# Water Quality Standards
# Human Health Criteria Workgroup

October 28, 2020

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# Oct 28, 2020 Meeting Agenda
# Human Health Criteria (HHC) Workgroup

- Introductions & Welcome of EPA Staff
- Quick review our previous meetings, July - September
- Q&A with EPA on HHC bioaccumulation factors
- Revisit HHC Workgroup Plan & outcomes
- Plan next meeting and conclude

Agenda uploaded on 10/27/20 to
https://dep.wv.gov/WWE/Programs/wqs/Pages/WQSpublicmeetings.aspx

# Review of HHC Workgroup Meetings

## July

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

# Equation for calculation
# Consumption of Water & Fish

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

| | |
|---|---|
| **AWQC** | = ambient water quality criteria |
| **toxicity value** | = either reference dose multiplied by relative source contribution or cancer slope factor, adjusted by $10^{-6}$ |
| **BW** | = body weight |
| **DI** | = drinking water intake |
| $\Sigma^{4}_{i=2}$ | = sum of values for aquatic trophic levels |
| $FCR_i$ | = fish consumption rate for aquatic Trophic Levels 2, 3, and 4 |
| $BAF_i$ | = bioaccumulation factor for aquatic TLs 2, 3, and 4 |

# Review of HHC Workgroup Meetings

## August

- IRIS updates to toxics data after EPA's 2015 revision, esp. Benzo(a)pyrene
- Went thru example EPA criteria document
- EPA's decision-making on drinking water intake and body weight numbers

**Table 3-33. Consumers-Only[a] Estimates of Combined Direct and Indirect[b] Water Ingestion Based on NHANES 2003–2006: Community Water (mL/day)**

| Age | Sample size | Mean | Percentile | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 10 | 25 | 50 | 75 | 90 | 95 | 99 |
| Birth to <1 month | 51 | 409* | 72* | 172* | 399* | 492* | 851* | 852* | 990* |
| 1 to <3 months | 85 | 531* | 103* | 341* | 513* | 745* | 957* | 1,019* | 1,197* |
| 3 to <6 months | 192 | 520* | 89* | 312* | 530* | 739* | 880* | 929* | 1,248* |
| 6 to <12 months | 416 | 356 | 43* | 94 | 270 | 551 | 772* | 948* | 1,161* |
| 1 to <2 years | 534 | 277 | 36* | 88 | 199 | 377 | 627* | 781* | 1,277* |
| 2 to <3 years | 508 | 321 | 43* | 105 | 227 | 448 | 722* | 911* | 1,374* |
| 3 to <6 years | 985 | 382 | 53 | 137 | 316 | 515 | 778 | 999 | 1,592* |
| 6 to <11 years | 1,410 | 511 | 79 | 178 | 413 | 690 | 1,072 | 1,404 | 2,099* |
| 11 to <16 years | 2,113 | 637 | 77 | 192 | 436 | 808 | 1,535 | 1,976 | 3,147 |
| 16 to <18 years | 944 | 702 | 97 | 236 | 515 | 966 | 1,571 | 1,883 | 3,467 |
| 18 to <21 years | 1,086 | 816 | 88 | 216 | 503 | 1,065 | 1,921 | 2,818 | 4,106 |
| ≥21 years | 7,616 | 1,227 | 192 | 469 | 991 | 1,741 | 2,546 | 3,092 | 4,576 |
| ≥65 years | 1,974 | 1,288 | 325 | 628 | 1,137 | 1,760 | 2,395 | 2,960 | 4,137 |
| All ages | 15,940 | 1,033 | 124 | 333 | 743 | 1,474 | 2,318 | 2,881 | 4,312 |

[a] Excludes individuals who did not ingest water from the source during the survey period.
[b] Direct water is defined as water ingested directly as a beverage; indirect water is defined as water added in the preparation of food or beverages.
* Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

Source: U.S. EPA analysis of NHANES 2003–2006 data.

# USEPA Water Intake Origins & Options

- Can calculate an age-weighted value for the mean & each percentile w/this data
- Data includes age range of birth to 78 years
- 5th percentile would be LEAST conservative
- 95th percentile would be MOST conservative

EPA HHC uses 90th percentile of adults >21

# Review of HHC Workgroup Meetings

## September

- Studied Bioaccumulation factor data in more detail
- Examined EPA spreadsheets on BAF data
- Discussed questions for October meeting

# Human Health Criteria

## EPA Decision Tree / Framework

Figure 3-1 from EPA Methodology

**For example, anthracene:**

- Nonionic organic chemical
- Mod-high hydrophobicity ($K_{ow}$ > 4)
- High metabolism

For anthracene EPA was not able to locate peer-reviewed BAFs or lab-measured BCFs for all three trophic levels, so EPA used available BCF for TL 2 & TL3 to estimate and derive national BAF for anthracene of 610 L/kg

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

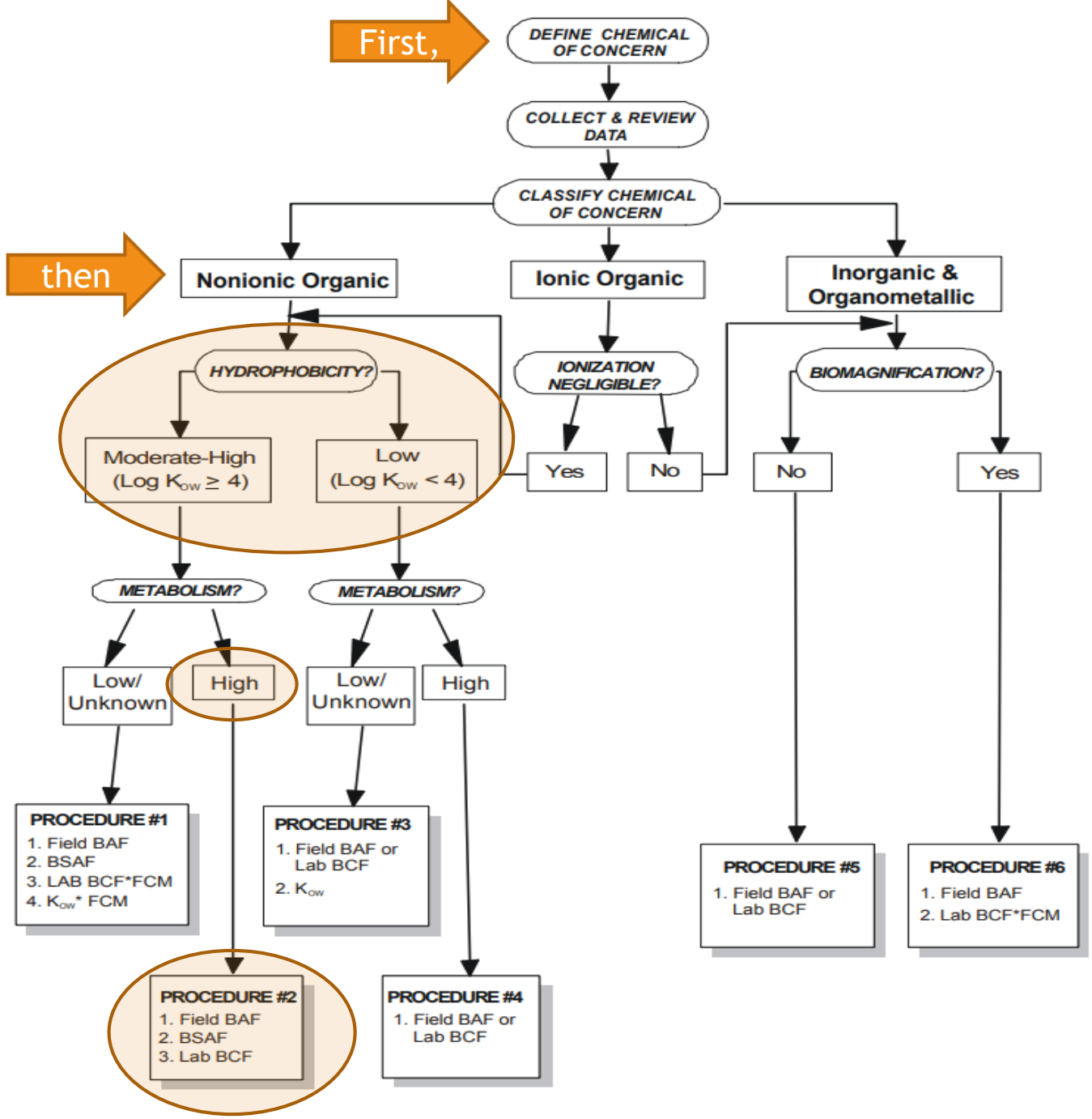


**Figure 3-1.** Framework for selection of methods for deriving national BAFs.

# Questions for EPA Folks

The decision tree in many cases led to the use of the octanol-water coefficient, the least preferred method for determining a BAF.

Can you expound on the use of $K_{ow}$ as far as your confidence in its accuracy in determining bioaccumulation, and whether that confidence changes from one type of chemical to another?

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 |

# Questions for EPA Folks

In several instances, data was used from a study for some chemicals, but not for other chemicals tested in the same study. For instance, Freitag et al 1985 was used for 1,2,4-Trichlorobenzene, 2,4-Dichlorophenol, and a few others, but the Freitag paper actually studied several other HHC chemicals for which the study was not used.

Could you give some insight as to how this was done?

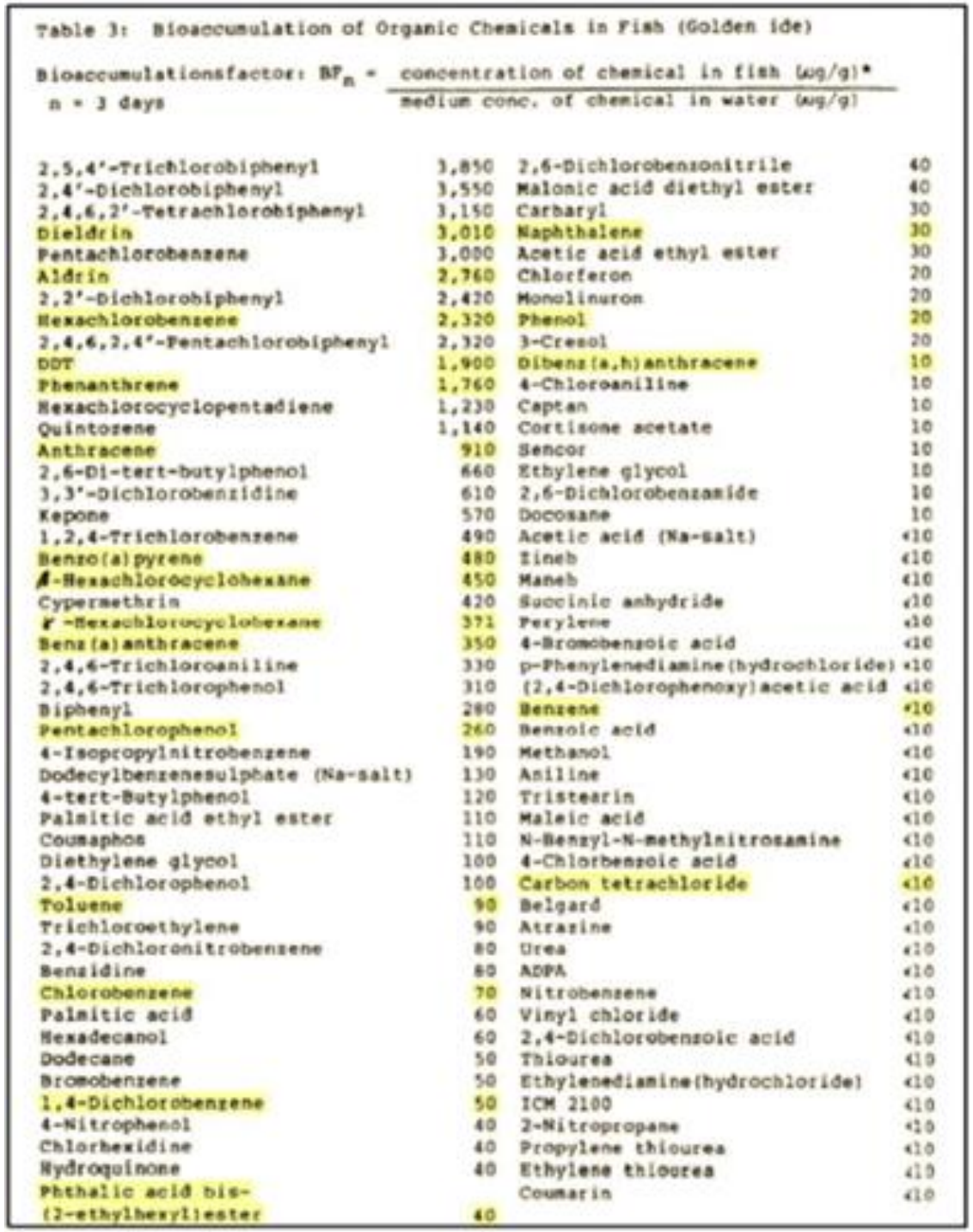

Table 3: Bioaccumulation of Organic Chemicals in Fish (Golden ide)

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 | Tineb | <10 |
| ß-Hexachlorocyclohexane | 450 | Maneb | <10 |
| Cypermethrin | 420 | Succinic anhydride | <10 |
| ɣ-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 EPA Folks

What are your plans to recalculate these criteria due to recent updates to toxicity research in the IRIS database?

Likewise, as a large majority of the studies used to calculate BAFs were done before 2000. Do you plan to re-examine these criteria with more recent BAF/BCF data?

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 |

# Questions for EPA Folks

There isn't a lot of information on how you moved through the decision tree on the last row of the decision tree, when you decided between using a the BAF method, BCF method, or $K_{ow}$ method to determine a National BAF.

Can you tell us more about how you made those decisions, for instance when you had BCF data but decided to use the $K_{ow}$ anyway?

# Questions for EPA Folks

| 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 |

# Additional questions for EPA

Further discussion on bioaccumulation factors and toxicity data

# HHC Workgroup Goals
a work in progress

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

# November meeting

What would you like us to discuss at the November meeting?

Does Wednesday Nov 18 at 9AM work for everyone?