# PCB Cleanup Study
# For the James, Maury, and Jackson Rivers

## Final Public Meeting

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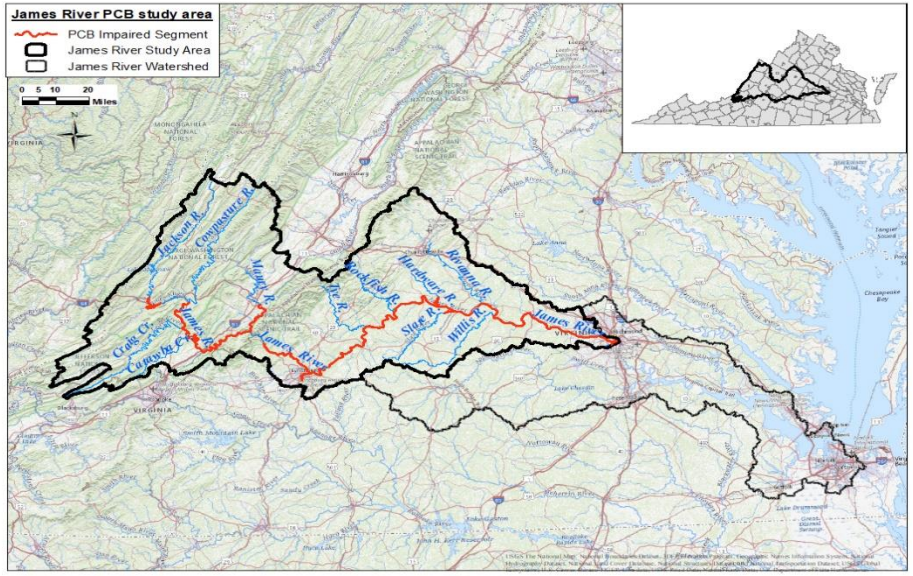
Watersheds Program Team Lead
Virginia Department of Environmental Quality

February 15, 2024

# Agenda

- Welcome and introductions
  - Meeting objectives
- PCB background and TMDL development
- James, Maury, Jackson PCB TMDL overview
  - Monitoring
  - Source assessment
  - TMDL endpoint/model/allocations
  - TMDL implementation
- Next steps
  - Public comment

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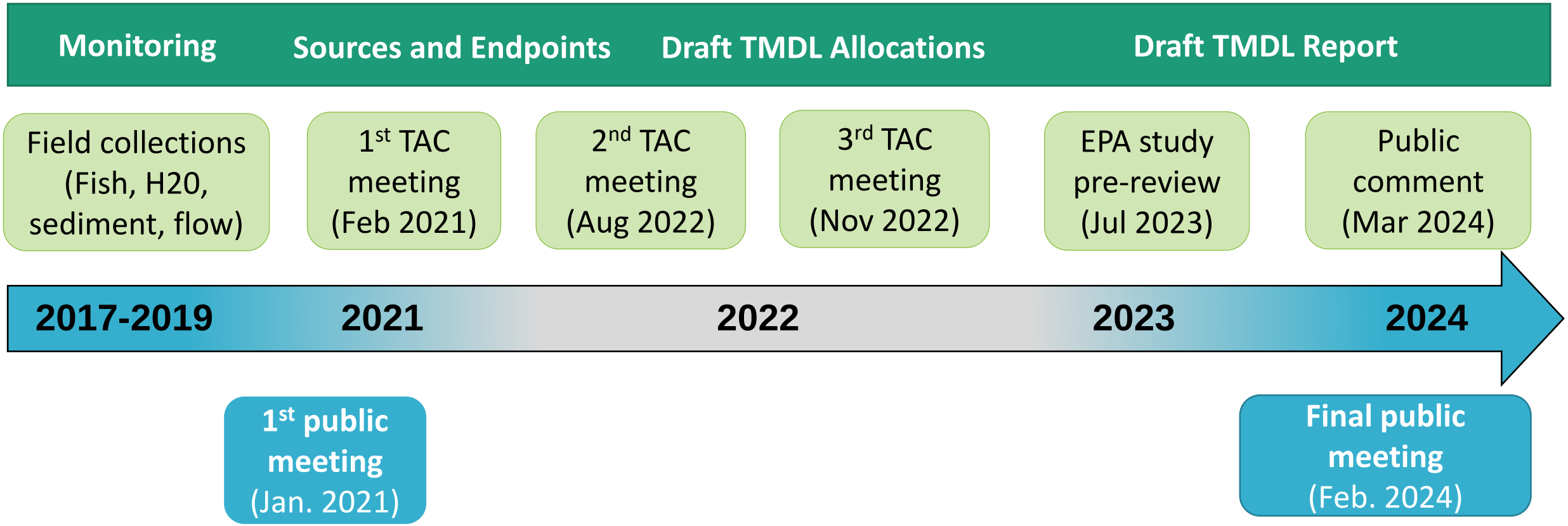
# TMDL Study Timeline

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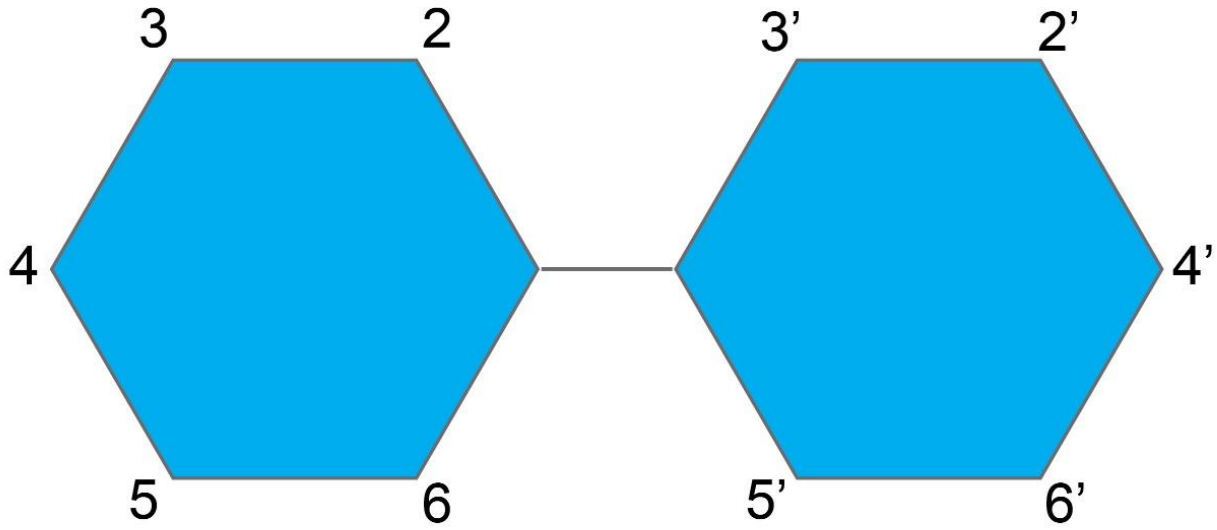
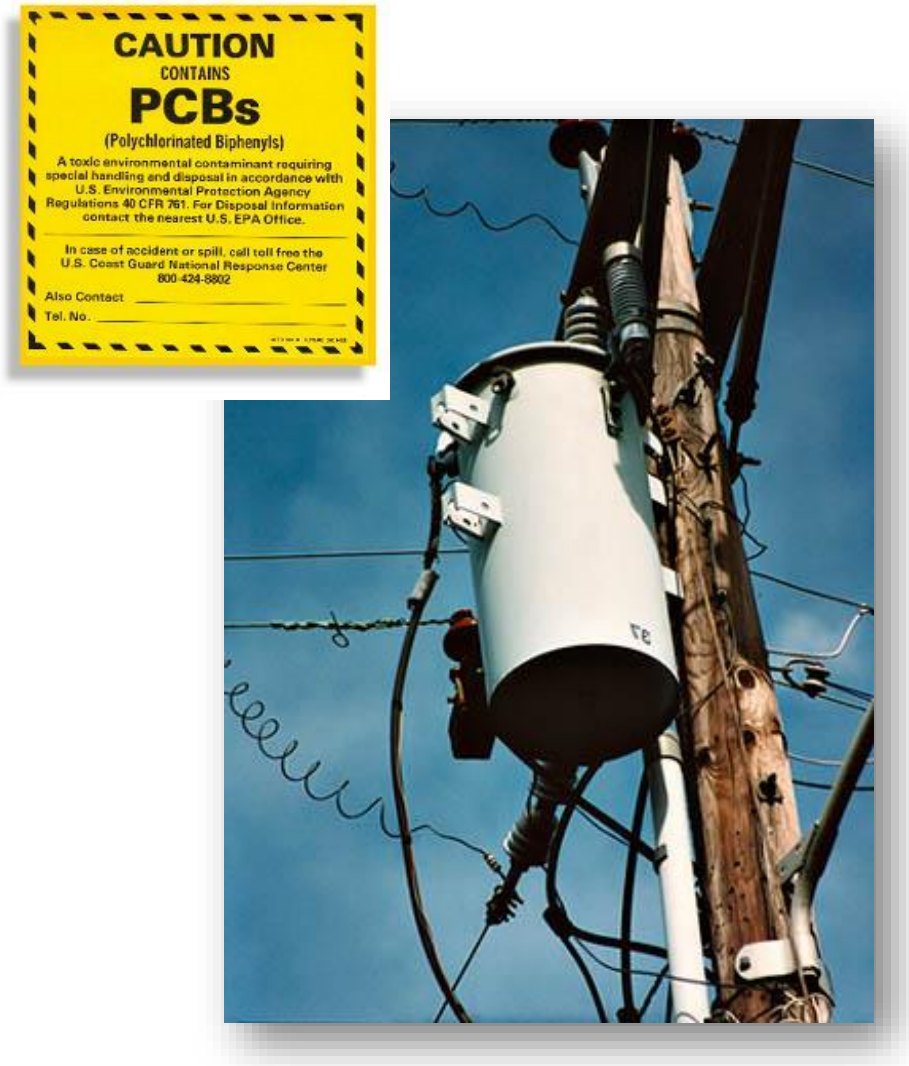
# Background: PCBs

- Biphenyl molecule (1-10 chlorine atoms)
- 209 distinct PCB Compounds
- Regulated by DEQ as Total PCB (tPCB) = 209 compounds summed
- Referred to as PCB Aroclors (Monsanto tradename) = mixture of PCB compounds



# Background: PCBs

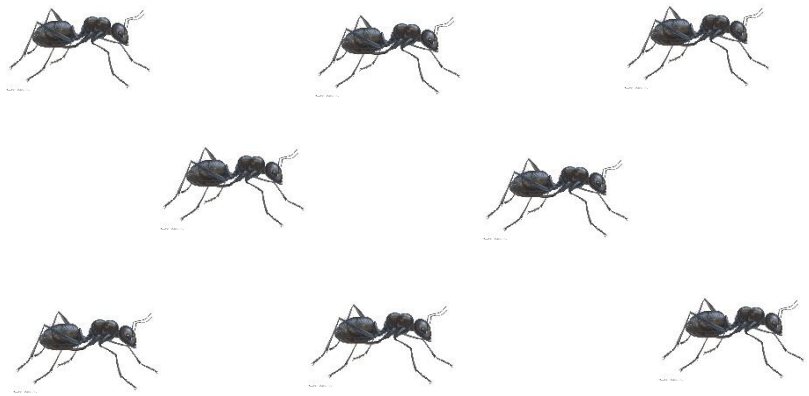
- Over 1.5 billion lbs. manufactured in the U.S. until 1977
- Legacy contaminant
- Very stable, heat resistant, persistent in the environment
- Common uses: transformers, circuit breakers, PVC products, caulking material, paints, etc.



# Toxics Substances Control Act

- 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

50 ppm compared to 0.00000058 ppm Water Quality Criteria



# Virginia's Water Quality Criterion – Total PCBs

| Agency | Fish Tissue Threshold (ppb) | WQC (pg/l) |
|---|---|---|
| VDH | 100 (Fish Consumption Advisory) | - - |
| DEQ | 18 (Tissue Value) | *580<br>*Applied on a long-term average |

- DEQ's Water Quality Assessment (Integrated Report)
  - VDH - Consumption Advisory = impairment
  - DEQ - two or more fish samples exceed screening value at a site or two water samples exceed criterion at a site = impairment

*From: DEQ's 2024 Water Quality Assessment Guidance Manual*

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# Virginia's PCB Water Quality Criterion =

Concentration of PCBs in the water that is low enough to ensure that fish are safe to eat

580 pg/L

One drop in 33 Olympic-sized swimming pools

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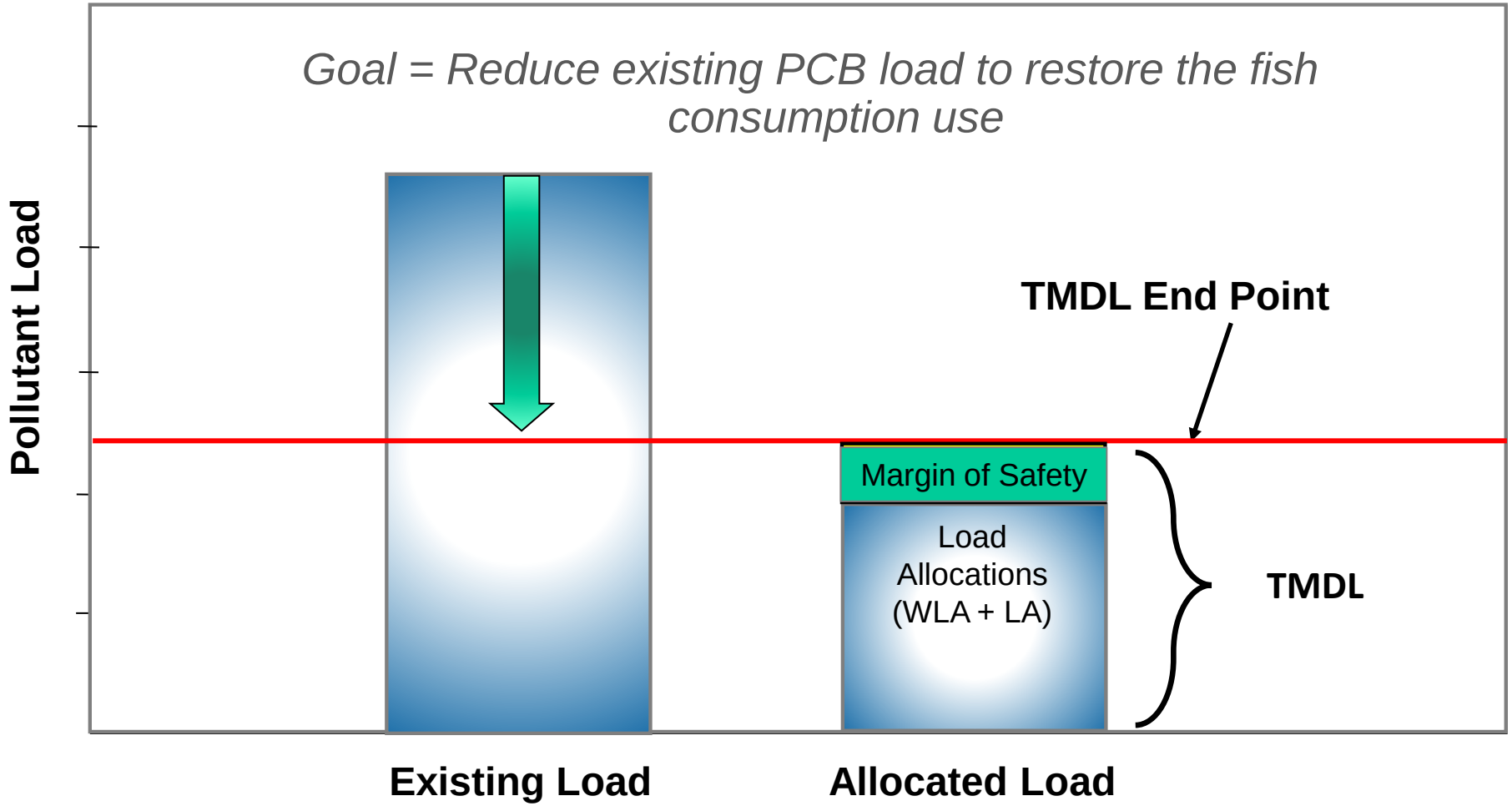
# Total Maximum Daily Load (TMDL)




For restoration the waterbody must meet two thresholds: 1) Numeric WQC *or site-specific value* and 2) fish tissue threshold.

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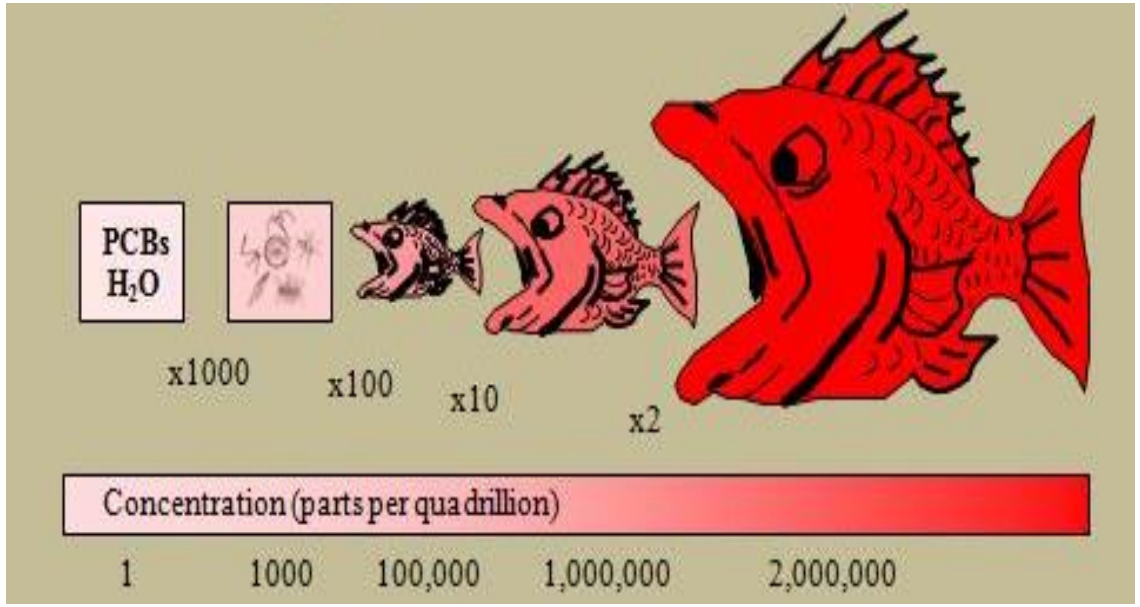
# Why PCBs Continue to be an Issue

- Human health concern
  - Fish consumption significant exposure pathway
  - Suspected carcinogen
  - Immunotoxicity, hepatotoxicity (liver)
  - Affects reproduction and development
- Persistent, bioaccumulates at a low conc. (pg/L) & biomagnifies
- Confirmed on-going releases

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# The TMDL Process

## Fish Consumption Advisory

Photo: www.pinterest.com/pin/engbretson-underwater-photography-in-2023--778419116863305470/

Low level PCB analysis

Identify problem

Source assessment
- Identify sources
- Estimate loads

Link sources to targets
- Assess linkages
- Estimate total load

TMDL allocations
- Reduce loads from point sources
- Divide remaining loads among sources

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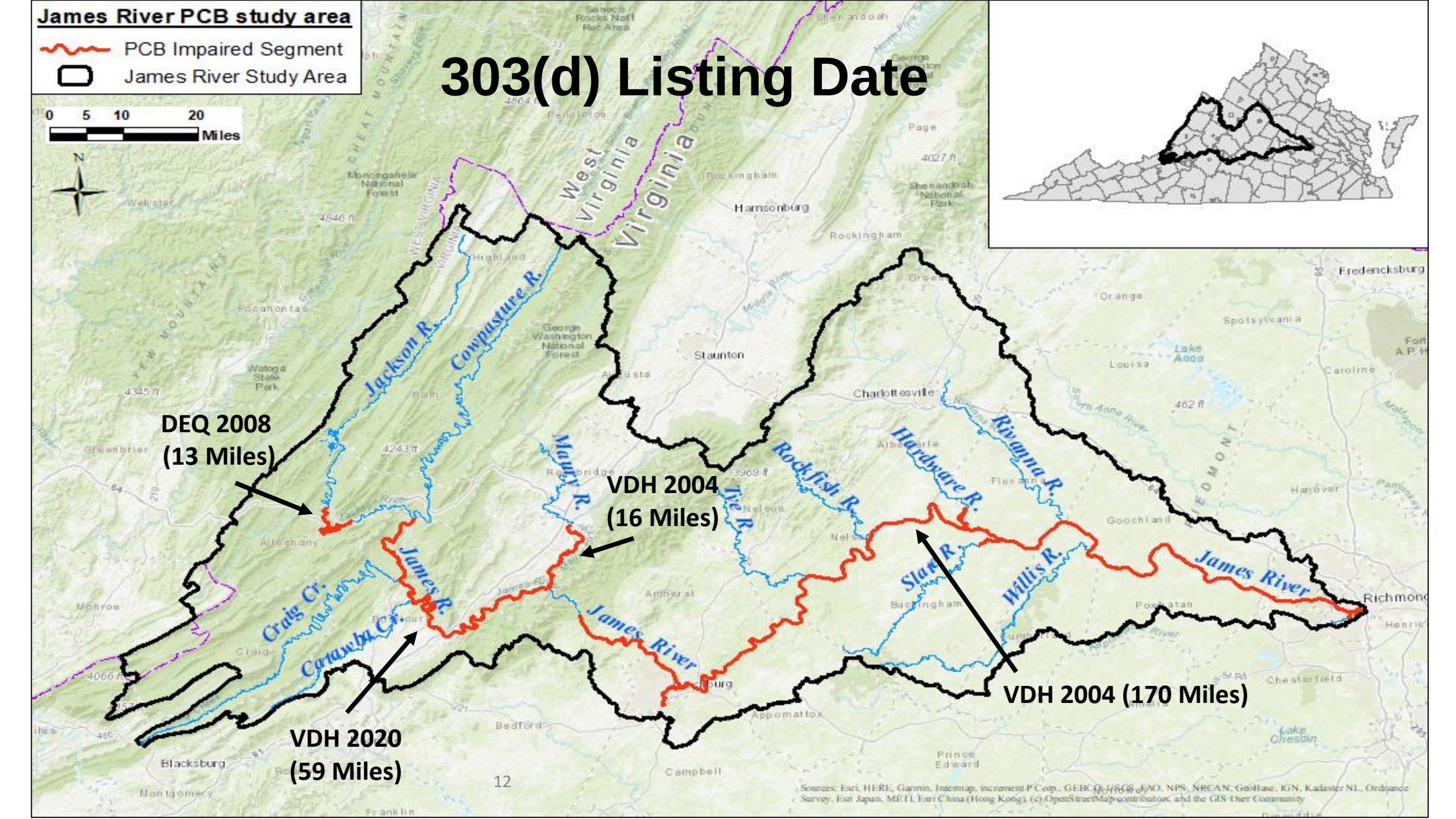
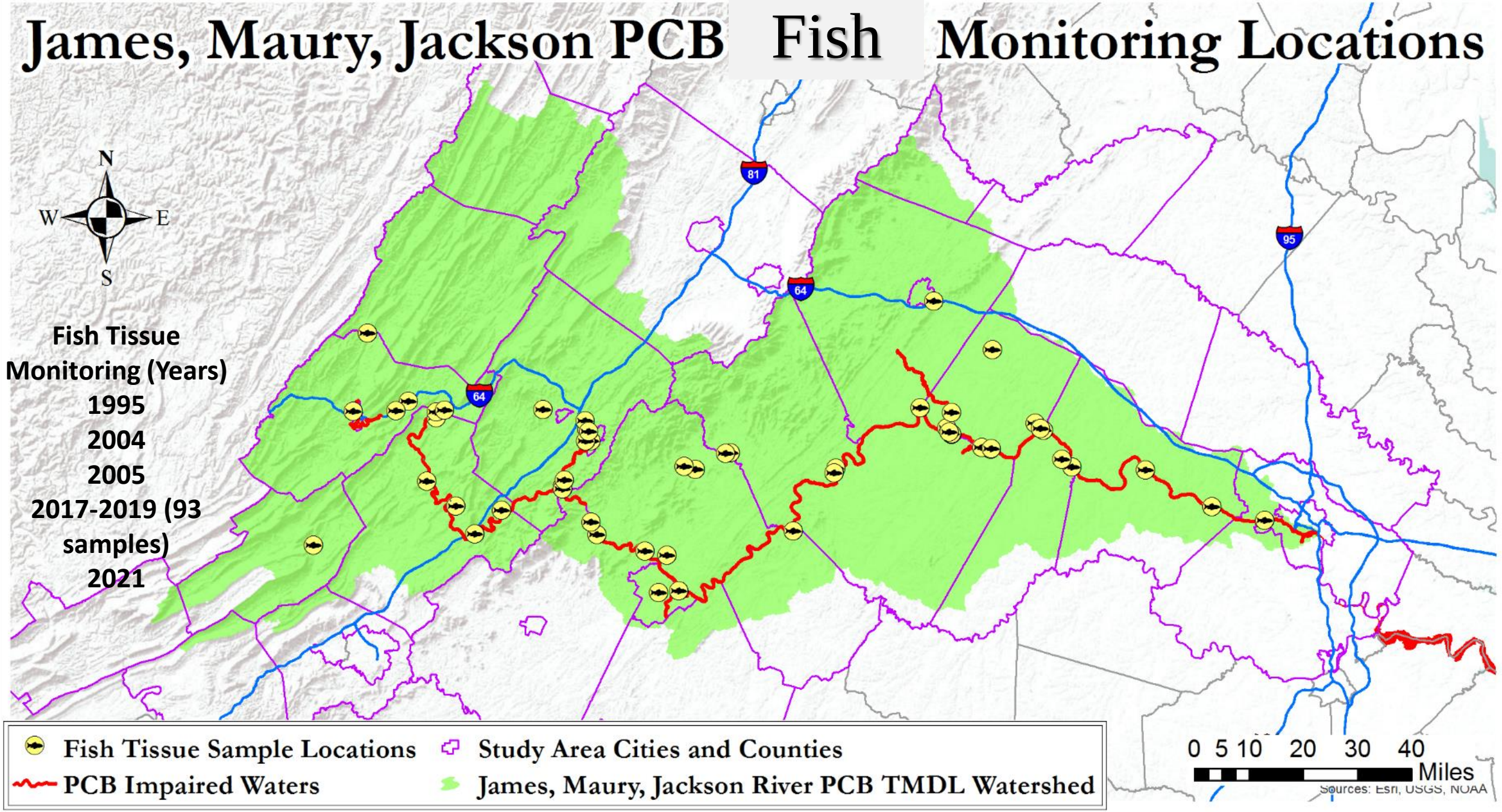

James River PCB study area
PCB Impaired Segment
James River Study Area
0 5 10 20
Miles
N
303(d) Listing Date
DEQ 2008
(13 Miles)
VDH 2004
(16 Miles)
VDH 2020
(59 Miles)
VDH 2004 (170 Miles)
Jackson R.
Cowpasture R.
James R.
Craig Cr.
Carvin's Cr.
Maury R.
Tye R.
Rockfish R.
Hardware R.
Rivanna R.
Slate R.
Willis R.
James River
West Virginia
Virginia
Harrisonburg
Staunton
Charlottesville
Fredericksburg
Richmond
Blacksburg
Lynchburg
Amherst
Appomattox
Campbell
Prince Edward
Buckingham
Goochland
Powhatan
Chesterfield
Hanover
Orange
Spotsylvania
Louisa
Caroline
Nelson
Albemarle
Fluvanna
Bedford
Craig
Monroe
Alleghany
Pocahontas
Greenbrier
Monongahela National Forest
George Washington National Forest
Shenandoah National Park
Watoga State Park
Lake Anna
Lake Chesdin
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

# Problem Identification
# Additional PCB Impairments Identified by DEQ*

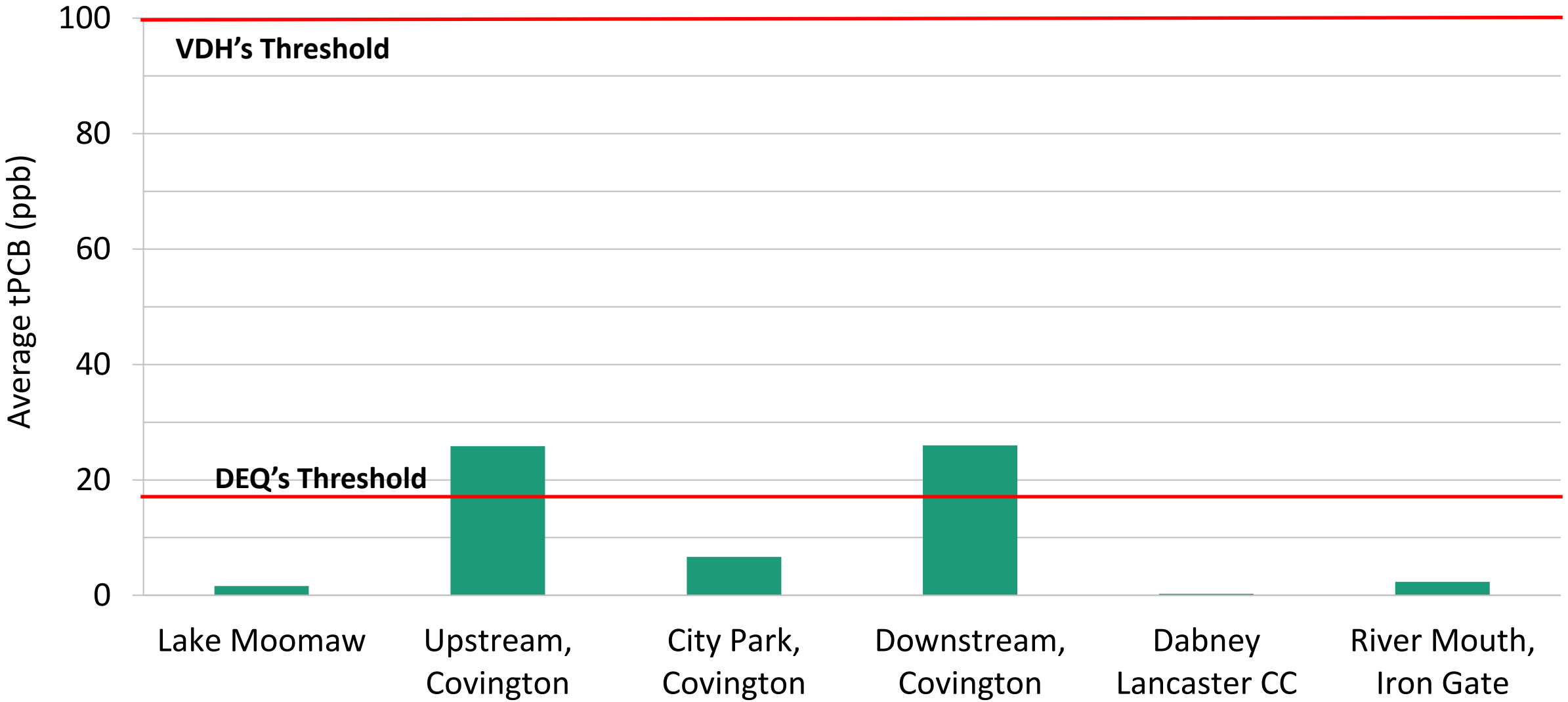
| Affected Water Body | Affected Localities | Listing Year | Length |
|---|---|---|---|
| Jackson River | City of Covington and Alleghany County | 2008 | 12.63 mi |
| Hardware River | Fluvanna and Albemarle counties | *2022 (revised)* 2008 | *(now) 7.21 mi* (was) 23.24 mi |
| Slate River | Buckingham County | 2008 | 3.88 mi |
| Fishing Creek | City of Lynchburg | 2020 | 6.32 mi |
| Reedy Creek | City of Richmond | 2020 | 1.08 mi |

***Does not affect swimming**

# James, Maury, Jackson PCB Fish Monitoring Locations



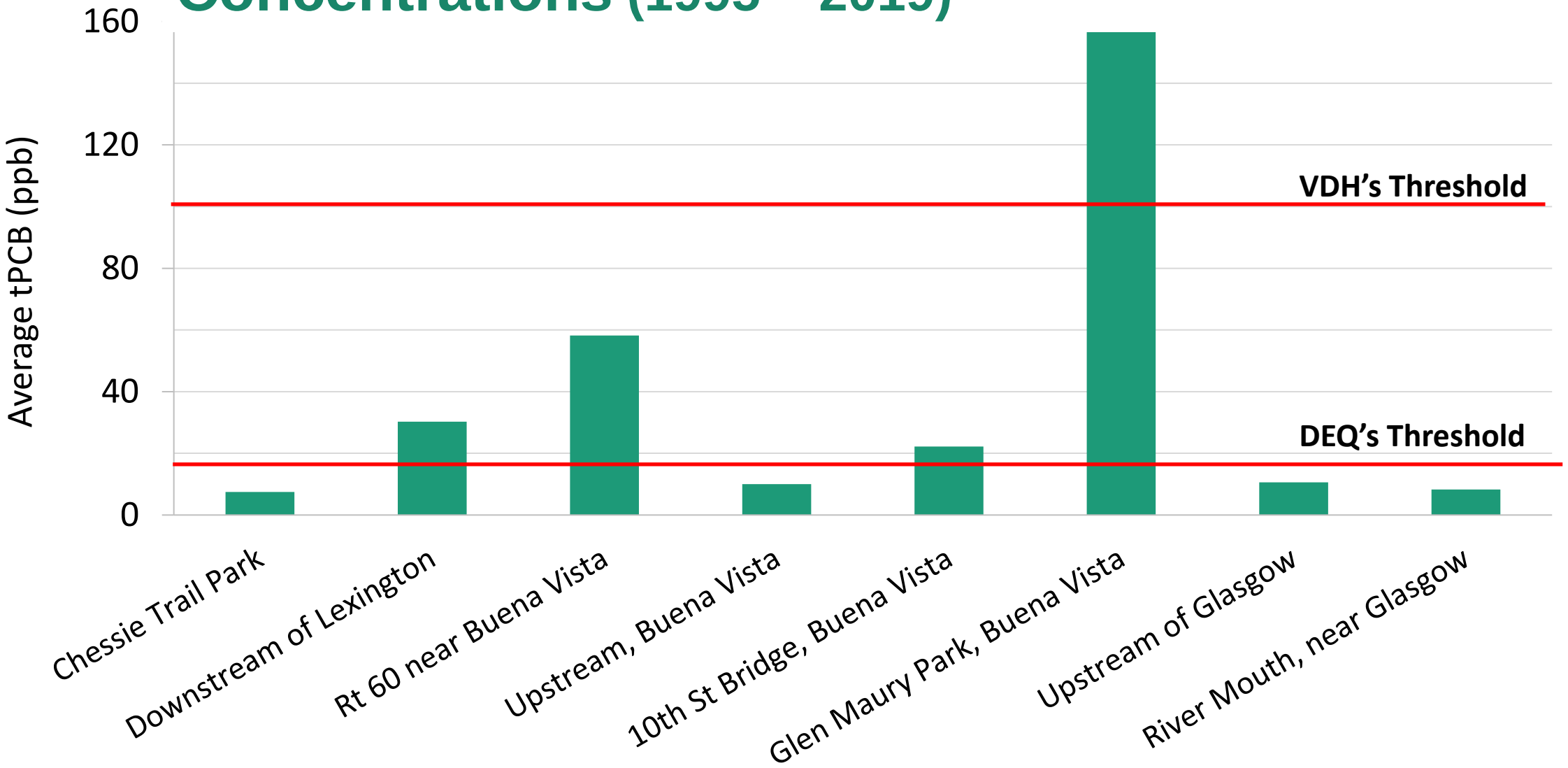
# Average Jackson River Fish Tissue Concentrations (1995 – 2017)*




*Note, all distances between sites are not equal

DEQ

# Average Maury River Fish Tissue Concentrations (1995 – 2019)*




*Note, all distances between sites are not equal

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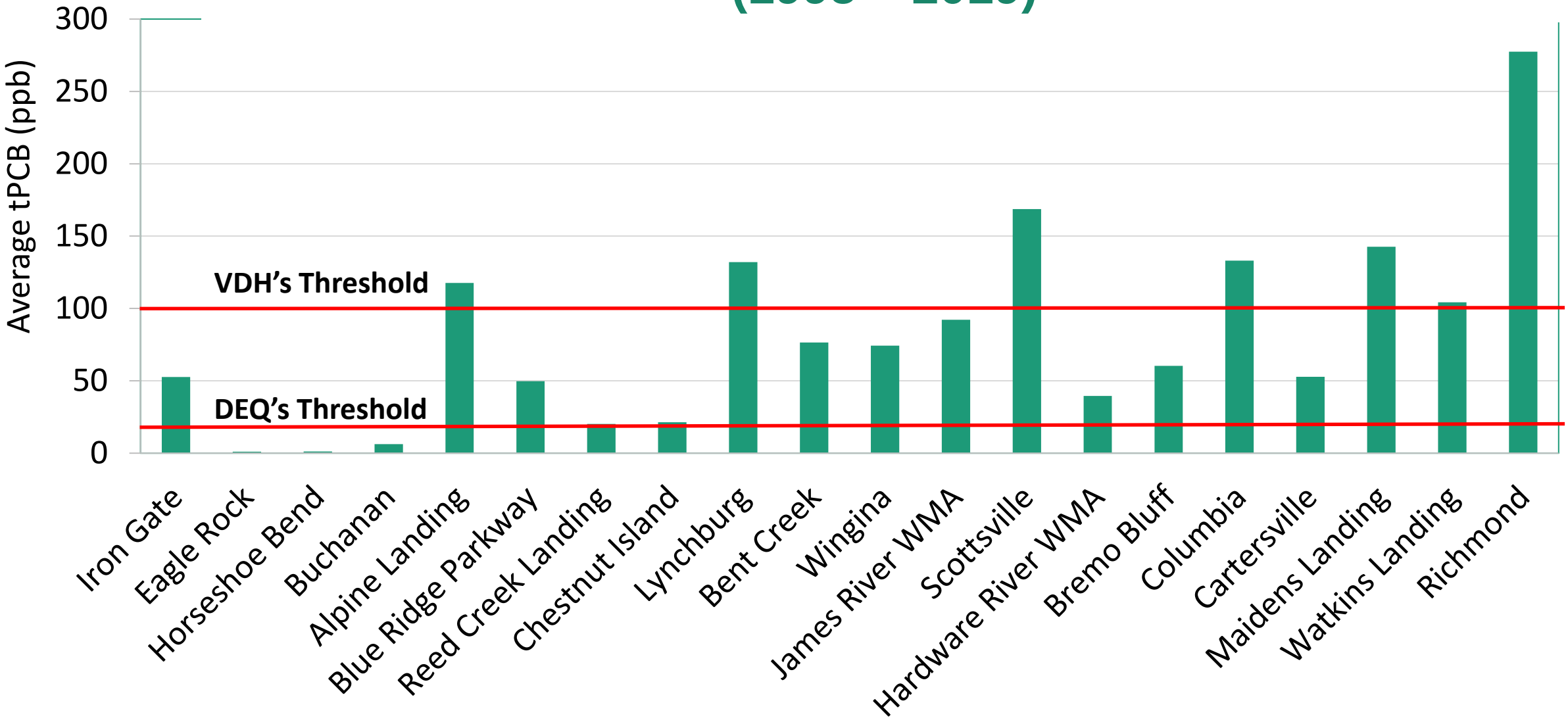
# Average James River Fish Tissue Concentrations (1995 – 2019)*




*Note, all distances between sites are not equal

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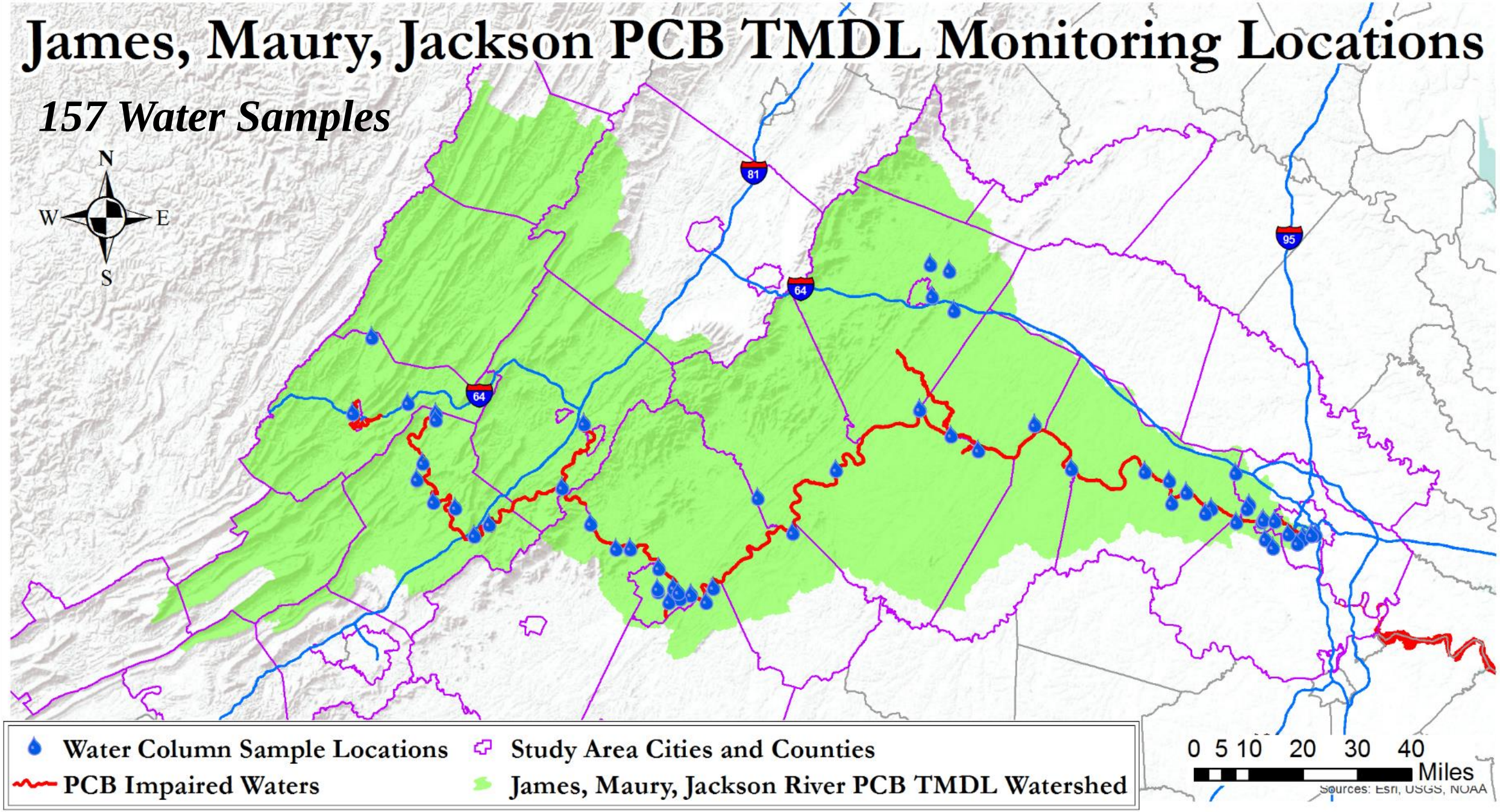
# DEQ TMDL Sampling Approach
## *2017 – 2019*

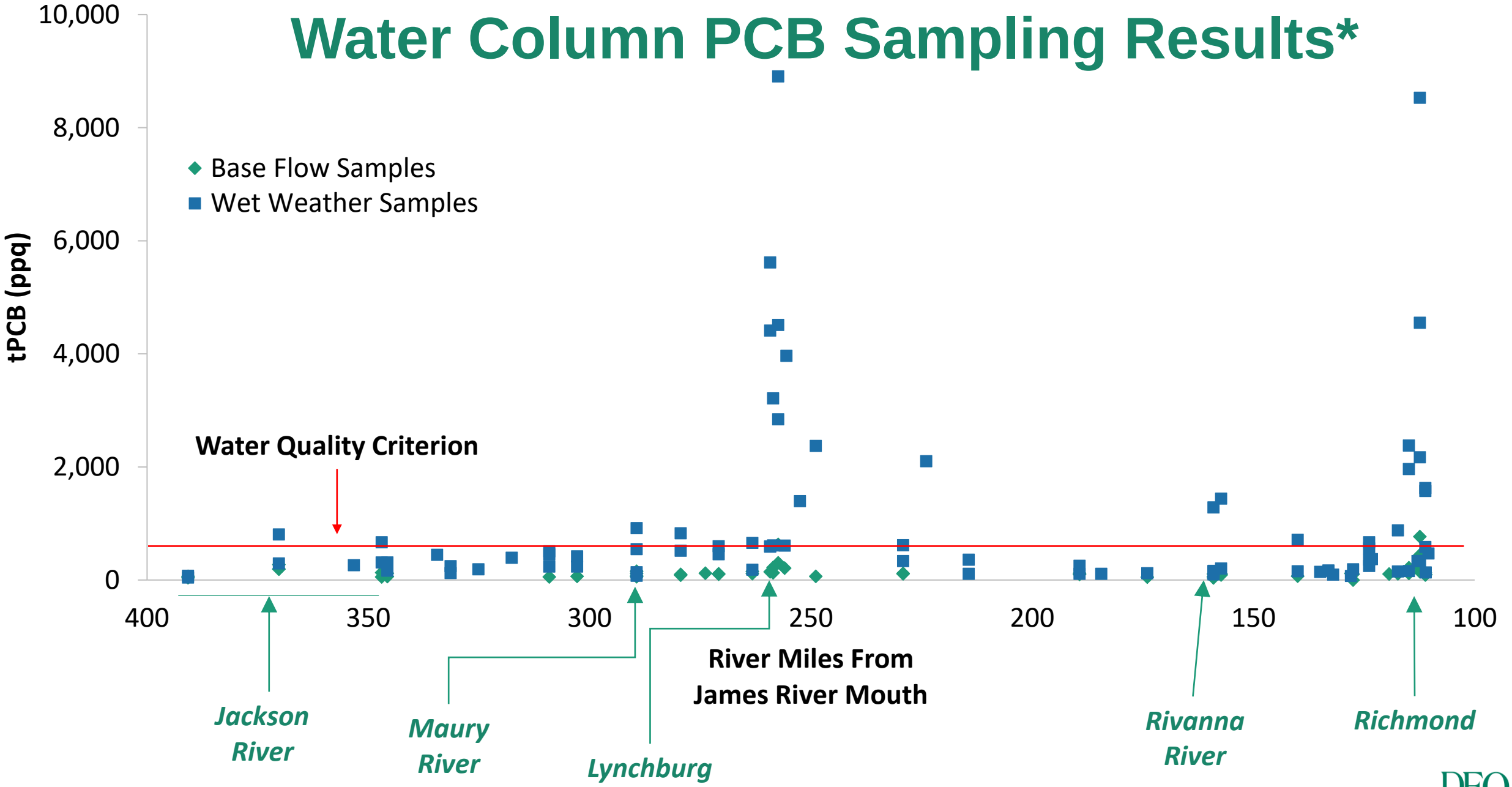
- Source identification
- TMDL model support
  - Calibration/validation
- 2017 – 2019: fish tissue, water column, sediment, flow
  - Fish tissue (n = 93)
  - Water column samples: High and Base Flow (n = 157)
  - Sediment samples (n = 26)

# James, Maury, Jackson PCB TMDL Monitoring Locations

***157 Water Samples***



# Water Column PCB Sampling Results*




*Tributaries are included where they flow into the James River

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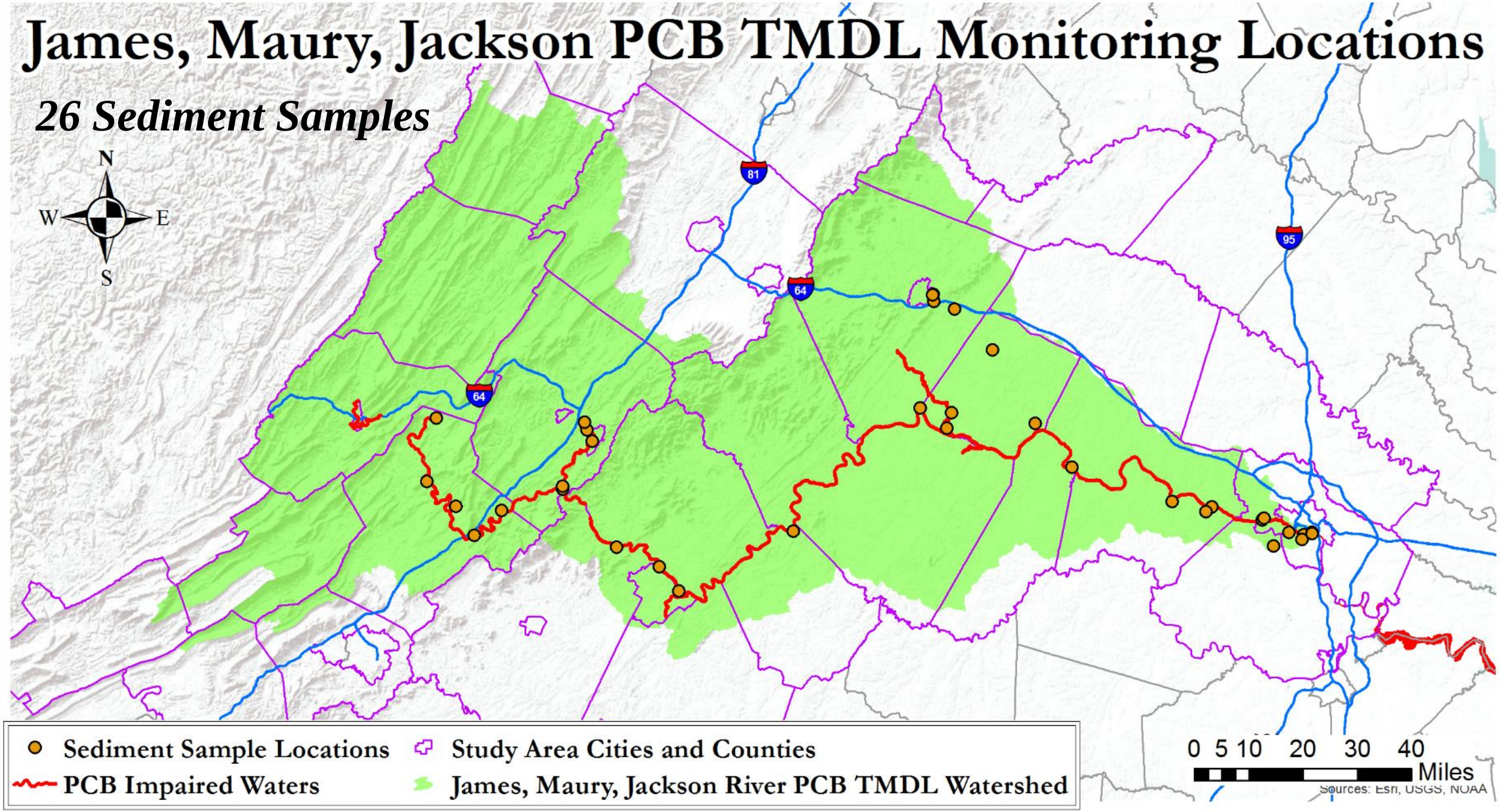
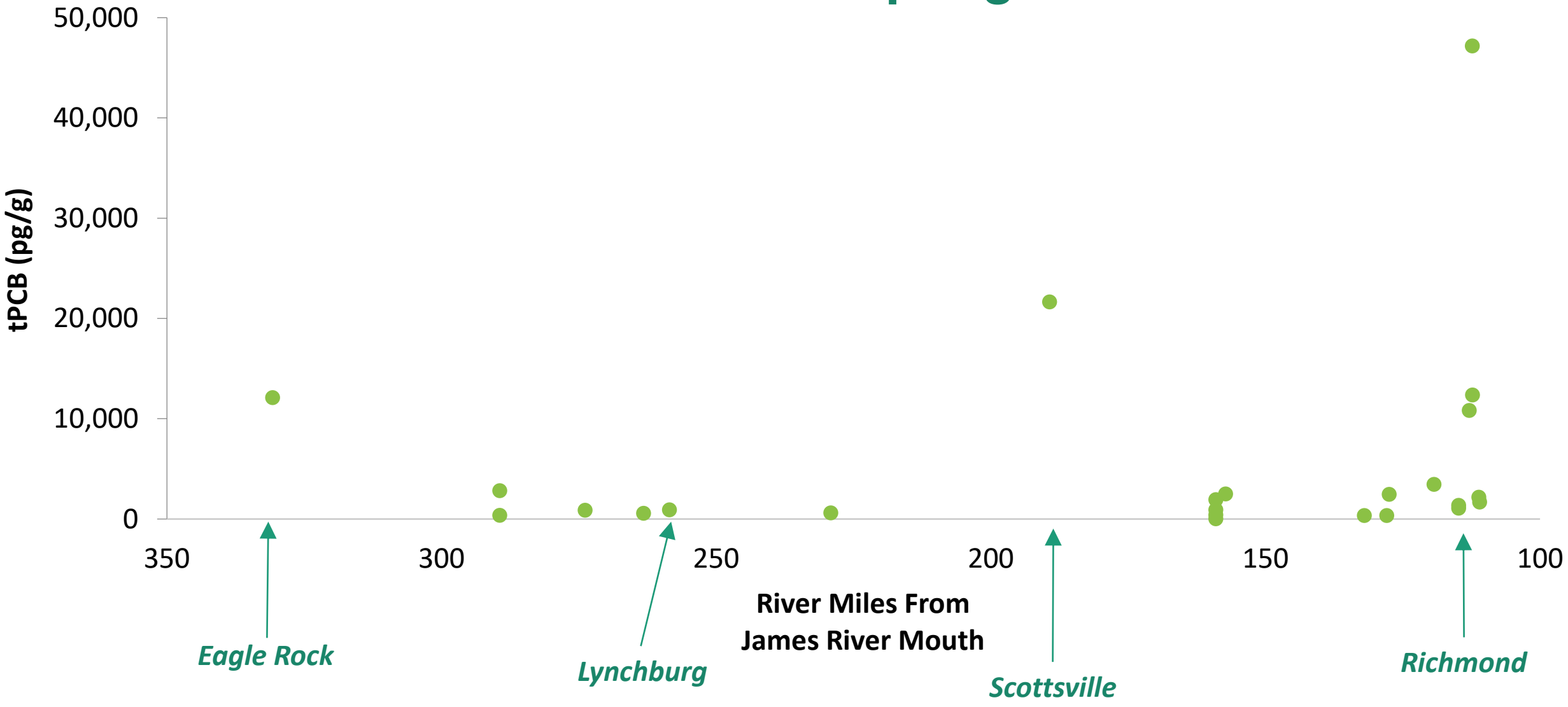
# James, Maury, Jackson PCB TMDL Monitoring Locations

***26 Sediment Samples***



# Sediment PCB Sampling Results




*Tributaries are included where they flow into the James River

# TMDL Source Categories

## Waste Load Allocation (WLA)

- Permitted Facilities
  - Municipal WWTPs (26)
  - Combined sewer overflows (2)
  - Industrial facilities (73)
    - Two permit types
  - Regulated stormwater (11)
    - MS4s

## Load Allocation (LA)

- Contaminated Sites
  - Rail yards/spurs
  - Electric utility transformer pads
  - Brownfields sites
  - DEQ Voluntary Remediation Program
- Spill sites

- Nonregulated surface load
  - Stormwater
  - Small tributaries
  - Unidentified contaminated sites
  - Unspecified permitted facilities
- Atmospheric deposition
- Streambed sediment

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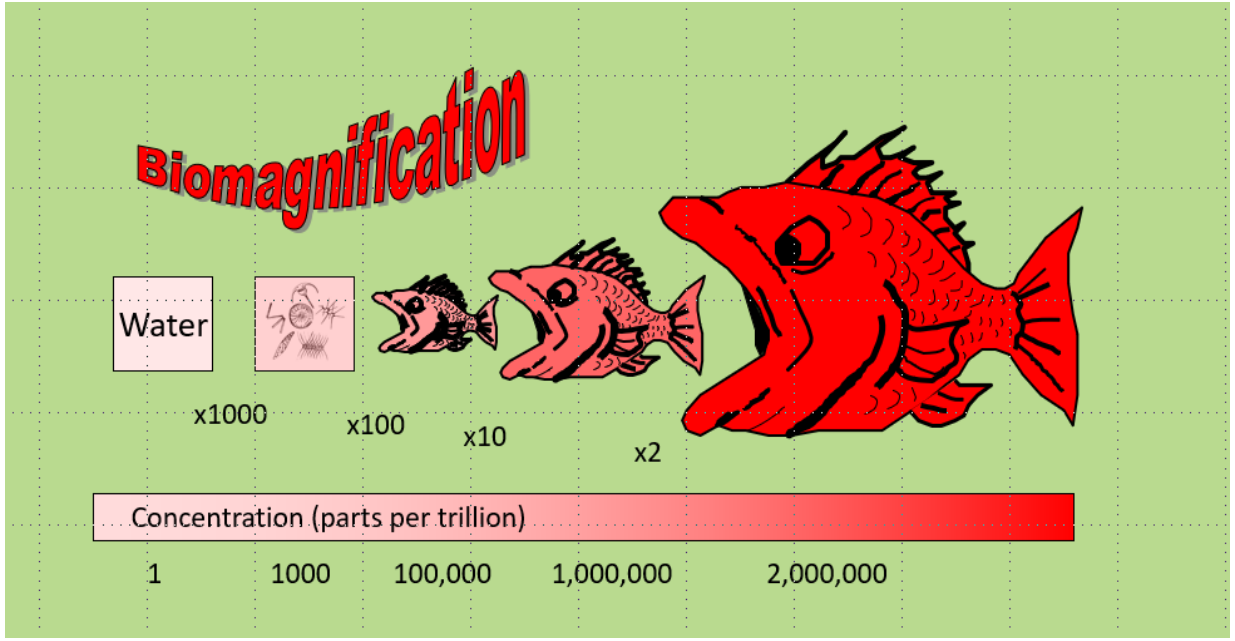
# TMDL Endpoints - Site-Specific

- PCB WQC derived from a single exposure pathway to fish
  - Bioconcentration/exposure via dissolved PCBs
- PCBs bioaccumulate at a low conc. (pg/L)
  - Water, sediment
- PCBs biomagnify
  - Food
- Narrative Water Quality Standard (accounts for toxic pollutants that bioaccumulate)

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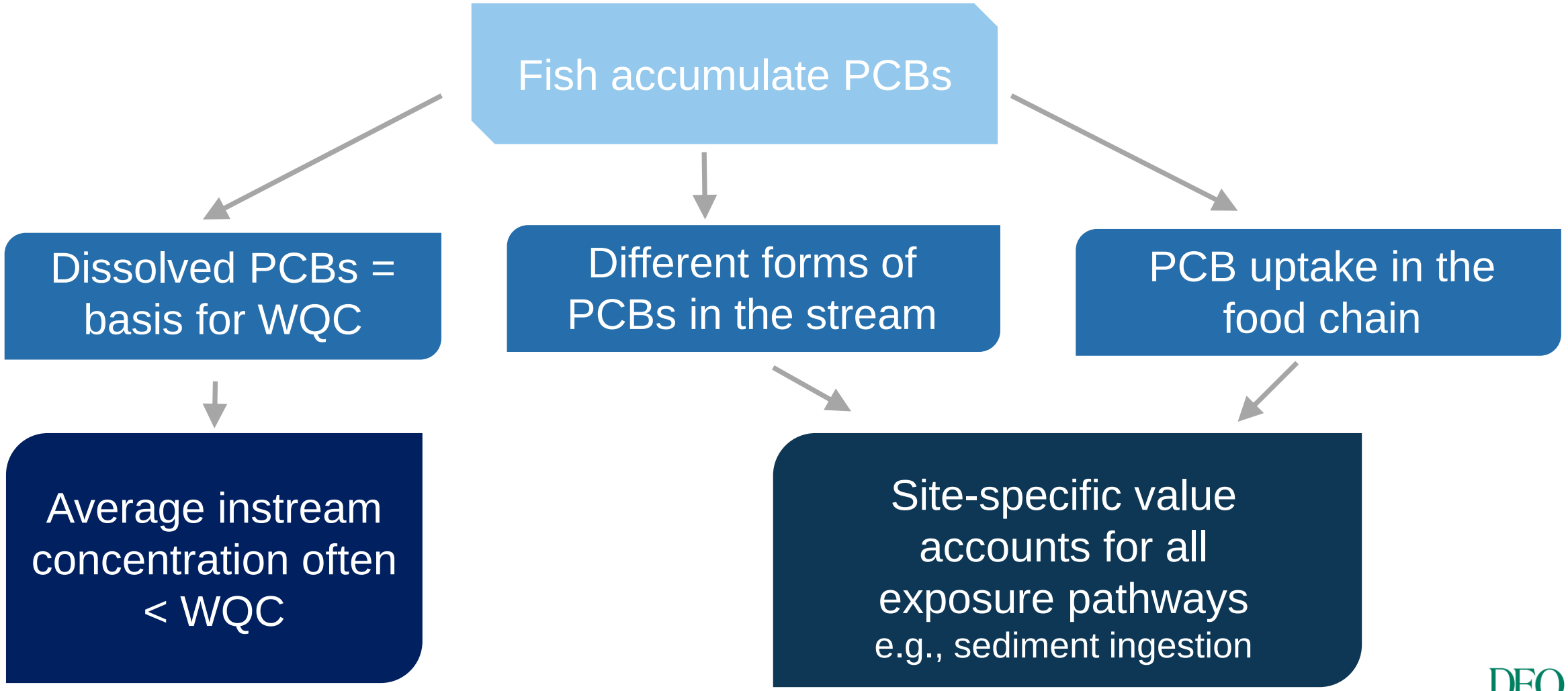
# Factors to Consider for a Site-Specific Endpoint

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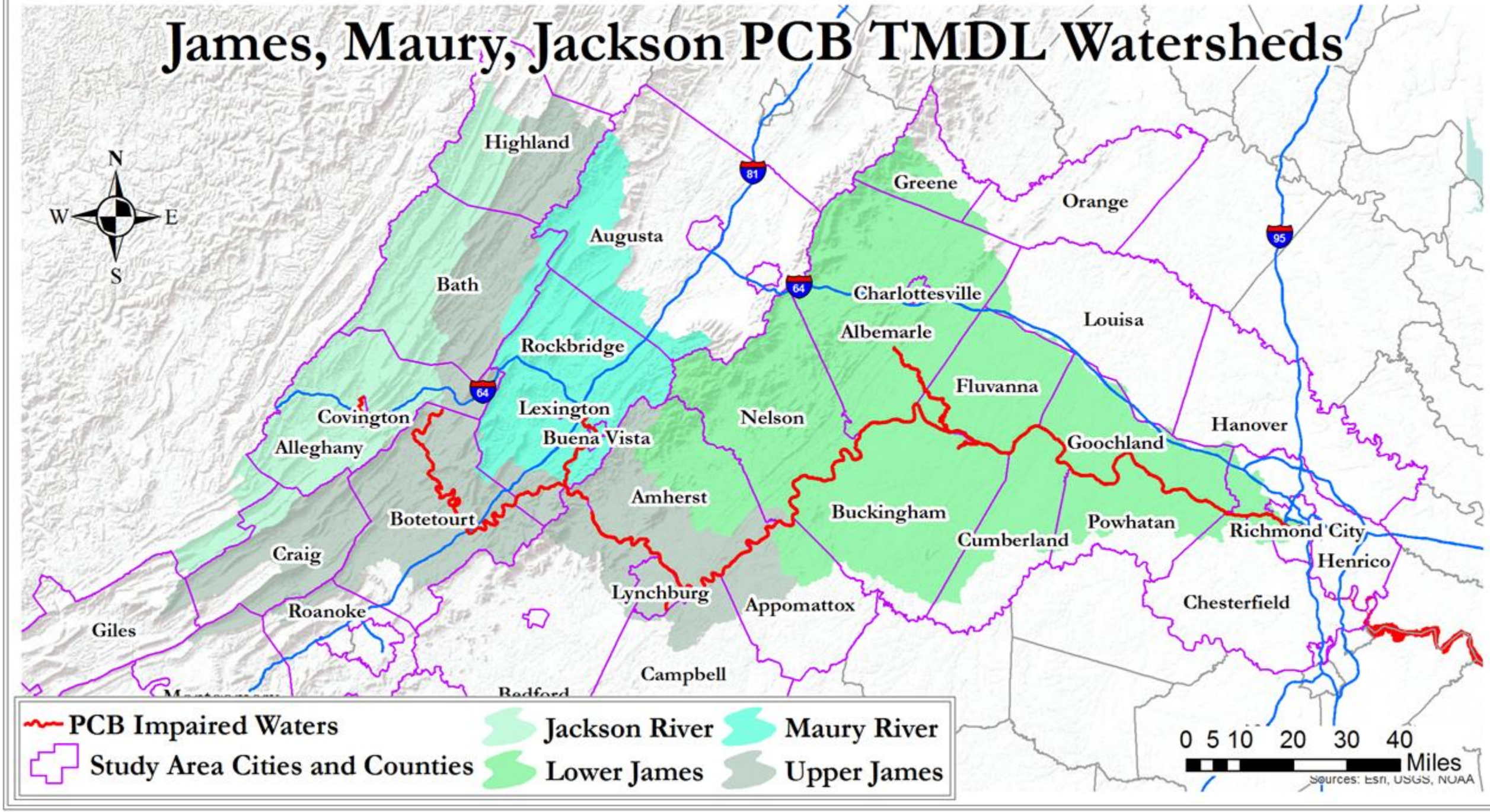
James, Maury, Jackson PCB TMDL Watersheds
N
W
E
S
Highland
Augusta
Bath
Rockbridge
Covington
Alleghany
Lexington
Buena Vista
Botetourt
Craig
Roanoke
Giles
Amherst
Lynchburg
Campbell
Bedford
Appomattox
Nelson
Greene
Orange
Charlottesville
Albemarle
Louisa
Fluvanna
Buckingham
Cumberland
Powhatan
Goochland
Hanover
Richmond City
Henrico
Chesterfield
81
64
64
95
PCB Impaired Waters
Study Area Cities and Counties
Jackson River
Lower James
Maury River
Upper James
0 5 10 20 30 40
Miles
Sources: Esri, USGS, NOAA

# Bioaccumulation Factor Endpoint Selection

- BAFs were calculated for individual fish species in each TMDL watershed
- Three scenarios presented:
  1. Use species of commercial/recreational interest with sample size ≥ 8
  2. Use consumption advisory species regardless of sample size
  3. Use consumption advisory species with a sample size ≥ 8

| TMDL Watershed | Scenario 1 Mean | Scenario 2 Mean | Scenario 3 Mean |
|---|---|---|---|
| Jackson River | 1024.1 pg/L* | n/a* | n/a* **(580)** |
| Maury River | 320 pg/L | 300 pg/L | 400 pg/L |
| Upper James River | 1,186.8 pg/L* | 91 pg/L | 120 pg/L |
| Lower James River | 140 pg/L | 61 pg/L | 52 pg/L |

**These cases would default to a TMDL endpoint equal to the criterion = 580 pg/L*

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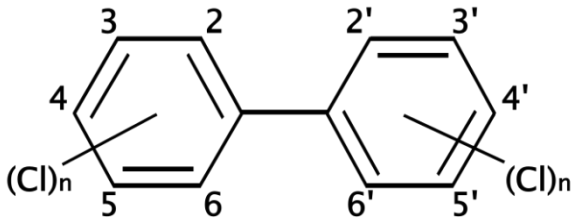
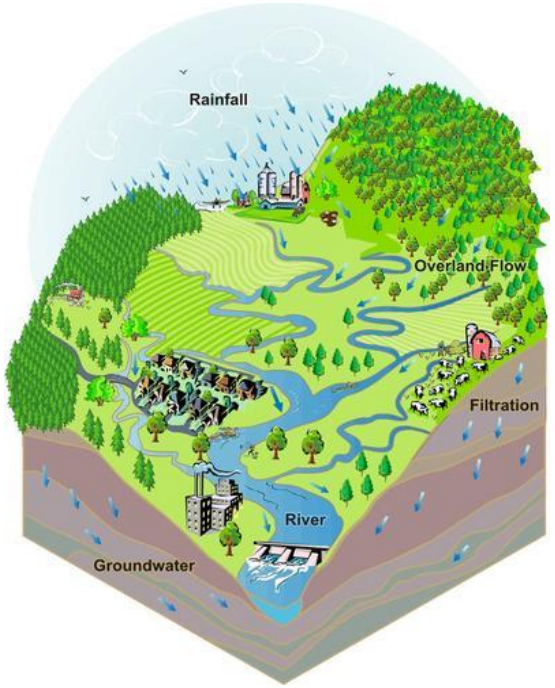
# HSPF Model
## *Process*

- PCB model consists of 3 major components:
  1. Hydrology
  2. Sediment transport
  3. PCB fate and transport




https://upload.wikimedia.org/wikipedia/commons/thumb/4/49/Polychlorinated_biphenyl_structure.svg/2000px-Polychlorinated_biphenyl_structure.svg.png



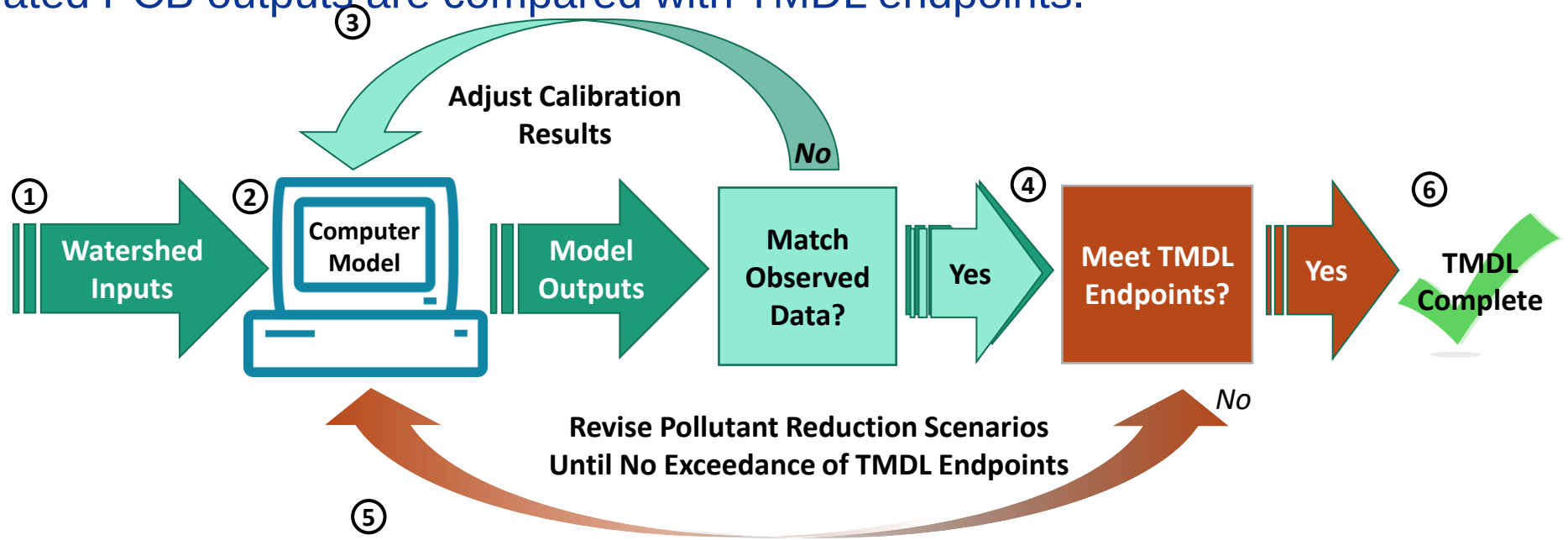

http://prairierivers.org/what-is-a-watershed/

- Model calibrated using observed data:
  1. Stream gage flow data
  2. Suspended sediment concentration data
  3. PCB concentration data

https://photogallery.sc.egov.usda.gov/netpub/server.np

# How is the model used?

1. Watershed inputs are used to develop model.
2. Model simulates watershed processes (flow, pollutant fate and transport).
3. Model is calibrated to observed data.
4. Calibrated PCB outputs are compared with TMDL endpoints.




5. Model allows evaluation of multiple pollution reduction scenarios.
6. Select acceptable reduction scenario to achieve TMDL.

# PCB Modeled Results and Allocations

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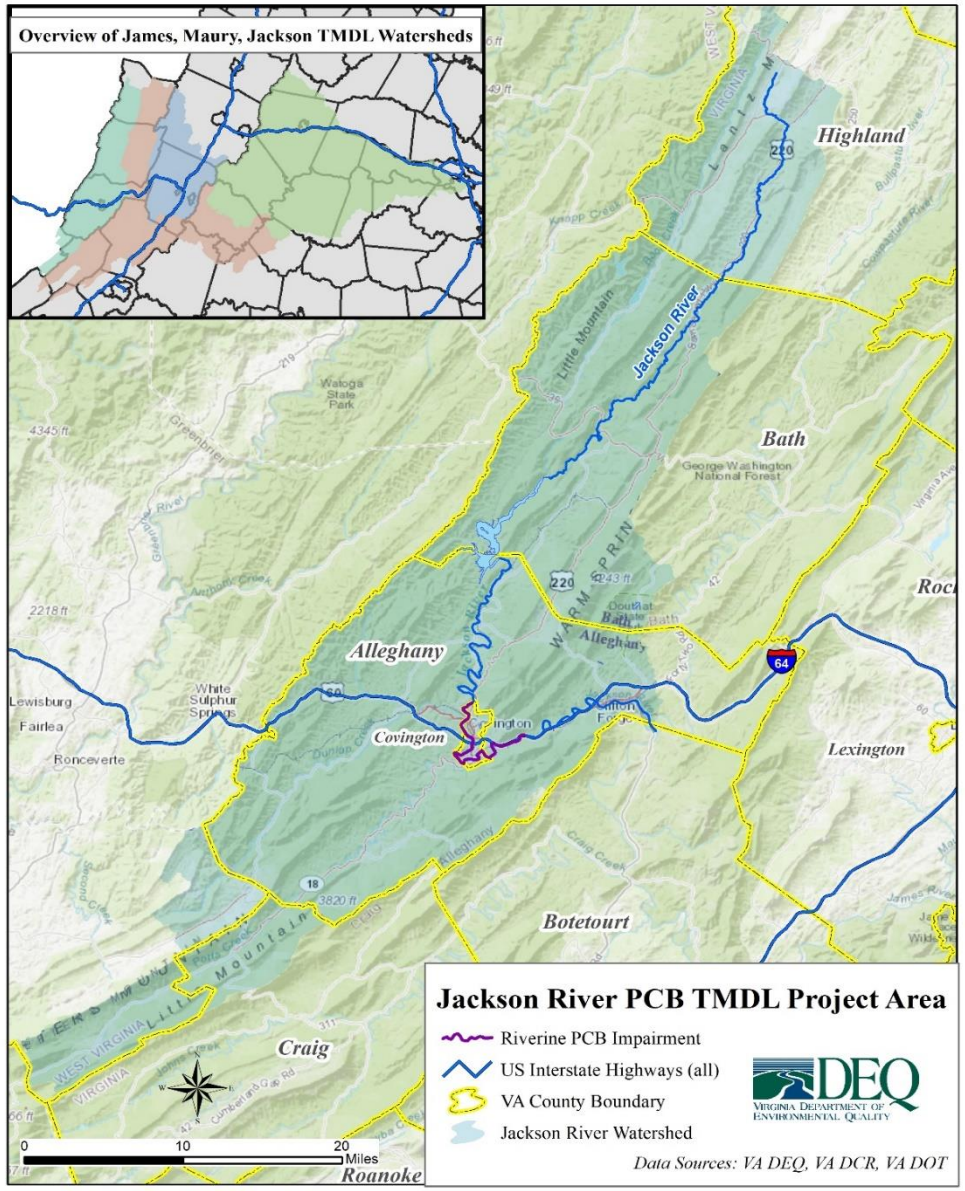
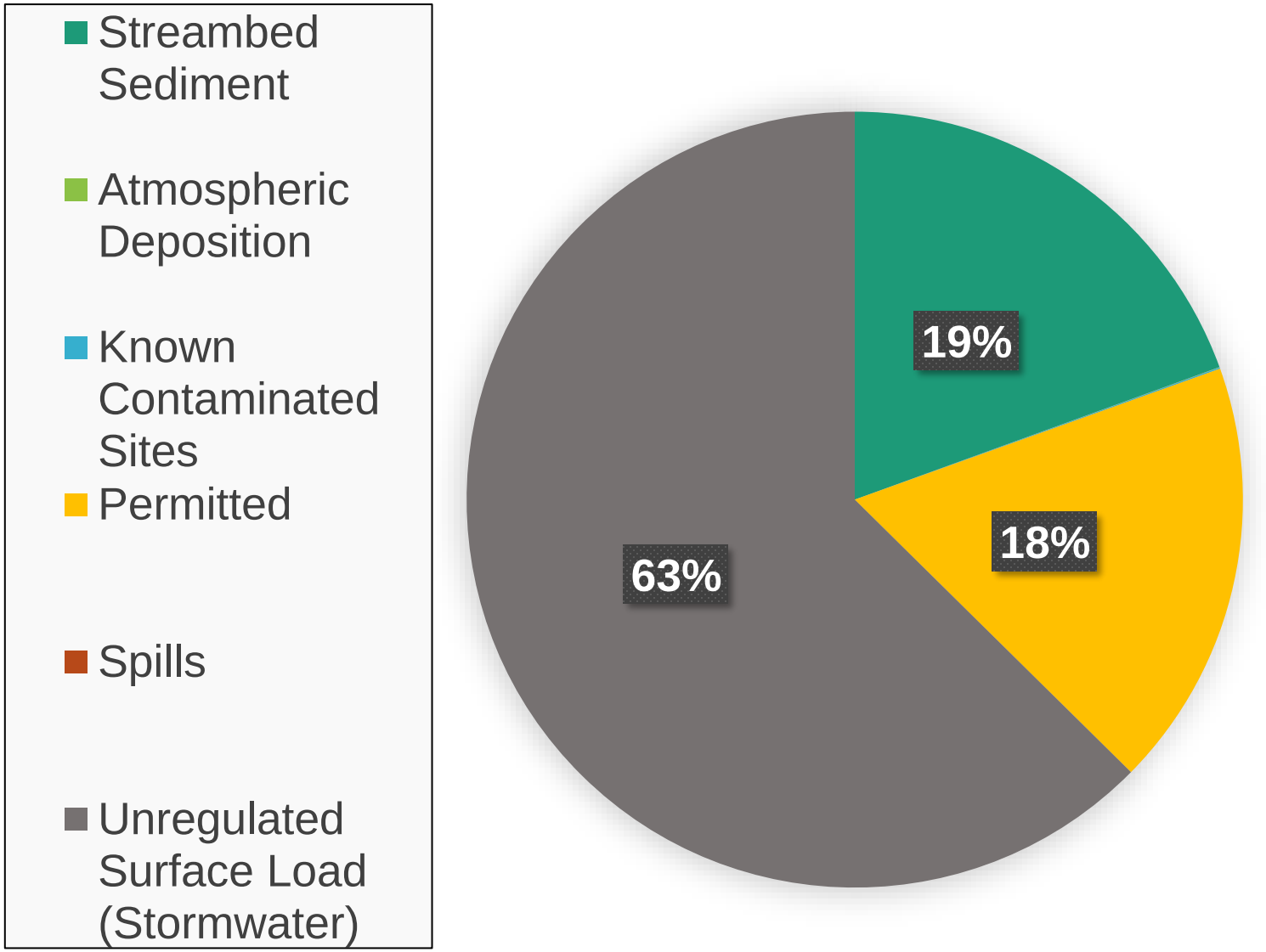
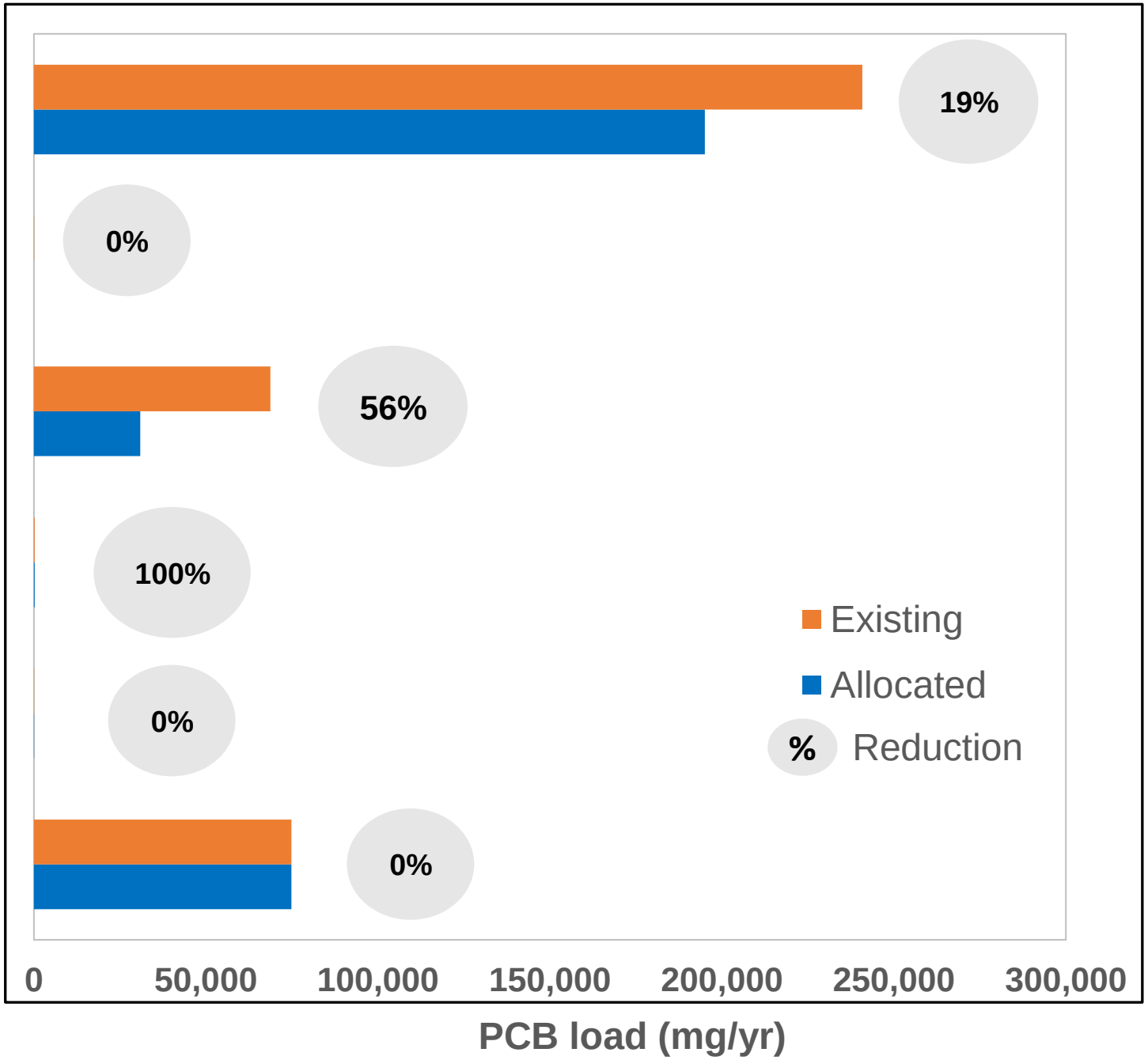
# Annual Relative Contributions to PCB Concentrations at the Jackson River Outlet



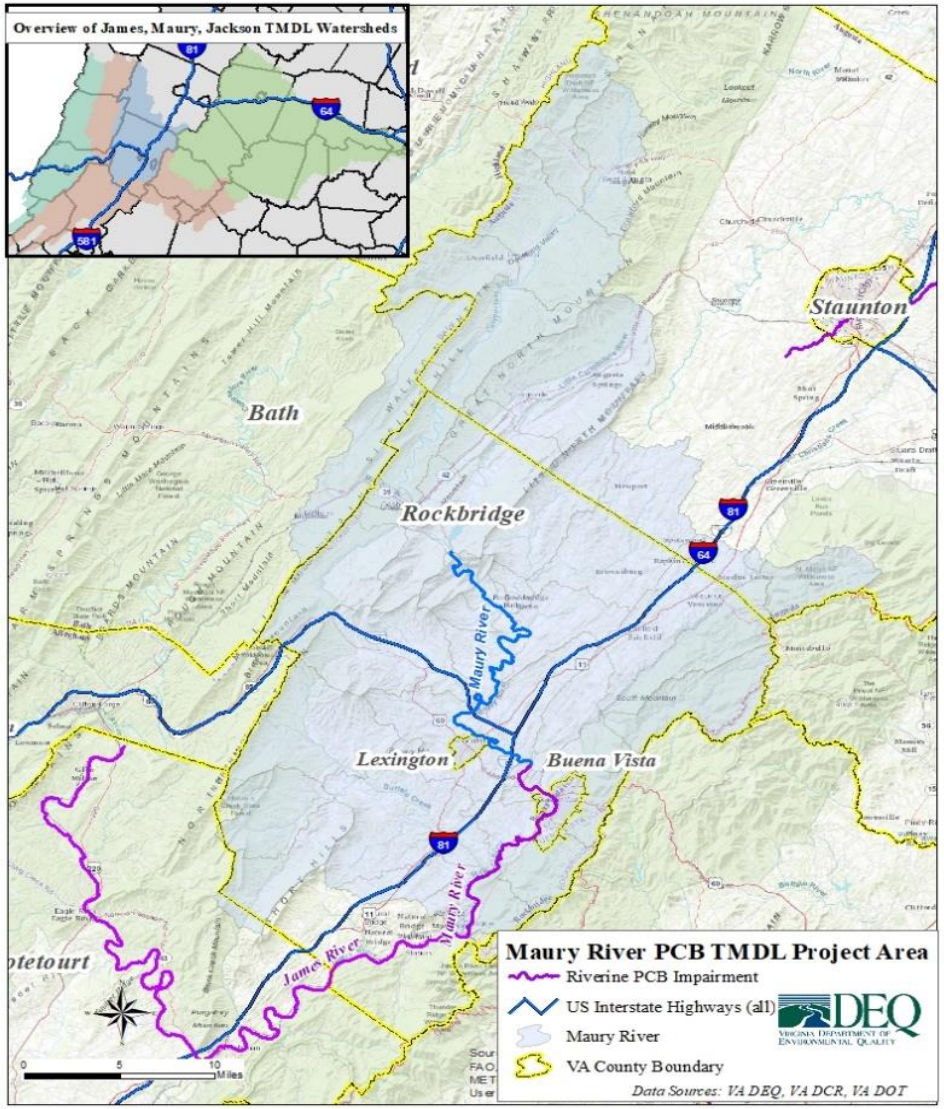



# Jackson River PCB Source Loads

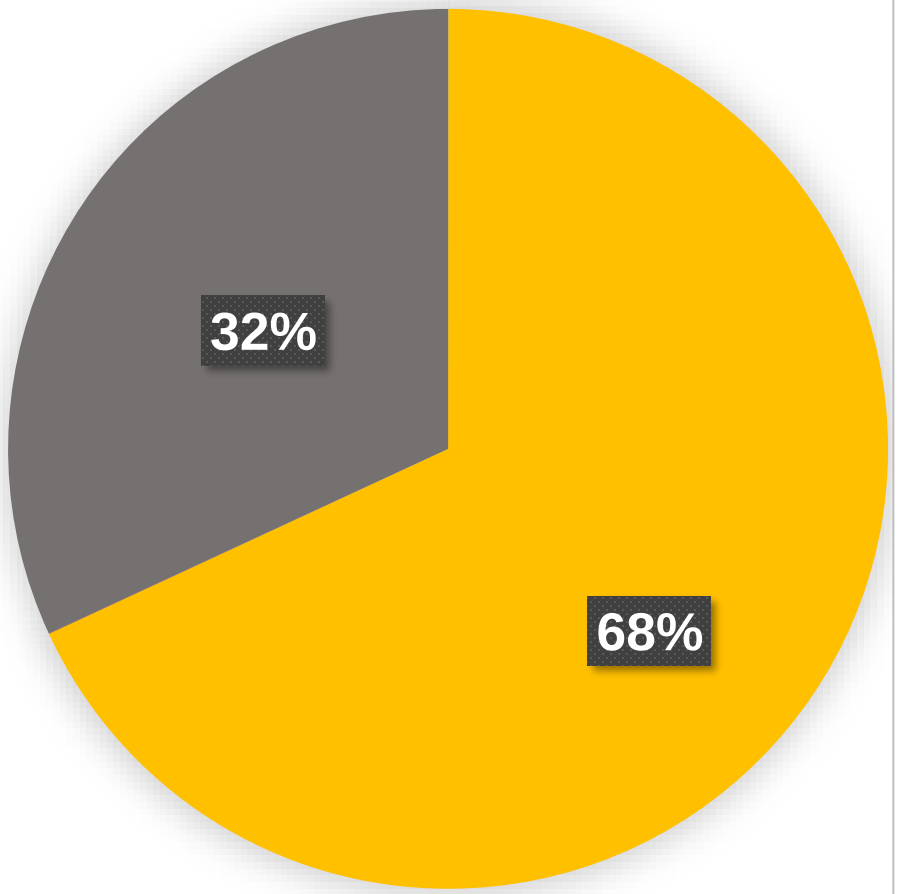
TMDL Endpoint = 580 pg/L (Applied as a Long-Term Average)



# Annual Relative Contributions to PCB Concentrations at the Maury River Outlet




- Streambed Sediment
- Atmospheric Deposition
- Known Contaminated Sites
- Permitted
- Spills
- Unregulated Surface Load (Stormwater)

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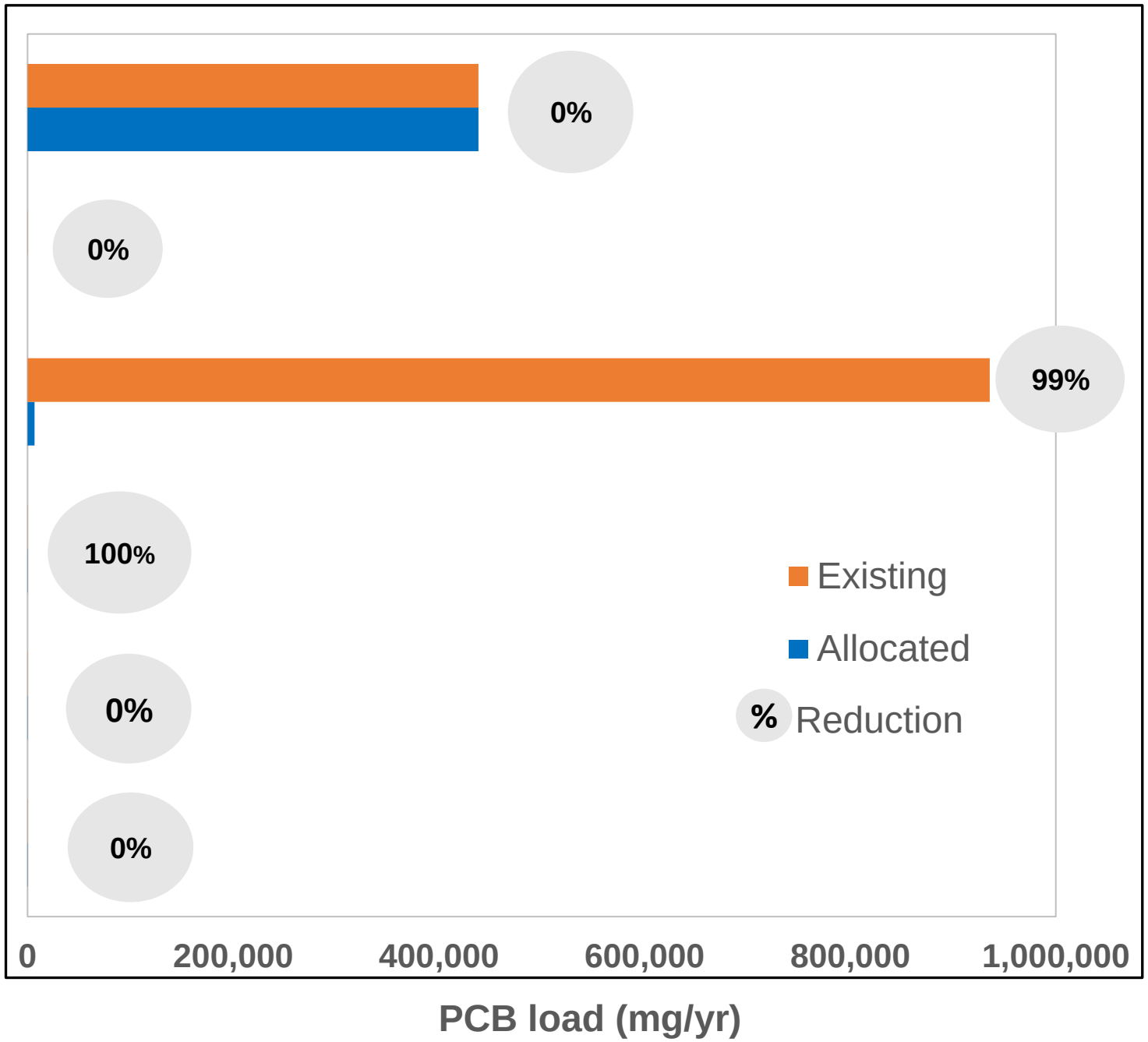
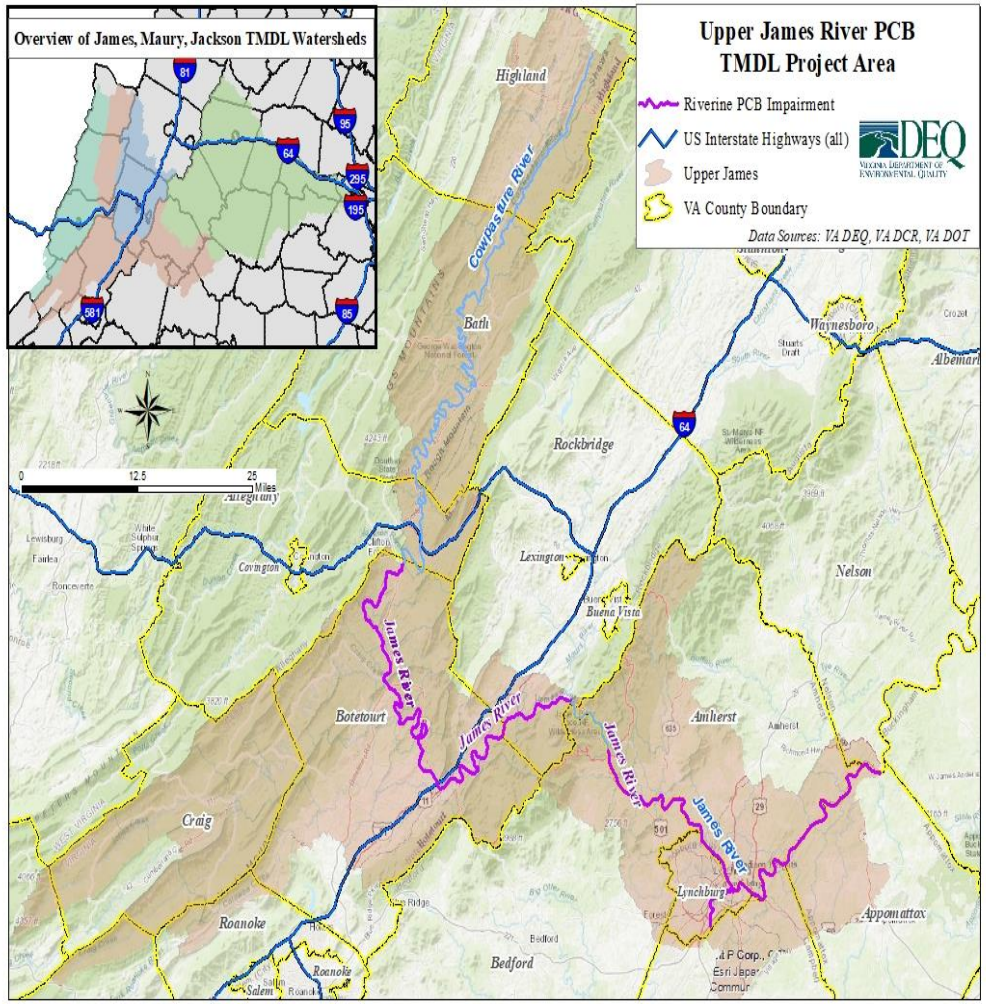
# Maury River PCB Source Loads

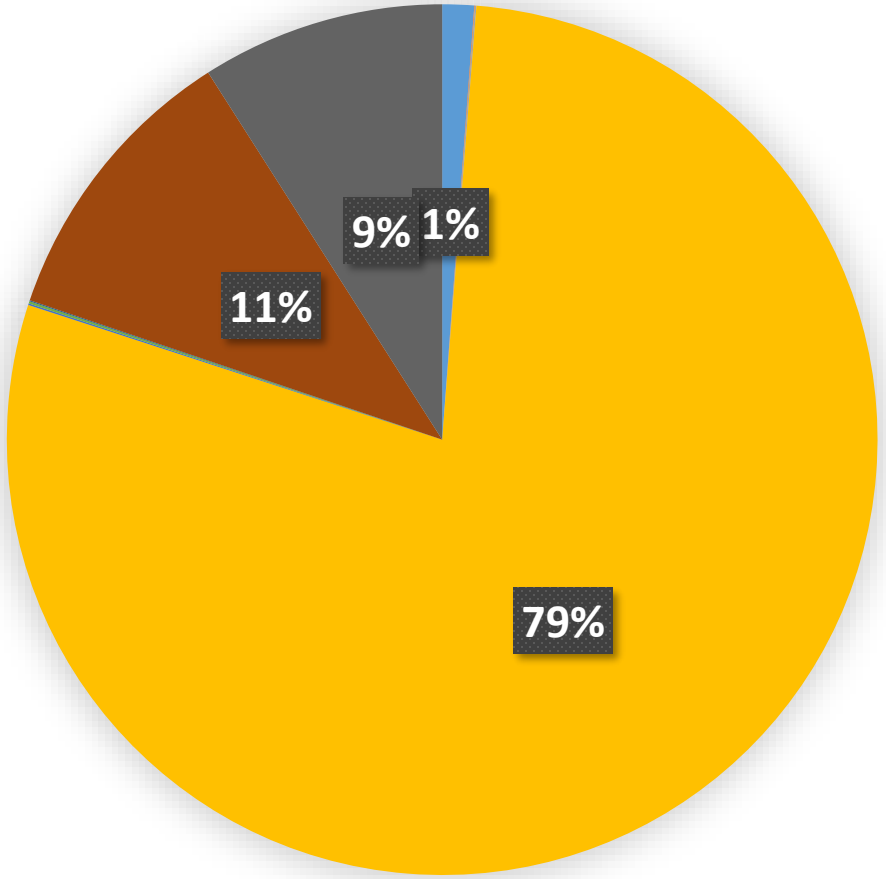
TMDL Endpoint = 400 pg/L (Applied as Long-Term Average)



# Annual Relative Contributions to PCB Concentrations at the Upper James River Outlet

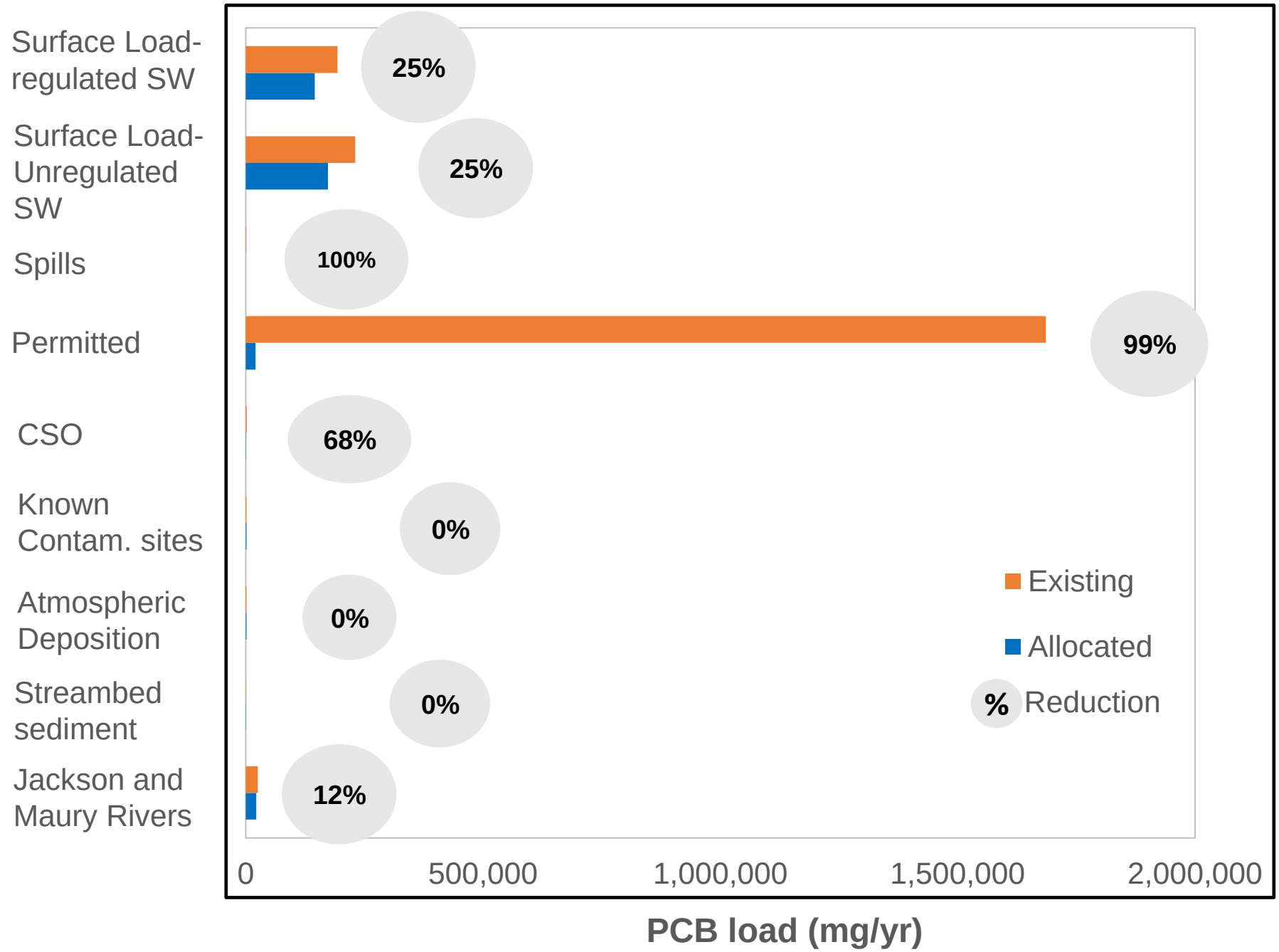



- Upstream Sources
- Streambed Sediment
- Atmospheric Deposition
- Permitted
- Known Contaminated Sites
- CSO
- Spills
- Surface Load - Unregulated
- Surface Load - Regulated

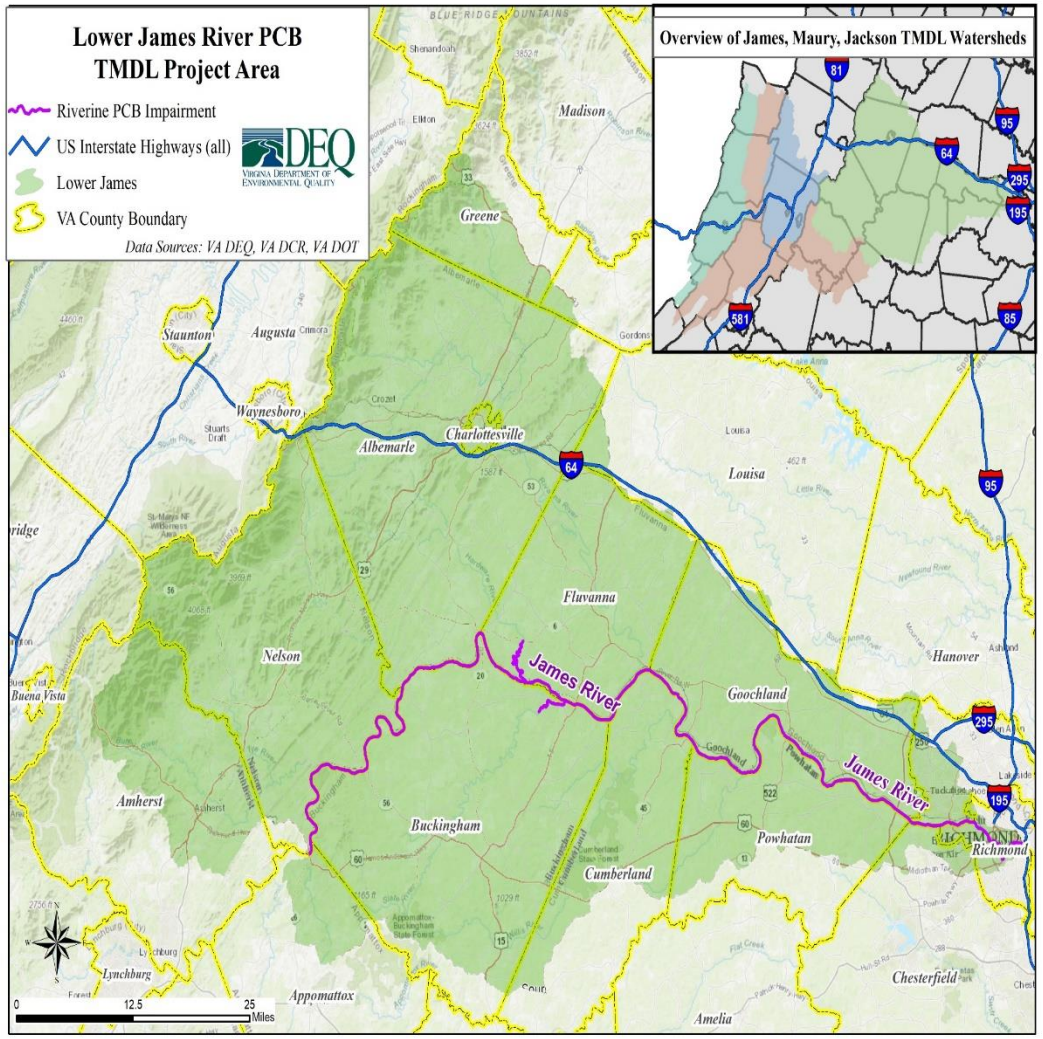


# Upper James River PCB Source Loads

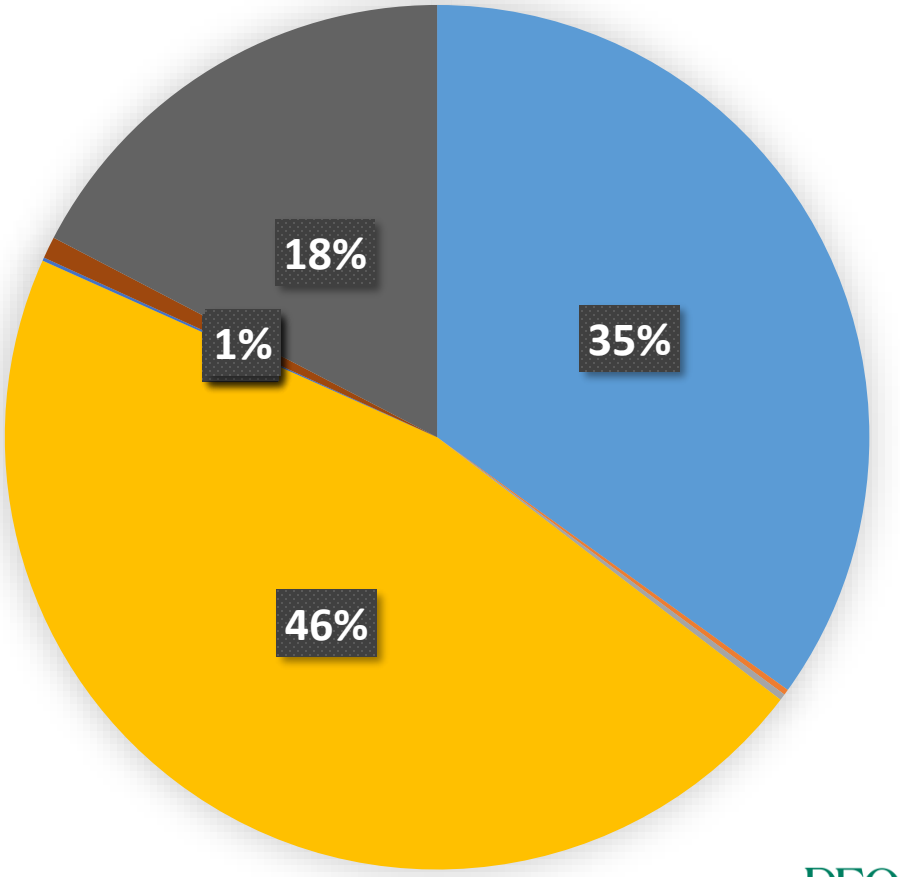
TMDL Endpoint = 120 pg/L (Applied as a Long-Term Average)



# Annual Relative Contributions to PCB Concentrations at the Lower James River Outlet




- Upstream Sources
- Streambed Sediment
- Atmospheric Deposition
- Permitted
- Known Contaminated Sites
- CSO
- Spills
- Surface Load - Unregulated
- Surface Load - Regulated

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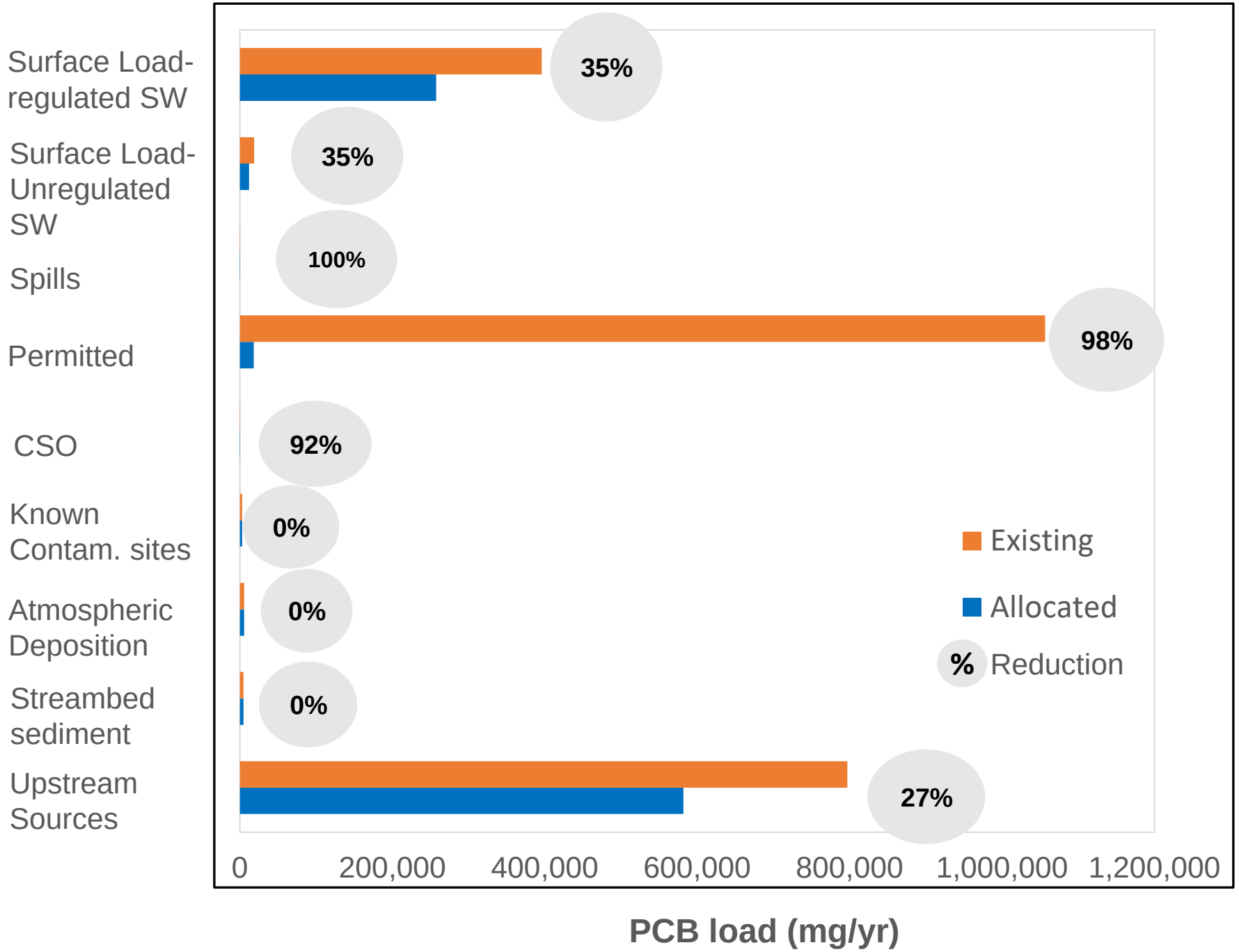
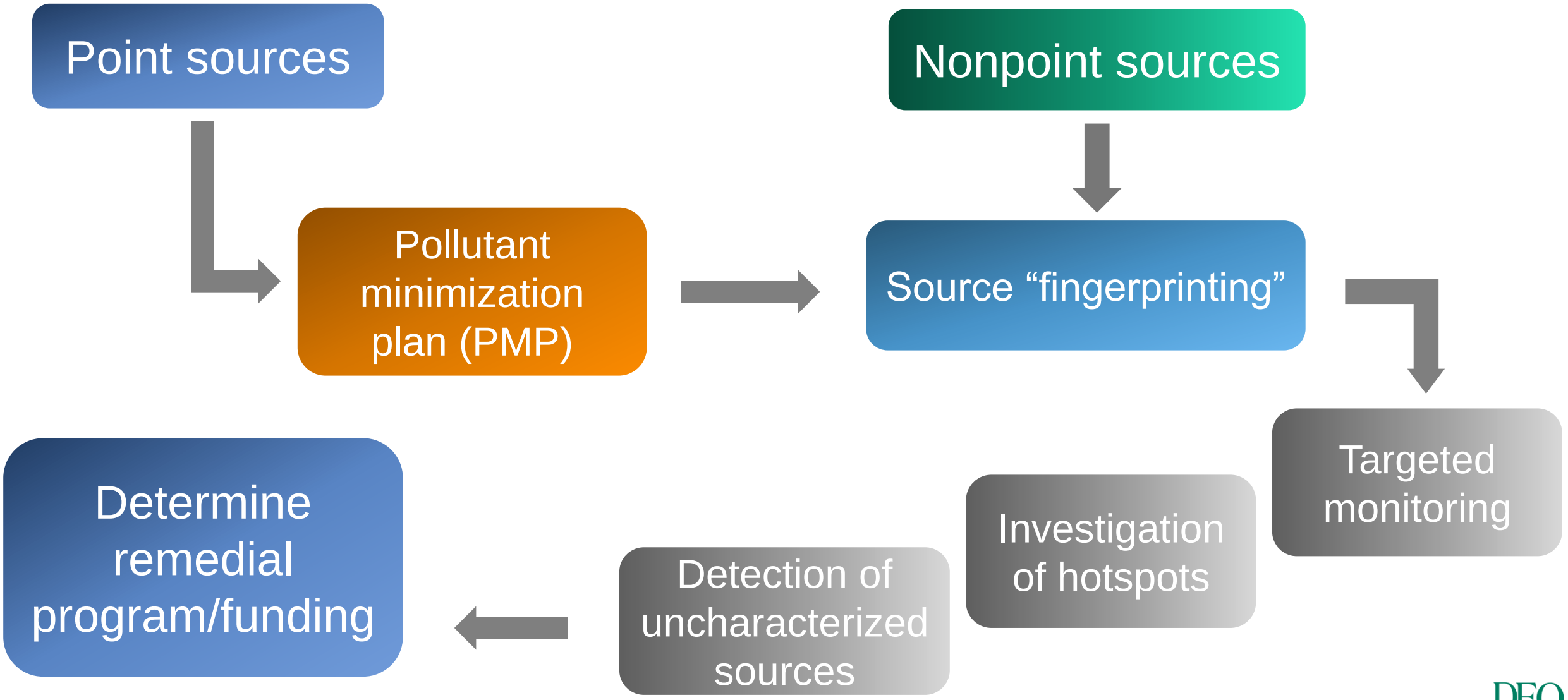
# Lower James River PCB Source Loads

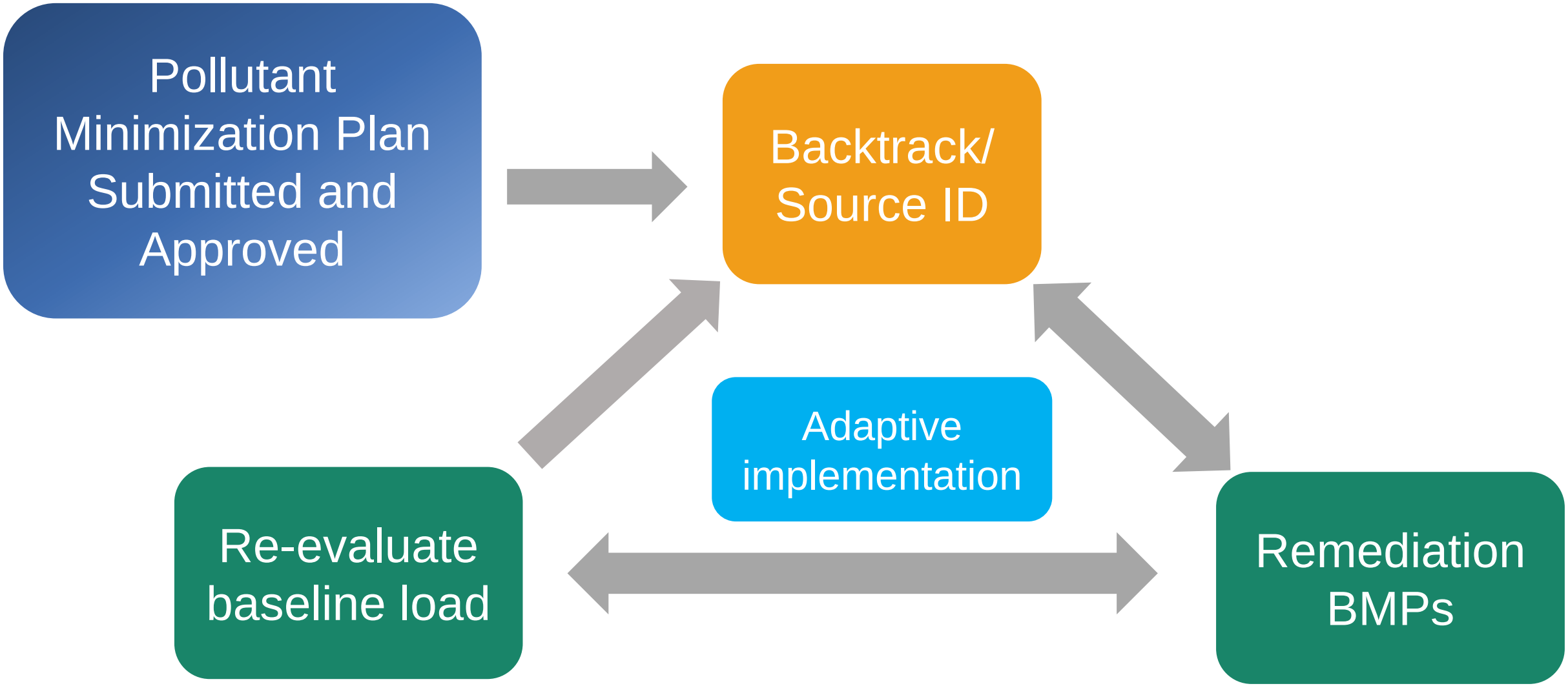
TMDL Endpoint = 52 pg/L (Applied as a Long-Term Average)



# TMDL Implementation Process



# Developing a Pollutant Minimization Plan for PCBs



# Next Steps

- DEQ is seeking comments on this draft study from **2/15/2024 – 3/18/2024**
- Complete an economic analysis of proposed WLA regulations
- The WLAs from the TMDL equation are incorporated into the Water Quality Management Regulation (9 VAC 25-720-60)

# Questions

- TMDL Development Team

DEQ

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