Water Quality Criteria for PCBs and the Linkage to the use of Fish Tissue for Impairment Listings – and – Washington's new Proposed Rule for Human Health Criteria and Implementation Tools

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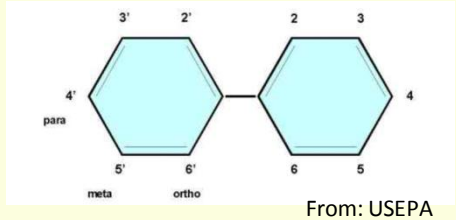
Contents of this presentation:

- What are the PCB criteria?
- The freshwater criterion and criterion equation for PCBs – what is taken into account
- The cancer slope factor used to calculate the PCB criteria
- The bioconcentration factor used in the PCB criteria – basis
- How is the use of fish tissue data linked to the PCB human health criteria?
- Site-specific considerations
- New Washington draft rule on human health criteria and implementation tools – summary information

PCB criteria for surface waters - status

The current PCB criteria for Washington are EPA's 1999 National Toxics Rule (NTR) criteria (40CFR131.36).



From: USEPA

NTR originally issued to Washington in 1992

- PCB criteria updated by EPA in 1999 to include a new CSF.

Current PCB criteria: **0.000170 µg/L =** 170 ppq (parts per quadrillion) in water.
These criteria apply to total PCBs (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses).

PCB criteria for WA currently under revision by both Washington and EPA.

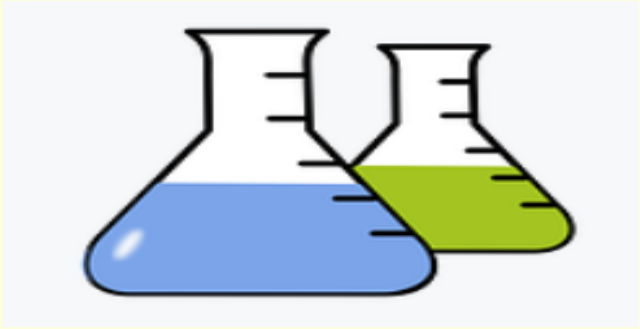
Will give information on current WA rule-making at the end of this presentation.

PCB criteria for surface waters

PCB criteria for WA are currently under revision by both Washington and EPA.

Entity	PCB criterion – freshwater (µg/L)	Status
Washington	0.000170	Under federal regulation. 1999 revision of the National Toxics Rule.
Idaho	0.00019 (new)	Rule approved by Idaho legislature 1/2016. Needs EPA CWA approval.
Spokane Tribe	0.0000013	CWA approved
Oregon	0.0000064	CWA approved

EPA Method	DL (µg/L)	QL (µg/L)
608	0.25	0.50
8082A	0.008	0.01
1668C	0.00005	0.0001



PCB criteria for surface waters – Current criterion for Washington: federal National Toxics Rule

Simplified equation for criterion that includes both water ingestion and fish consumption as exposure routes:

$$\text{Criterion} = \frac{\text{Risk Level x BW}}{\text{Cancer Slope Factor x [DI+ (FCR x Bioconcentration Factor)]}}$$

Equation inputs:

Risk Level

DI = Drinking Water Intake

Bioconcentration Factor = BCF

Body Weight

FCR = Fish Consumption Rate

CSF = Cancer slope factor

The criteria that include exposures from both fish and shellfish tissues and from drinking surface waters are referred to a “freshwater” criteria for this presentation.

PCB criteria for surface waters – EPA NTR

$$\text{Criterion} = \frac{\text{Risk Level x BW}}{\text{Cancer Slope Factor x [}\cancel{\text{DI}}\text{ + (FCR x Bioconcentration Factor)]}}$$

Risk level = 1 x 10^{-6} = one-in-one-million additional risk of developing a cancer over a lifetime (this risk only occurs once after 70 years, not every day or every year, etc…)

Body Weight = 70 kg. = 154 lbs. This is an average adult body weight based on national survey data.

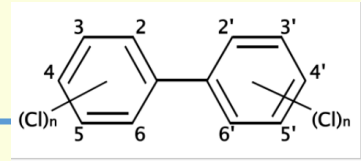
DI = Drinking Water Intake =2 Liters/day. This is the 90th percentile of national adult ingestion based on national surveys. (Does not influence calculated PCB value because of BCF)

Fish Consumption Rate = 6.5 g/day

CSF = Cancer slope value = 2.0. This value was developed by EPA to account for environmental mixtures. (Discussed briefly on next 2 slides)

BCF = Bioconcentration Factor = 31,200 = Described after the CSF

Cancer Slope Factor for PCBs



Chemical structure of PCBs. The possible positions of chlorine atoms on the benzene rings are denoted by numbers assigned to the carbon atoms.

Figure from Wikipedia; accessed 2/5/2016

Why are we talking about this?

- Because Spokane monitoring includes congener analysis, and the new CSF considers this.
- The CSF is linked to the PCBs that accumulate in fish.

Pre-1996 situation

"Previous assessments developed a single dose-response slope (7.7 per mg/kg-d average lifetime exposure) for evaluating PCB cancer risks (U.S. EPA, 1988a). With no agreed-on basis for reflecting differences among environmental mixtures, this slope was used by default for any mixture." (from EPA 1996)

- The 1996 reassessment contains an approach that includes consideration of toxicity, persistence and degradation of congeners, and environmental mixtures.
- EPA's Integrated Risk Information System (IRIS) was updated (1996) (summarized on next slide).
- EPA updated the NTR PCB criteria in 1999 to include use of the new CSF (2.0).

EPA 1996. *PCBs: Cancer Dose-Response Assessment and **Application to Environmental Mixtures**.* EPA/600/P–96/001F September 1996. http://www3.epa.gov/epawaste/hazard/tsd/pcbs/pubs/pcb.pdf.

Cancer Slope Factor for PCBs

The EPA 1996 PCB reassessment contains a tiered approach that includes consideration of toxicity, persistence, and environmental mixtures in choice of the CSF

EPA's Tiered Approach for Risk assessment			
Environmental mixture characterized by…	**High Risk And Persistence**	Low Risk And Persistence	Lowest Risk And Persistence
CSF (mg/kg-day)	**2.0**	0.4	0.07
When to use	**Food chain exposure** Sediment or soil ingestion Dust or aerosol inhalation Dermal exposure, if an absorption factor has been applied to reduce the external dose Presence of dioxin-like, tumor-promoting, or, persistent congeners in other media Early-life exposure (all pathways and mixtures)	Ingestion of water-soluble congeners Inhalation of evaporated congeners Dermal exposure, if no absorption factor has been applied to reduce the external dose	Congener or isomer analyses verify that congeners with more than 4 chlorines comprise less than 1/2% of total PCBs

Information in this table is summarized from EPA 1996, Table 4-1: Tiers of human potency and slope estimates for environmental mixtures (page 43). http://www3.epa.gov/epawaste/hazard/tsd/pcbs/pubs/pcb.pdf

Bioconcentration factor used in the PCB criteria calculations

The BCF of 31,200 is based on laboratory-derived BCFs for fish and invertebrates
Freshwater and marine species used.
This is a standard approach to BCF development based on EPA 1980 guidance.

Examples below from: EPA 1980. *Ambient Water Quality Criteria for Polychlorinated Biphenyls*. EPA 440/5-80-068.				
Fresh or Marine	Organism	BCF (L/kg)	Days exposed	Mixture
FW	Phantom midge (whole body)	2,700	14	Arochlor 1254
FW	Scud (whole body)	108,000	60	Arochlor 1242
FW	Brook trout (fillets)	3000	500	Arochlor 1254
FW	Fathead minnows (whole body)	120,000	240	Arochlor 1242
MW	Diatom (whole organism)	1,000	14	Arochlor 1242
MW	Eastern oyster (edible portion)	Up to 101,000	245	Arochlor 1016
MW	Grass shrimp (whole body)	27,000	16	Arochlor 1254
MW	Sheepshead minnow (adult – whole body)	30,000	28	Arochlor 1254

The PCB BCF of 31,200 L/kg. Where did it come from?

Source: EPA 1980 PCB criteria document

Includes:

Combination of freshwater (21) and marine (11) tests with associated lipid data.

Assumption that BCFs are steady-state

- Geometric mean of the 1% lipid normalized PCB BCF values = 10,385
  - BCF adjusted to 3.0 percent lipids (weighted average of consumed fish and shellfish) = 31155
    - Weighted average BCF for edible portions of consumed freshwater and marine aquatic organisms is 31,200.

Where do those units come from?

$$\frac{mg/kg}{mg/L} = \frac{L}{kg}$$

EPA 1980. *Ambient Water Quality Criteria for Polychlorinated Biphenyls*. EPA 440/5-80-068.

Site-specific sources of variability in accumulation factors

EPA (2009) describes sources of variability in BAFs:

*"…EPA recognizes that **BAFs vary not only between chemicals and trophic levels, but also among different ecosystems and waterbodies; that is, among sites.** The bioaccumulation potential of a chemical can be affected by various site-specific physical, biological, and chemical factors:*

- *water temperature and dissolved oxygen concentration;*
- *sediment-water disequilibria;*
- *organism health, physiology and growth rate;*
- *food chain structure;*
- *food quality; and*
- *organic carbon composition.*

EPA 2009. **Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000).** Draft Technical Support Document Volume 3: Development of Site-Specific Bioaccumulation Factors. EPA-822-R-08-001

Site-specific factors that affect the applicability of BCFs and BAFs to specific waterbodies

"National average BAF value for a given chemical and trophic level may not provide the most accurate estimate of bioaccumulation for certain waterbodies in the United States. ***At a given location, the BAF for a chemical may be higher or lower than the national BAF, depending on the nature and extent of site-specific influences****." EPA 2009*

- This statement also applies to BCFs.

- This leaves states in a difficult position when adopting statewide criteria.
- States use the EPA national BCFs even though they are not necessarily reflective of specific waterbodies.
- It is impractical to develop site-specific accumulation factors for all the different waterbodies and chemicals and then put those into rule.

How are 303(d) listings for human health criteria and uses determined?

Ecology Policy 1-11 guides how Ecology assesses data on waterbody segments and makes listing decisions on the water quality status.

For human health criteria and uses:

- A 303(d) listing requires use of **resident fish tissue.**
- Water measures are not used.
- Fish Advisories can be used in some circumstances.

Policy 1-11 last revised in 2012. Policy 1-11 is developed through a public process

Next Policy 1-11 revision process was announced on January 20 2016

NEW!

Notice of Call for Data and Scoping Process

"…a **60-day scoping process to solicit all stakeholder and tribal ideas about areas they think should be revised or clarified in Water Quality Policy 1-11**, *Assessment of Water Quality for the Clean Water Act Sections 303(d) and 305(b) Integrated Report."* *http://www.ecy.wa.gov/programs/wq/303d/2016index.html*

Ecology Policy 1-11: http://www.ecy.wa.gov/programs/wq/303d/WQpolicy1-11ch1.pdf

How is tissue used to assess waters?

Policy 1-11 (page 50):

*"Tissue: Criteria **tissue equivalent concentrations are back-calculated to surface water concentrations using bioconcentration factors** (BCF) that were used to derive the human health criteria in the NTR."*

*"All tissue samples used for the Assessment must be from **resident fish**. Fin fish **fillet** tissue samples, **whole shellfish** tissue samples, and **edible shellfish muscle** samples must have **at least three single-fish samples** or a **single composite sample made up of at least three separate fish of the same species**. Fin fish fillet tissue samples may be analyzed with skin on or skin off."*

Fish tissue equivalent concentration (FTEC) = BCF x human health criterion

FTEC for PCBs = 5.3 ppb (parts per billion) in tissue

The FTEC is a listing trigger, not a criterion. The criterion is 170 ppq in water.

Do the FTEC or the criteria have anything to do with fish advisories?

No.

- The FTEC is only used for 303(d) listing, it is not a health statement. WDOH makes health assessments in its fish advisory development process.
- The criteria are numeric water concentration values, and do not have any direct numeric connection to WDOH fish advisories.
- If water concentrations are kept at or below criteria, levels of toxics in fish should remain safe for consumers and should not prompt fish advisories (if BCF in criterion calculation works as assumed for a specific waterbody) .
- The fish advisories are based on real levels of toxics in fish tissues, and take into account local information as well as health benefits of eating fish and shellfish.
- Dave McBride (WDOH) will talk about this in a later presentation.

Spokane PCB listings are based on resident fish

What are resident fish?

Working definition:

"species whose tissue contaminant levels are representative of the waterbody they were collected in, non-anadromous"

Why focus on resident fish? Reasons include:

- They live in limited geographic areas. They pick up pollutants in these waters and help identify waterbodies with sources of pollutants.
- They are what people are catching and eating from a specific waterbody.
- Because resident fish tissues represent catch it does not matter if fish were planted or not – as long as they represent the contaminant levels that would accumulate in a resident fish from a specific waterbody.

Hatchery fish

Concerns expressed about use of hatchery fish to assess and/or list waterbodies

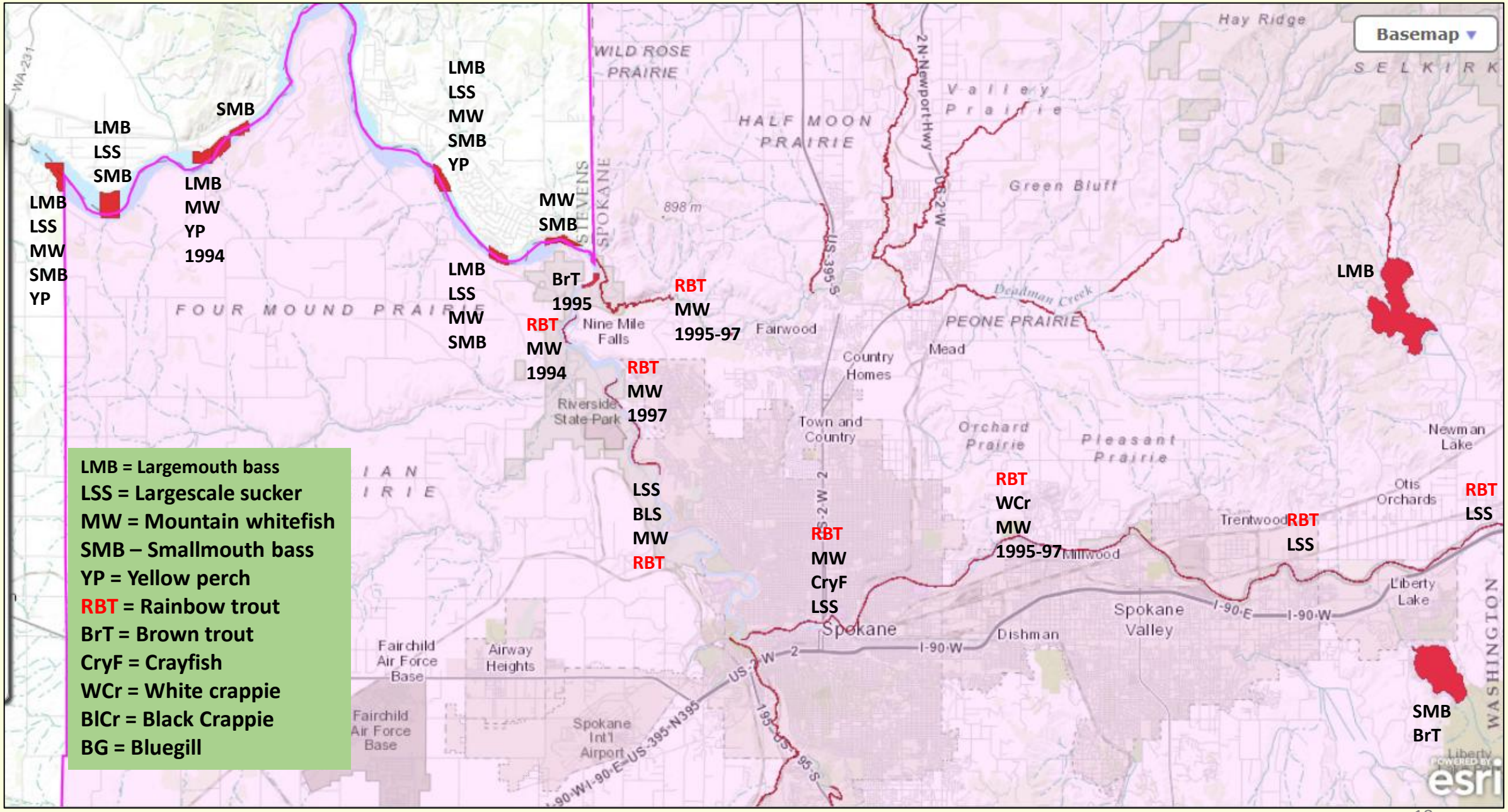
Does the listing process distinguish between hatchery and non-hatchery fish?

- No. It is possible that some rainbow trout could be from hatcheries.

Would eliminating potential hatchery fish from the data set make a difference in Spokane listings?

- No. All listings where rainbow trout have tissue exceedances also have other resident species with tissue exceedances (see map).

2014 Candidate impairment listings along Spokane River and Long Lake. **Note new NHD segment size.**



Reports (not data collection dates) published earlier than 2000 are indicated.

Other issues with stocked fish?

Lakes:

Concern expressed that PCBs are entering the food web though stocked fish and building up in edible fish tissues to levels that prompt listings.

Depending on the lake, other sources also possible: hydroseeding, deicers, oils, etc…

Sources and pathways to lakes can't be quantified with our current information

- the relative contribution of different sources of PCBs is unknown

Hatchery information

2006 Source study → Source control → New source study

Step 1: 2006 Ecology study looked at PCBs and hatcheries. State hatcheries took actions to reduce PCBs.

Step 2: New hatchery study in planning and design phase – slated to begin in 2016

Ecology 2006. *Persistent Organic Pollutants in Feed and Rainbow Trout from Selected Trout Hatcheries.* Publication No. 06-03-017. https://fortress.wa.gov/ecy/publications/documents/0603017.pdf

Washington draft HHC and implementation tools rules:

September 2015 - EPA publishes a proposed revision to the National Toxics Rule for Washington

First draft rule:

- **Feb 2015** Draft Rule - linked to Governor's toxics control bill
- Bill not approved, so a **rule not finalized**

➢ Further consideration by leaders and management

October 2015 announcement by Governor that Ecology will move forward with a **second draft rule**. Changes in some risk management decisions because this draft rule will not be linked to a toxics bill.

- Stay with state's current risk level: One-in-one-million (10^{-6})
- Remove overlay that said that "no criterion would go higher than the NTR criterion."

Second draft available on 2/3/2016.
http://www.ecy.wa.gov/programs/wq/ruledev/wac173201A/1203ov.html

New (second) proposed human health criteria and implementation tools rule for Washington

Available as of 2/3/2016	
Proposed Rule language	Draft Environmental Impact Statement (prepared under the State Environmental Policy Act)
Preliminary Cost-Benefit Analysis	Small Business Economic Impact Statement
Washington State Water Quality Standards: Human health criteria and implementation tools key decision document	
Draft Citation List	Draft Implementation Plan

Public Hearings and Webinars

Date	Time	Format	Location
Tuesday, April 5, 2016	6:30 p.m.	In-person	Seattle
Wednesday, April 6, 2016	6:30 p.m.	In-person	Spokane
Thursday, April 7, 2016	1:30 p.m. - 4:30 p.m.	Webinar	-
	6:30 p.m.	Webinar	-

Proposed rule highlights - criteria

- FCR = 175 g/day
- Cancer risk level = one-in-one-million (1×10^{-6}; unchanged from current state WQS and NTR)
- Hazard Quotient for non-carcinogens = 1 (unchanged from current NTR criteria)
- Arsenic proposal = 10 ug/L, paired with narrative arsenic pollution minimization requirements
- PCB proposal = 170 ppq (unchanged from NTR criteria; based on chemical-specific risk level and "no greater than" default)
- Mercury = no proposed criteria – remain under federal regulation
- Criteria calculated using BCFs from NTR

Proposed rule highlights – implementation tools

- Compliance schedule language (term unspecified)
- Variance language (no variances, just the recipe)
- New intake credit language

Implementation language very similar to first draft rule from January 2015.

Date of intended adoption: on or after August 1, 2016

Also ongoing: EPA's proposed new human health criteria regulation for Washington.

Questions/Discussion