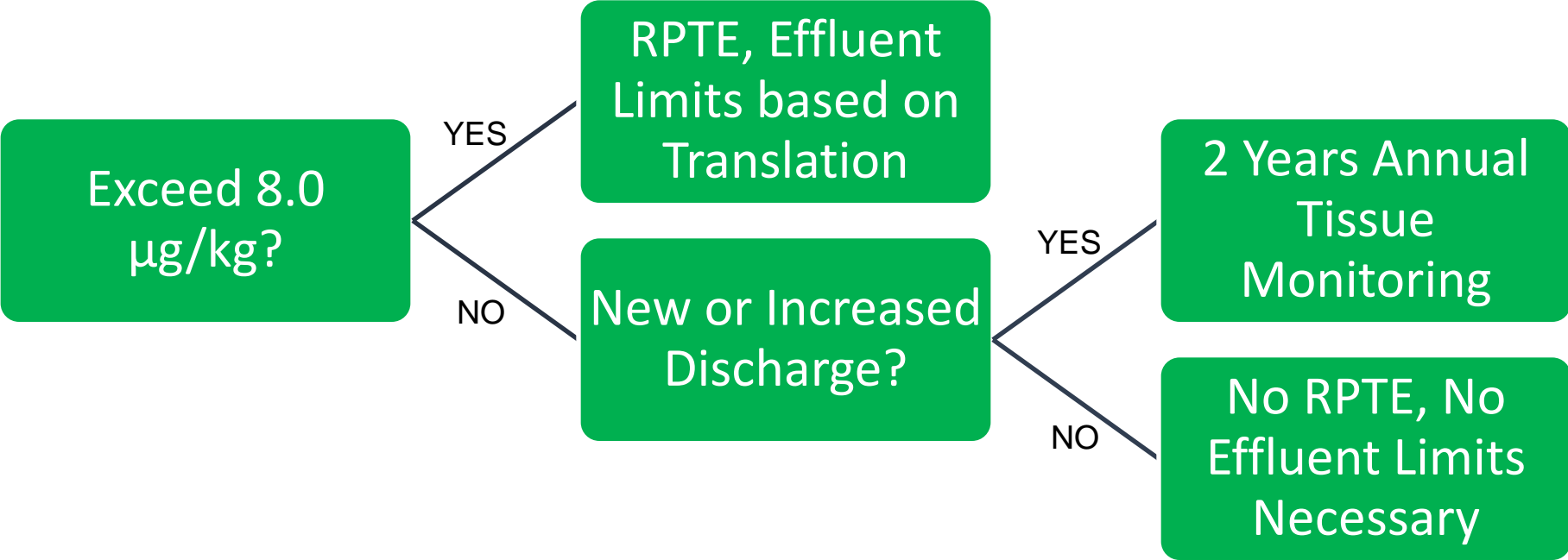
Implementation Principles



Permitting



Permitting



Steady State

- Not highly accumulative
- Tissue based compliance and translation

Incidental Ingestion

- Tissue based criterion (with water column translation) adequately addresses
 - Incidental ingestion is negligible
 - Acute effects occur at (relatively) high doses (i.e., 100-200 mg)



Discussion



STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

Your name
Your title