

# It's everywhere, but is it toxic? A Basin-Wide Survey of 6-PPDq in Brook Trout waters of the Delaware River Basin

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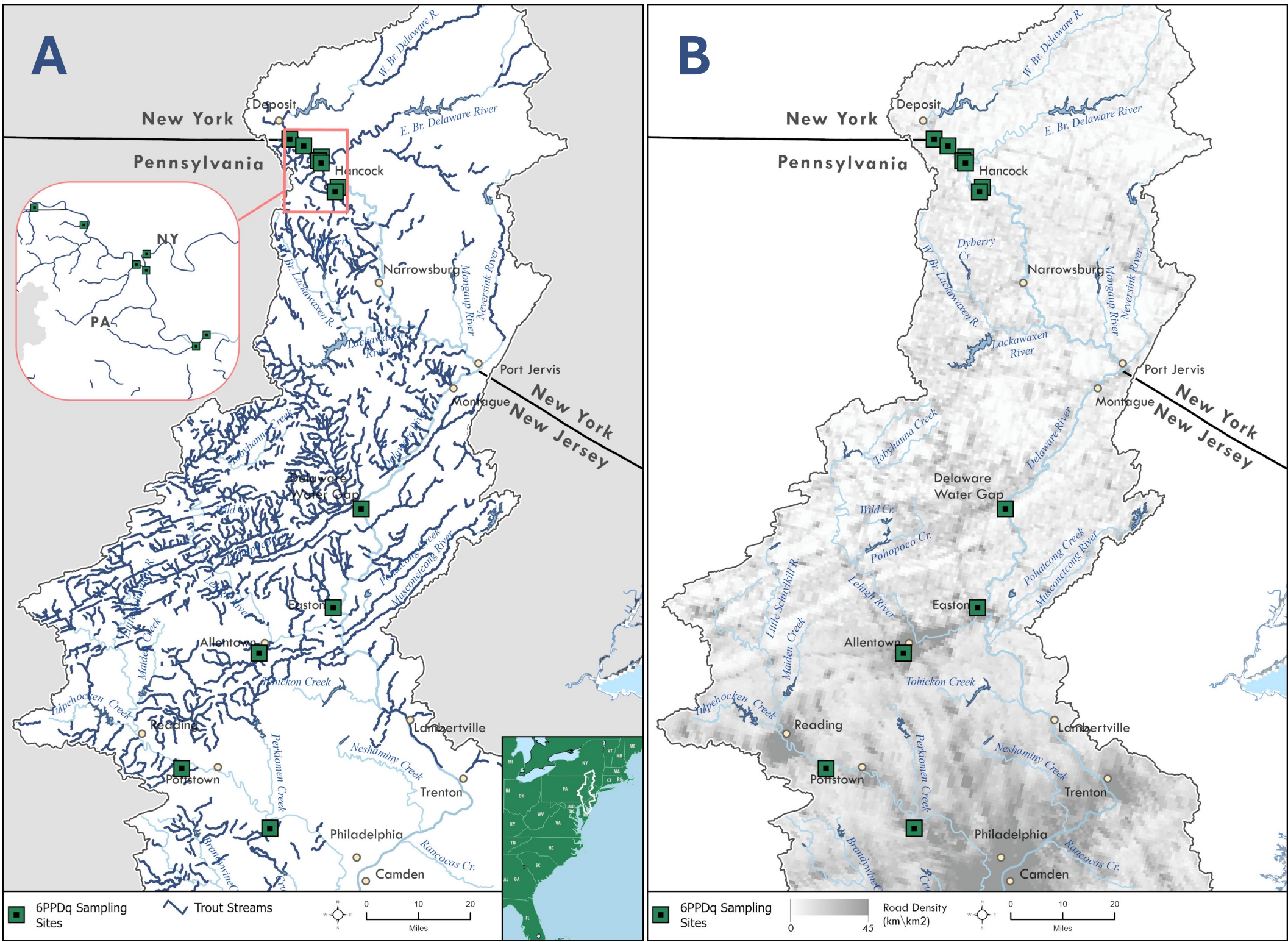
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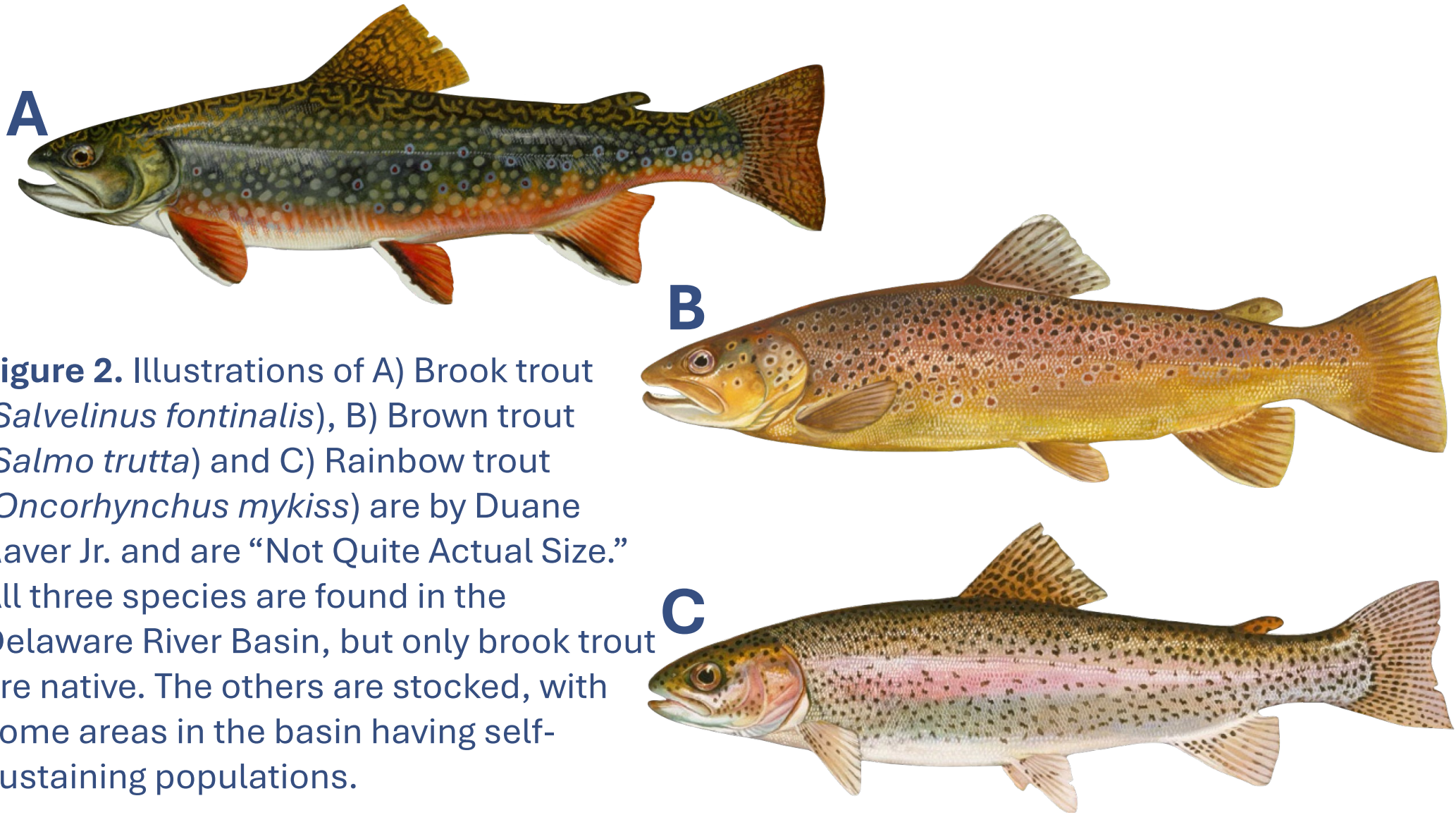


## The Delaware River Basin, Trout & 6-PPDq

- Most trout waters in the Delaware River Basin are in the upper basin and headwaters around Hancock, NY, but some live in karst-geology streams lower in the basin fed by cold water seeps (Figure 1a).
- Three trout species, rainbow, brown and brook, can be found in the Delaware River Basin (Figure 2).
- Brook trout is the only native species, while the others are stocked and have self-sustaining populations in parts of the basin.
- Multiple stressors (erosion, non-native fish, dams, culverts, pollution, rising water temperatures, overfishing, etc.) have reduced populations and their spatial extent within the Delaware River Basin.
- 6-PPDq is an emerging contaminant, largely from car tire rubber, that is toxic to various trout species, with the most sensitive being juvenile brook trout.
- This study aimed to develop a baseline understanding of 6-PPDq presence in the Delaware River Basin to better assess its potential for impacts on the native brook trout population.



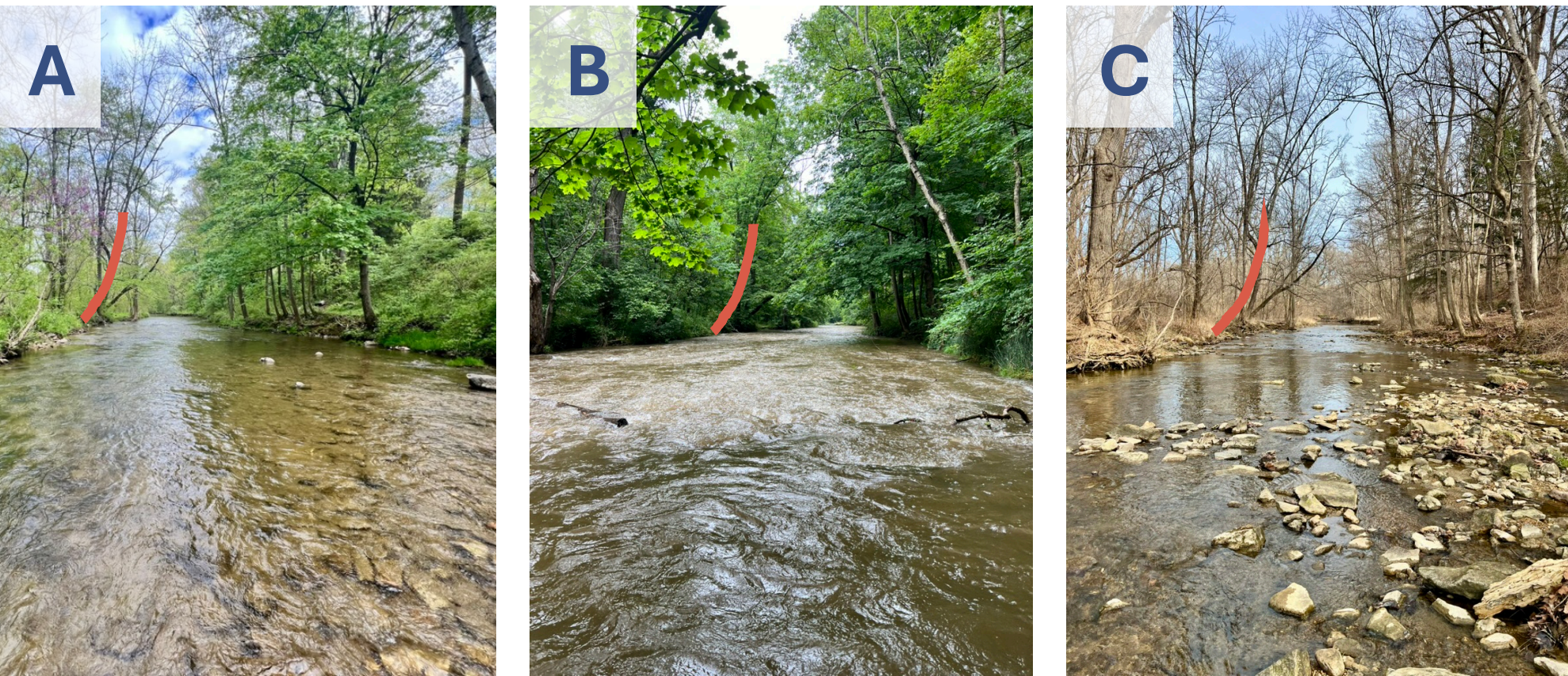
**Figure 1.** A) 6-PPDq sampling sites in relation to trout stream of the Delaware River Baim. B) 6-PPDq sampling sites in relation to road density of the Delaware River Basin.



**Figure 2.** Illustrations of A) Brook trout (*Salvelinus fontinalis*), B) Brown trout (*Salmo trutta*) and C) Rainbow trout (*Oncorhynchus mykiss*) are by Duane Raver Jr. and are “Not Quite Actual Size.” All three species are found in the Delaware River Basin, but only brook trout are native. The others are stocked, with some areas in the basin having self-sustaining populations.

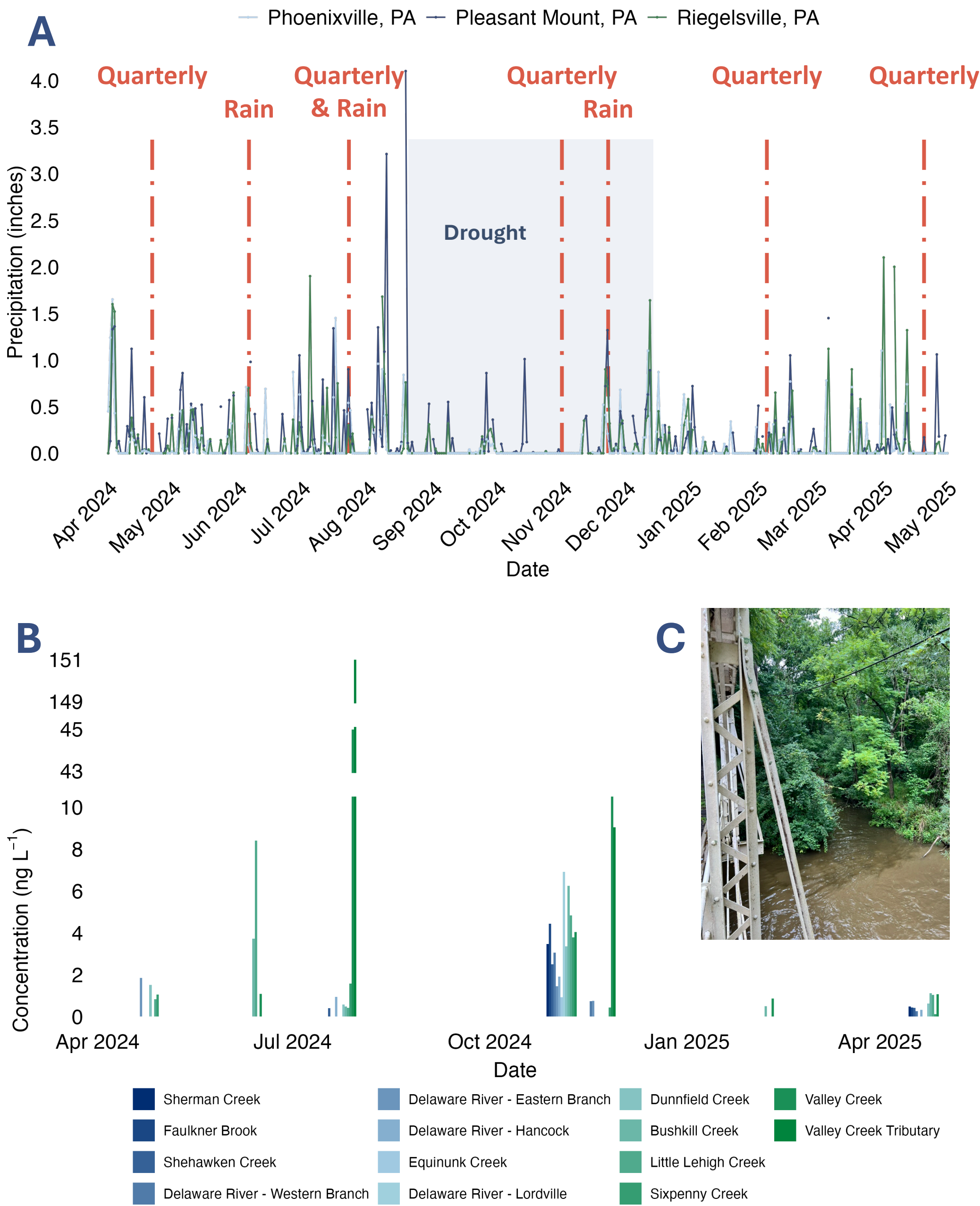
## Experimental Design

- Fourteen sampling sites were chosen based on their spread throughout the Delaware River Basin, status as a trout stream (Figure 1a, and proximity to paved surfaces (Figure 1b).
- 250 ml triplicate samples were taken quarterly from April 2024 through April 2025 (Figure 4a).
- Rain event samples (Figure 4a) were collected on 3 occasions to attempt to capture the influence of rain events on 6-PPDq concentrations.
- The Temple University WET Center followed a modified USEPA Method 1634 for sample processing and analysis.
- Analysis was performed using a Waters Xevo TQs UPLC/MS/MS with an LOD and LOQ of 0.1 and 0.35  $\mu\text{g L}^{-1}$ , respectively.



**Figure 3.** Valley Creek during normal (April 2024; **A**), high (July 2024; **B**) and low (February 2025; **C**) flow conditions across the sampling period. B occurred during a rain event and resulted the highest concentrations observed during the study. C occurred when the entire basin was just starting to exit a month-long drought.

## Results



**Figure 4.** **A)** Rainfall amounts at 3 locations, representing the upper, middle and lower extent of sampling sites across the Delaware River Basin. The lines added represent sampling dates and whether they were the normal quarterly sampling or occurred following a rain event. **B)** Concentrations of 6-PPDq observed at sampling sites for each sampling event. Note that the y-axis is broken from 10 to 40 and 46 to 146  $\text{ng L}^{-1}$  due to high concentrations observed at the Valley Creek and Valley Creek Tributary sites during a rainfall event in July 2024. **C)** Water flowing into Valley Creek from the Valley Creek Tributary site, where the highest concentration of 6-PPDq was observed on July 24, 2024, during a rain event. This water drains directly from the Pennsylvania Turnpike near Valley Forge, PA.

## Key Findings / Conclusions

- 6-PPDq was found at every site sample at least once during the study.
  - Dry Weather sample: 49% detection at  $2.2 \pm 1.9 \text{ ng L}^{-1}$  when detected.
  - Wet weather samples: 70% detection at  $1.7 \pm 2.5 \text{ ng L}^{-1}$  when detected (excludes Valley Creek).
- Only 1 sample, Valley Creek Tributary at  $150.99 \text{ ng L}^{-1}$  on 07/23/24, exceeded a known brook trout acute toxicity ( $\text{LC}_{50}$ ) threshold of  $90 \text{ ng L}^{-1}$ .
  - An ephemeral stream that does not support trout and drains directly from the Pennsylvania Turnpike (Figure 4c).
  - This concentration was diluted to  $44.97 \text{ ng L}^{-1}$  at site in nearby Valley Creek, which does support trout (Figure 3).
  - Valley Creek and its tributary were the only sites where acute toxicity is a concern.
- 6-PPDq was found in every sample during a peak drought sampling event in early November 2024.
  - Concentrations were elevated relative to other sampling events, including rain events.
  - Reasons are unknown!
  - There may always be background levels of 6-PPDq in the stream due to tire wear particles or tires, but those concentrations are diluted under non-drought flow conditions?*
- Sublethal thresholds and effects for brook trout are needed.
- Future work will examine additional brook trout streams using a recently released USGS 6-PPDq Source Heat Map to identify sampling sites.
  - <https://geonarrative.usgs.gov/6ppdqsource dashboard/>



## Acknowledgments & References

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