James River, Maury River, Jackson River PCB Cleanup Study

Second Technical Advisory Committee Meeting

Mark Richards

Virginia Department of Environmental Quality

August 2, 2022

Agenda

- **Welcome and Introductions**
  - Meeting Objectives
- **Refresher – TMDL Development**
- **Setting the TMDL Endpoint**
  - Bioaccumulation Factor/WQS
  - Endpoint Discussion
- **Watershed Modeling**
  - HSPF
  - Discuss TMDL Allocations
- **Wrap-up & Next Steps**

DEQ

Our goals for today…

- Review with you
  - PCB background information and existing impacts within the James River watershed
  - PCB source assessment
- You share your thoughts
  - Setting the TMDL endpoint
  - PCB Allocations

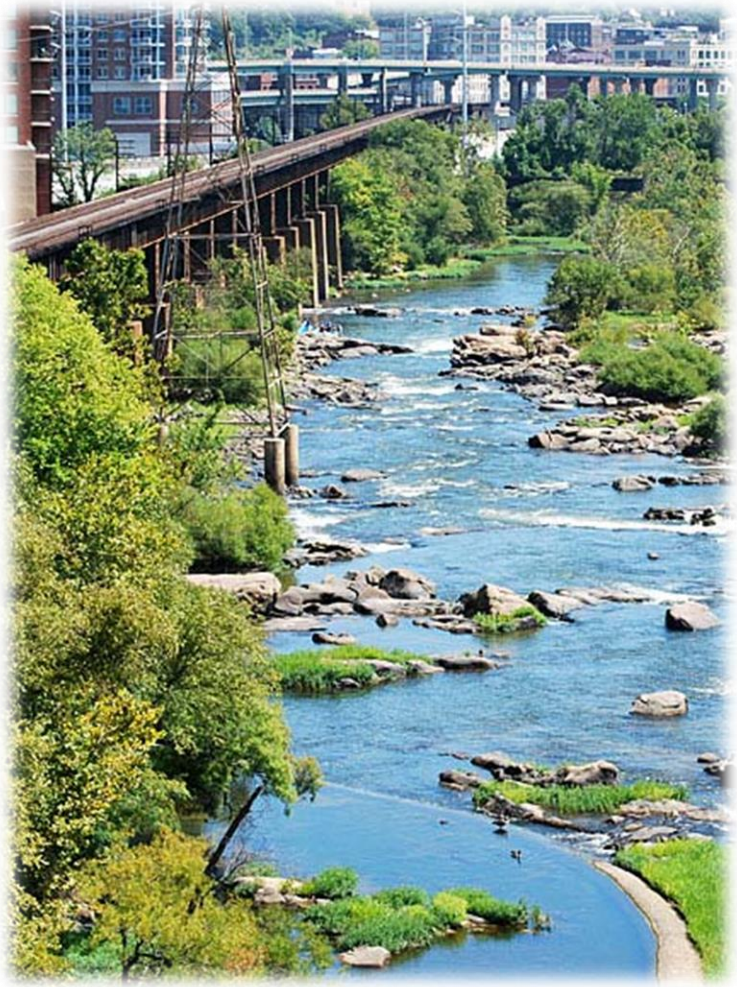
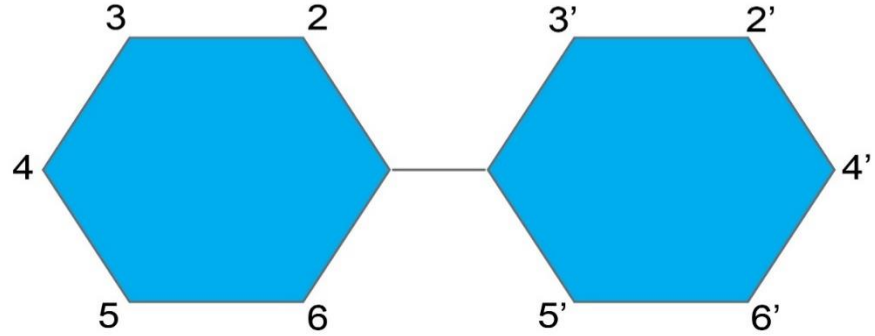


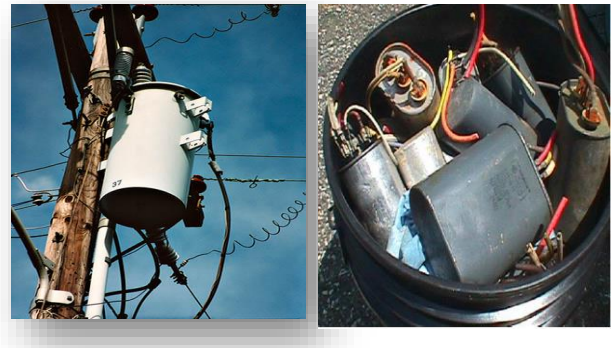
Photo: October Greenfield, Friends of the Rappahannock

Polychlorinated Biphenyls: PCBs

- Biphenyl molecule (1-10 chlorine atoms)
- Aroclors (Monsanto tradename) = mixture of PCB compounds
  - Examples 1248, 1254, 1260
- Legacy Contaminant (banned 1977)
  - Inadvertent production allowed and common
- Stable & persists in the environment
- Common uses:
  - Transformers, capacitors, hydraulic fluids, circuit breakers, PVC Products, carbonless copy paper, caulking material, paints, and more!



209 distinct PCB Compounds



VA Water Quality Criterion – Total PCBs

Agency	Fish Tissue Threshold (ppb)	WQC (pg/L)
VDH	100 (Fish Consumption Advisory)	- -
DEQ	18 (Screening Value)	640 Draft update (580)

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

From: DEQ's 2022 Water Quality Assessment Guidance Manual

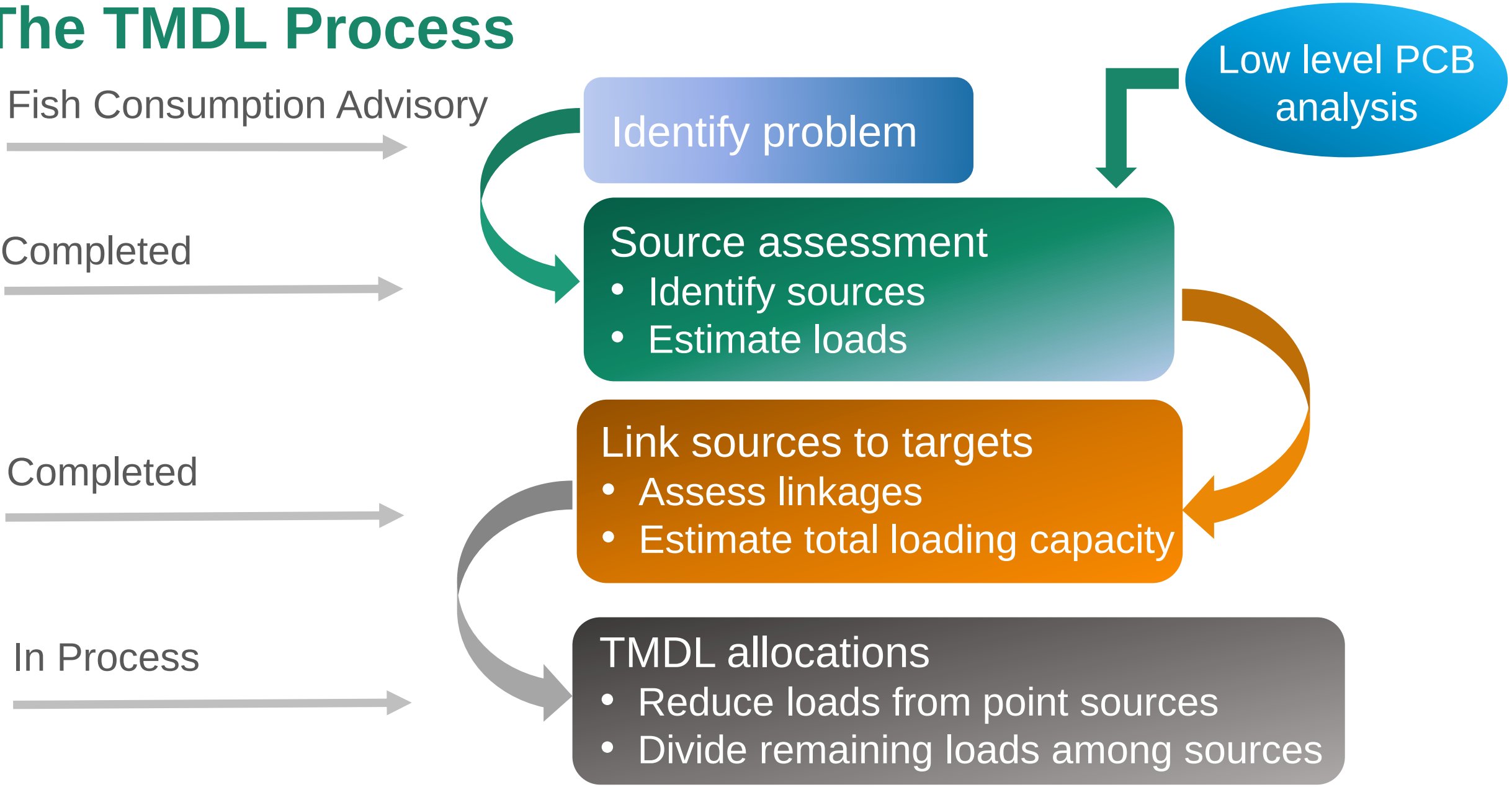
PCB Water Quality Criterion (Total PCBs)

Criteria	Existing Criterion	Revised Crtierion
Water	640 pg/L (ppq)	580 pg/L
Fish Tissue Threshold	18 ng/g (ppb)	18 ng/g
Duration and Frequency	No reference, 0% exceedence	New footnote: Human health criteria based on the assumption of average amount of exposure on a long term basis

Triennial Review Approval Timeline

DEQ

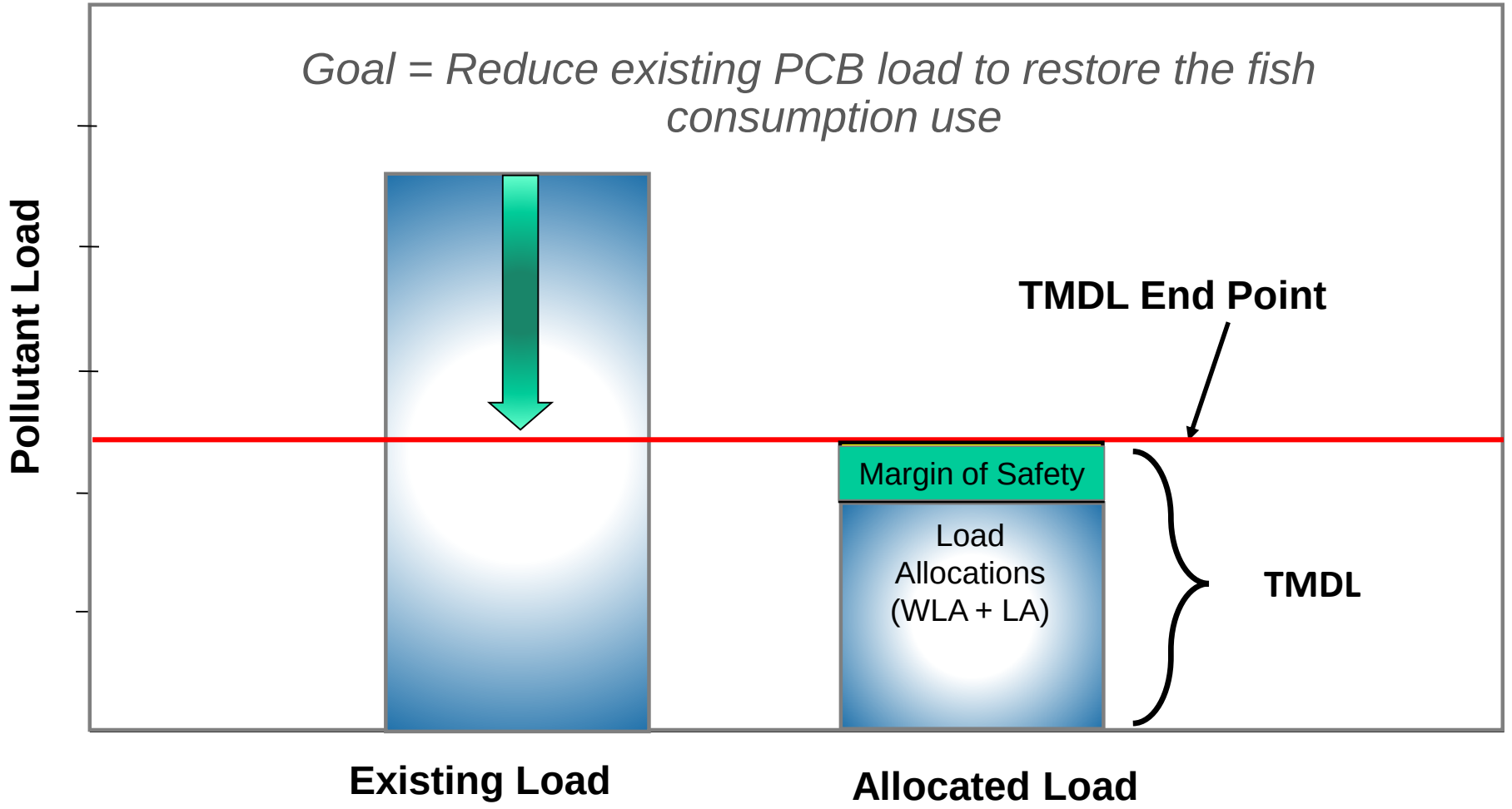
The TMDL Process



TMDL = Sum of WLA + Sum of LA + MOS

DEQ

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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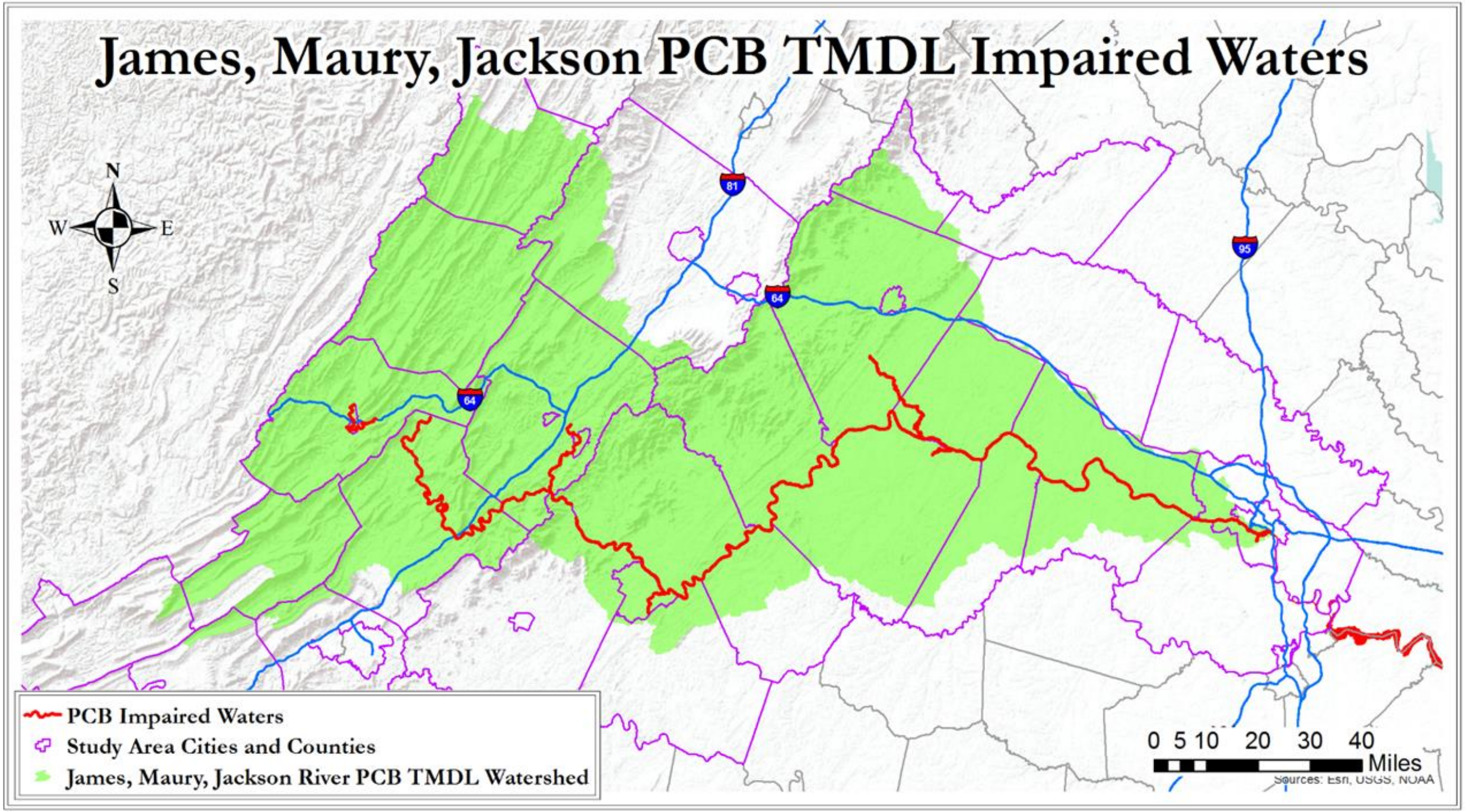
Water Quality Impairments in the Project Area

DEQ


James, Maury, Jackson PCB TMDL Impaired Waters
N
W
E
S
81
64
64
95
PCB Impaired Waters
Study Area Cities and Counties
James, Maury, Jackson River PCB TMDL Watershed
0 5 10 20 30 40
Miles
Sources: Esri, USGS, NOAA

Problem Identification

VDH Fish Consumption Advisories*

Affected Water Body Boundaries	Affected Localities	Listing Year	Species	Advisory description
Upper James River from the head of the James near Iron Gate to Balcony Falls Dam downstream of Glasgow	Botetourt County and Rockbridge County	2020	Carp	≤2 meals/month
Maury River from Buena Vista at Rt. 60 - 16 miles to James River	Rockbridge County and Buena Vista City	2004	Redbreast Sunfish, Rock Bass, Yellow Bullhead Catfish, Carp	≤2 meals/month
James River from Big Island Dam to I-95 James River Bridge in Richmond.	Amherst County, Bedford County, Lynchburg City, Campbell County, Appomattox County, Nelson County, Buckingham County, Albemarle County, Fluvanna County, Cumberland County, Goochland County, Powhatan County, Henrico County, Chesterfield County, Richmond City	2004	Gizzard Shad, Carp, American Eel, Flathead Catfish, Quillback Carpsucker	≤2 meals/month

http://www.vdh.virginia.gov/environmental-health/public-health-toxicology/fish-consumption-advisory/

***Does not affect swimming**

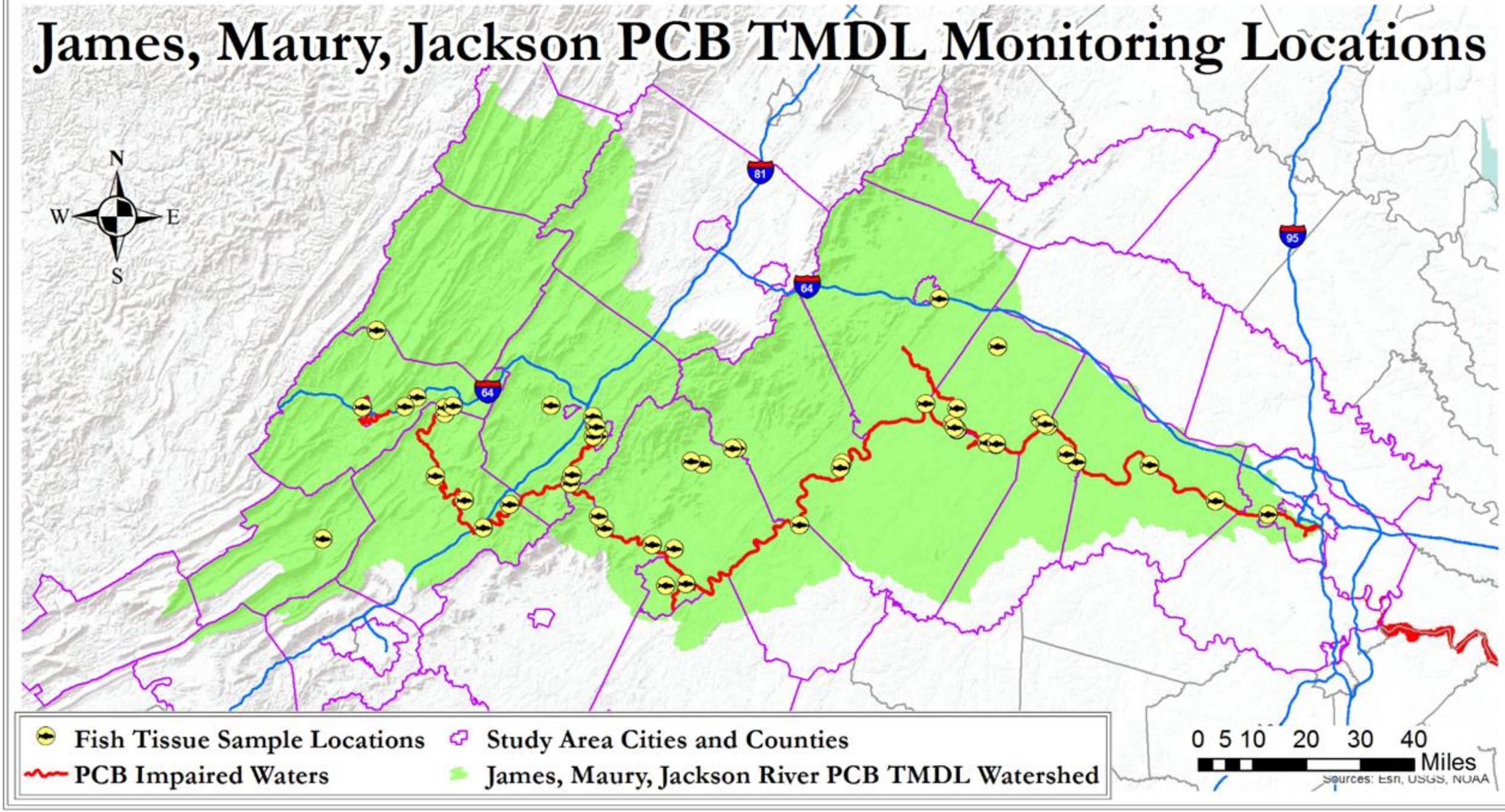
Problem Identification

Additional PCB Impairments Identified by DEQ*

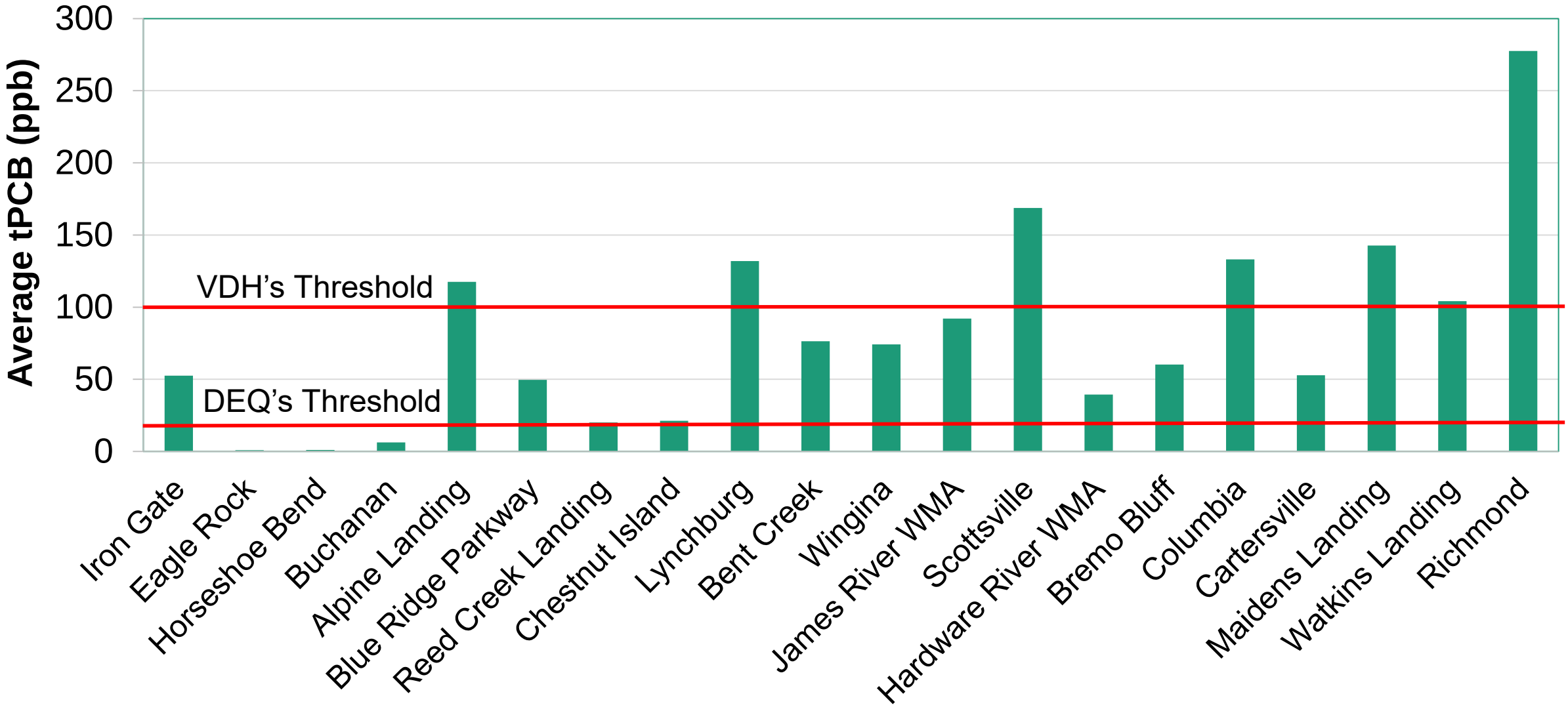
Affected Water Body	Affected Localities	Listing Year	Length
Jackson River	City of Covington and Alleghany County	2008	12.63 mi
Hardware River	Fluvanna and Albemarle counties	2022 (revised) 2008	(now) 7.21 mi (was) 23.24 mi
Slate River	Buckingham County	2008	3.88 mi
Fishing Creek	City of Lynchburg	2020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

***Does not affect swimming**

James, Maury, Jackson PCB TMDL Monitoring Locations

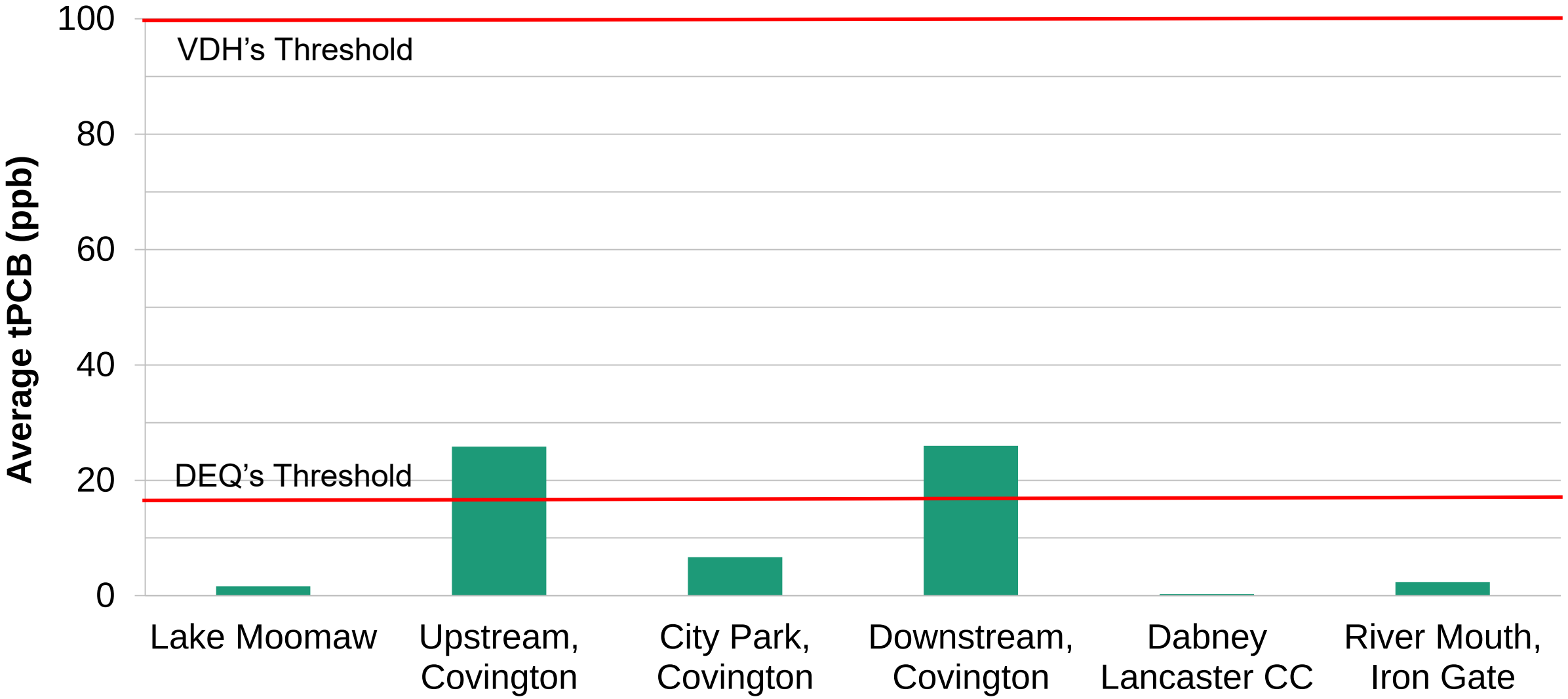


Average James River Fish Tissue Concentrations (1995-2019)



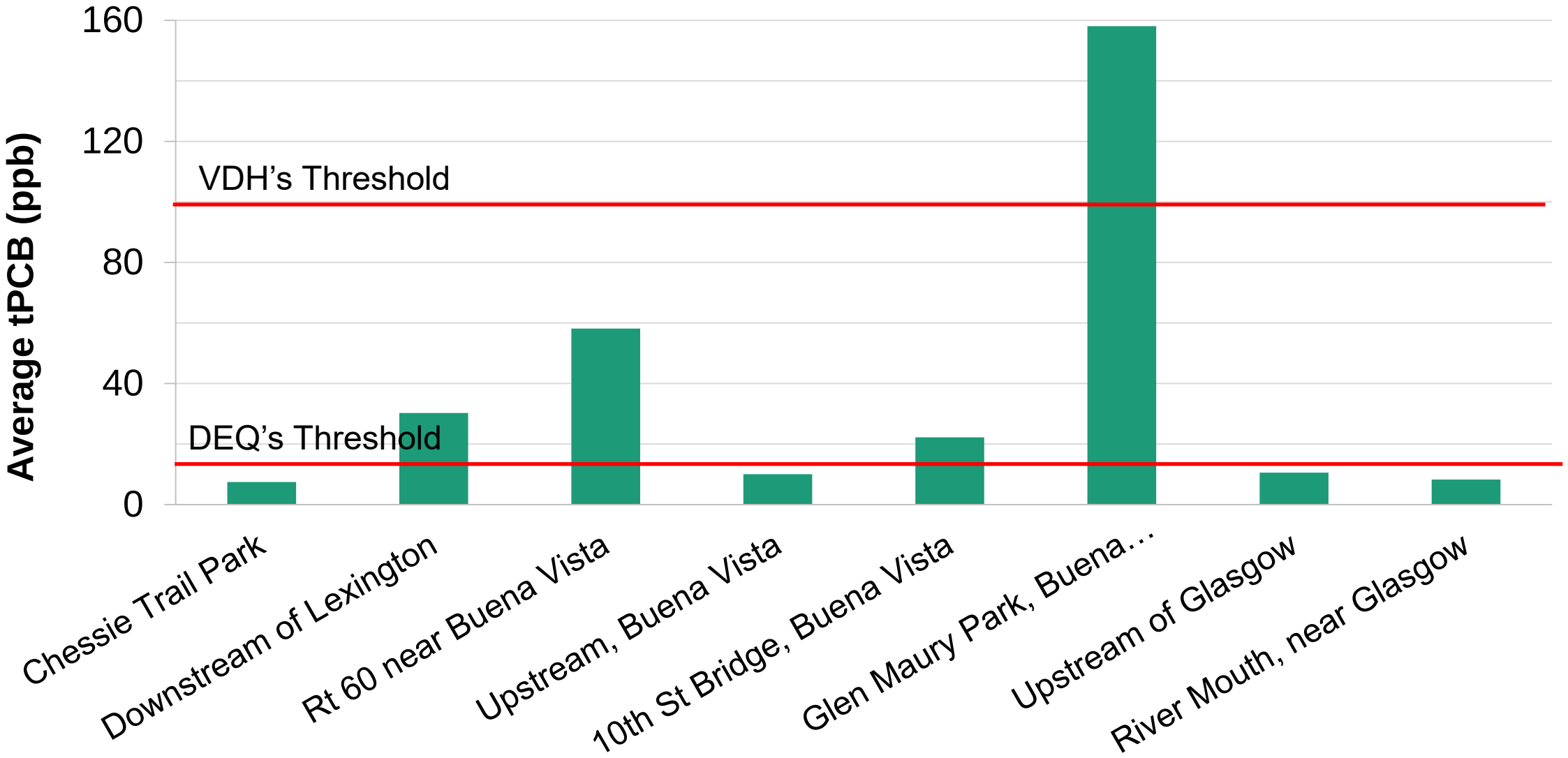
Note, all distances between sites are not equal

Average Jackson River Fish Tissue Concentrations (1995-2017)



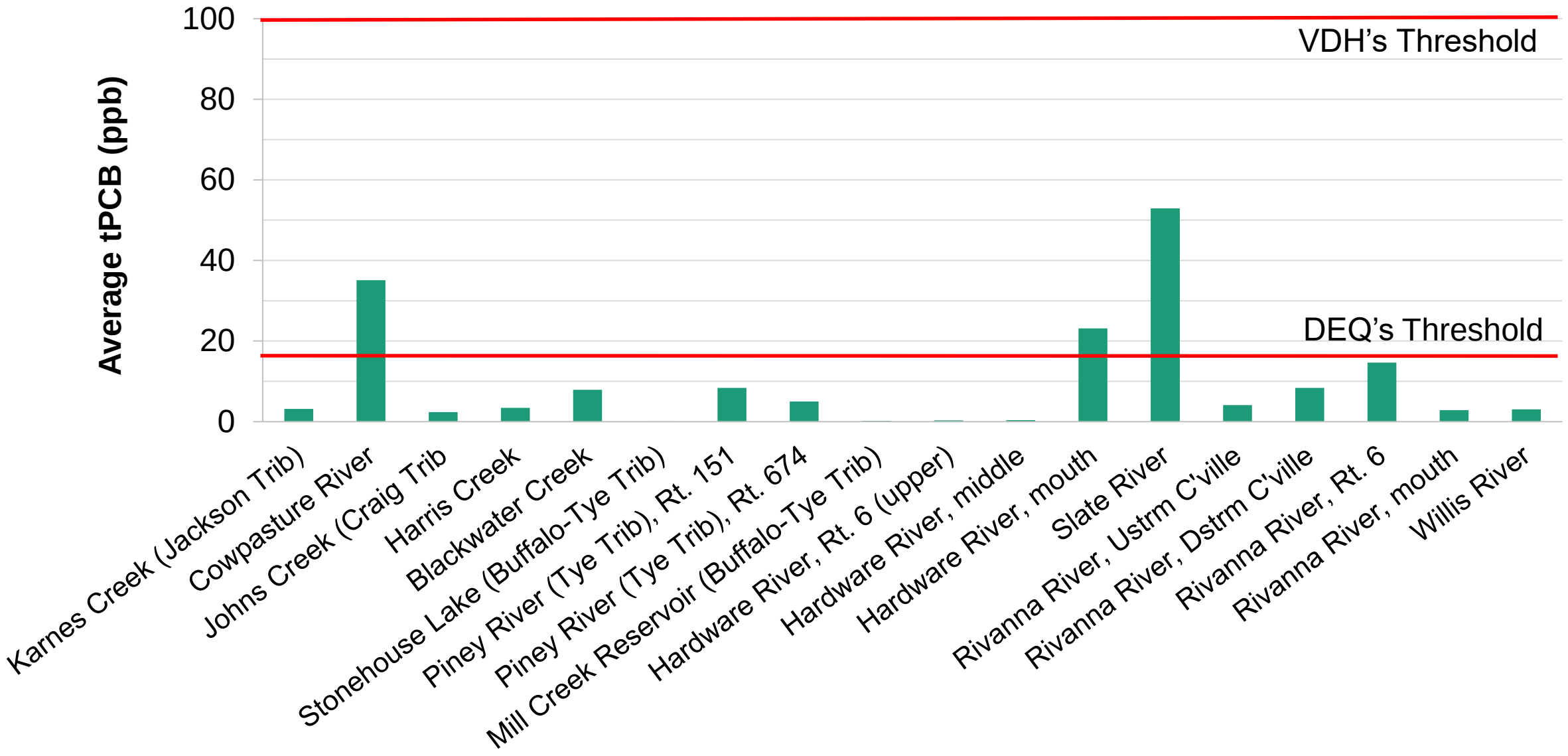
Note, all distances between sites are not equal

Average Maury River Fish Tissue Concentrations (1995-2019)



Note, all distances between sites are not equal

Average James River Fish Tissue Concentrations in Other Tributaries (1995-2018)

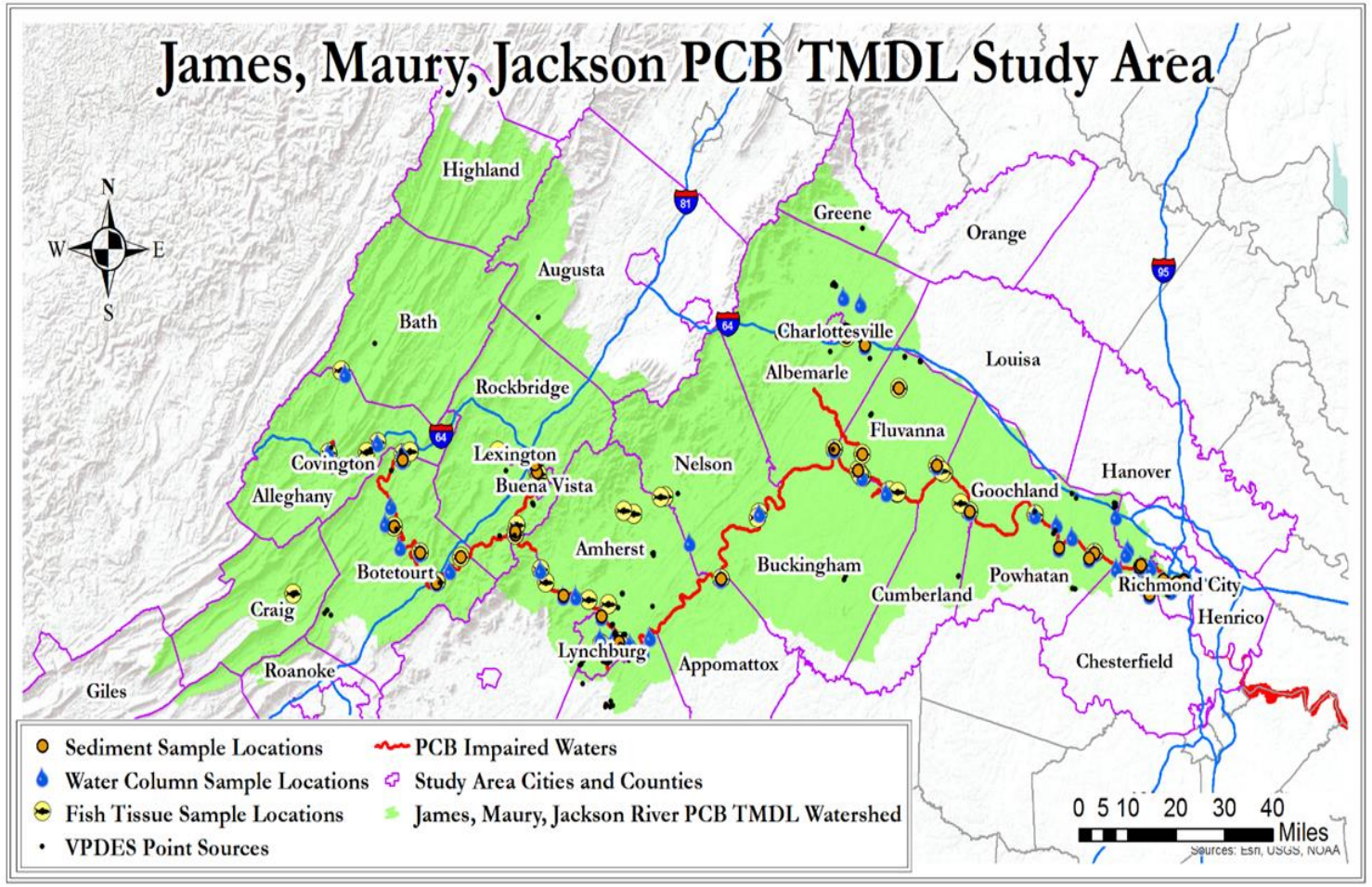


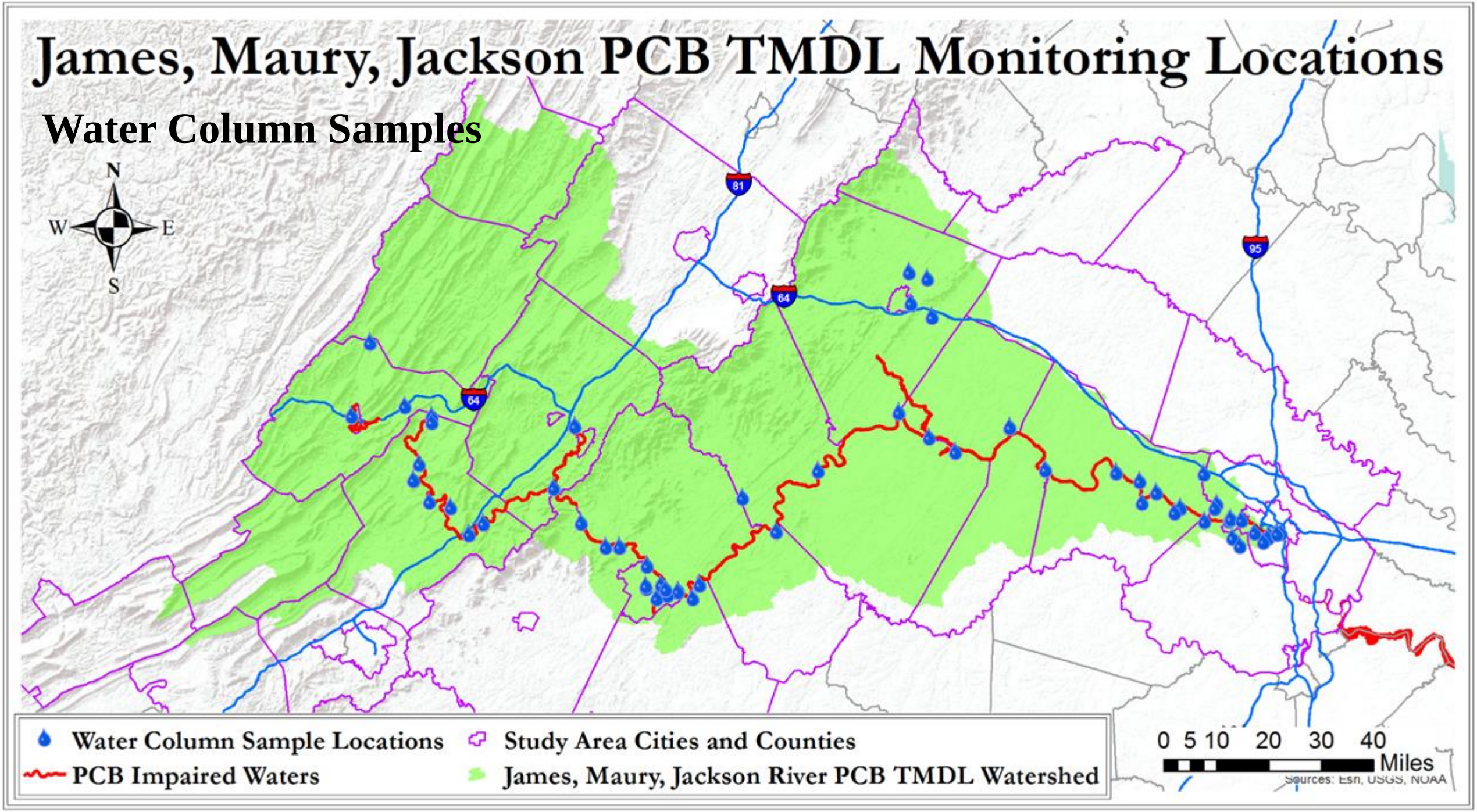
Note, tributaries are arranged from upstream to downstream

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 & Base Flow (n = 157)
  - Sediment samples (n = 26)




James, Maury, Jackson PCB TMDL Monitoring Locations
Water Column Samples
N
W
E
S
81
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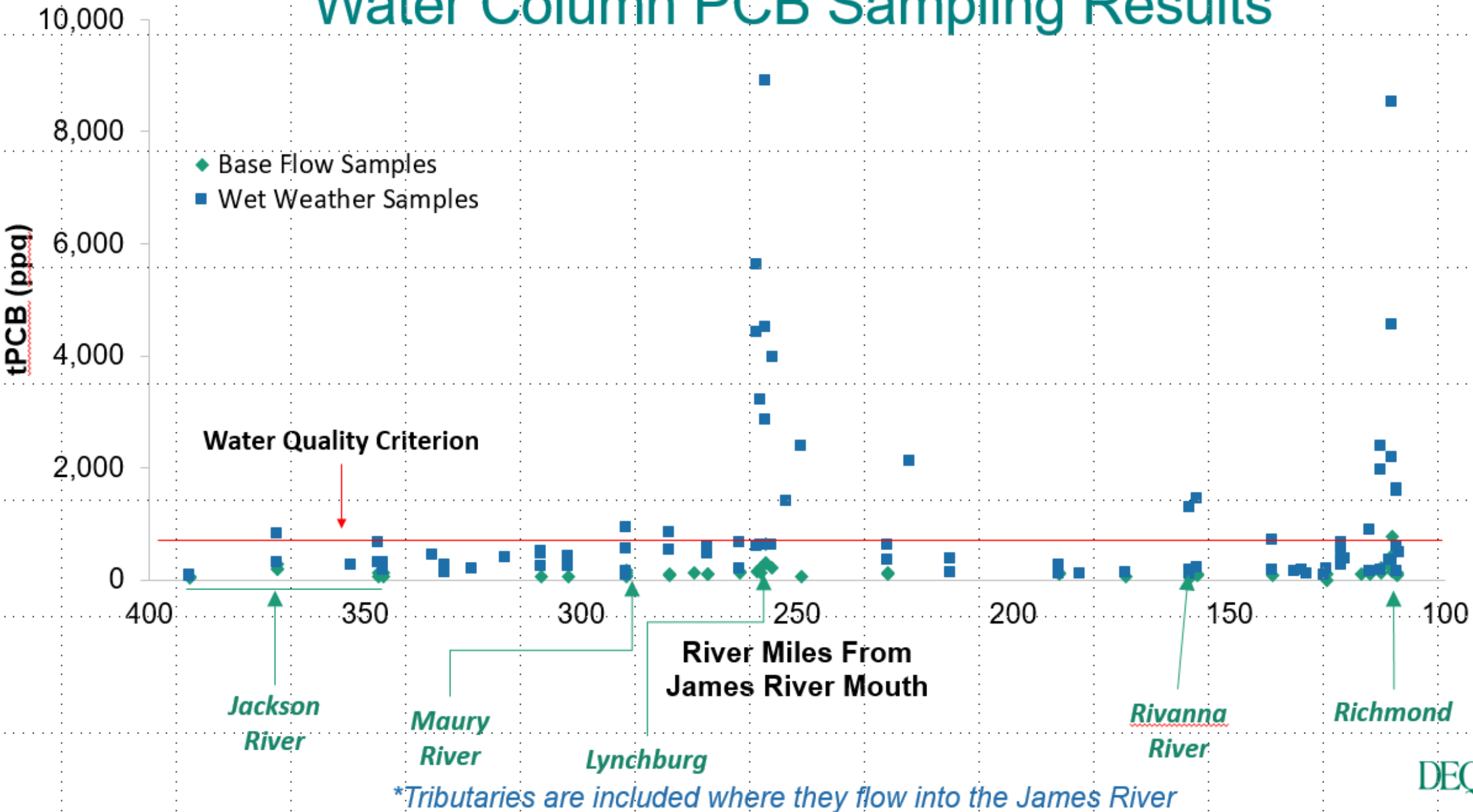
95
Water Column Sample Locations
Study Area Cities and Counties
PCB Impaired Waters
James, Maury, Jackson River PCB TMDL Watershed
0 5 10 20 30 40
Miles
Sources: Esri, USGS, NOAA

Water Column PCB Sampling Results

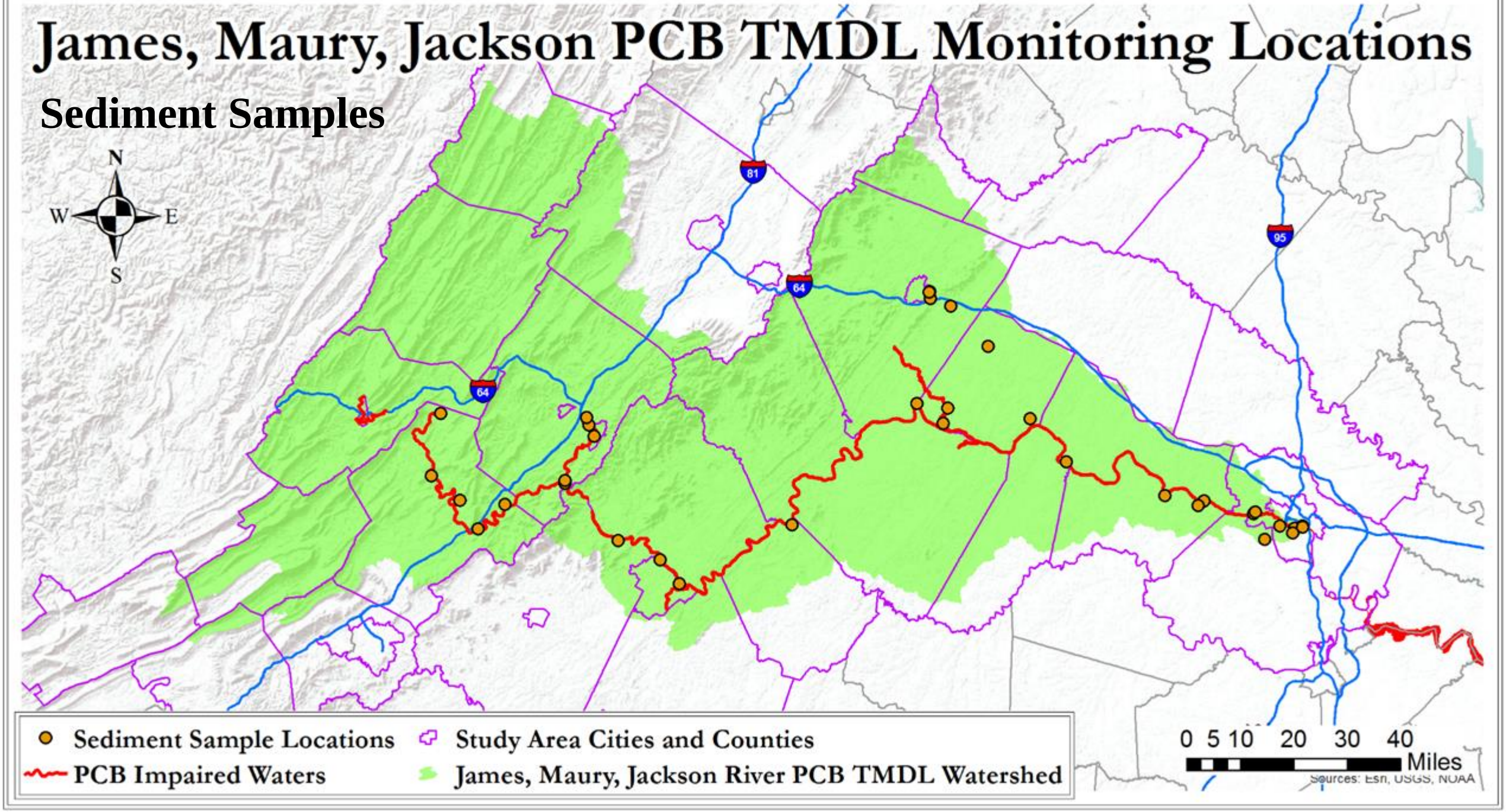


*Tributaries are included where they flow into the James River

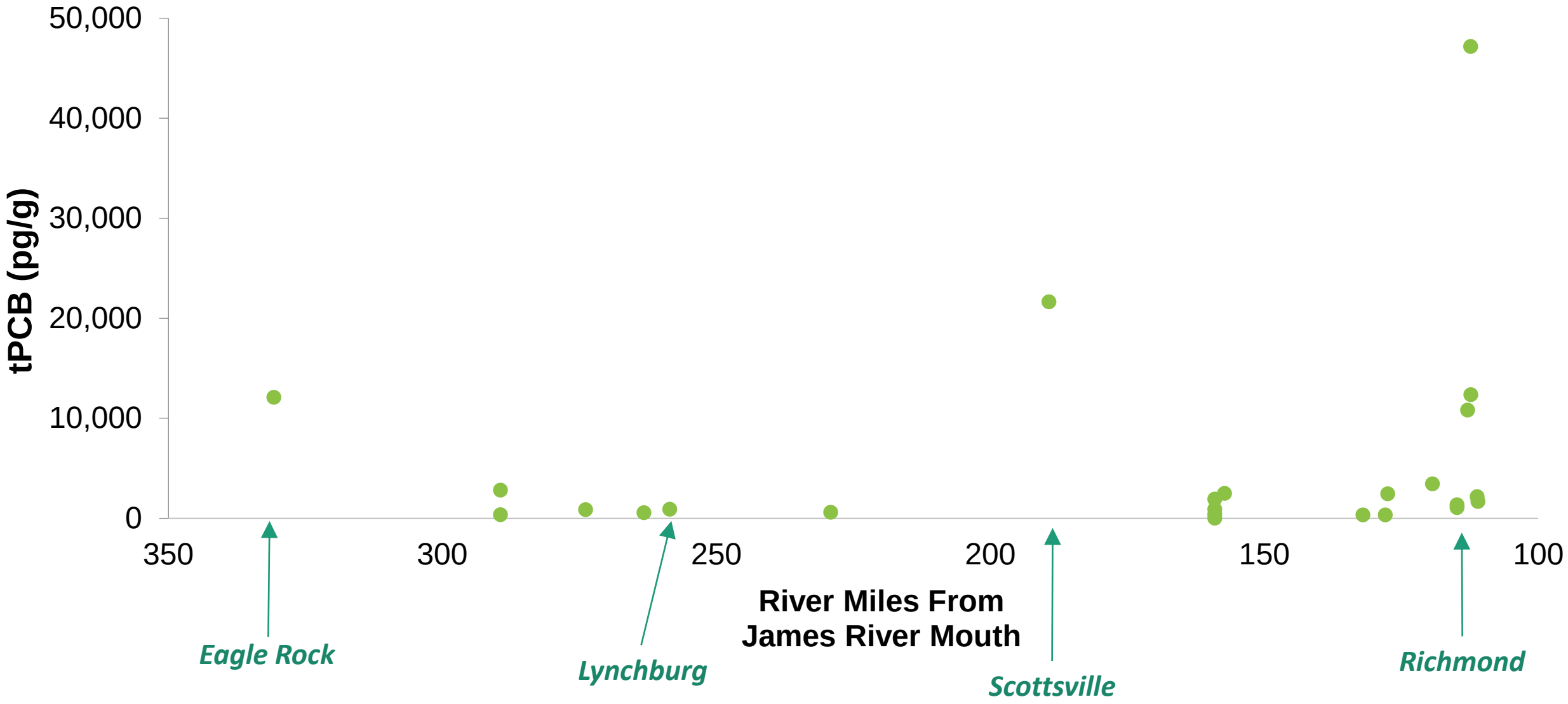
DEQ

James, Maury, Jackson PCB TMDL Monitoring Locations

Sediment Samples



Sediment PCB Sampling Results



*Tributaries are included where they flow into the James River

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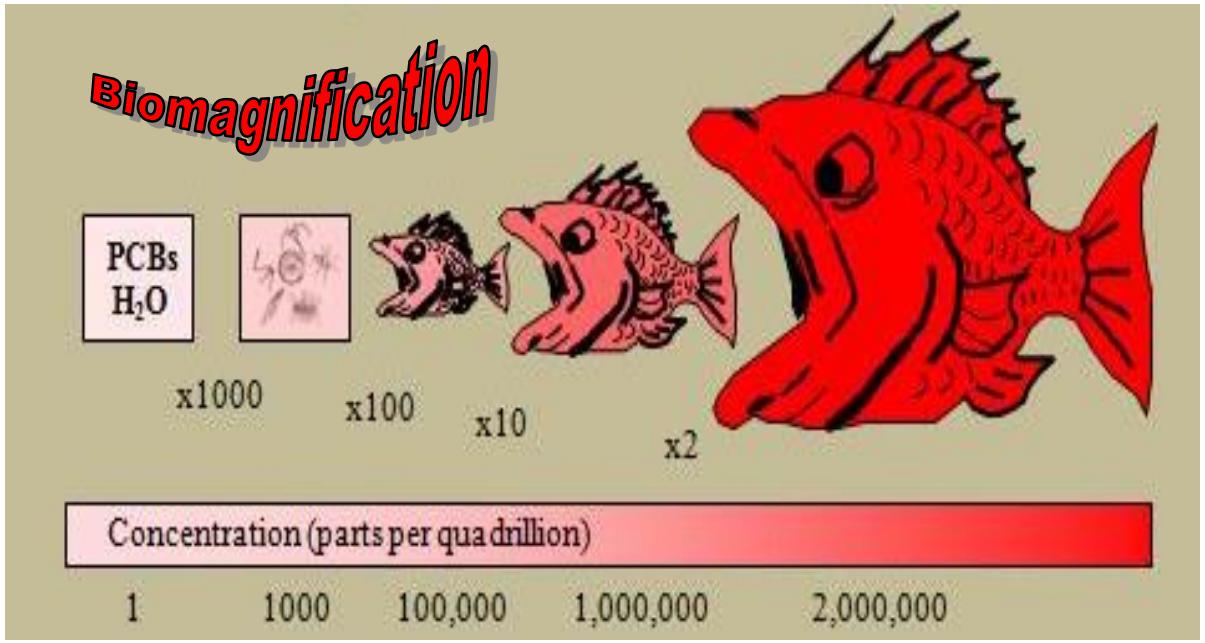
TMDL Endpoints

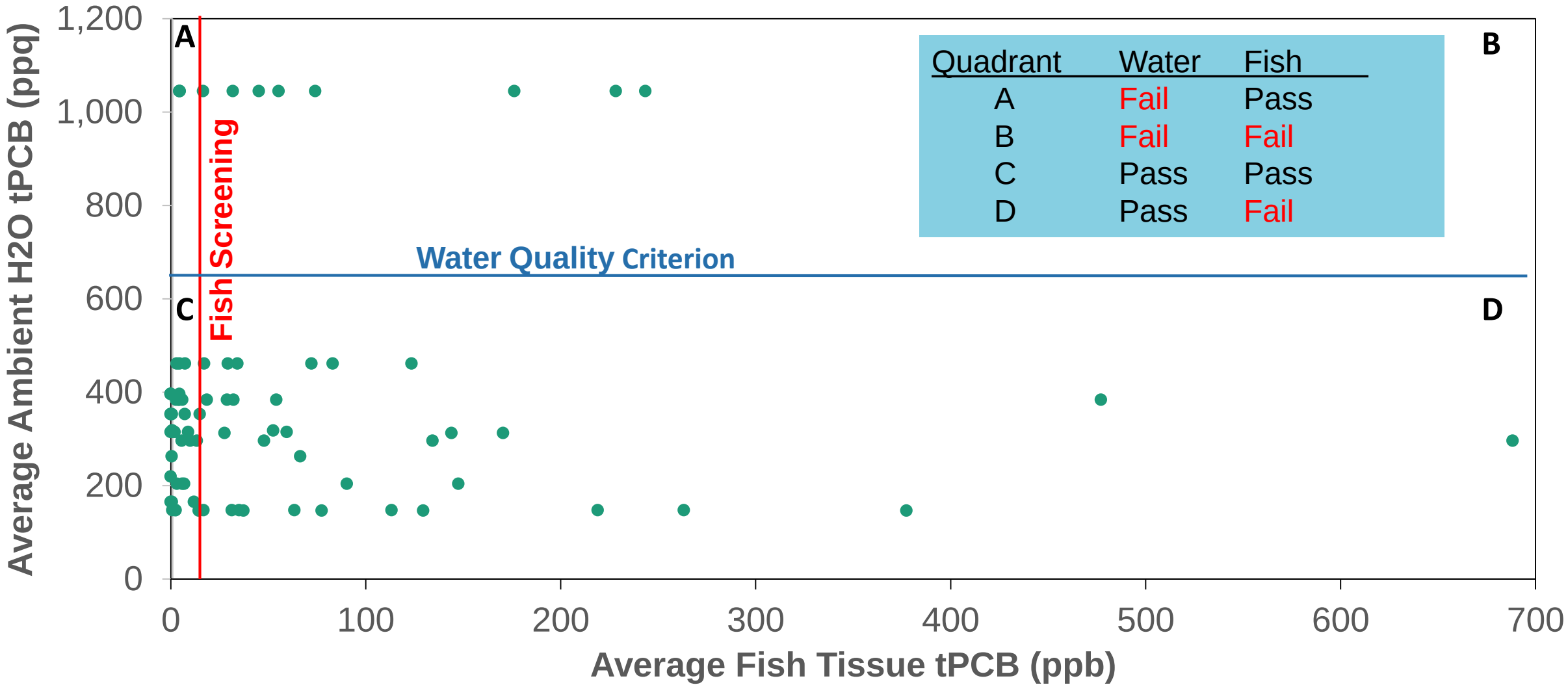
Site Specific TMDL Endpoint

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



DEQ

Average Fish Tissue Concentration vs. Average Water Concentrations



DEQ

Determining a PCB Endpoint: Two Options

Use water quality criterion

*640 pg/L

Default if < site specific value

*Impending Revision = 580 (pg/L)

Calculate site-specific value

Based on fish tissue samples from impaired stream

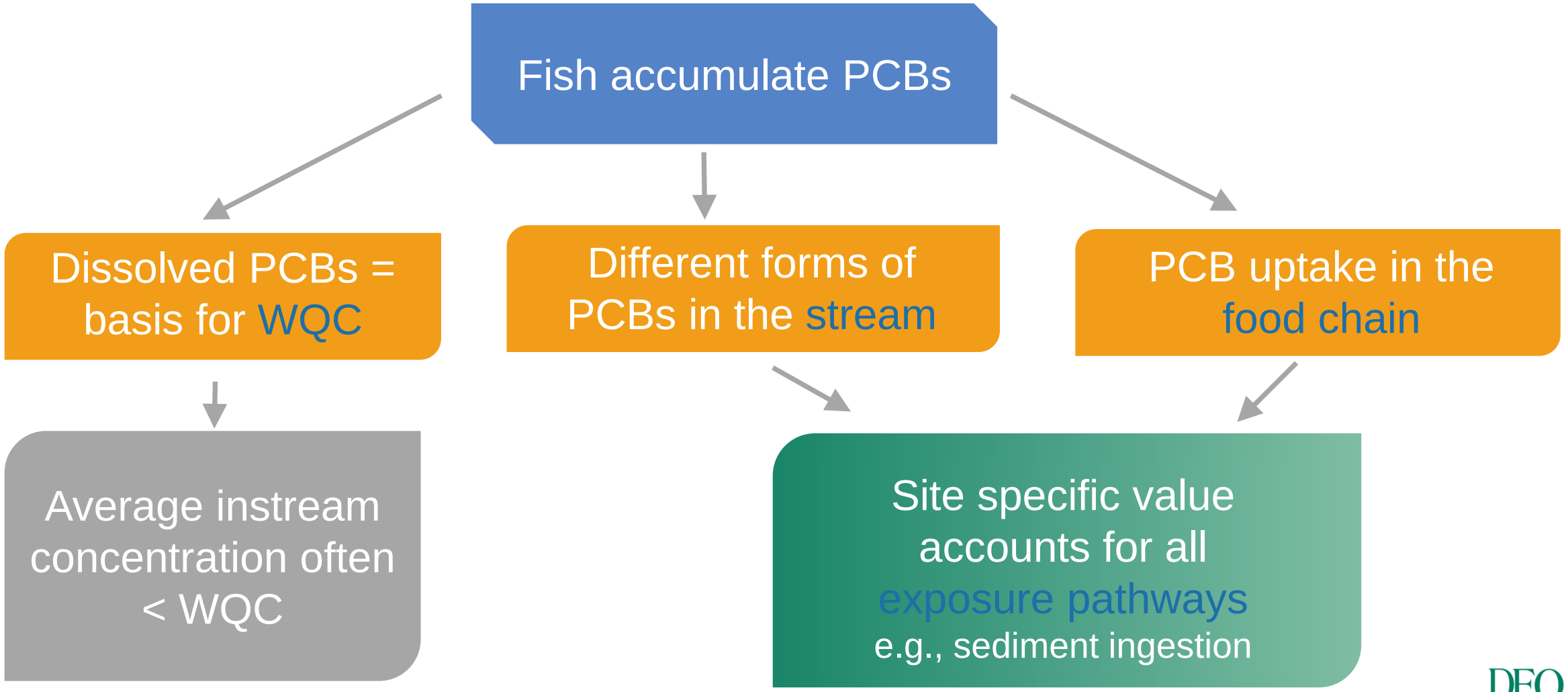
Calculate bioaccumulation factor for each species

PCB levels in the stream ⟷ PCB levels in fish tissue

Bioaccumulation Factor Approach (BAF)

DEQ

Factors to Consider for a Site-Specific Endpoint



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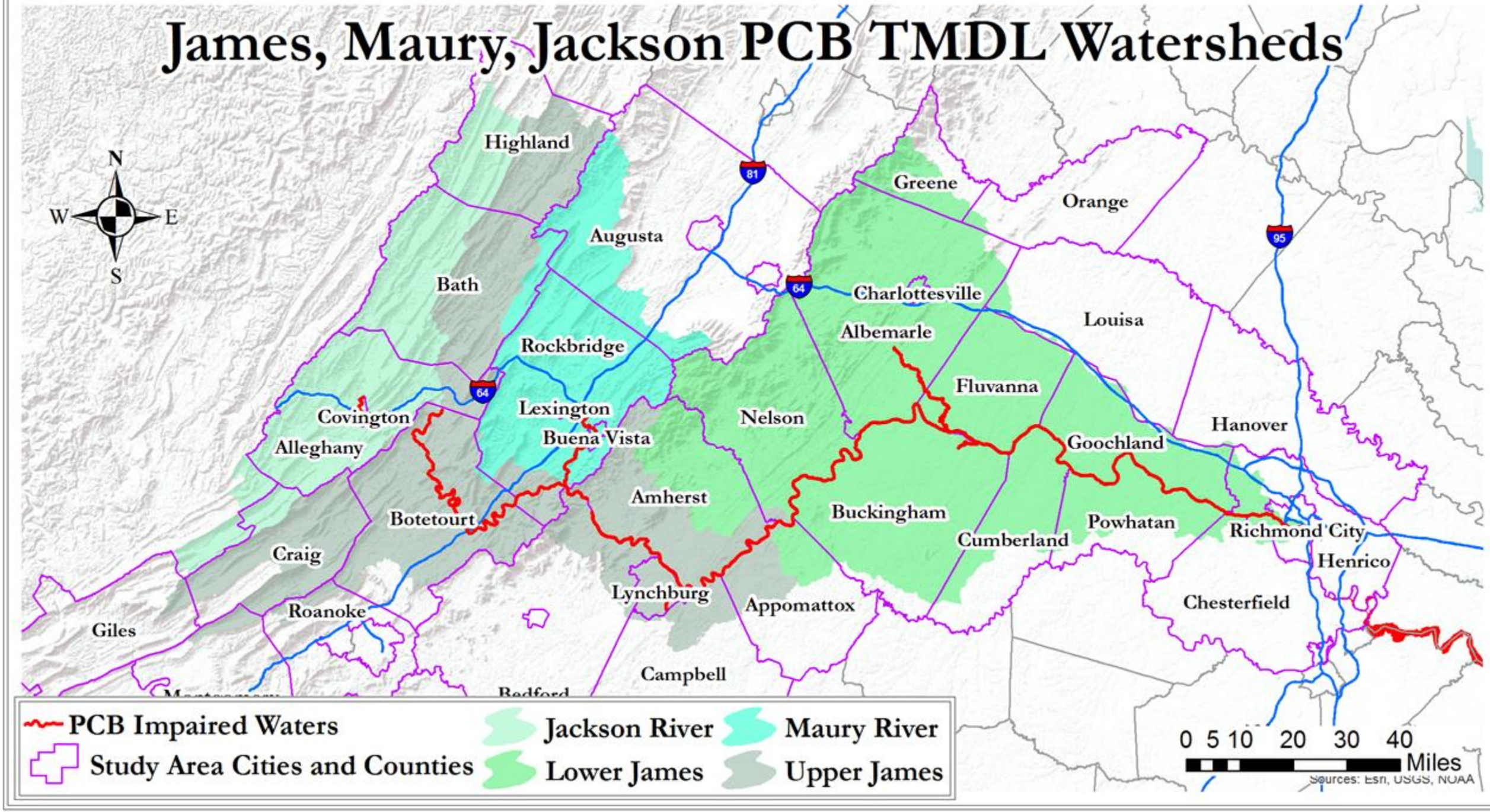
Calculating a bioaccumulation factor (BAF)

Within the home range of a fish species

Within a TMDL watershed

Ratio of Water PCBs and Fish Tissue PCBs → Normalized for freely dissolved PCBs and fish tissue lipid content → Median of home range values → Normalized by median fish lipid content & freely dissolved PCBs → Normalized values divided by fish tissue threshold value (18 ppb)

- BAF values are calculated for each fish species in a TMDL watershed
- The TMDL endpoint is based on some average of selected fish species BAF values


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

BAF Endpoint Selection

- BAFs are calculated for each fish species in each TMDL watershed
- Three Scenarios Proposed:
  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 ppq*	n/a*	n/a*
Maury River	320 ppq	300 ppq	400 ppq
Upper James River	1,186.8 ppq*	91 ppq	120 ppq
Lower James River	140 ppq	61 ppq	52 ppq

**These cases would default to a TMDL endpoint equal to the criterion = 640 ppq*

DEQ

Sources Considered in PCB TMDL Development

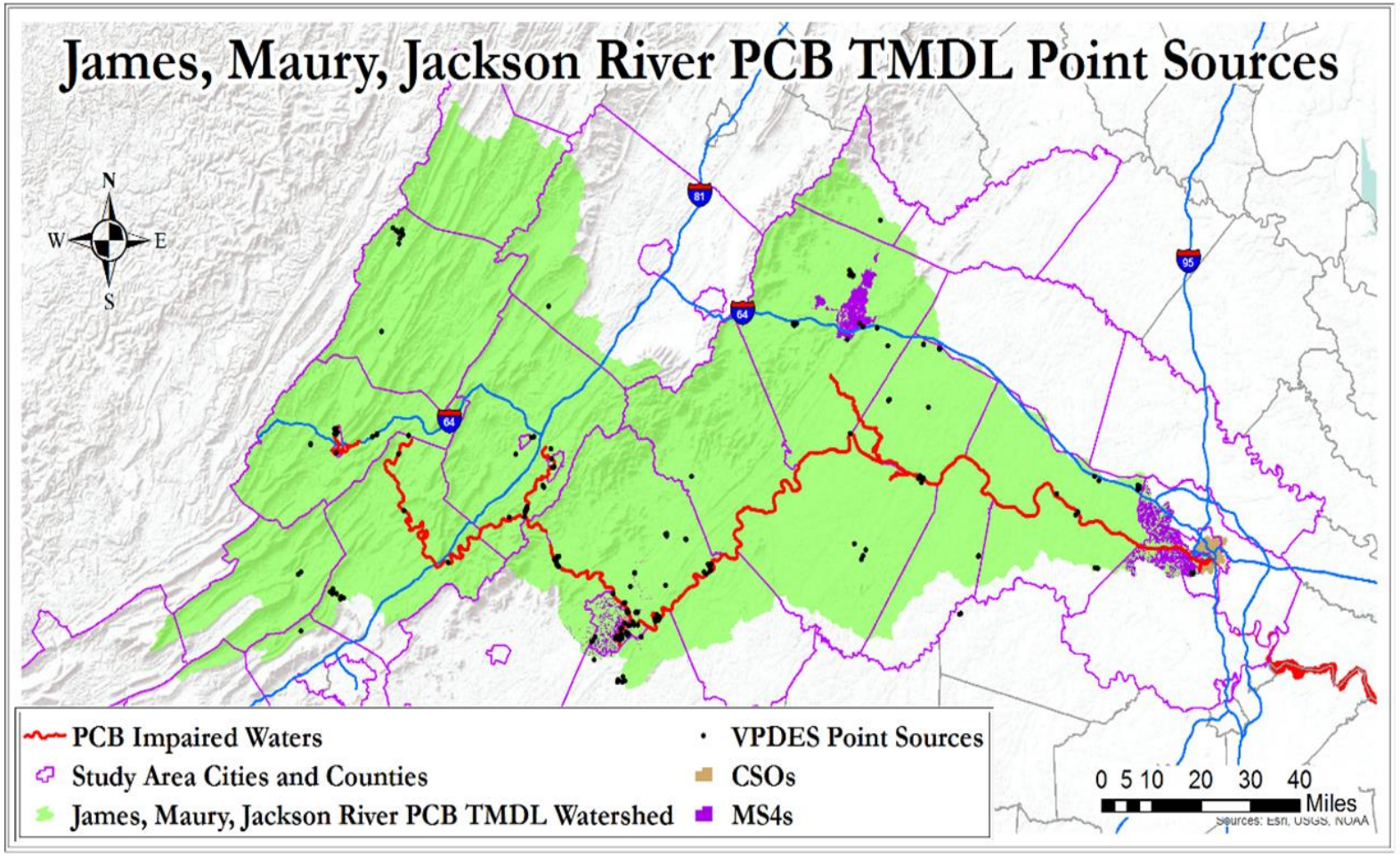
TMDL Source Category:

Permitted facilities

(26) Municipal WWTPs
(2) CSOs

(73) Industrial Facilities
- Individual (Large)
- Storm Water General Permits

(11) Regulated Storm Water (*MS4s)



** Municipal Separate Storm Sewer System*

DEQ

TMDL Source Category:

Contaminated sites

Brownfields

Spill sites

Electric Utility Transformer Pads

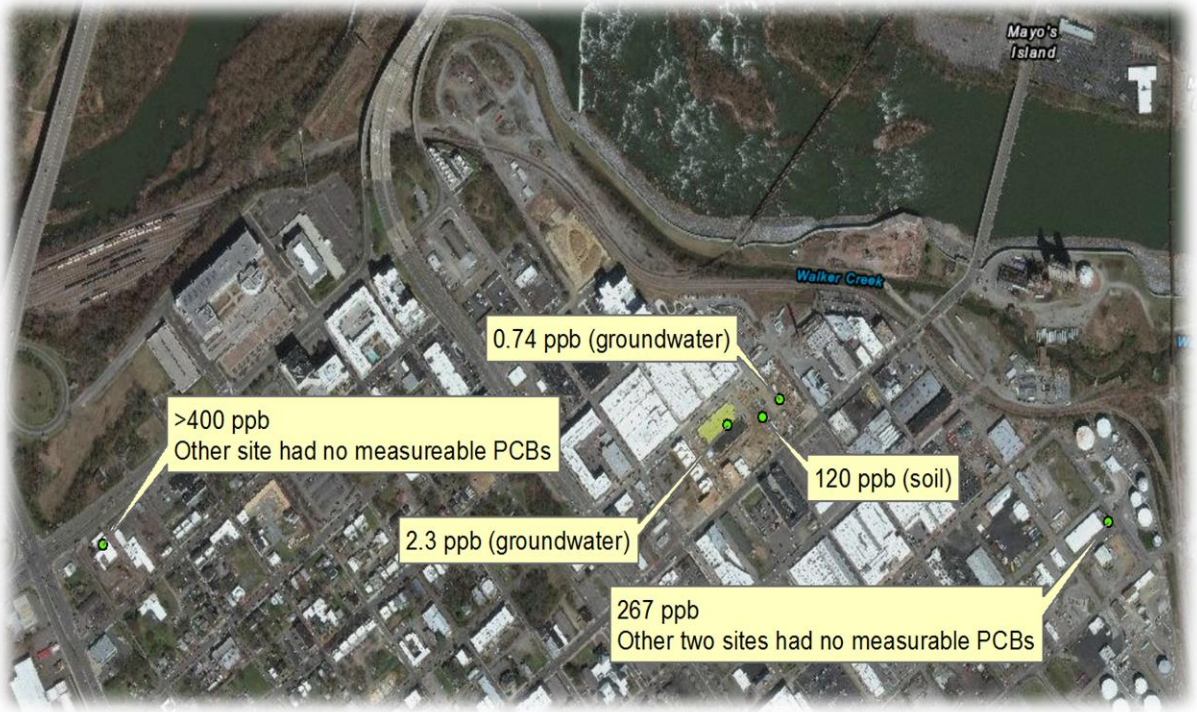
Rail Yards/Spurs

Voluntary remediation program (DEQ)

~~RCRA Corrective Action~~

Sites reviewed for PCBs as a Contaminant of Concern (COC):

- 12 RCRA sites – 0 with PCBs
- Over 40 VRP sites - 1 with PCBs
- Over 80 Brownfield sites - 2 with PCBs



DEQ

TMDL Source Categories:

Unregulated surface load

Atmospheric deposition

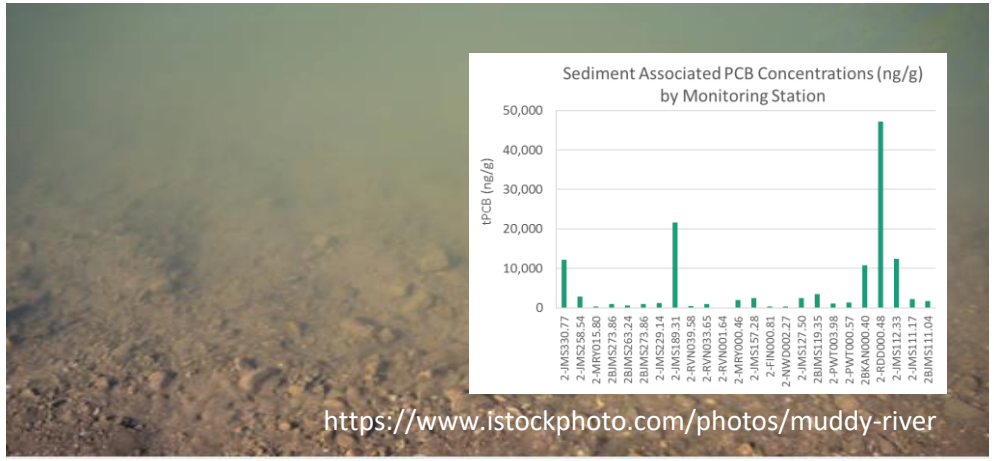
Unregulated Stormwater

Unidentified Contaminated Sites

Streambed sediment

Loads from small tributaries

Unspecified Point Sources



https://www.istockphoto.com/photos/muddy-river

Modeling PCBs

James, Maury, Jackson PCB TMDL TAC Meeting

August 2, 2022

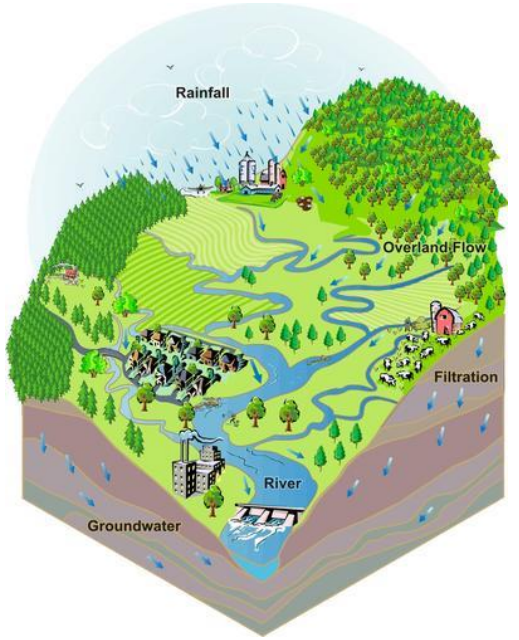
Model Process

- PCB model consists of

  3 major components:

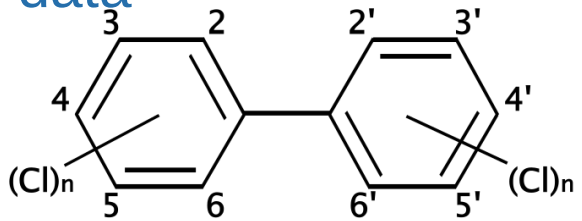
  1. Hydrology
  2. Sediment transport
  3. PCB fate and transport

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



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

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

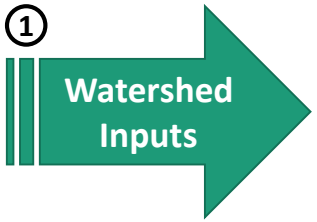


https://upload.wikimedia.org/wikipedia/commons/thumb/4/49/Polychlorinated_biphenyl_structure.svg/2000px-Polychlorinated_biphenyl_structure.svg.png

DEQ

How is the model used?

1. Watershed inputs are used to develop model.



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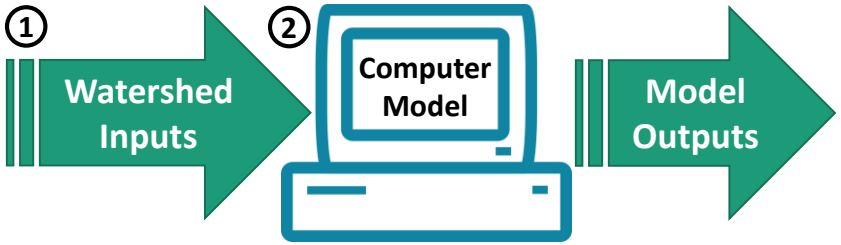
2. Model simulates watershed processes (flow, pollutant fate and transport).



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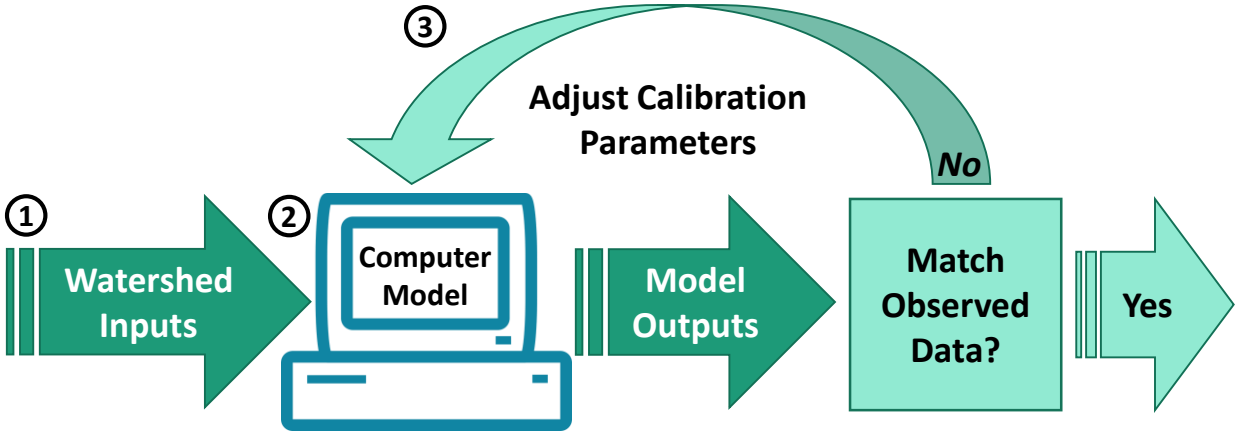

DEQ

How is the model used?

1. Watershed inputs are used to develop model.
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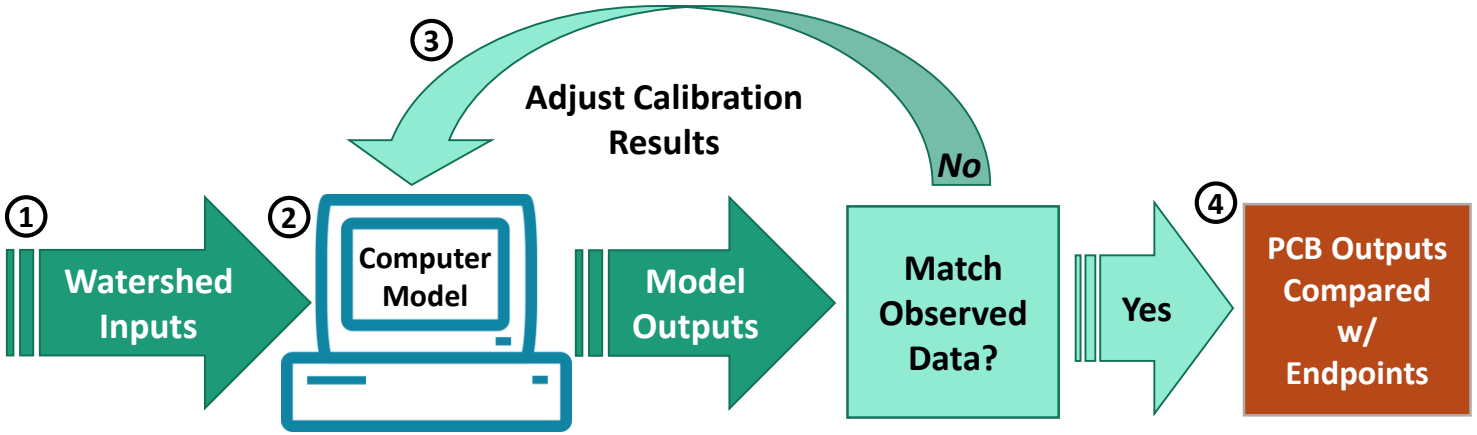
3. Model is calibrated to observed data.
4. Calibrated PCB outputs are compared with TMDL endpoints.



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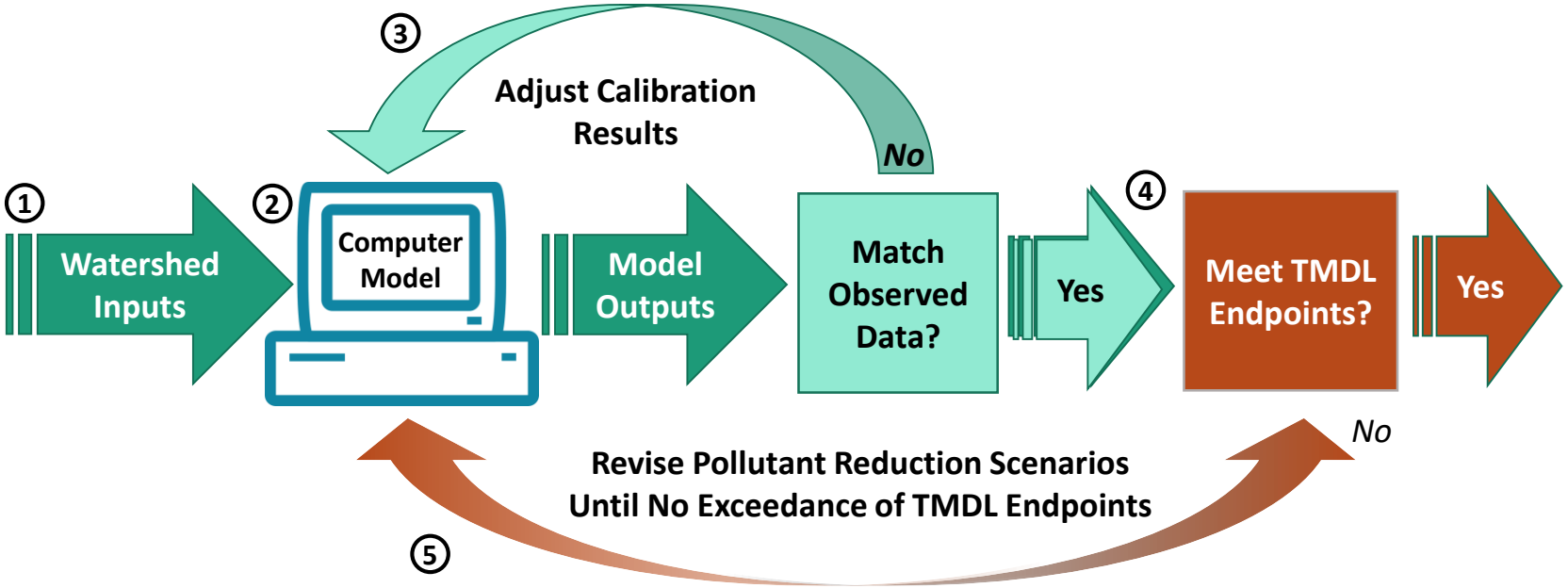

5. Model allows evaluation of multiple pollution reduction scenarios.

DEQ

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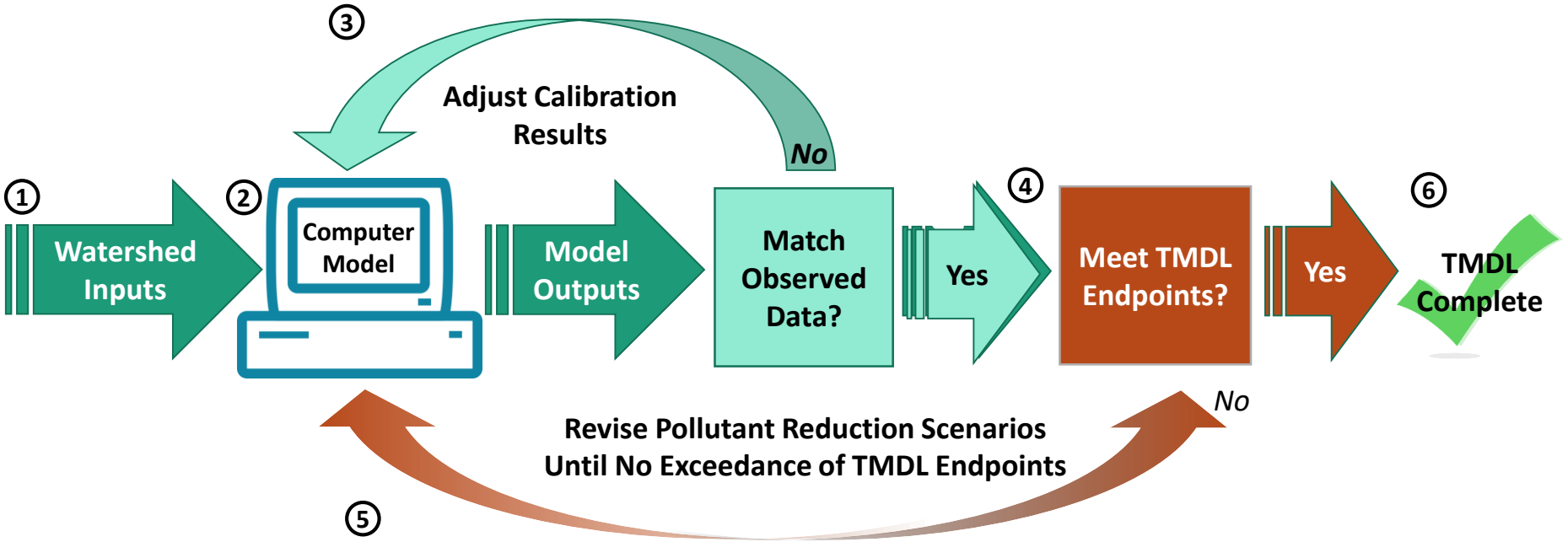


5. Model allows evaluation of multiple pollution reduction scenarios.
6. Stakeholders select acceptable reduction scenario to achieve TMDL.

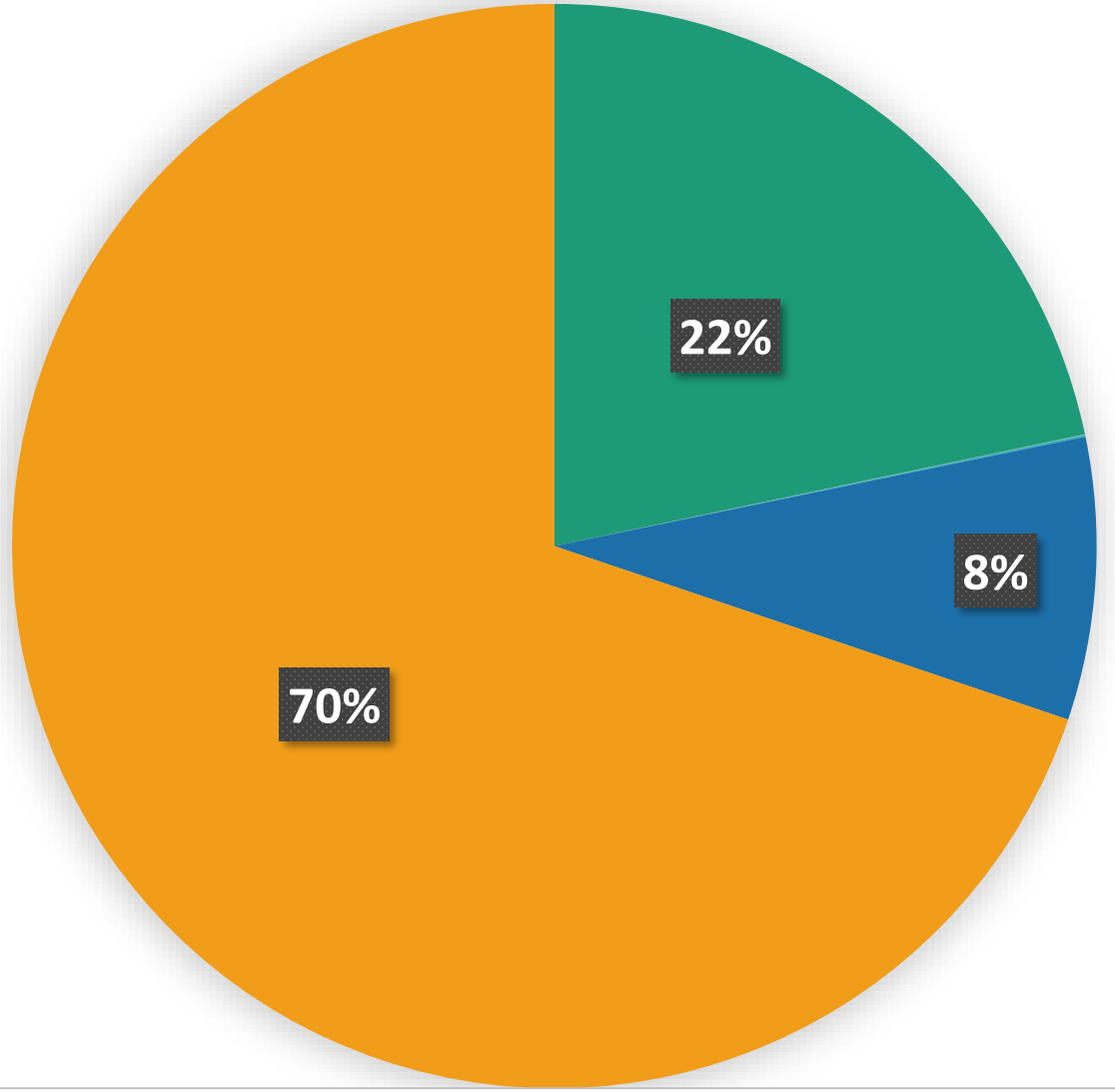
DEQ

PCB Allocations

DEQ

Annual Relative Contributions to PCB Concentrations at the Jackson River Outlet

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



Jackson River PCB Allocations (Consistent w/Existing WQC)

Allocation Scenario	Required PCB Loading Reductions to Meet TMDL Endpoint, %						% Exceedance of WQC (640 pg/L)	Daily Mean tPCB conc. (pg/L)	Daily Median tPCB conc. (pg/L)
	Loads from Permitted Sources	Loads from Nonregulated Surface Sources	Loads from Streambed Sediments	Spills	Known Contam. Sites	Atm. Deposition			
Existing Conditions	0	0	0	0	0	0	13	531	220
0% Exceedance of WQC	51	86	0	100	0	0	0	198	177

Allocations based on meeting ≤ 10% instream exceedance rate and 0% Exceedance of current WQC

Jackson River PCB Allocations (Revised Criterion)

- Scenario includes:
  - Use of the revised numeric WQC (580 pg/L) as TMDL Endpoint
  - Application of tPCB WQS footnote - “Long Term Average”

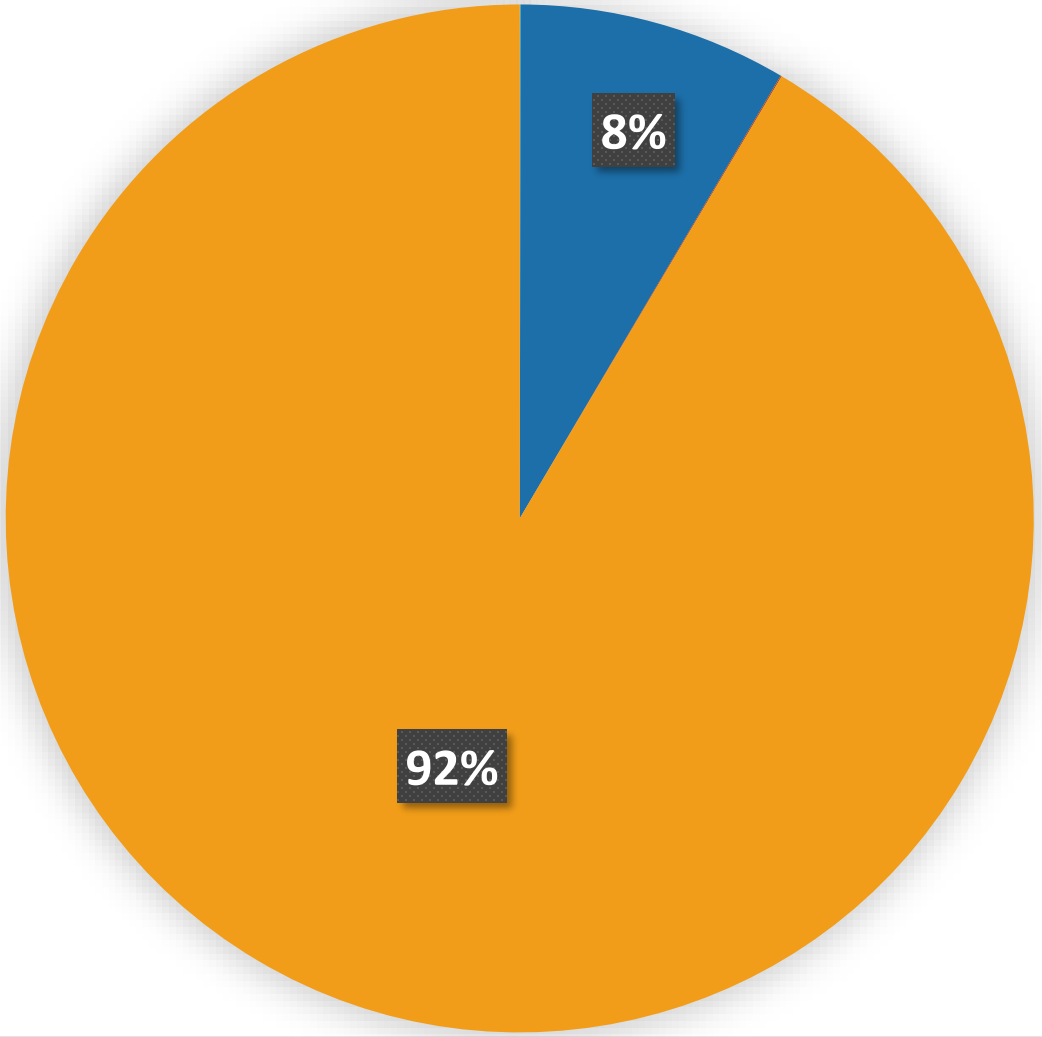
Allocation Scenario	Required PCB Loading Reductions to Meet the TMDL Endpoint (%)						Exceedance of 580 pg/L (%)	Daily Mean tPCB conc. (pg/L)	Daily Median tPCB conc. (pg/L)
	Loads from Permitted Sources	Loads from Nonregulated Surface Sources	Loads from Streambed Sediments	Spills	Known Contam. Sites	Atm. Deposition			
Existing Conditions	**0**	**0**	**0**	**0**	0	0	**13.2**	**531**	**220**
Allocated Conditions*	**56**	**19**	**0**	**100**	0	0	**12.6**	**397**	**114**
0% Exceedance of 580 pg/L	**56**	**86**	**0**	**100**	**0**	**0**	**0**	**140**	**114**

**Daily simulated PCB concentration closest to the upper 95% CL that is greater than the endpoint but no greater than the 90th percentile of the model output dataset*

DEQ

Annual Relative Contributions to PCB Concentrations at the Maury River Outlet

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



Maury River PCB Allocations (Consistent w/Existing WQC)

Allocation Scenario	Required PCB Loading Reductions to Meet TMDL Endpoint, %						TMDL Endpoint Exceedance (%)			% Exceedance (640 pg/L)	Daily Mean tPCB conc. (pg/L)
	Loads from Permitted Sources	Loads from Nonregulated Surface Sources	Loads from Streambed Sediments	Spills	Known Contam. Sites	Atm. Deposition	Scenario 1 (320 pg/L)	Scenario 2 (300 pg/L)	Scenario 3 (400 pg/L)		
Existing Conditions	0	0	0	0	0	0	14	14	13	13	648
Scenario 1 (≤10% Exceedance of 320 pg/L)	**99.4**	**94**	**0**	**100**	**0**	**0**	**1**	**1**	**<1**	**0**	**18**
Scenario 2 (≤10% Exceedance of 300 pg/L)	**99.5**	**94**	**0**	**100**	**0**	**0**	**1**	**1**	**<1**	**0**	**18**
Scenario 3 (≤10% Exceedance of 400 pg/L)	**99.3**	**94**	**0**	**100**	**0**	**0**	**1**	**1**	**<1**	**0**	**18**

Allocations based on meeting ≤ 10% instream exceedance rate and 0% Exceedance of current WQC

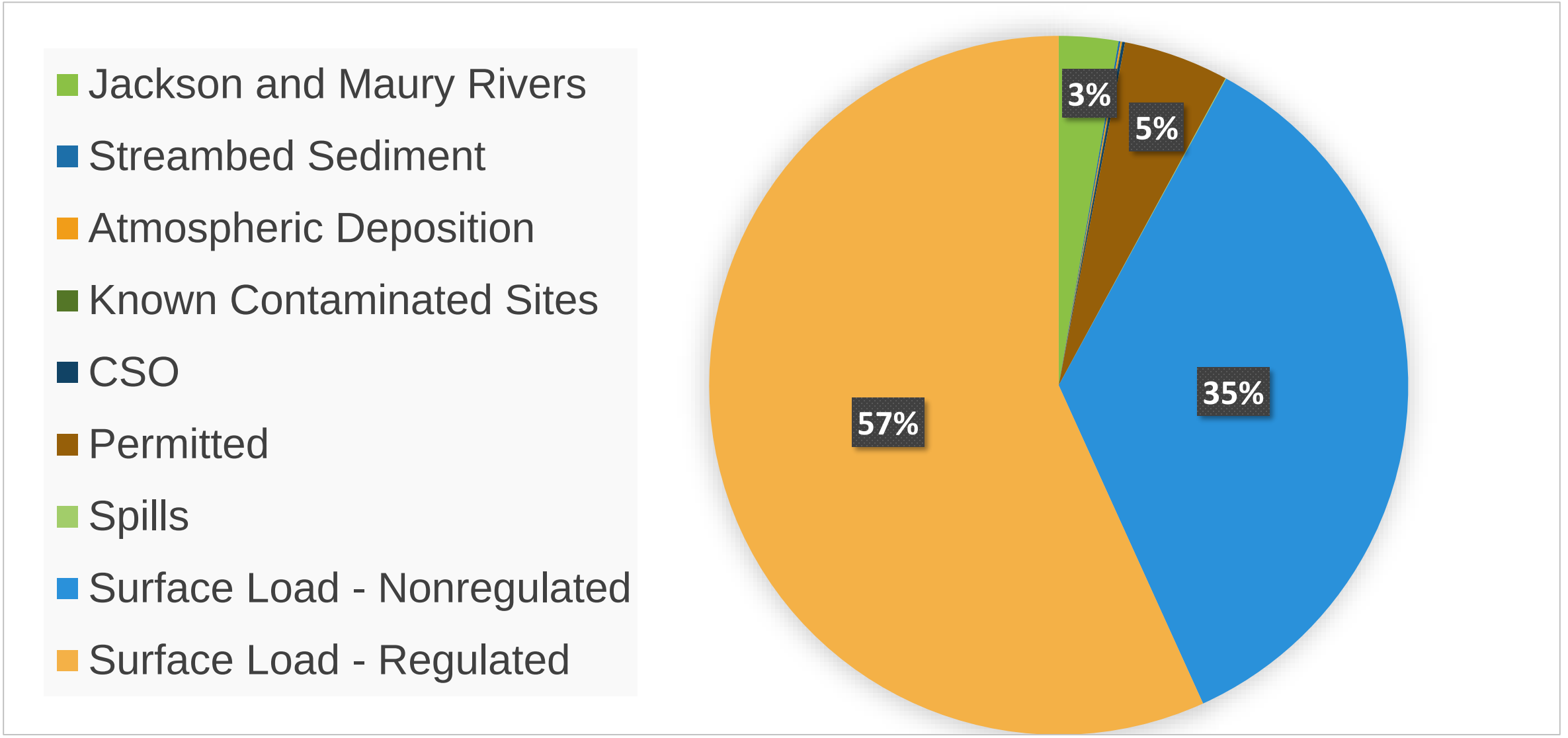
Maury River PCB Allocations (Proposed WQC)

- Scenario includes:
  - Suggested site specific BAF (400 pg/L) selected as the TMDL Endpoint
  - Application of footnote - “Long Term Average”

Allocation Scenario	Required PCB Loading Reductions to Meet the TMDL Endpoint (%)						Exceedance of 580 pg/L (%)	Daily Mean tPCB conc. (pg/L)
	Loads from Permitted Sources	Loads from Nonregulated Surface Sources (SW)	Loads from Streambed Sediments	Spills	Known Contam. Sites	Atm. Deposition		
Existing Conditions	0	0	0	0	0	0	13.2	649
Allocated Conditions*	**99.3**	**0**	**0**	**100**	**0**	**0**	**12.6**	**538**
0% Exceedance of 580 pg/L	99.3	94	0	100	0	0	0	18

**Daily simulated PCB concentration closest to the upper 95% CL that is greater than the endpoint but no greater than the 90th percentile of the model output dataset*

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



Upper James River PCB Allocations (Consistent w/Existing WQC)

Allocation Scenario	Required PCB Loading Reductions to Meet TMDL Endpoint, %							TMDL Endpoint Exceedance (%)			Daily Mean tPCB conc (pg/L)	Daily Median tPCB conc (pg/L)
	Loads from Jackson and Maury Rivers	Loads from Permitted Sources[1]	CSOs	Loads from Surface Sources		Loads from Streambed Sediments	Spills	Scenario 1 (640 pg/L)	Scenario 2 (91 pg/L)	Scenario 3 (120 pg/L)		
				MS4 Permits	Non-Regulated Areas							
Existing Conditions	0	0	0	0	0	0	0	15	57	47	308	103
Scenario 1 *(0% Exceedance of 640 pg/L)*	**85**	**94.7**	**68**	**85**	**84**	**0**	**100**	**0**	**16**	**13**	47	16
Scenario 2 *(≤10% Exceedance of 91 pg/L)*	**85**	**99.1**	**68**	**95**	**95**	**0**	**100**	**0**	**5**	**2**	18	6
Scenario 3 *(≤10% Exceedance of 120 pg/L)*	**85**	**98.9**	**68**	**90**	**90**	**0**	**100**	**0**	**12**	**8**	33	12

Allocations based on meeting ≤ 10% instream exceedance rate and 0% Exceedance of current WQC; Load reductions from Contaminated Sites and Atmospheric deposition are also set to 0%.

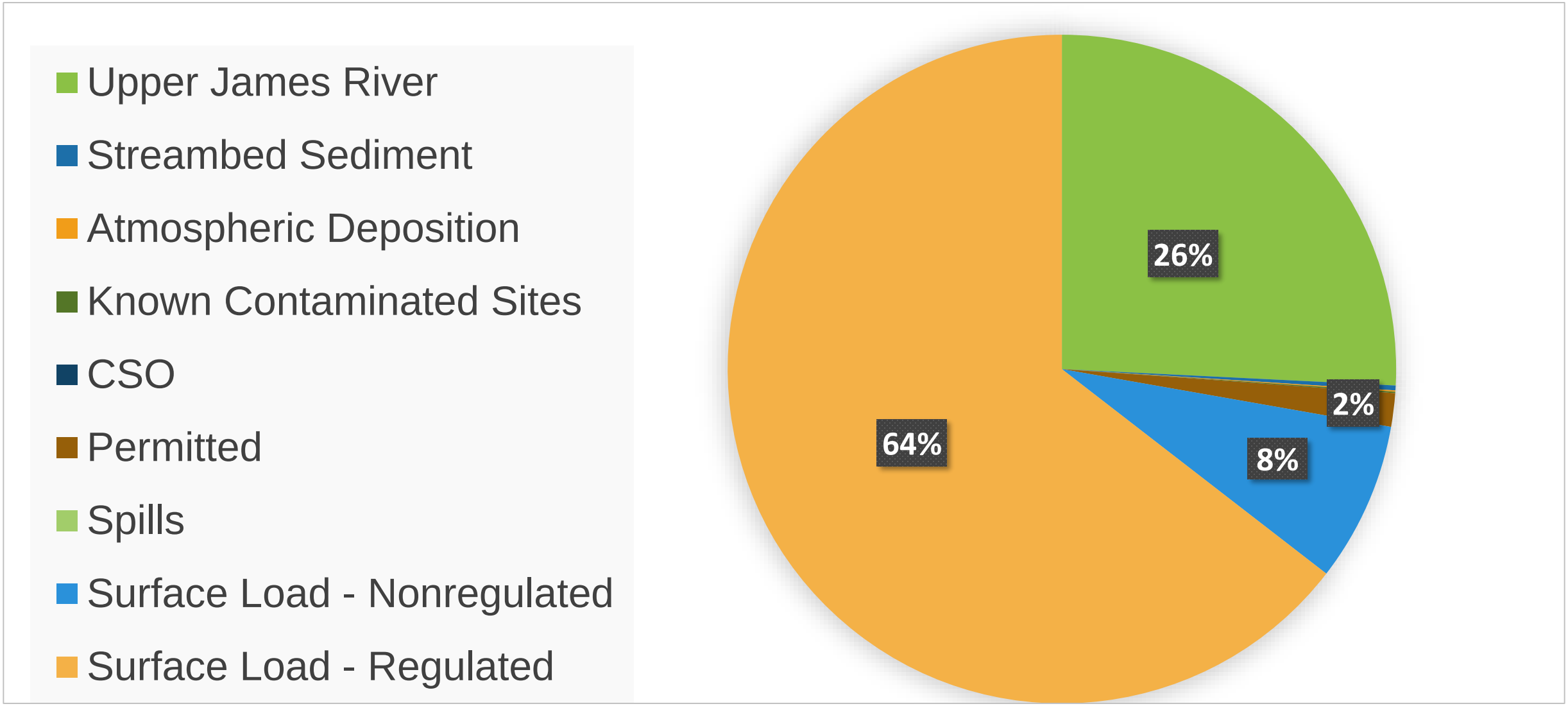
Upper James River PCB Allocations (Proposed WQC)

- Scenario includes:
  - Suggested site specific BAF (TBD pg/L) as the TMDL Endpoint
  - Application of footnote - “Long Term Average”

Scenarios under development

DEQ

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



Lower James River PCB Allocations (Consistent w/Existing WQC) – Scenarios 2 and 3 need to be updated

Allocation Scenario	Required PCB Loading Reductions to Meet TMDL Endpoint, %							TMDL Endpoint Exceedance (%)			Daily Mean tPCB conc (pg/L)
	Loads from Jackson and Maury Rivers	Loads from Permitted Sources[1]	CSOs	Loads from Surface Sources		Loads from Streambed Sediments	Spills	Scenario 1 (140 pg/L)	Scenario 2 (61 pg/L)	Scenario 3 (52 pg/L)	
				MS4 Permits	Non-Regulated Areas						
Existing Conditions	0	0	0	0	0	0	0	42	59	66	662
Scenario 1 (≤10% Exceedance of 140 pg/L)	85	95.3	92	94	44	0	100	10	18	19	45
Scenario 2 (≤10% Exceedance of 61 pg/L)	95	97.9	92	96	96	0	100	5	10	13	26
Scenario 3 (≤10% Exceedance of 52 pg/L)	90	98.2	92	98	98	0	100	0.3	8	10	17

Allocations based on meeting ≤ 10% instream exceedance rate and 0% Exceedance of current WQC; Load reductions from Contaminated Sites and Atmospheric deposition are also set to 0%.

Lower James River PCB Allocations (Consistent w/Existing WQC) Place holder for updated table

Allocations based on meeting ≤ 10% instream exceedance rate and 0% Exceedance of current WQC; Load reductions from Contaminated Sites and Atmospheric deposition are also set to 0%.

Lower James River PCB Allocations (Proposed WQC)

- Scenario includes:
  - Suggested site specific BAF (TBD pg/L) selected as the TMDL Endpoint
  - Application of footnote - “Long Term Average”

Scenarios under development

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TMDL Implementation

- Complete TMDL - consistent with the existing WQC
- Begin addressing PCBs in watershed
  - VPDES Individual and General Permits Implementation
    - Opportunity to start screening effluent for PCBs
      - Limited PCB screening data for accurate baseline load (e.g., only 30% WWTPs provided data)
    - ISWGP Regulation is to be renewed in 2024
  - MS4 WLAs
    - TMDL completion coincides with MS4 General Permit renewal (fall 2023), Phase I renewal, plus Richmond City Integrated Permit
- Incorporate allocations for updated criterion in an Appendix
- Modify TMDL to reflect changes when WQS approved

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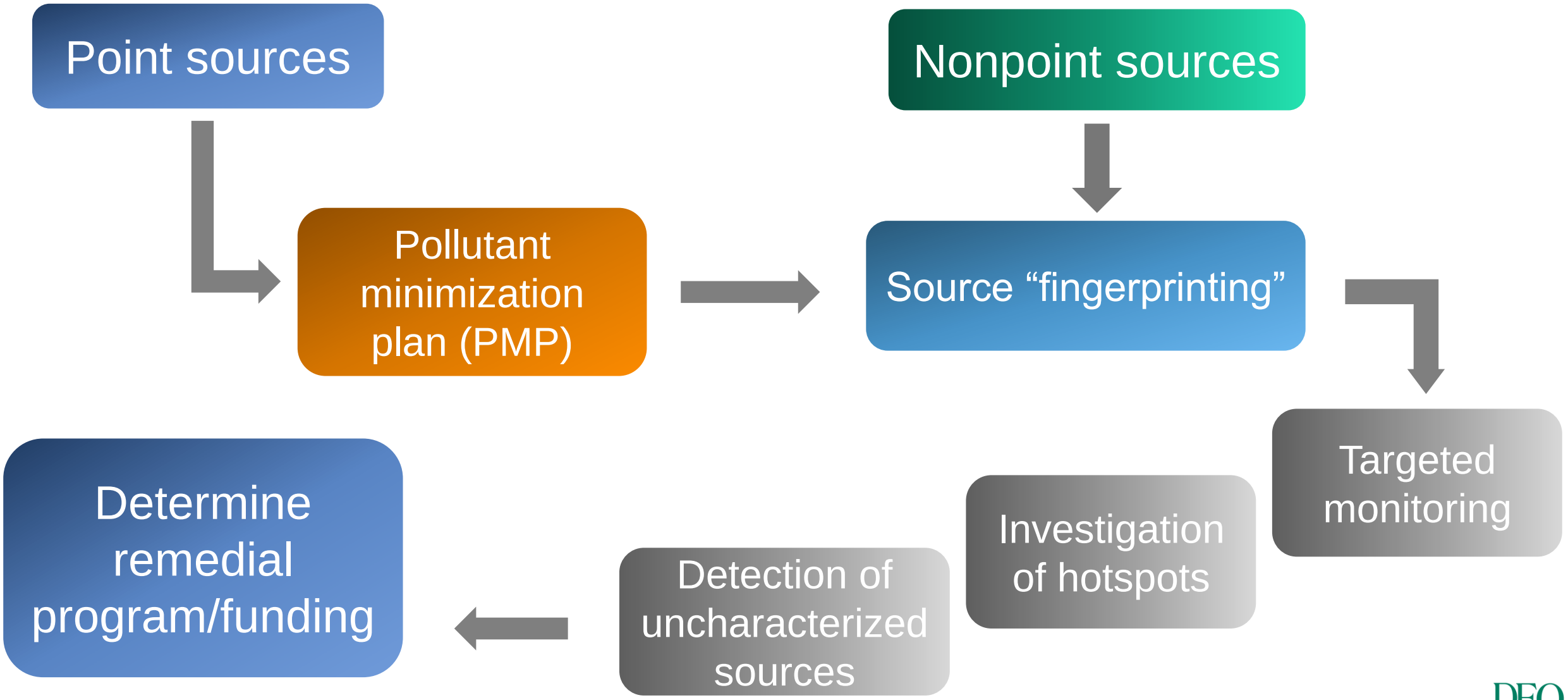
TMDL Implementation Process



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Next Steps

- Future TAC meeting(s)
  - Third TAC - Fall 2022
  - Additional (?)
- Finalize and share the draft TMDL
  - Fall 2022
- Final Public Meeting

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