Grant Report for USGS 104b / CT IWR Award

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| **State:** | Connecticut |
| **Title:** | Vernal pool and BMP pond impacts on regional salt pollution dynamics |
| **Project Type:** | Research |
| **Focus Categories:** | 1. NON POINT POLLUTION (NPP) 2. WATER QUALITY (WQL) 3. SOLUTE TRANSPORT (ST) |
| **Research Category:** | Water Quality |
| **Keywords:** | road salt pollution; freshwater salinization; land use; BMP ponds; vernal pools |
| **Start Date:** | 3/1/2020 |
| **End Date:** | 2/28/2021 |
| **Congressional District:** | CT-003 |
| **PI:** | Steven P. Brady  Assistant Professor of Ecology  Biology Dept., Southern Connecticut State University  New Haven, CT 06515  Email: brady.steven@gmail.com; Phone: 203-392-7206 |
| **Co-PIs:** | Gaboury Benoit  Professor of Environmental Chemistry  Director, Hixon Center for Urban Ecology  Yale School of Forestry & Environmental Studies  Vice President, Mill River Watershed Association  New Haven, CT 06511  Email: gabouryb@gmail.com; Phone: 203-432-5139 |

**Products**

*Proposals*

As a result of this work, we have written several follow-on grant proposals to further study salt pollution dynamics. Some of these proposals were unsuccessful (including a large NSF proposal), but two proposals were successful:

1. USGS 104b/CT-IWR 2021-22: Groundwater and catch basin roles in regional salt pollution dynamics at multiple scales
2. USGS 104b/CT-IWR 2023-24: Road salt in soils and its effects on overwintering amphibians

*Manuscripts*

We are currently preparing two manuscripts to submit to peer-reviewed scientific journals. One manuscript, focuses on salt storage dynamics, is nearing completion and will be submitted to *Environmental Science and Technology* in fall 2023. The second manuscript, which focuses on mass balance characteristics of salt pollution, will be submitted in early winter 2023.

**Number of students supported**

Two students were hired and mentored directly on this project: SCSU undergraduate student Jessie Peterman and Yale master’s student Brendan Wirth. Jessie was trained in mass balance modeling approaches, GIS, field techniques for monitoring salt pollution dynamics (managing deployable loggers, collecting grab samples) and biological responses (benthic invertebrate stream surveys). Jessie leveraged her experience on this project in the context of a summer fellowship with the Elm City Innovation Initiative, was later admitted to the Yale School of the Environment where she received her Master’s in 2023. Brendan Wirth refined a colorimetric method for analysis of bromide tracer, calculated preliminary salt budgets for flow data, and made measurements of infiltration rates. We have shared preliminary results with the Mill River Watershed Association and students in professor Brady’s and Benoit’s courses, reaching approximate 30 undergraduate students and 15 graduate students.

**Diversity summary**

During this grant period, we hired one female undergraduate student, Jessie Peterman, who grew up and continued to live as an adult in New Haven, CT. Many of the students in PI Brady’s undergraduate courses – who were taught about stormwater dynamics and salt pollution in the context of work from this grant – are minority students and students from underrepresented backgrounds.

**USGS staff involved**

None

**Awards**

PI Brady was awarded a junior sabbatical fellowship in fall 2020 because of his overall research productivity, which was greatly enhanced by the work and academic research time supported by this USGS / CT-IWR grant.

**Project Summary**

Salt is a widespread, serious, and growing pollution problem that compromises water quality and harms aquatic life. Levels of salt pollution in many fresh surface waters in the United States now exceed the EPA chronic exposure criteria for chloride. Despite its simple chemistry, salt is also among the most difficult substances to remove by any practical conventional form of water treatment, and it can be a significant impediment to water reuse for irrigation or drinking. Here, we developed a robust study system to analyze the behavior of road salt pollution from its source of entry via deicing through its surface and subsurface pathways in and through both natural and modified features of the landscape. Critically, we applied a hierarchical approach, studying salt across all spatial scales from a single catch basin up through an entire watershed encompassing multiple towns, and draining into the main stem Mill River. We found in general that salt behavior in our watershed is perplexing. Much of the salt deposited each year is not exported, residing for instance at the bottoms of stormwater and natural ponds, and seeping into sediment, where it is thought to enter shallow and ultimately deeper groundwaters. These salt storage sources later appear to release salt back into surface waters in the middle of summer, long after the deicing season. These findings point to the important and complex roles of both surface and subsurface waters in mediating the storage and transport dynamics of this widespread pollutant.