Water Quality Standards
Human Health Criteria Workgroup

Sept 29, 2020

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Sept 29, 2020 Meeting Agenda
Human Health Criteria (HHC) Workgroup

- Revisit HHC Workgroup Plan & outcomes
- Review of last few meetings
- Bioaccumulation Factors – presentations from Chris Smith & Jenni Henthorn
- Discuss upcoming meeting with EPA
- Plan next meeting and conclude

Agenda uploaded on 9/28/20 to https://dep.wv.gov/WWE/Programs/wqs/Pages/WQSpublicmeetings.aspx

HHC Workgroup Plan
a work in progress

Workgroup Goals

1. **Reasonable standards** – approvable by WV Legislature & EPA
2. **Protective regulations** – protect West Virginians
3. **Learn** – broaden horizons, gain better understanding
4. **Consensus** – agree on what to propose in 2021

Review of HHC Workgroup Meetings

July

- Calculation changes in EPA 2015 recommended criteria
- WV Risk Factor for carcinogens: 1 in a million
- Went over factors of EPA's equation
- Other States – what neighboring states are doing on HHC

August

- IRIS updates to toxics data after EPA's 2015 revision
- Went thru example EPA criteria document
- EPA's decision-making on drinking water intake and body weight numbers

Bioaccumulation Factors

$$AWQC\ (\mu g/L) = \frac{\text{toxicity value (mg/kg-d)} \times BW\ (kg) \times 1{,}000\ (\mu g/mg)^{b}}{DI\ (L/d) + \sum_{i=2}^{4} (FCR_i\ (kg/d) \times BAF_i\ (L/kg))}$$

Now, Presentations by Chris Smith
and Jennie Henthorn

Bioaccumulation Factors (BAFs)

Chris Smith

Human Health Criteria Workgroup meeting

September 29, 2020

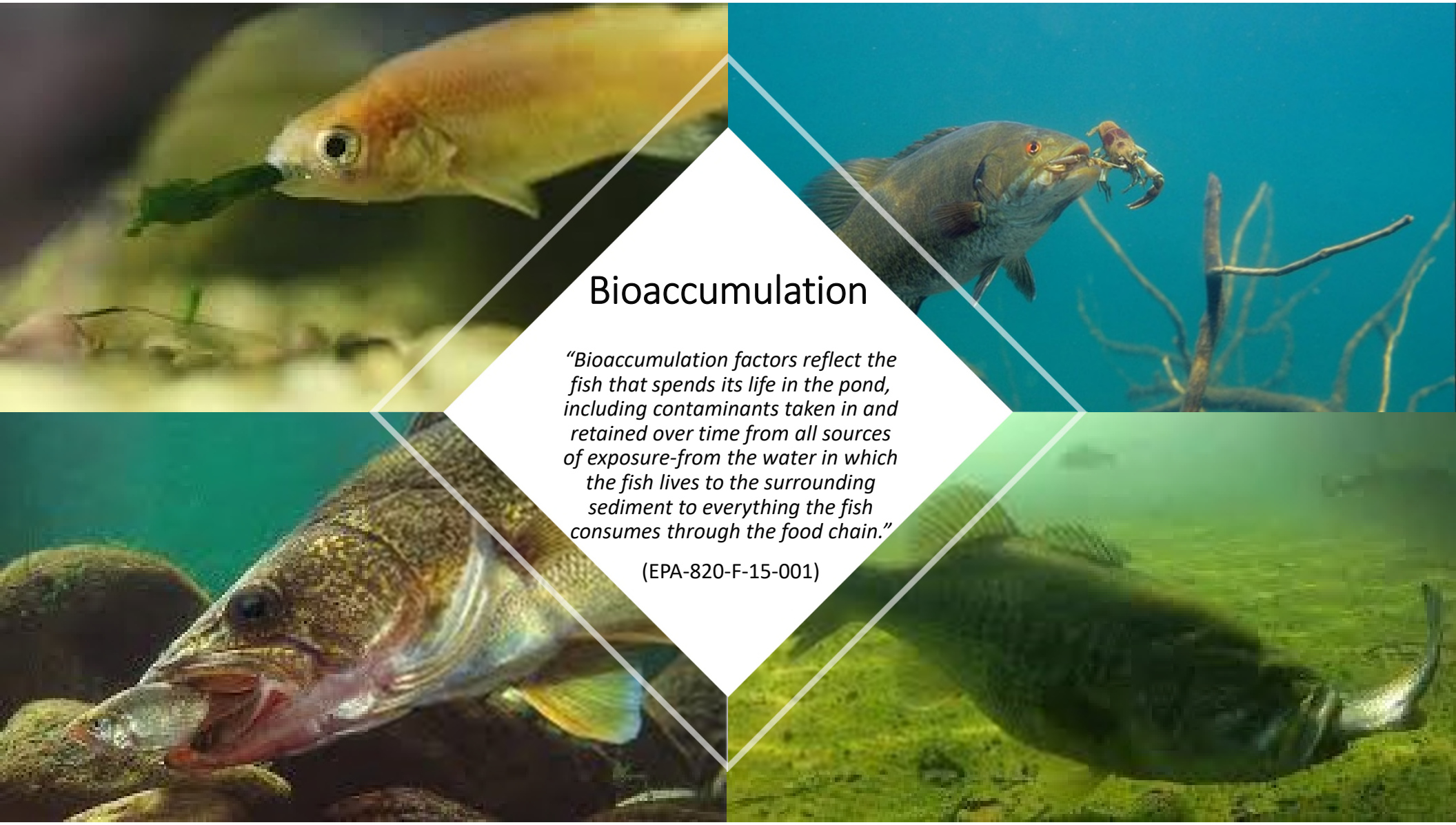
2015 EPA HHC updated equation inputs

- Human body weight
- Drinking water consumption rate
- Fish consumption rate
- Some updated CSFs/Rfds
- **BCFs to BAFs**

Bioconcentration

"Bioconcentration factors reflect the propensity of an organism to accumulate chemicals in its tissues, based only on exposure to the water- in other words, those factors that affect a fish that swims through a polluted pond."

(EPA-820-F-15-001)

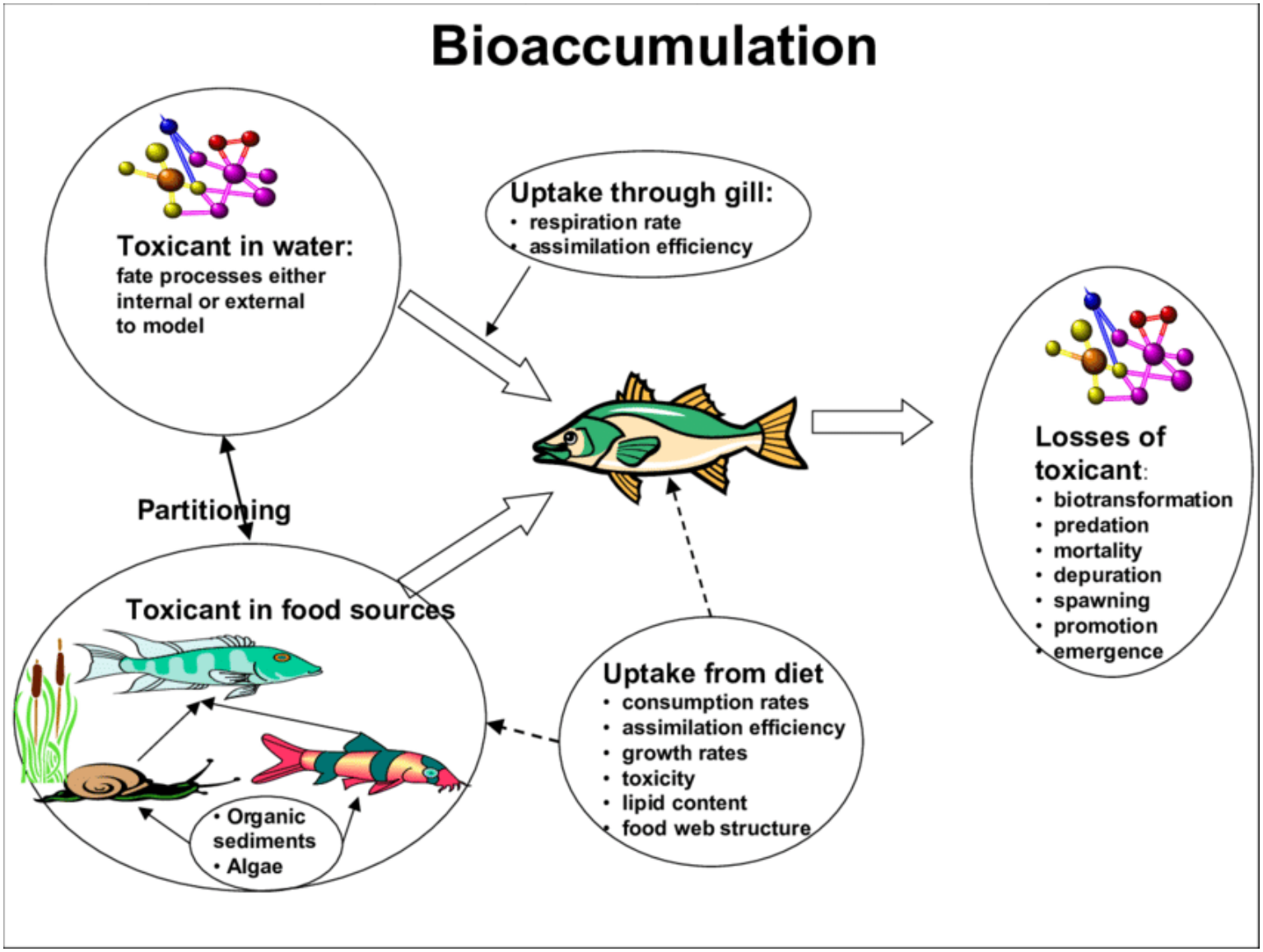


Bioaccumulation

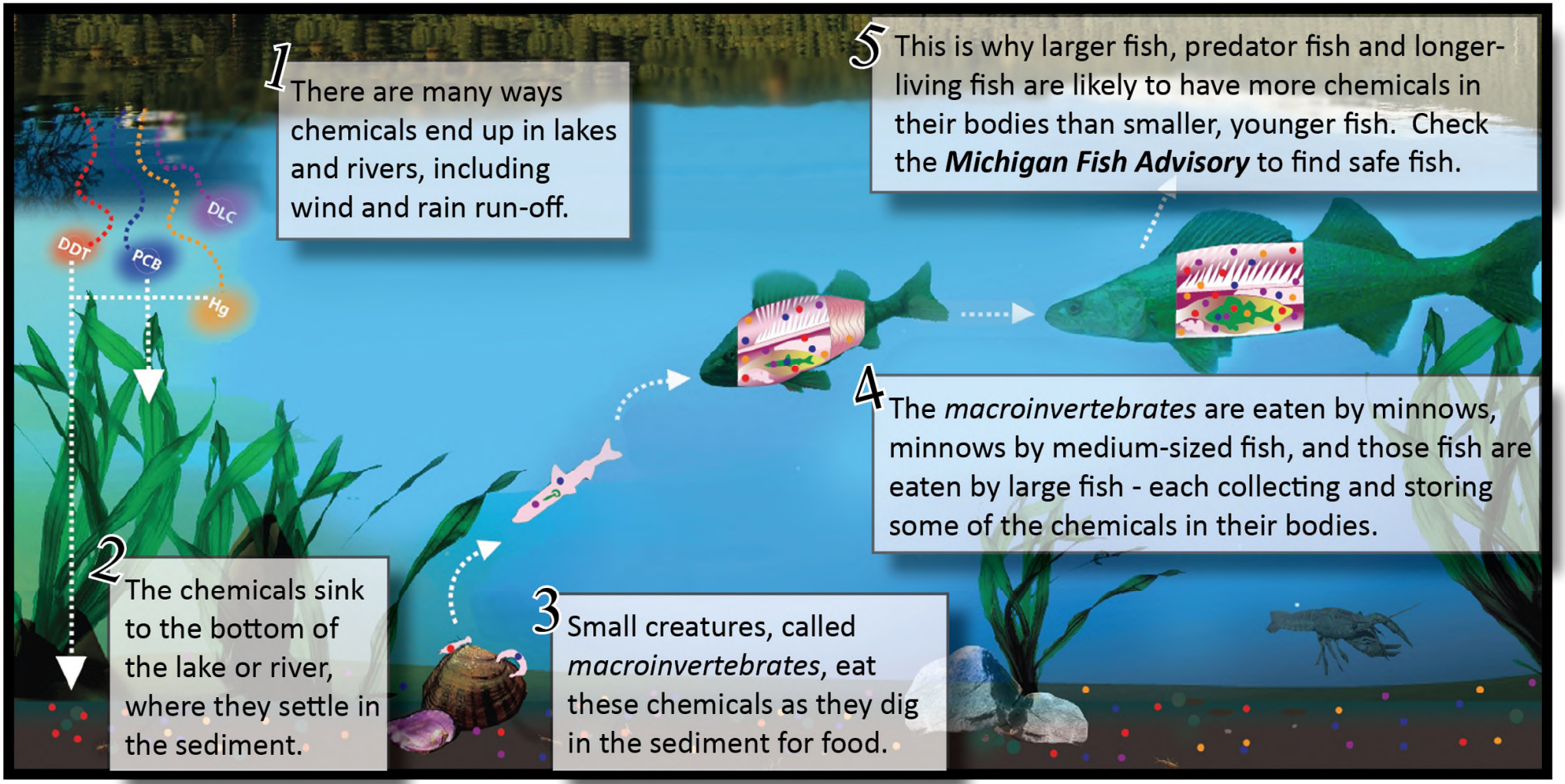
"Bioaccumulation factors reflect the fish that spends its life in the pond, including contaminants taken in and retained over time from all sources of exposure-from the water in which the fish lives to the surrounding sediment to everything the fish consumes through the food chain."

(EPA-820-F-15-001)

Bioaccumulation



Bioaccumulation in Action



Aquatic Food Web Components

Trophic Level	Functional Group	Examples
T1	Primary Producers	• aquatic plants • algae • cyanobacteria • sulfur bacteria
T2	Herbivores	• zooplankton • snail • mollusk • insects (with aquatic larvae)

Aquatic Food Web Components

Trophic Level	Functional Group	Examples
T3	Benthivores Zooplanktivores Omnivores	• leeches • insects (dragonfly, damselfly, various beetles) • fish (common carp, alewife, channel catfish, killifish, black crappie, bluegill sunfish, yellow perch)
T4	Piscivores Top carnivores	• mammals (river otter, harbor seal) • birds (belted kingfisher, great blue heron, osprey) • reptiles/amphibians (northern water snake, bullfrog, eastern newt) • fish (bass, pike, walleye, trout)

2015 EPA HHC calculation

7.2 AWQC for Carcinogenic Toxicological Effects

For consumption of water and organisms:

$$\text{AWQC } (\mu g/L) = \frac{\text{toxicity value } (10^{-6} / \text{CSF}) \text{ [mg/kg-d]} \times \text{BW (kg)} \times 1{,}000 \ (\mu g/mg)}{\text{DI (L/d)} + \sum_{i=2}^{4} (\text{FCR}_i \text{ (kg/d)} \times \text{BAF}_i \text{ (L/kg)})}$$

For consumption of organisms only:

$$\text{AWQC } (\mu g/L) = \frac{\text{toxicity value } (10^{-6} / \text{CSF}) \text{ [mg/kg-d]} \times \text{BW (kg)} \times 1{,}000 \ (\mu g/mg)}{\sum_{i=2}^{4} (\text{FCR}_i \text{ (kg/d)} \times \text{BAF}_i \text{ (L/kg)})}$$

7.1 AWQC for Noncarcinogenic Toxicological Effects

For consumption of water and organisms:

$$\text{AWQC } (\mu g/L) = \frac{\text{toxicity value (RfD [mg/kg-d]} \times \text{RSC)} \times \text{BW (kg)} \times 1{,}000 \ (\mu g/mg)}{\text{DI (L/d)} + \sum_{i=2}^{4} (\text{FCR}_i \text{ (kg/d)} \times \text{BAF}_i \text{ (L/kg)})}$$

For consumption of organisms only:

$$\text{AWQC } (\mu g/L) = \frac{\text{toxicity value (RfD [mg/kg-d]} \times \text{RSC)} \times \text{BW (kg)} \times 1{,}000 \ (\mu g/mg)}{\sum_{i=2}^{4} (\text{FCR}_i \text{ (kg/d)} \times \text{BAF}_i \text{ (L/kg)})}$$

BCF vs BAF in HHC calculation

2002

$$\frac{(10^{-6}/q1^{*}) \bullet 70\ kg \bullet 1000\ \mu g/mg}{(2\ L/d + (0.0175\ kg/d \bullet BCF\ [L/kg]))}$$

2015

$$\frac{\text{toxicity value } (10^{-6} / CSF)\ [mg/kg\text{-}d] \times BW\ (kg) \times 1{,}000\ (\mu g/mg)}{DI\ (L/d) + \sum_{i=2}^{4} (FCR_i\ (kg/d) \times BAF_i\ (L/kg))}$$

Aldrin

7.1 AWQC for Noncarcinogenic Toxicological Effects

For consumption of water and organisms:

$$\text{AWQC } (\mu g/L) = \frac{\text{toxicity value (RfD [mg/kg-d] } \times \text{ RSC)} \times \text{BW (kg)} \times 1{,}000\ (\mu g/mg)}{\text{DI (L/d)} + \sum_{i=2}^{4} (\text{FCR}_i\ (\text{kg/d}) \times \text{BAF}_i\ (\text{L/kg}))}$$

$$= \frac{0.00003\ \text{mg/kg-d} \times 0.20 \times 80.0\ \text{kg} \times 1{,}000\ \mu g/mg}{2.4\ \text{L/d} + (0.0076\ \text{kg/d} \times 18{,}000\ \text{L/kg}) + (0.0086\ \text{kg/d} \times 310{,}000\ \text{L/kg}) + (0.0051\ \text{kg/d} \times 650{,}000\ \text{L/kg})}$$

$$= 0.0000784\ \mu g/L$$

$$= 0.00008\ \mu g/L \text{ (rounded)}$$

FCR	TL2	0.0076 kg/d
	TL3	0.0086 kg/d
	TL4	0.0051 kg/d
BAF	TL2	18,000 L/kg
	TL3	310,000 L/kg
	TL4	650,000 L/kg

EPA methods for deriving BAFs

BAF Method

BSAF Method

BCF Method

K_{ow} Method

BAF Method

- Uses measured BAFs derived from data obtained from field studies
- Field-measured BAFs are normalized by adjusting for the water-dissolved portions of the chemical and the lipid fraction of fish tissue for each species as well as the fraction of the total concentration of chemical in water that is freely dissolved
- Multiple field BAFs are averaged using a geometric mean of the normalized BAFs by species and TL
- EPA chose the recommended 50th percentile dissolved and particulate organic carbon content for the national-level default values

BSAF Method

- Uses biota-sediment accumulation factors (BSAFs) to estimate BAFs
- EPA did not use measured BSAFs to calculate national BAFs

BCF Method

- Uses BAFs estimated from laboratory-measured bioconcentration factors
- Laboratory-measured BCFs are normalized with the lipid fraction and the fraction of the total concentration of chemical in water that is freely dissolved, then multiplied by the food chain multiplier where applicable
- Multiple values are averaged using a geometric mean across species and then across TL to compute baseline BAFs
- EPA chose the recommended 50th percentile dissolved and particulate organic carbon content for the national-level default values

K_{ow} Method

Predicts BAFs based on a chemical's K_{ow} with or without adjustment using a food chain multiplier.

Bioaccumulation Factors

Jennie Henthorn
Human Health Criteria Work Group
September 29, 2020

Determination of Criteria Factors

	CSF (per mg/kg-d)	RfD (mg/kg-d)	WV RSC	Bioaccumulation Factor (L/kg tissue)			WV Cat A Criteria (µg/l)	WV Cat C Criteria (µg/l)	Drinking Water (µg/l)
				TL2	TL3	TL4			
1,1,1-Trichloroethane	ND	2	0.2	6.9	9	10	12868	369046	13333
1,1,2,2-tetrachloroethane	0.2	0.02	0.2	5.7	7.4	8.4	0.2	5.6	0.2
Aldrin	17	0.00003	0.2	18000	310000	650000	0.0000014	0.0000014	0.0020

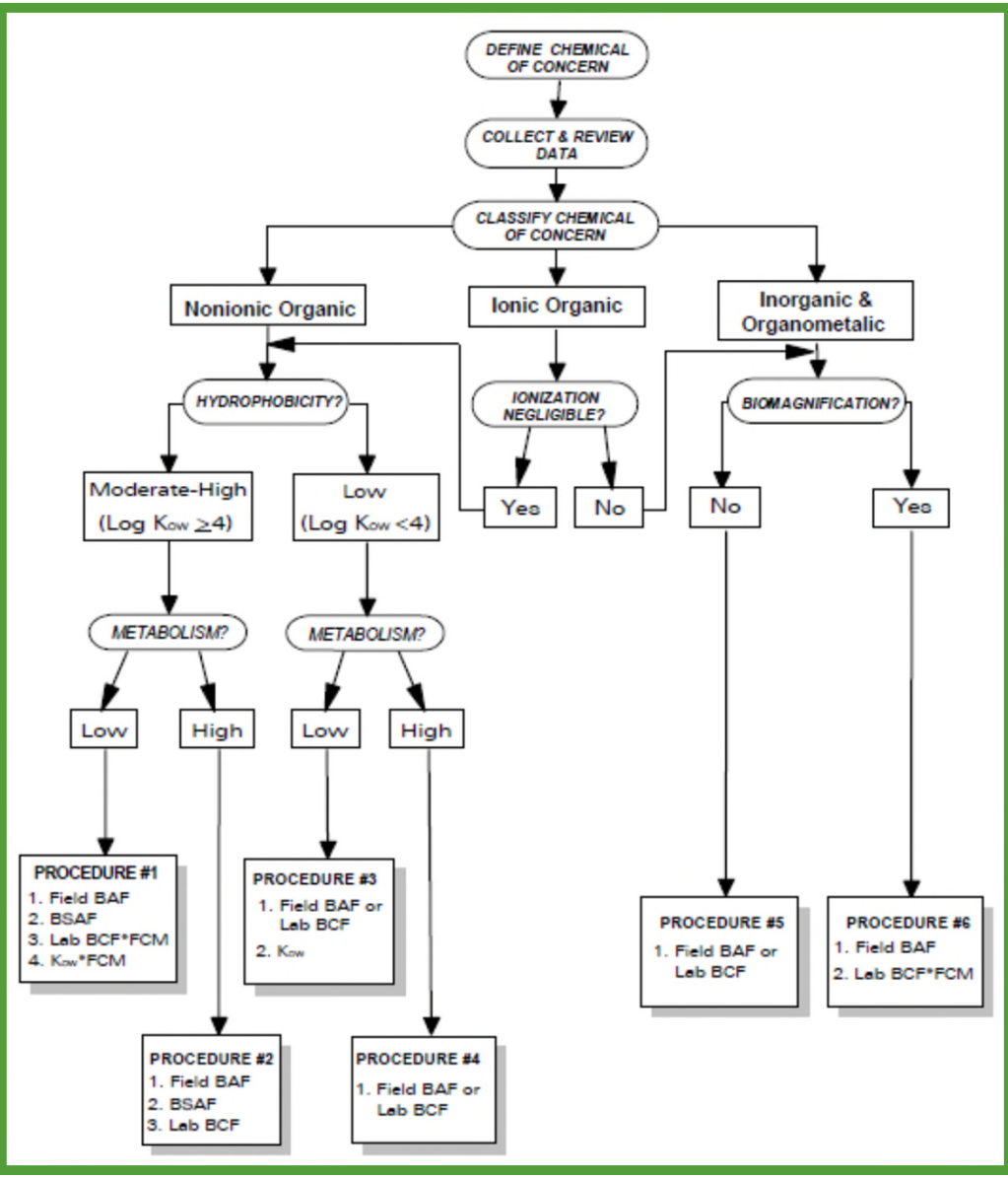
What are BAFs?

- Aquatic organisms can accumulate certain chemicals in their bodies when exposed through water, their diet, and other sources.
- Human health criteria account for potential bioaccumulation of chemicals in fish and shellfish through the use of bioaccumulation factors (BAFs).
- A BAF is the ratio (in L/kg tissue) of a concentration of a chemical in tissue to its concentration in the surrounding water

$$\mathbf{BAF} = \frac{C_t}{C_w}$$

EPA Framework for Deriving BAFs

EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000)



Hierarchy or Preference for Four Options:

Methodology, p. 5-10.

1) **BAF** - Bioaccumulation Factors calculated from actual exposure in surface waters

2) **BSAF** – Bio-sediment Accumulation Factors calculated from sediment exposures

3) **BCF** – Bioconcentration Factors calculated from laboratory exposure studies

4) Log K_{ow} – Calculated values based on the octanol-water partition coefficient for the chemical

Step 1: Compile the Research

https://www.epa.gov/sites/production/files/2016-01/national-bioaccumulation-factors-supplemental-information.xlsx

Original BAF and BCF Data

Chemical Name	CAS Number	BAF or BCF?	Secondary Citation	Species	Log BAF or BCF (ORIGINAL - TEXT)	Converted BAF or BCF (L/kg-tissue) (ORIGINAL - TEXT)	Log BAF or BCF *(NUMERIC)*	Converted BAF or BCF in (L/kg-tissue) *(NUMERIC)*	Whole Body or Other Data	Temperature (Mean Deg Celsius)	Total Organic Carbon - Water (Mean, mg/L)	Wet Weight (Mean, g)	Lipid Content (Mean Measured %)
1,1,1-Trichloroethane	71-55-6	BAF	Saisho K, H	Killifish (Cyprinodontidae)		2.54		2.54	Uncertain	22 +/-3	NA	NA	NA
1,1,1-Trichloroethane	71-55-6	BAF	Saisho K, H	Blue mussel (Mytilus edulis)		2.95		2.95	NA	20 +/-2	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	95-94-3	BAF	Oliver, B.G.	Rainbow trout (Oncorhynchus mykiss)	3.69897	5000	3.69897	5000	Whole body	10	NA	3200	7.9
1,2,4,5-Tetrachlorobenzene	95-94-3	BAF	Oliver, B.G.	Amphipod (Pontoporeia hoyi)	4.87408	74830.77	4.87408021	74830.77	Whole body	8	0.25	NA	3
1,2,4,5-Tetrachlorobenzene	95-94-3	BAF	Oliver, B.G.	Oligochaete (Tubifex tubifex)	4.309866	20411.08	4.30986598	20411.08	Whole body	8	0.25	NA	1
1,2,4,5-Tetrachlorobenzene	95-94-3	BAF	Oliver, B.G.	Shrimp (Mysis relicta)	3.832739	6803.6	3.83273877	6803.6	Whole body	8	0.25	NA	5
1,2,4,5-Tetrachlorobenzene	95-94-3	BAF	Pereira, W.	Atlantic Croaker (Micropogonias undulatus)	3.392416	2468.4	3.39241554	2468.4	Whole body	NA	NA	NA	2.2
1,2,4,5-Tetrachlorobenzene	95-94-3	BAF	Pereira, W.	Blue Catfish (Ichtalurus furcatus)	3.418334	2620.2	3.41833444	2620.2	Whole body	NA	NA	NA	3.3
1,2,4,5-Tetrachlorobenzene	95-94-3	BAF	Pereira, W.	Blue Crab (Callinectes sapidus)	2.898999	792.5	2.89899927	792.5	Whole body	NA	NA	NA	0.5
1,2,4,5-Tetrachlorobenzene	95-94-3	BAF	Pereira, W.	Spotted sea trout (Cynoscion nebulosis)	2.631708	428.26	2.63170751	428.26	Whole body	NA	NA	NA	2.3
1,2,4-Trichlorobenzene	120-82-1	BAF	Burkhard, L	Atlantic Croaker (Micropogonias undulatus)	3.405833	2545.85	3.40583281	2545.85	Whole body	NA	79.3	NA	NA
1,2,4-Trichlorobenzene	120-82-1	BAF	Burkhard, L	Gulf Menhaden (Brevoortia patronus)	3.516072	3281.5	3.51607241	3281.5	Whole body	NA	79.3	NA	NA
1,2,4-Trichlorobenzene	120-82-1	BAF	Burkhard, L	Mummichog (Fundulus heteroclitus)	3.33643	2169.85	3.33642971	2169.85	Whole body	NA	79.3	NA	NA
1,2,4-Trichlorobenzene	120-82-1	BAF	Oliver, B.G.	Rainbow trout (Oncorhynchus mykiss)	3	1000	3	1000	Whole body	10	NA	3200	7.9
1,2,4-Trichlorobenzene	120-82-1	BAF	Oliver, B.G.	Amphipod (Pontoporeia hoyi)	4.101334	12627.99	4.10133423	12627.99	Whole body	8	0.25	NA	3

Step 2: Select the BAFs

Chemical Name	Mean Log Kow	BCF from 2002/2003 HHAWQC (L/kg-tissue)	Log Kow Method			BAF Method			BCF Method			Alternative BCF (L/kg-tissue)	Selected Values Used for AWQC Calculations			
			National BAF TL 2 (L/kg-tissue)	National BAF TL 3 (L/kg-tissue)	National BAF TL 4 (L/kg-tissue)	National BAF TL 2 (L/kg-tissue)	National BAF TL 3 (L/kg-tissue)	National BAF TL 4 (L/kg-tissue)	National BAF TL 2 (L/kg-tissue)	National BAF TL 3 (L/kg-tissue)	National BAF TL 4 (L/kg-tissue)		National BAF TL 2 (L/kg-tissue)	National BAF TL 3 (L/kg-tissue)	National BAF TL 4 (L/kg-tissue)	Alternative BCF (Rounded) (L/kg-tissue)
Acenaphthene	3.98	242	180	250	290	--	--	--	3,500,000	510	3.5	510	ND	ND	ND	510
Acrolein	-0.01	215	1.0	1.0	1.0	--	--	--	--	28	--		1.0	1.0	1.0	ND
Acrylonitrile	-0.92	30	1.0	1.0	1.0	--	--	--	--	38	--		1.0	1.0	1.0	ND
Aldrin	6.5	4670	18,000	310,000	650,000	--	--	--	--	38,000	--		18,000	310,000	650,000	ND
alpha-BHC	3.8	130	120	160	190	1,700	1,400	1,500	--	86	710		1,700	1,400	1,500	ND
alpha-Endosulfan	3.83	270	130	180	200	--	--	--	47	4,700	--		130	180	200	ND
Anthracene	4.45	30	530	1,200	1,100	11,000	--	--	460	800	--	606.6300355	ND	ND	ND	610
Benzene-Lower CSF	2.13	5.2	3.6	4.5	5.0	--	--	--	4.3	--	11		3.6	4.5	5.0	ND
Benzene-Upper CSF	2.13	5.2	3.6	4.5	5.0	--	--	--	4.3	--	11		3.6	4.5	5.0	ND
Benzidine	1.34	87.5	1.4	1.6	1.7	--	--	--	700	57	--		1.4	1.6	1.7	ND
Benzo (a) Anthracene	5.61	30	6,000	55,000	77,000	--	--	--	3,800	21,000	--	3889.730068	ND	ND	ND	3,900
Benzo (a) Pyrene	6.06	30	12,000	170,000	300,000	13,000	--	--	8,900	1,700	--	3889.730068	ND	ND	ND	3,900
Benzo (b) Fluoranthene	6.04	30	12,000	160,000	290,000	--	--	--	2,800	150,000	--	3889.730068	ND	ND	ND	3,900
Benzo (k) Fluoranthene	6.06	30	12,000	170,000	300,000	--	--	--	69,000	--	--	3889.730068	ND	ND	ND	3,900
beta-BHC	3.78	130	110	160	180	--	--	--	--	--	130		110	160	180	ND
beta-Endosulfan	3.62	270	80	110	130	--	--	--	47	3,700	--		80	110	130	ND
Bis(Chloromethyl) Ether	-0.38	63	1.0	1.0	1.0	--	--	--	--	--	--		1.0	1.0	1.0	ND
Bis(2-Chloroethyl) Ether	1.34	6.9	1.4	1.6	1.7	--	--	--	--	5.3	--		1.4	1.6	1.7	ND
*Bis(2-Chloro-1-Methylethyl) Ether	2.48	2.47	6.7	8.8	10	--	--	--	--	5.0	--		6.7	8.8	10	ND
Bis(2-Ethylhexyl) Phthalate	7.5	130	25,000	390,000	690,000	--	680	750	150	9,000	--	714.1428429	ND	ND	ND	710
Bromoform	2.4	3.75	5.8	7.5	8.5	--	--	--	3.2	7.6	--		5.8	7.5	8.5	ND
Butylbenzyl Phthalate	4.73	414	980	2,900	2,600	--	15,000	24,000	--	3.3	--	18973.66596	ND	ND	ND	19,000
Carbon Tetrachloride	2.64	18.75	9.3	12	14	--	--	--	--	5.0	44		9.3	12	14	ND
Chlordane	5.54	14100	5,300	44,000	60,000	--	--	--	--	67,000	--		5,300	44,000	60,000	ND
Chlorobenzene	2.84	10.3	14	19	22	--	390	120	1,400	8.8	--		14	19	22	ND

Factors Used in BAFBCF™ to Calculate BAFs

- EPA's data is very old:

Undated	**2**
2010-2019	3
2000-2009	9
1990-1999	50
1980-1989	63
1970-1979	34
TOTAL	161

- Preliminary research from 2002 to the present identified more than seventy-five studies that require review to determine whether they are suitable for inclusion in the calculation of BAFs.
- Some of the studies cited by EPA were used for only one chemical, even though they report BAFs for other chemicals where K_{ow} values were used.

Basis for EPA Recommended Bioaccumulation Factors

- Most EPA's BAFs were calculated from Log K_{ow}:

Calculated **from** K_{ow}	59
BCF Method	6
BAF Method	11
Copied from Benzo(a)pyrene	6
Other alternative Method	12
TOTAL	94

- This is the least preferred method for determination of BAFs.

Example Study in EPA Spreadsheet

Chemical Name	BAF or BCF?	Secondary Citation	Species	Log BAF or BCF (ORIGINAL - TEXT)	Converted BAF or BCF (L/kg-tissue) (ORIGINAL - TEXT)
1,2,4-Trichlorobenzene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	2.40	250.00
2,4-Dichlorophenol	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	2.41	260.00
2,4-Dichlorophenol	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Golden ide		100
Hexachlorobenzene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	5.39	248000.00
Pentachlorobenzene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	3.60	4000.00
Pentachlorophenol	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	3.10	1250.00
Phenol	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	2.30	200.00
Toluene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	2.58	380.00
Trichloroethylene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	1.95	90.00
Vinyl Chloride	BCF	Freitag et al. 1985	Algae		40.00
Vinyl Chloride	BCF	Freitag et al. 1985	Fish		<10
Vinyl Chloride	BCF	Freitag et al. 1985	Golden Ide (Fish)		<10

Golden Ide Data from Study

- Data in yellow indicates parameters reported in the Freitag study but not included in the EPA database.

Table 3: Bioaccumulation of Organic Chemicals in Fish (Golden ide)

Bioaccumulationsfactor: BF_n = concentration of chemical in fish (ug/g)* / medium conc. of chemical in water (ug/g)

n = 3 days

2,5,4'-Trichlorobiphenyl	3,850	2,6-Dichlorobenzonitrile	40
2,4'-Dichlorobiphenyl	3,550	Malonic acid diethyl ester	40
2,4,6,2'-Tetrachlorobiphenyl	3,150	Carbaryl	30
Dieldrin	3,010	Naphthalene	30
Pentachlorobenzene	3,000	Acetic acid ethyl ester	30
Aldrin	2,760	Chlorferon	20
2,2'-Dichlorobiphenyl	2,420	Monolinuron	20
Hexachlorobenzene	2,320	Phenol	20
2,4,6,2,4'-Pentachlorobiphenyl	2,320	3-Cresol	20
DDT	1,900	Dibenz(a,h)anthracene	10
Phenanthrene	1,760	4-Chloroaniline	10
Hexachlorocyclopentadiene	1,230	Captan	10
Quintozene	1,140	Cortisone acetate	10
Anthracene	910	Sencor	10
2,6-Di-tert-butylphenol	660	Ethylene glycol	10
3,3'-Dichlorobenzidine	610	2,6-Dichlorobenzamide	10
Kepone	570	Docosane	10
1,2,4-Trichlorobenzene	490	Acetic acid (Na-salt)	<10
Benzo(a)pyrene	480	Zineb	<10
β-Hexachlorocyclohexane	450	Maneb	<10
Cypermethrin	420	Succinic anhydride	<10
γ-Hexachlorocyclohexane	371	Perylene	<10
Benz(a)anthracene	350	4-Bromobenzoic acid	<10
2,4,6-Trichloroaniline	330	p-Phenylenediamine(hydrochloride)	<10
2,4,6-Trichlorophenol	310	(2,4-Dichlorophenoxy)acetic acid	<10
Biphenyl	280	Benzene	<10
Pentachlorophenol	260	Benzoic acid	<10
4-Isopropylnitrobenzene	190	Methanol	<10
Dodecylbenzenesulphate (Na-salt)	130	Aniline	<10
4-tert-Butylphenol	120	Tristearin	<10
Palmitic acid ethyl ester	110	Maleic acid	<10
Coumaphos	110	N-Benzyl-N-methylnitrosamine	<10
Diethylene glycol	100	4-Chlorbenzoic acid	<10
2,4-Dichlorophenol	100	Carbon tetrachloride	<10
Toluene	90	Belgard	<10
Trichloroethylene	90	Atrazine	<10
2,4-Dichloronitrobenzene	80	Urea	<10
Benzidine	80	ADPA	<10
Chlorobenzene	70	Nitrobenzene	<10
Palmitic acid	60	Vinyl chloride	<10
Hexadecanol	60	2,4-Dichlorobenzoic acid	<10
Dodecane	50	Thiourea	<10
Bromobenzene	50	Ethylenediamine(hydrochloride)	<10
1,4-Dichlorobenzene	50	ICM 2100	<10
4-Nitrophenol	40	2-Nitropropane	<10
Chlorhexidine	40	Propylene thiourea	<10
Hydroquinone	40	Ethylene thiourea	<10
Phthalic acid bis-(2-ethylhexyl)ester	40	Coumarin	<10

Questions for Jennie and Chris

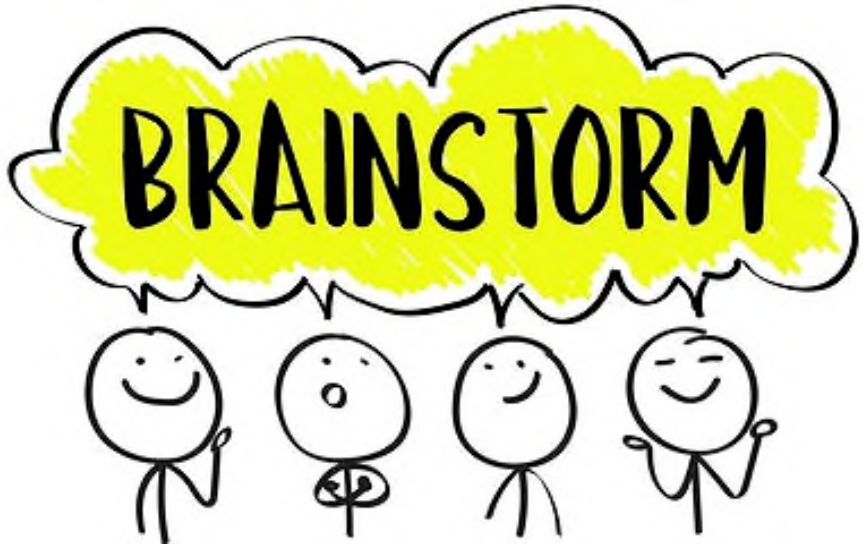
Further discussion on bioaccumulation factors

October Meeting

with guests from:
EPA Headquarters Office of Science and Technology
And Region 3 Water Quality Standards

LOOKING BACK ON WHAT WE'VE LEARNED SO FAR…

WHAT DO WE WANT TO LEARN FROM EPA?



October meeting

Does Wednesday Oct 28 at 10AM work for everyone?