

# Spatial Analysis of Nutrient Waste Discharged at Combined Sewer Overflows (CSOs)

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## Rationale

The city of Pittsburgh experiences intense rain storms that lead to an increase in sewer overflows into the city's three rivers. Finding which combined sewer overflow (CSOs) outfalls contribute the most nutrient discharge will help 3 Rivers Waterkeeper to know which areas to focus when researching this problem.

## Approach

Using ArcMap and the Sewer Atlas helps us to identify CSO-sheds within the ALCOSAN treatment area which then can be used to calculate population. Showing the issue of combined sewer overflows in a series of CSO maps selected by 3 River Waterkeeper (3RWK) will help contextualize the issue for the public to understand the severity of the problem.

## Questions

We evaluated the scientific literature and conducted research into nutrient waste—specifically nitrogen discharge—at different combined sewer overflows by spatial analysis to answer the following questions:

- How do we map the sewer lines that drain to a specific CSO?
- How do we compute the flux of nutrients to a specific CSO?
- How much nitrogen pollution is produced in CSO-sheds?

## Findings

### How do we map the sewer lines that drain to a specific CSO?

Using the 3 River Wet Weather's Sewer Atlas and with the help of Emily Mercurio, network traces were created on four selected CSOs from the 3 Rivers Waterkeeper (3RWK) sampling map. This network trace provided an area that has sewer lines that connect to the CSO which was then called a "CSO-shed". Figure 1 is an example CSO-shed in ArcMap.

**Negley Run CSO-shed and Network Trace**

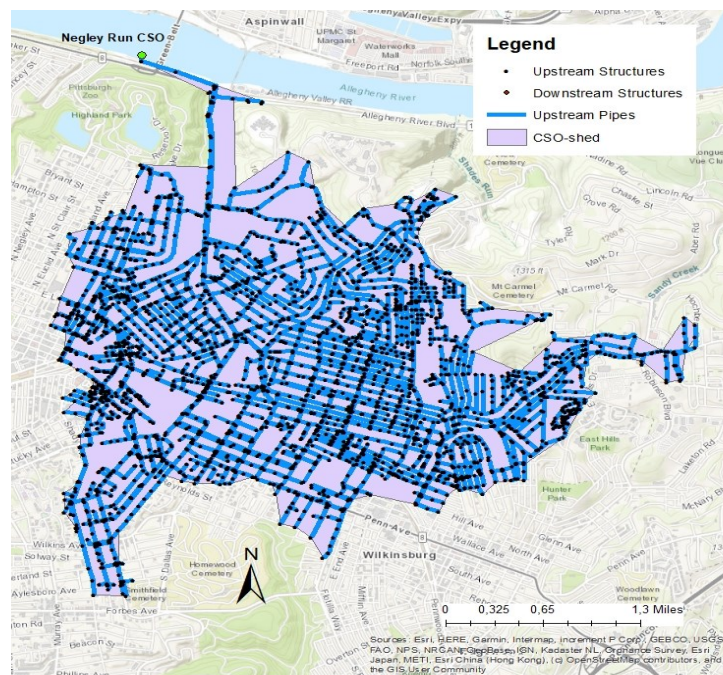


Figure 1. Negley Run CSO-shed. Green point is the Negley Run CSO outfall and blue lines represent sewer lines.

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## Combined Sewer Overflows (CSOs)

Pittsburgh has a combined sewer system so, the stormwater and the sewage will mix together during intense rain events and will pour untreated, diluted sewage into the rivers or other water systems. This can lead to high levels of nutrient waste polluting the natural water systems which can be dangerous for the water, wildlife, and people.

### How do we compute the flux of nutrients to a specific CSO?

Using the CSO-sheds made with the Sewer Atlas, population data, nutrient waste permits, and network tracing can help find where and how much nutrient waste is contributing to the different CSOs. The population calculations resulted as follows: Lawrenceville shed, 34,832 ; Large Downtown CSO-shed, 13,650 ; Negley Run CSO-shed, 24,339 ; Northside CSO-shed, 4602.

### How much nitrogen pollution is produced in CSO-sheds?

Using census data, calculations were performed to approximate how much nitrogen the population of each area in the ALCOSAN service were contributing to the sewer system. The per capita nitrogen waste values (6-17 g/day/person) were multiplied by the population of the area. The average daily nitrogen mass loading estimations were as follows: Lawrenceville, 400.6 kg/day ; Large Downtown , 157.0 kg/day; Negley Run, 279.9 kg/day; Northside , 52.9 kg/day.

## Implications

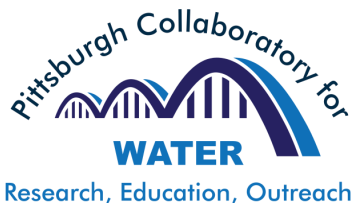
- The use of CSO-sheds can help water quality testing with respect to learning about which sewer lines contribute to the CSOs and calculating the populations affecting these CSOs.
- Calculating the nitrogen that contributes to CSO-sheds can support further calculations for nitrogen waste being discharged at CSOs.
- Future research can be done on calculating the amount nitrogen waste discharged at CSOs with rainfall data to get annual values of nutrient waste.

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***To ensure that the Pittsburgh rivers get healthy, the community must support the research and policy work on CSOs.***

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