Rulemaking Docket 58-0102-1801
Arsenic Human Health Criteria
Discussion Paper #1

Background

Idaho Water Quality Standards (WQS; IDAPA 58.01.02) provide numeric toxics criteria for the protection of human health for two exposure scenarios – exposure through fish consumption only, and exposure through fish + drinking water consumption. The former are applied to waters designated for recreation use, the latter are applied to waters that are also designated as domestic water supply.

In 2010, Idaho adopted 10 µg/L as the numeric criteria for inorganic arsenic (As) for both fish only and fish + water exposures. This value was based on the Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL), and was chosen, in part, because of concerns about background levels in Idaho waters that exceed the US Environmental Protection Agency's (EPA's) national recommendation for As. In addition, the adoption of the MCL as the criteria for As was an attempt to rectify the apparent disconnect where water with As concentrations below the MCL could be delivered to consumers as drinking water under the SDWA but would require treatment before being discharged into water bodies designated for domestic water supply use.

EPA approved the 10 µg/L criteria in 2010.

In May 2016, EPA entered into a consent decree with Northwest Environmental Advocates to reconsider EPA's 2010 approval of Idaho's human health criteria (HHC) for As. In September 2016, EPA disapproved Idaho's 10 µg/L As HHC for both consumption of fish only and consumption of fish + water. The consent decree requires that EPA propose new HHC for As by November 15, 2018, and that EPA either approve an Idaho submittal of revised HHC for As, or promulgate federal criteria, by July 15, 2019.

Previously, DEQ stated that we believed it was prudent to await EPA's updates to the IRIS Toxicological Review of Inorganic As and subsequent update to the EPA section 304(a) recommended criteria for As before considering revisions to state WQS. DEQ still believes that rulemaking to revise As criteria would benefit greatly by updated IRIS toxicological information and EPA section 304(a) guidance. However, to date, no updates or revisions have been proposed. Therefore, in an effort to avoid promulgation of federal As criteria for Idaho, DEQ has initiated rulemaking to revise HHC for As.

This rulemaking will enable Idaho to adopt HHC for As under state rulemaking and may prevent federal promulgation of criteria for Idaho by EPA.

History of Arsenic Criteria in Idaho

The following timeline is intended to give a brief summary of how Idaho HHC for As have changed since 1992 (Table 1).

Table 1. Timeline of changes to Idaho Human Health Criteria for Arsenic, 1992 - Present.

Date	Action	Arsenic Human Health Criteria		Notes
		Fish Only (µg/L)	Fish + Water (µg/L)	
December 22, 1992	EPA promulgation of the National Toxics Rule (NTR), including As criteria for human health	0.14	0.018	Based on fish consumption rate of 6.5 g/day, drinking water intake of 2 L/day, body weight of 70 kg, and BCF of 44. These federally promulgated criteria become effective for Clean Water Act Purposes in Idaho
August 24, 1994	Idaho adopts NTR into state WQS by reference			
March 8, 1995	Idaho As criteria revised by State Legislature	6.2	0.02	Revised Fish Only criterion using BCF of 1, rounded Fish + Water criterion up from 0.018
June 25, 1996	EPA approves Idaho adoption of NTR and revised As criteria			
November 10, 1997	EPA final Federal rule removing Idaho from the NTR for As becomes effective			Idaho criteria adopted in 1995 become effective for Clean Water Act purposes
March 19, 1999	Idaho adoption of revised As criteria based on then-current (1999) SDWA MCL approved by state legislature	50	50	Submitted for EPA approval April 23, 1999. EPA has not acted on this submittal. Submittal predates adoption of the "Alaska Rule"; criteria are effective for Clean Water Act purposes upon effective date of final rule
January 22, 2006	SDWA MCL for drinking water reduced from 50 µg/L to 10 µg/L becomes effective			
March 29, 2010	Idaho adoption of revised As criteria based on SDWA MCL approved by state legislature	10	10	Submitted for EPA approval June 21, 2010. Approved by EPA July 7, 2010; effective for Clean Water Act purposes
September 15, 2016	EPA disapproval of 50 µg/L and previously approved 10 µg/L As criteria			

In 2017, the Association of Clean Water Act Administrators (ACWA) conducted a survey of States on behalf of the New Jersey Department of Environmental Protection to identify current As criteria and current implementation strategies and research being carried out by each state. A summary of the survey results was prepared by ACWA and is provided as Appendix A.

Inputs to the Human Health Criteria Equation

HHC are derived based on exposure factors and chemical-specific toxicity information.

Arsenic is a carcinogen; carcinogens are not considered to have any risk-free dose. Criteria for such toxins are calculated using the linear low-dose extrapolation equation.

The linear low-dose extrapolation equation is as follows:

$$\text{AWQC} = \text{RSD} * \left(\frac{\text{BW}}{\text{DI}+(\text{FI} * \text{BAF})}\right) * 1000$$

Where:

AWQC = ambient water quality criterion
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)
DI = drinking water intake (L/day)
FI = fish intake (kg/day)
BAF = bioaccumulation factor (L/kg)

For more information on how these equations were derived and used to develop criteria, see the EPA's *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (EPA 2000).

Risk-specific dose (RSD)

The risk-specific dose (RSD) is used for carcinogens where there is a linear dose-response relationship. The RSD is the dose that results in an incremental cancer risk at the target risk factor. RSD is calculated as:

$$\frac{Target\ Incremental\ Cancer\ Risk}{Cancer\ Slope\ Factor}$$

RSD is expressed as mg/kg-day.

Target Incremental Cancer Risk

The target incremental cancer risk is the risk of one additional incidence of cancer (above background risk that is always present) in a population. For example, a target incremental cancer risk of 1×10^{-6} equates to 1 new cancer in a population of a 1,000,000; a target incremental cancer risk of 1×10^{-4} equates to 1 new cancer in a population of 10,000.

Idaho WQS specify that DEQ shall use a target incremental cancer risk of 1×10^{-5} to derive HHC (IDAPA 58.01.02.210.05.b.ii)[1].

[1] The cancer risk factor, body weight, drinking water intake, fish intake, and bioaccumulation factors specified in IDAPA 58.01.02.210.05.b.ii were approved by the Idaho State Legislature and submitted for EPA approval in 2016. EPA has not yet acted on this submission. Selection of a cancer risk factor, drinking water intake, fish intake or bioaccumulation factors that deviates from those specified in WQS would require revisions to this section.

Cancer Slope Factor

The cancer slope factor is a chemical-specific value that expresses incremental lifetime risk as a function of the rate of intake of the chemical.

Cancer slope factors are expressed as $(mg/kg\text{-}day)^{-1}$.

Body Weight (BW)

The body weight used for calculation of criteria is not an individual's body weight, but rather an estimate taken from the distribution of body weights for the target population. For calculating HHC this typically is the population's mean or average body weight, expressed as kg.

Idaho WQS specify that DEQ shall use the mean adult body weight of the population to be protected to derive HHC (IDAPA 58.01.02.210.05.b.ii).

Drinking Water Intake

Daily drinking water ingestion rate, assumed to be from the same source water as fish that may be eaten. Like body weight, the drinking water intake rate is an estimate taken from the distribution of drinking water ingestion rates for the target population. For calculating HHC this is typically from the upper end of the distribution, such as 90^{th} percentile, and is expressed as L/day.

Idaho WQS specify that DEQ shall use an adult 90^{th} percentile drinking water ingestion rate of the population to be protected to derive HHC (IDAPA 58.01.02.210.05.b.ii).

Fish Intake

Fish intake is the daily fish ingestion rate, or fish consumption rate. Fish intake is a representative estimate taken from the distribution of fish consumption rates for the target population. Fish intake is expressed as kg/day. This is not anyone's regular, every day rate of consuming fish, but rather expresses consumption, which may vary greatly from day to day, as a long term (lifetime) average.

Idaho WQS specify that DEQ shall use a fish consumption rate representative of the population to be protected to derive HHC (IDAPA 58.01.02.210.05.b.ii).

Bioaccumulation

An important part of determining appropriate HHC is identifying potential for pollutants to increase in concentration in fish and other aquatic organisms that people may consume. This increases exposure, relative to the water, and can be measured as a bioconcentration rate or bioaccumulation rate. The latter varies by trophic level among other factors. Both are a ratio of the concentration in tissue to the concentration in water. Chemicals can act very differently in the aquatic environment. For example, hydrophobic chemicals avoid partitioning into a water phase and rather partition into nonpolar phases of lipids or organic carbon (EPA 2003). Different behavior among chemicals affects how a chemical might bioconcentrate, bioaccumulate, or biomagnify in aquatic organisms, in their consumers, and in the greater food web.

Bioconcentration is "the net accumulation of a chemical by an aquatic organism as a result of uptake directly from the ambient water, through gill membranes or other external body surfaces" (EPA 2003).

Bioaccumulation "is a process in which a chemical substance is absorbed in an organism by all routes of exposure as occurs in the natural environment, i.e., dietary and ambient environmental sources" (Arnot and Gobas 2006).

Bioconcentration factors (BCFs) and bioaccumulation factors (BAFs) are "ratios (in liters per kilogram of tissue) of the concentration of a chemical in the tissue of an aquatic organism to its concentration in water" (EPA 2003).

Biomagnification is "the increase in concentration of a chemical in the tissue of organisms along a series of predator-prey associations, primarily through the mechanism of dietary accumulation" (EPA 2003). Chemicals which have a propensity for biomagnification will often have highest BAFs in the higher trophic level species. Chemicals that tend to biomagnify will usually have significantly greater field-measured BAF values compared to laboratory generated BCF values (Arnot and Gobas 2006).

Field-based BAF data for chemicals may be difficult to find but are generally preferred for calculating HHC. BAF is a preferred input in determining HHC at the national level for EPA and at the state level for the Idaho Department of Environmental Quality (DEQ) since BAF values include both dietary contributions as well as direct uptake from the environment (such as diffusion across the gill surface); BCF values only account for direct uptake from the environment.

One way to reduce the variability associated with BAF values is to calculate the values by trophic level (TL). More specifically, calculation by TL helps to account for broad physiological differences, such as lipid content or life stage, among organisms that may influence bioaccumulation (EPA 2003).

Idaho WQS specify that DEQ shall use a trophic level weighted BAF or BCF to derive HHC (IDAPA 58.01.02.210.05.b.ii).

Issues to consider

There are several important issues that must be addressed when considering updates to Idaho's HHC for As.

Natural Background

Arsenic is a common element in the Earth's crust and can be released to the environment through natural processes such as weathering of soils and rock. Arsenic is associated with volcanism and geothermal activity. In many instances in Idaho, natural background concentrations of As in waters may exceed water quality criteria that are derived using the linear low-dose extrapolation equation. This is particularly true of ground water.

A statewide assessment of major rivers in Idaho was conducted in 2006 and 2008 to measure the concentrations of As, mercury, and selenium in fish tissue and water. DEQ collected single grab-samples from 34 major rivers. Inorganic As concentrations ranged from 0.02 to 12.0 µg/L, with a mean of 1.75 µg/L and median of 0.84 µg/L (DEQ 2010).

EPA's current inorganic As criteria recommendations are 0.14 µg/L for fish only and 0.018 µg/L for fish + water. Only two of the 34 major river sites sampled had inorganic As concentrations that were less than the EPA recommended fish only criterion of 0.14 µg/L; none of the sites sampled had inorganic As below the fish + water criterion of 0.018 µg/L (DEQ 2010).

Idaho WQS has a natural background provision that states:

> **Natural Background Conditions as Criteria.** When natural background conditions exceed andy applicable water quality criteira set forth in Secions 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from natural background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401 (IDAPA 58.01.02.200.09).

While this provision may provide Idaho with some flexibility in dealing with waters with natural As concentrations that exceed criteria, DEQ has had limited success implementing this provision when determining impaired water bodies or developing total maximum daily loads (TMDL).[2]

Setting ambient water quality criteria that are well below natural background concentrations can have several negative consequences.

Water bodies may be listed as impaired for As despite not having any human caused contributions of As to the water body. This could result in allocation of state resources to develop a total maximum daily load (TMDL) that would not be able to prescribe any meaningful As reduction strategies.

Furthermore, water bodies identified as impaired would not be considered Tier II waters under Idaho's antidegradation policy, meaning that they would not be considered high quality waters for recreation and would only receive Tier I protections under Idaho's antidegradation policy, allowing increased degradation without review of alternatives to degradation or a socioeconomic review (IDAPA 58.01.02.052).

Organic vs. Inorganic Arsenic

While there is some indication that organic As may contribute to As toxicity and bioaccumulation, it is generally understood that inorganic As is much more toxic to humans than organic As. As such, EPA derived its cancer RSD and developed its current recommended HHC based on human exposure to inorganic As only. It is possible that future updates to EPA's recommended As criteria may include consideration of organic As toxicity. For purposes of this rulemaking, DEQ intends to follow EPA's lead and limit criteria to inorganic As.

[2] DEQ has successfully used natural conditions as the basis for temperature TMDLs using Potential Natural Vegetation (PNV) as a measure of natural shade targets for streams.

Uncertainty in Bioaccumulation

Bioaccumulation of As is a source of significant uncertainty when deriving HHC.

EPA's recommended criteria are based on a BCF of 44. This value was calculated as the geometric mean of BCF from two species: an eastern oyster and Bluegill.

Oregon's freshwater As criteria are based on a BCF of 14. This value was calculated as the geometric mean of data from four finfish studies that included Rainbow Trout and Bluegill.

Field-derived As BAFs for total As from the statewide major river assessment ranged from >3 – 2,333, with a mean BAF of 143. But this is for all forms of As, not inorganic As alone (DEQ 2010).

While it is generally accepted that inorganic As is much more toxic than organic As, there is very little information on BCFs or BAFs for inorganic As. Oregon accounted for the use of total As in the calculation of the BCF with an inorganic proportion factor of 10%.

The mean BAF for inorganic As from the statewide assessment of major rivers was at least 11. However, an exact calculation was not possible since the concentration of inorganic As in most samples was below the detection limit. In these instances, the detection limit was used in place of the water concentration to calculate the BAF (DEQ 2010). It is likely that the actual BAF would be higher if we were able to quantify the concentration of inorganic As in the collected water samples. Moreover, the BAFs calculated in the statewide assessment of major rivers were based on a single sampling event, and did not account for the temporal variability of As in the surface waters sampled (DEQ 2010).

More research and field monitoring would be required to further our understanding of bioaccumulation of As and, specifically, inorganic As.

Identification of appropriate inputs to the Human Health Criteria Equation for Deriving Arsenic Criteria

Generally, States and Tribes follow EPA's *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (EPA 2000) when deriving HHC for toxic chemicals.

EPA's 2000 Human Health Methodology (EPA 2000) clearly states that the selection of a cancer risk level is a risk management decision to be made by a State; and that selection of either 10^{-6} or 10^{-5} for the general population is an acceptable risk level, provided that highly exposed subpopulations don't exceed a 10^{-4} risk level.

Idaho's Human Health Criteria

In 2015 Idaho updated HHC for 209 new or revised criteria for 105 toxic pollutants. These revisions did not include changes to Idaho's As criteria for protection of human health. The revised criteria were submitted for EPA approval in December 2016.

For carcinogens, Idaho used the linear low-dose extrapolation equation to calculate HHC for both fish only and fish + water. Idaho used chemical-specific cancer slope factors and BAF/BCF values taken from EPA's 2015 recommended HHC. In addition, Idaho used the following inputs to the linear low-dose extrapolation equation, as indicated in Idaho WQS (IDAPA 58.01.02.210.05.b.ii):

- Target Incremental Cancer Risk = 1×10^{-5}
- BW = 80 (kg)
- DI = 2.4 (L/day)
- FI = 0.0665 (kg/day)

EPA has not yet acted on the submitted revisions to Idaho WQS.

For more information on the inputs to the HHC equations used in the development of Idaho's HHC, see *Idaho Human Health Criteria: Technical Support Document* (DEQ 2015).

EPA's 304(a) recommendation

EPA's most recent recommended HHC for As are 0.14 µg/L for consumption of fish only and 0.018 µg/L for consumption of fish + water. These criteria were derived based on the following inputs to the linear low-dose extrapolation equation:

- Target Incremental Cancer Risk = 1×10^{-6}
- Cancer Slope Factor = 1.75 $(mg/kg\text{-}day)^{-1}$
- BW = 70 (kg)
- DI = 2.0 (L/day)
- FI = 0.0065 (kg/day)
- BCF = 44 (L/kg)

While EPA has revised guidance on deriving human health criteria and has updated both the As cancer slope factor (1.5 $(mg/kg\text{-}day)^{-1}$) and recommended national human health criteria for many toxic chemicals using updated body weight (80 kg), drinking water intake (2.4 L/day), and fish ingestion rates (0.022 kg/day), the national As recommendations have not changed. Uncertainty in appropriate cancer slope factor and bioaccumulation rates appear to be the main issue delaying an update to EPA's recommended criteria for As.

Oregon's Approach

Oregon's EPA-approved As criteria for human health are 2.1 µg/L for fish only and fish + water. These criteria were derived based on the linear low-dose extrapolation equation modified to

account for the proportion of total As in fish tissue that is inorganic, and, thus, toxic to humans, as well as adjustments in risk.

The modified linear low-dose extrapolation equation Oregon used to calculate their 2011 HHC for As includes an inorganic proportion factor (IF), and is as follows:

$$\text{AWQC} = \left(\frac{Target\ incremental\ Cancer\ Risk}{Cancer\ Slope\ Factor}\right) * \left(\frac{\text{BW}}{\text{DI}+(\text{FI} * \text{BCF} * \text{IF})}\right) * 1000$$

The following inputs to the modified linear low-dose extrapolation equation were used to derive Oregon's human health criteria for As:

- Target Incremental Cancer Risk:
    - fish only = 1.1×10^{-5}
    - fish + water = 1×10^{-4}
- Cancer Slope Factor = 1.5 $(mg/kg\text{-}day)^{-1}$
- BW = 70 (kg)
- DI = 2.0 (L/day)
- FI = 0.175 (kg/day)
- BCF = 14 (L/kg)
- IF = 10%

In addition to application of the IF, Oregon also selected two different cancer risk factors when calculating their human health criteria for As. For consumption of fish only, Oregon used an incremental cancer risk factor of 1.1×10^{-5}. For consumption of fish + water, Oregon used an incremental cancer risk factor of 1.0×10^{-4}. This bifurcation in risk was used to equalize the criteria. An adjustment upward from 1.0×10^{-5} for the fish only criterion was used to keep the lower exposure criterion from being more stringent than the water + fish criterion.

A comparison of variables used to calculate HHC for other toxics in Idaho, As criteria in the EPA recommended criteria, and As criteria in Oregon is presented below (Table 2).

Table 2. Comparison of input variables used in developing HHC for toxics in Idaho and for inorganic As.

	Idaho 2015 HHC	EPA Recommended As Criteria	Oregon Freshwater As Criteria	
Target Incremental Cancer Risk	1×10^{-5}	1×10^{-6}	Fish only	Fish + water
			1.1×10^{-5}	1×10^{-4}
Cancer Slope Factor	--	1.75	1.5	
Body Weight (kg)	80	70	70	
Drinking Water Intake (L/day)	2.4	2.0	2.0	
Fish Intake (kg/day)	0.0665	0.0065	0.175	
BCF	--	44	14	
Inorganic Proportion Factor (%)	--	--	10	

Potential Approaches

DEQ could follow any number of options for revisions to Idaho's human health criteria for As. Some possible approaches are outlined below.

Adopt EPA Recommended Criteria

DEQ could adopt the federally recommended As criteria of 0.14 µg/L for fish only and 0.018 µg/L for fish + water. These criteria do not account for known local fish consumption rates, do not use inputs consistent with IDAPA 58.01.02.210.05.b.ii, nor do they account for increased body weight and drinking water intake used to derive EPA's latest recommended toxics criteria. Furthermore, there are significant questions related to the basis of EPA's BCF, its appropriateness to conditions in Idaho, and the cancer slope factor used to derive these criteria.

Modify EPA Recommended Criteria using Idaho-Specific Inputs

DEQ could modify the federal recommendation by updating the inputs to reflect the incremental cancer risk, body weight, drinking water intake, and fish ingestion rates that were used in deriving Idaho's 2015 human health criteria revisions and specified in IDAPA 58.01.02.210.05.b.ii. This would still require identification of an appropriate bioaccumulation rate (BCF or BAF) for calculating As criteria.

Follow Oregon's Approach

DEQ could follow Oregon's approach, using literature-derived BCF and inorganic proportion factor and using different incremental cancer risks for the fish only and fish + water criteria derivations. Although this was approved for Oregon, there is no certainty it would be approved for Idaho.

Summary

In response to EPA disapproval of current standards, Idaho has initiated rulemaking to revise human health criteria for As. Important issues to discuss when deriving As criteria are questions of natural background conditions for As in Idaho surface waters, the role of organic and inorganic forms of As in toxicity, and uncertainty in appropriate bioaccumulation rates to use in derivation of As criteria. Three possible approaches to developing criteria have been identified to facilitate further discussion.

References

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Appendix A. Summary of ACWA Survey Results of State Arsenic Criteria and Implementation Strategies

ACWA Survey on arsenic (02-06-2017 to 02-24-2017)

Target participants: Monitoring, Standards and Assessment Committee (ACWA)

Background

Arsenic is a naturally occurring carcinogenic metalloid that is highly toxic if long-term exposure occurs. In New Jersey, the human health freshwater criterion (HHC) for arsenic is 0.017 µg/L of total arsenic based on EPA's recommended criteria. The extremely low HHC results in regulatory challenges since there is no technology available to measure arsenic to 0.017 µg/L. New Jersey Department of Environmental Protection (NJDEP) is contemplating developing a water quality standards (WQS) variance for arsenic as a regulatory tool based on EPA's 2015 revisions to the water quality regulations at 40 CFR 131. To that effect, this questionnaire is an attempt to determine current practices and research being performed by other state/regulatory counterparts. Please respond by February 24th. If you have any questions, please do not hesitate to contact Biswarup Guha (Roop) at biswarup.guha@dep.nj.gov.

#	State	Agency Name	Contact Person	Email	As HHC (ug/L)	Is HHC based on EPA recommendation of 0.018 µg/L	As regulated for surface water municipal and industrial dischargers?							Developing a WQS variance	
							Yes/No	Minimum reporting limit (RL) that the labs report	Treatment systems specific to As at municipal WWTPs and industrial dischargers	Research for WWTP treatment for As to achieve As conc. < 10 µg/L	Use of innovative methods or non-conventional technology	Cost analyses for the As treatment systems	Minimum effluent limitation (ug/L applied to dischargers?	How would Highest Attainable Conditions (HAC) be determined	How to address situations when ambient conc. > effluent conc. using the best feasible treatment
1	UT	Utah Division of Water Quality	Chris Bittner	cbittner@utah.gov	150 ug/L for arsenic water & organism. 10 ug/L for raw water sources for drinking water.	No	Yes	1	N/A	No	No	No	N/A	No plans	Normally, Utah would promulgate a site-specific standard based on natural concentrations but EPA has not been receptive to Montana's proposal to implement this approach for the Madison River. Utah is closely monitoring the outcome for the Madison River.
2	NC	NC Department of Environmental Quality (DEQ)	Connie Brower	connie.brower@ncdenr.gov	10 ug/L	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	SC	SC Department of Health and Environmental Control	Jeff DeBessonet	debessjp@dhec.sc.gov	10 ug/L	No	Yes	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	KY	Division of Water	Peter Goodmann	Peter.Goodmann@ky.gov	N/A	No	Yes	N/A	N/A	No	Don't know	No	Acute: 340 ug/L and Chronic: 150 ug/L	No plans	N/A
5	NH	NH Department of Environmental Services	Gregg Comstock	gregg.comstock@des.nh.gov	0.018 ug/L		Yes	2	None have permit limits. A few have "report" requirements.	No	No	No	None have permit limits for As	No plans - standards do not currently allow for variances	N/A
6	MT	Montana DEQ	Melissa Schaar	Mschaar@mt.gov	10 ug/L	No	Yes	1	None. Arsenic removal has proven effective for WWTPs using conventional treatment technologies for concentrations as great as 30 ug/L treating to 2 ug/L.	No	No	No	10 ug/L	No plans	N/A

7	IL	Illinois EPA	Brian Koch	Brian.Koch@illinois.gov	Acute: 360 ug/L and Chronic: 190 ug/L	No	Yes	50	Unsure, but unaware of any STPs that have issues with arsenic.	No	Unsure	No	190 ug/L	No plans	N/A
8	AK	Alaska DEC	Brock Tabor	brock.tabor@alaska.gov	AK is currently reviewing all human health criteria, which will include updating HHC to EPA-recommended 2015 values. There hasn't been a conclusion regarding As criterion yet.		Yes	3	Not many are required to monitor for As, but for those that do the reported values range from 6.15-42 ug/L.	No	No	No	1240 ug/L based on data from one facility	AK is currently working on adoption of the authority to develop variances in its WQS. Once rulemaking efforts are complete, AK will begin to review the need for As variances.	N/A
9	VA	Virginia Department of Environmental Quality	David Whitehurst	david.whitehurst@deq.virginia.gov		No	Yes	1	Unknown - no municipal facilities.	No	Unsure	No	It varies based on effluent flow and dilution, but the lowest in the database is 120 ug/L	No plans	N/A
10	AZ	Arizona Department of Environmental Quality	Jason Jones	jdj@azdeq.gov	10 ug/L	No	Yes	0.5	No AZ NPDES permit holders perform treatment to meet As standard of 10 ug/L.	Most research is dedicated to changing from 50 ug/L to 10 ug/L, but many technologies will go below 10 ug/L.	No	Yes, but for water treatment plants.	10 ug/L	No plans	N/A
11	AR	Arkansas Department of Environmental Quality	Standards: Sarah Clem and Permits: Carrie McWilliams		No freshwater As HHC in the State Water Quality Standards and no plans to add one at this time.	No	AR doesn't have a standard for As, so limits are not included in permits.	0.5	Unsure	Unsure	Unsure	No	Compare in-stream waste concentration to 1.4 ug/L, which is EPA recommended criteria.	No plans	N/A
12	ID	Idaho DEQ	Don A. Essig	Don.Essig@deq.idaho.gov	Currently 10 ug/L. Revisions to HHC after 2018 once EPA adopts national 304(a) recommendation	Based on section 304(a) of Clean Water Act									
13	OR	Oregon DEQ	Debra Sturdevant	sturdevant.debra@deq.state.or.us	2.1 ug/L	No	Yes	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	WA	Washington Department of Ecology	Cheryl Niemi	cheryl.niemi@ecy.wa.gov	Adopted new criteria of 10 ug/L but it was disapproved by EPA, and EPA promulgated a new regulation for WA.	No	Past practice has deferred implementation of HHC for As.	0.5	None	No	No	No	N/A	Need to investigate more	N/A

15	FL	Florida DEP	Daryll Joyner	Daryll.Joyner@dep.state.fl.us	10 ug/L	No, but waiting on EPA's update	Yes	1	Treatment systems are on a case-by-case basis but must be capable of meeting water quality standards and criteria	Unknown	Unknown	No	10 ug/L for surface waters classified as potable supply, and 50 ug/L for other surface waters	No	N/A
16	TX	Texas Commission on Environmental Quality	Jill Csekitz	jill.csekitz@tceq.texas.gov	10 ug/L	No	Yes	0.5	Unsure about treatment methods for industrial WWTPs. No municipal WWTPs in Texas.	No	Unknown	No	Daily average permit limits range from 19.9 ug/L to 810 ug/L.	No	N/A
17	MD	Maryland Department of the Environment	Timothy Fox	tim.fox@maryland.gov	0.18 ug/L	No	Yes	2	None	No	No	No	Nationally recommended HHC	No	N/A
18	CA	California Regional Water Quality Control Board, San Francisco Bay Region	Bill Johnson	Bill.Johnson@waterboards.ca.gov	5 ug/L	No	Yes	1	Many WWTPs provide only secondary treatment. They achieve 150 ug/L (4 day) and 340 ug/L (1 hour).	No	No	No	Marine dischargers have limits based on saltwater objectives of 36 ug/L (4 day) and 69 ug/L (1 hour).	No plans	N/A
19	CA	California Regional Water Quality Control Board, Los Angeles Region	Deborah Smith	deborah.smith@waterboards.ca.gov	10 ug/L	No	Yes	0.4	None	No, concentrations are already below this. For Publicly Owned Treatment Works, they range from 0.4-3 ug/L.	No	No	10 ug/L as monthly average	No	N/A