Investigating Chemicals from Wastewater Discharges in Tinkers Creek—Practical approaches to a successful field deployment

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But it takes cooperation

Chemical research is no longer a shot in the dark

City of Solon  City of Bedford
City of Twinsburg  Portage County  City of Bedford Heights
Summit County  National Park Service  Ohio EPA
Tinkers Creek

The largest tributary to the Cuyahoga River
A textbook study area

7 WWTPs
96 mi² drainage

Landuse
34% commercial and residential
Why study Tinkers Creek?

TMDL for the Cuyahoga River reported unknown sources of impairment in Tinkers Creek, recommended a study to determine sources of impairment.

(Fish population did not exploit available habitat)
Percent of effluent in Tinkers Creek

- 75% during low flow
- 27% mean annual flow

27 mg/d discharge from the 7 WWTPs
Strategy: What is coming to the stream?

Sample the known sources—bracket the WWTPs

![Downstream station](image1)

![Upstream station](image2)
Polar Organic Chemical Integrative Sampler (POCIS)

4-inch Schedule 40 PVC

Length @ 10.5 inches
A standard POCIS device has 41 cm$^2$ of effective sampling surface area

Two configurations are typically used:

- **Pharmaceuticals**
- **Generic** (for most pesticides, hormones, etc.)
Why use POCIS?

• Logistics: Cannot duplicate application with field crews

• Timing: Peak-flow and WWTP capture guaranteed

• Ease: No moving parts or adjustments

• Concentrates trace levels of chemicals

• Time-weighted concentrations
  – Important for risk assessment determinations
Disadvantages

• Vandalism: Can be a problem in popular areas

• Deployment: Anchoring in position

• Chemical analyses: Limited by target chemicals, available methods, and laboratories
Deployment

POCIS position critical when collecting a sample below the outfall

Complete mixing is obvious here

But what about here?
Substrate can make deployment difficult

Bedrock and boulder substrates are the most challenging places to deploy a monitoring device for an extended period.

Anchoring is next to impossible
Swift water can be unmanageable
Anchoring the device
Exposed roots and dead stumps

Trees offer a solid point to attach cable, but the cable can be a liability during high water; it will pull the device to the bank.
Boulders and riprap

Mid-channel anchor best option
Cable length

Longer cables exert greater tension on the canister, allow greater movement
Depth

Can limit sampling opportunities

Smaller streams may become too shallow in the summer
Device will move with an increase in flow

To the bank

To the depositional area
Steep banks favorable

Device less apt to rest on bank shelf when water recedes (if cable is short)
Debris

The threat of debris restricts cable placement, safety is also a concern.

Branched trees worse

Use two separate cables, one from each bank, the shorter cable should break.
Vandalism possible

Because the device is visible

Visible from every direction
Retrieval

Placed in air-tight can and shipped with ice packs

Smaller can is a field blank (POCIS ring and semi-permeable membrane device)
General processing scheme for POCIS

Exterior Cleaning

Solvant Extraction & Chemical Recovery

Transport to lab sealed in airtight can

Deployment and Fractionation

Chemical Analysis

Bioassay/Toxicity testing

Phase II of study
What is next for Tinkers Creek?

Tissue study on fish

Future R&D?
• Compare cold water data to warm water data
What to consider for your study?

• Timing
  – Stream size, other data collected, school year

• Canister placement
  – Mixing, anchoring for high water

• Tissue study on fish

• Target chemicals
Questions?