
DEQ
VIRGINIA DEPARTMENT OF
ENVIRONMENTAL QUALITY

Developing Endpoints in PCB TMDLs

Making use of Virginia's narrative criteria

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6-4-24

Background: Polychlorinated Biphenyls (PCBs)

Over 1.5 Billion lbs. manufactured in the U.S. until 1977

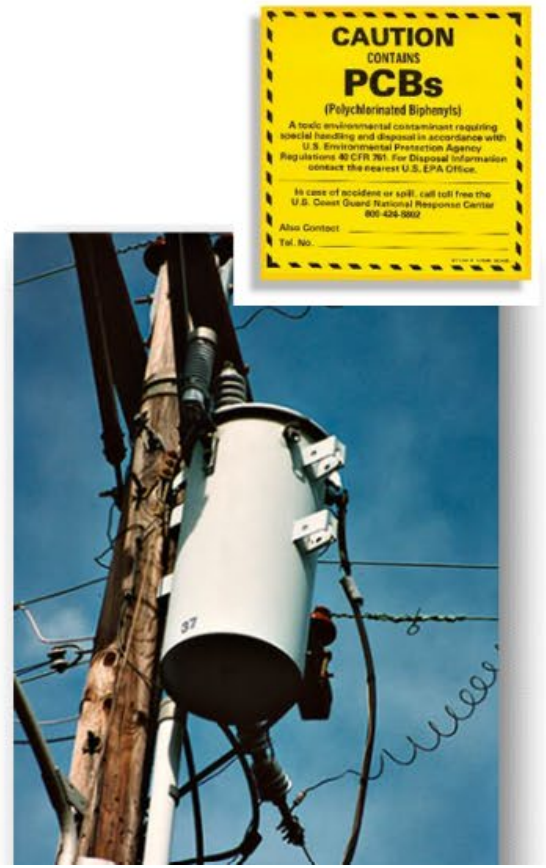
Legacy contaminant

Very stable and heat resistant

Persistent in the environment

Common uses

Transformers, circuit breakers, PVC products, caulking material, paints…



Toxics Substances Control Act (TSCA)

- 1976 Law regulates PCBs
  - Bans manufacture, processing, use and distribution
  - Non-PCB Transformer defined as containing < 50 ppm PCB
  - Inadvertent manufacture of PCBs – products up to 50 ppm allowed to leave site as long as annual average is < 25 ppm
    - ***Unintentional*** by-products of manufacturing processes

Photo: onekindplanet.org

50 ppm compared to DEQ's WQC of 0.00000058 ppm

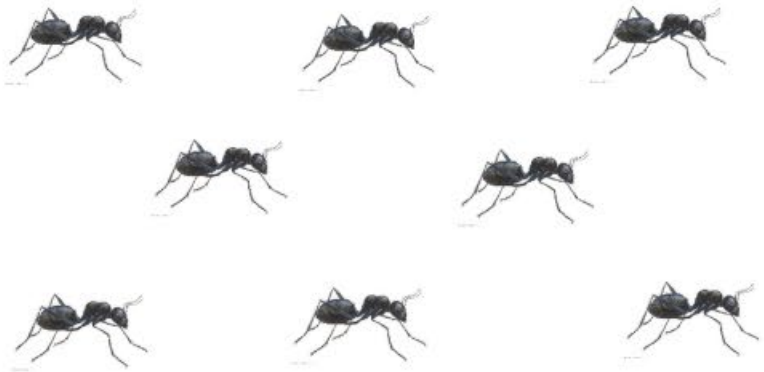


Photo: Britannica.com

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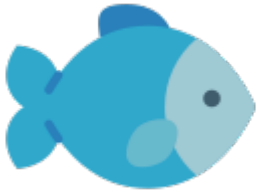
VA PCB Criterion and Threshold

Water column criteria: 580 pg/L

- Based on EPA guidelines
- Promulgated



Fish Tissue Screening Threshold value: 18 ppb

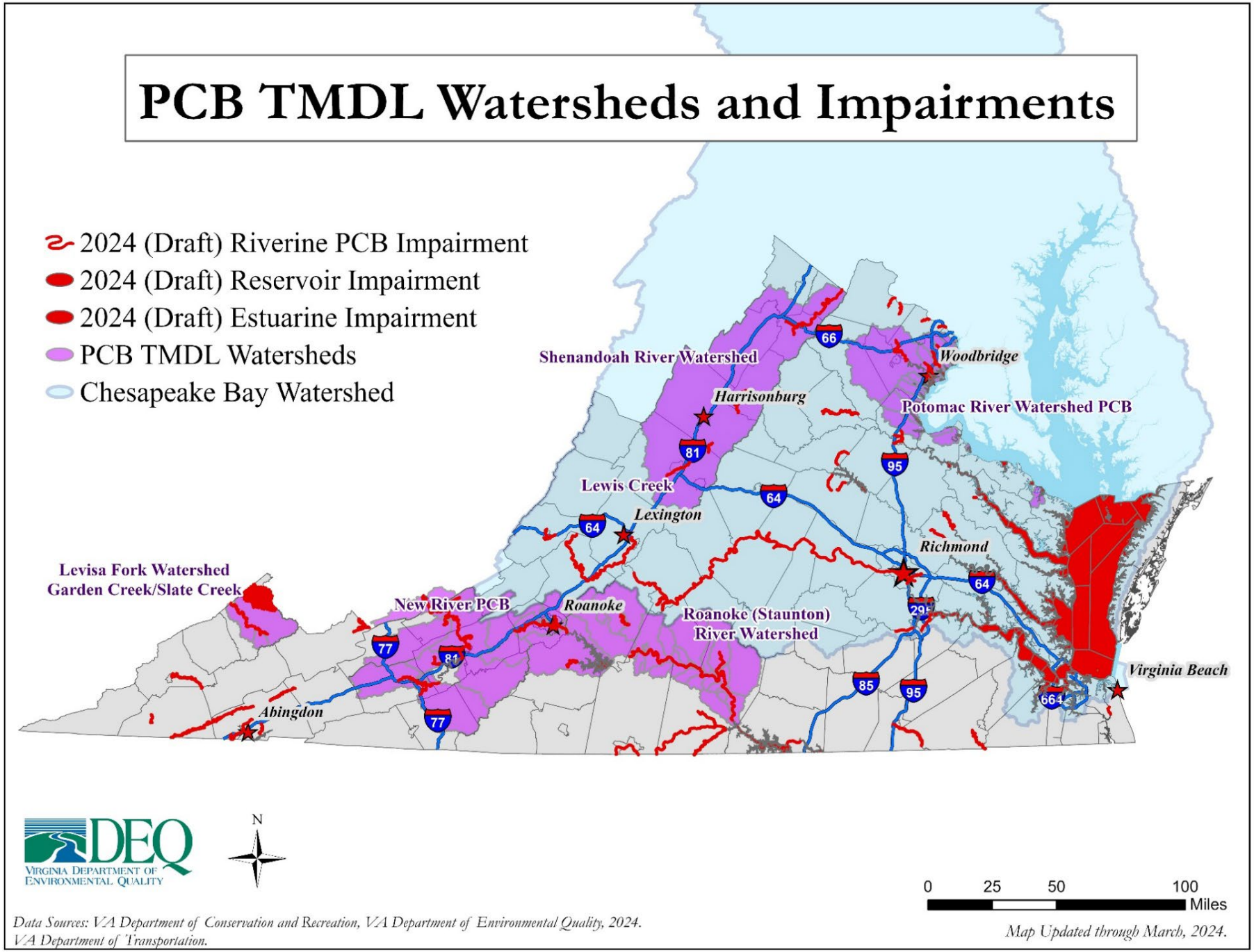
- Based on EPA guidelines
- Not promulgated

VA DEQ's Water Quality Assessment (Integrated Report)

Two or more fish samples exceed screening value at a site or two water samples exceed criterion at a site = impairment

Images: https://www.flaticon.com/

PCB TMDL Watersheds and Impairments



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Data Sources: VA Department of Conservation and Recreation, VA Department of Environmental Quality, 2024. VA Department of Transportation.

Map Updated through March, 2024.

PCB Water Quality Criterion and Threshold - Derivation

Fish Screening Value $= \frac{RL\ x\ BW}{CSF\ x\ CR}$ $\qquad$ $Water\ Quality\ Criterion = \frac{RL\ x\ BW}{CSF\ x\ CR\ x\ BCF}$

Where:

BW = average adult body weight 80 kg

CR = fish consumption rate 0.022 kg/day (2 meals per month)

RL = human health criteria at risk level 0.00001 (1 in 100,000 population)

CSF = cancer potency factor of 2 (USEPA-IRIS, 1997)

BCF = USEPA recommended bioconcentration factor of 31,200 (USEPA, 1980)

- VA PCB criterion based on EPA guidelines
  - Water concentration translated using a Bioconcentration Factor (BCF)
    - **Bioconcentration** refers to *"the uptake and retention of a chemical by an aquatic organism from water only."*
    - Assumes fish only obtain PCBs through gills from the water column (ratio of PCB conc. in fish to that in water)

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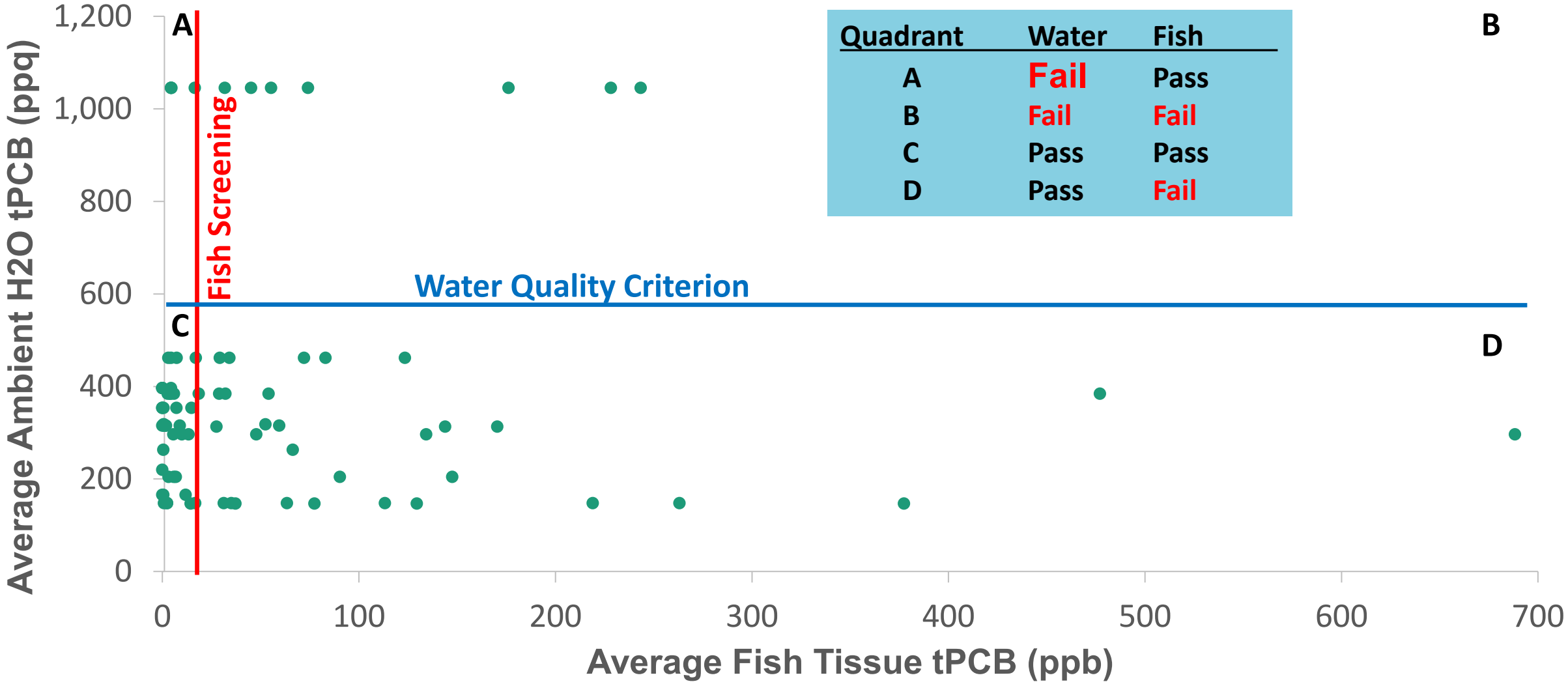
Average Fish Tissue Concentration vs. Average Water Concentrations



Quadrant	Water	Fish
A	Fail	Pass
B	Fail	Fail
C	Pass	Pass
D	Pass	Fail

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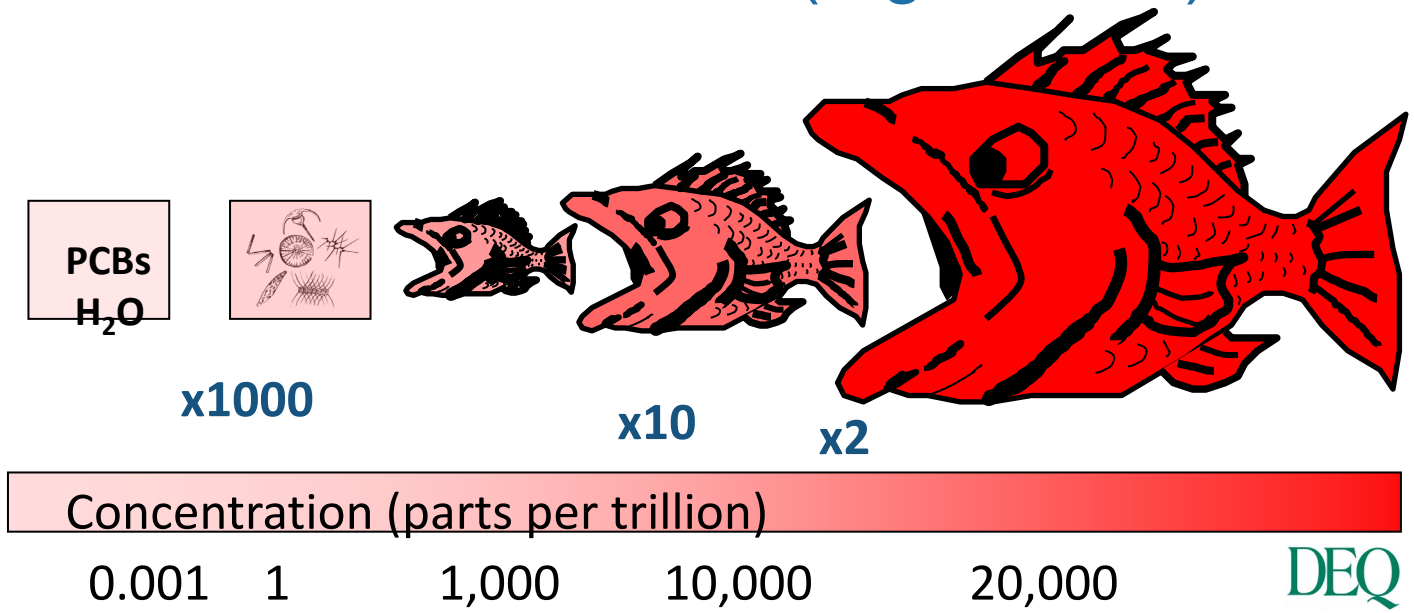
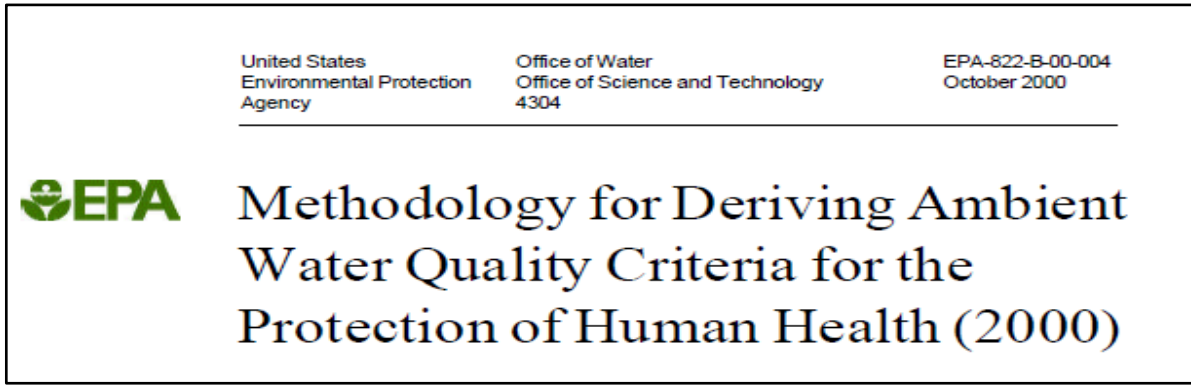
How are fish exposed to PCBs?

- Intake through gills from water column
  - Basis of existing WQC (1980 EPA guidelines)
- Ingestion of contaminated sediment
  - Indirect uptake from foraging (e.g. carp)
- Exposure through skin from contaminated sediment (e.g. catfish)
- Ingestion of prey
  - Biomagnification



Bioconcentration & Bioaccumulation


United States Environmental Protection Agency | Office of Water Office of Science and Technology 4304 | EPA-822-B-00-004 October 2000

EPA

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

- Bioconcentration and Bioaccumulation Concepts
  - **Bioconcentration** refers to *"the uptake and retention of a chemical by an aquatic organism from water only."*
  - **Bioaccumulation** refers to *"the uptake and retention of a chemical by an aquatic organism from all surrounding media (e.g., water, food, sediment)."*
- "For some chemicals (e.g., highly persistent and hydrophobic [PCBs]), the magnitude of bioaccumulation by aquatic organisms can be substantially greater than the magnitude of bioconcentration."
- "…EPA encourages States and authorized Tribes to derive BAFs [Bioaccumulation Factors] that are specific to certain regions or waterbodies, where appropriate."

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Narrative WQS

9VAC25-260-20. General criteria

A. State waters, including wetlands, shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene established standards or interfere directly or indirectly with designated uses of such water or which are inimical or harmful to human, animal plant, or aquatic life.

Specific substances to be controlled include, but are not limited to: floating debris, oil, scum, and other floating materials; toxic substances **(including those which bioaccumulate)**; substances that produce color, tastes, turbidity, odors, or settle to form sludge deposits; and substances which nourish undesirable or nuisance aquatic plan life. Effluents which tend to raise the temperature of the receiving water will also be controlled. Conditions within mixing zones established according to 9VAC25-260-20B do not violate the provisions of this subsection.

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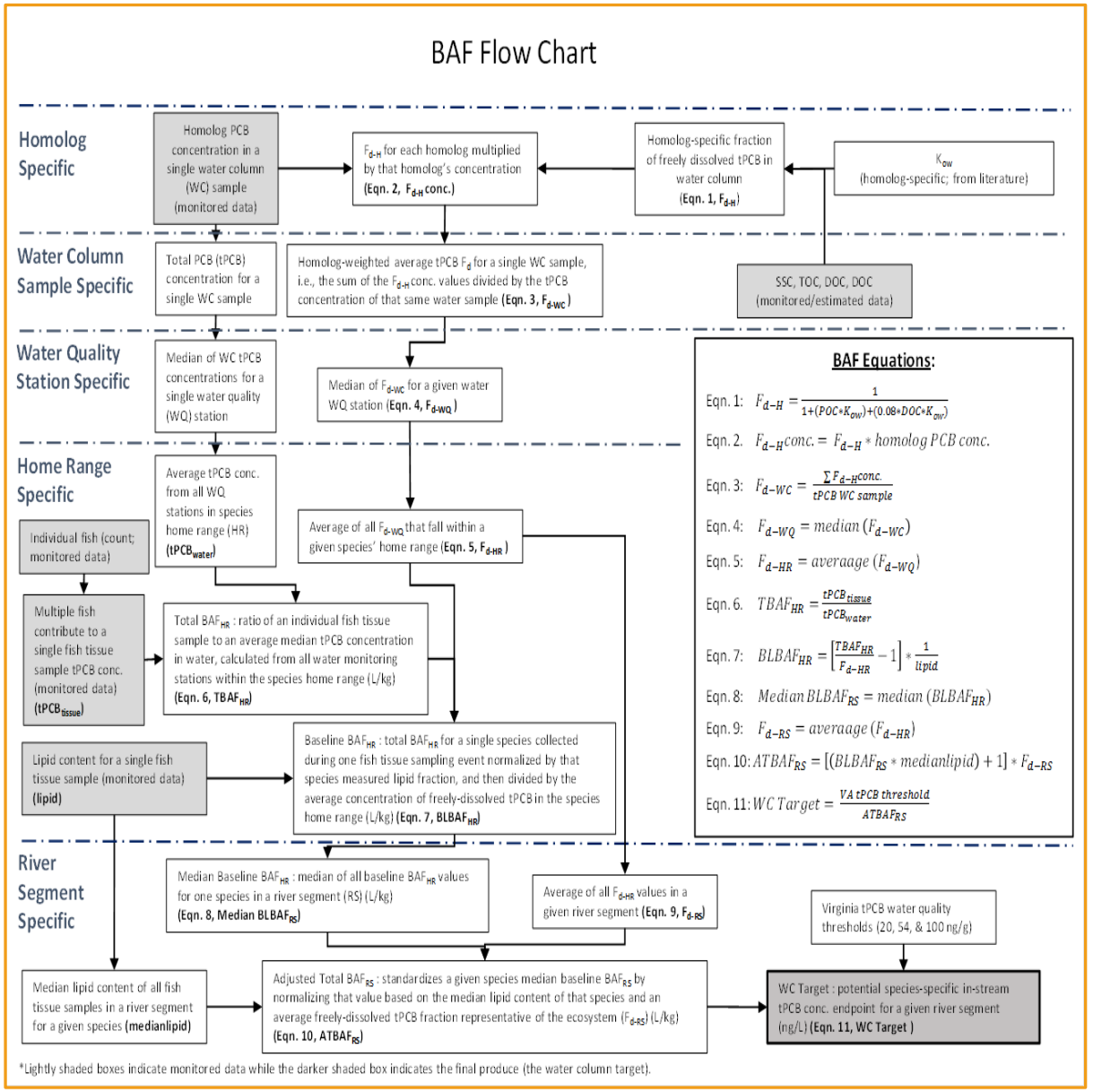
Bioaccumulation Factors (BAFs)

- EPA Method (EPA-822-03-030, 2003)
- Utilize site specific data (i.e., water data) to reflect exposure of fish and their food
  - Pathways of PCB exposure includes through gills, from food, and indirect ingestion of contaminated sediment
  - Trophic Transfer
- More realistic



Using BAF to Calculate TMDL Endpoint

1. BAF values are calculated for each fish species in a TMDL watershed
2. Water quality target concentrations calculated for each fish species (fish tissue screening threshold/ BAF)

Species	BAF (L/Kg)	WQ Target (pg/L, or ppq)
American Eel	719	25
Fallfish	63	290
Rock Bass	31	580
Sunfish sp.	71	250
Smallmouth Bass	50	360
White Sucker	170	110
Yellow Bullhead	323	56

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Using BAF to Calculate TMDL Endpoint

3. The TMDL endpoint is based on some average of selected fish species specific water quality targets
   - Scenario 1: Mean of all species
   - Scenario 2: Mean of all species of a specific feeding strategy
   - Scenario 3: Consumption advisory species

TMDL Watershed	Scenario 1 Mean	Scenario 2 Mean	Scenario 3 Mean
Mountain Run	240 ppq	310 ppq	25 ppq

DEQ water quality criterion: 580 pg/L (ppq)

TMDL Implementation (Pt Sources)

- Adaptive Implementation Strategy
  - Iterative implementation process that makes progress towards achieving water quality goals
- Use BMP based Water Quality Based Effluent Limits (WQBELs)
  - 40CFR 122.44(k)
    - BMP based WQBELs can be used where “Numeric effluent limitations are infeasible; or [t]he practices are reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the CWA.”
- Pollutant Minimization Plans

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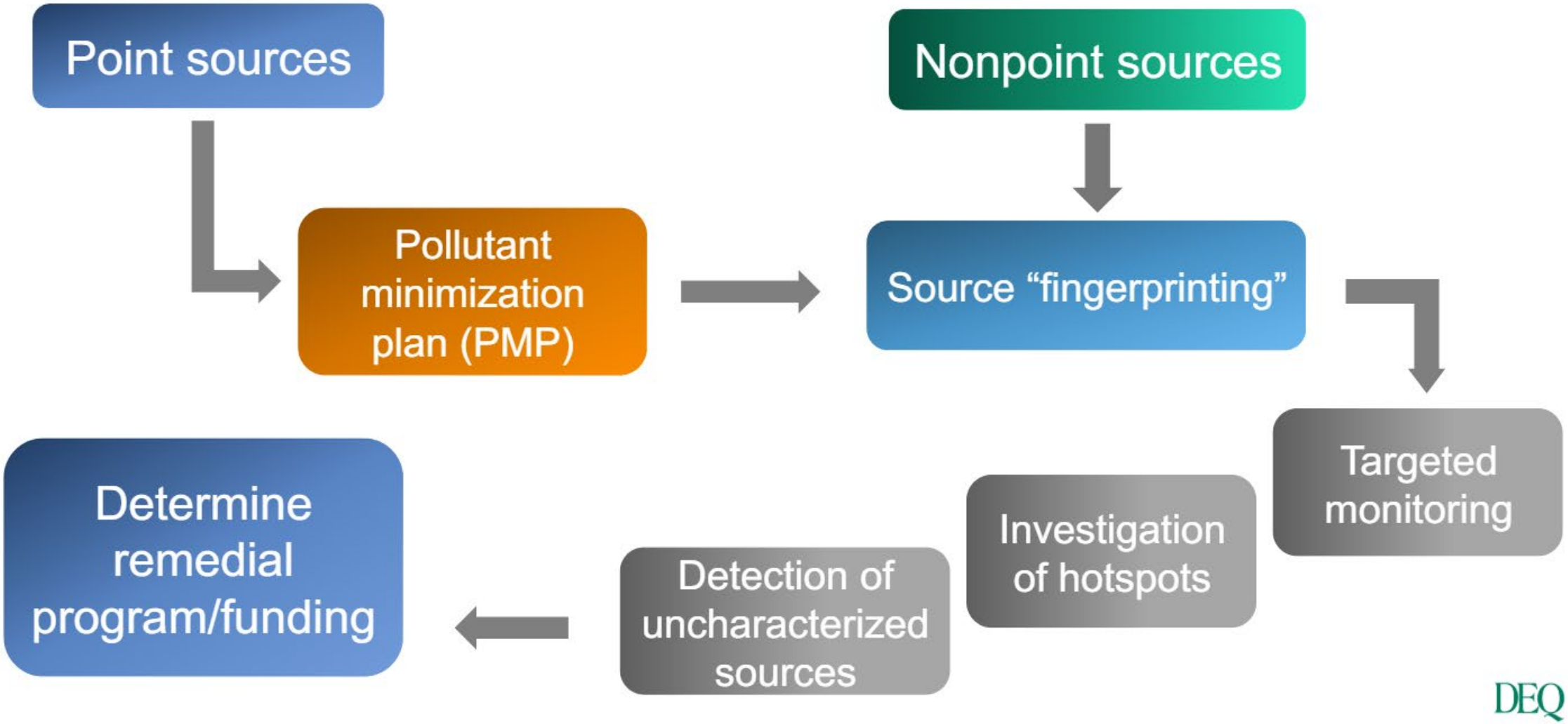
TMDL Implementation Process



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