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Efficacy of compost amended biofiltration swales as green stormwater infrastructure for treatment of toxicants in Salish Sea road run-off

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Speaker

Benjamin D. Leonard, Katherine T. Peter, Bowen W. Du, Edward Kolodziej, Nathaniel L. Scholz, John D. Stark, and Jenifer K. McIntyre



Efficacy of Compost Amended Biofiltration Swales as Green Stormwater Infrastructure for Treatment of Toxicants in Salish Sea Road Run-off

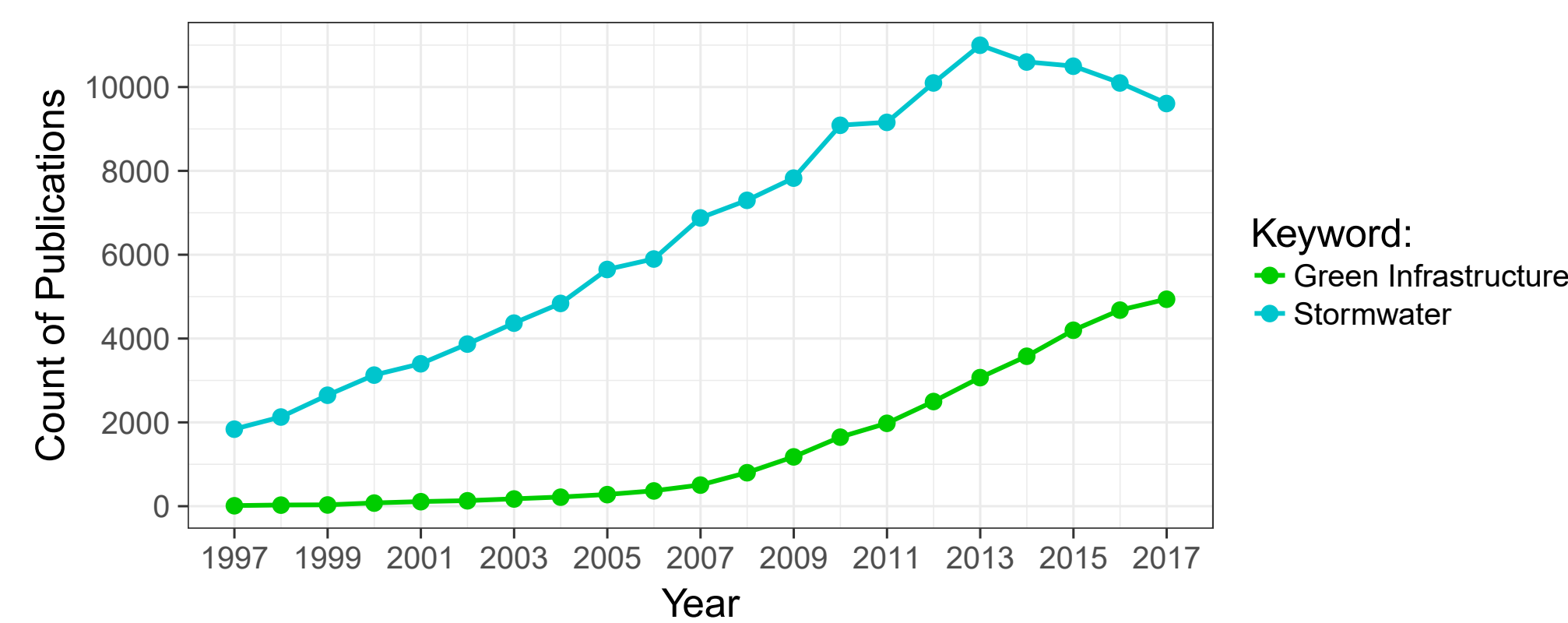
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INTRODUCTION

Biofiltration swales, or bioswales, use vegetated soil substrates to filter contaminants from stormwater, decrease sediment load, and reduce erosion. Following a storm, runoff moves slowly through the swale at a shallow depth. While stormwater is retained in the bioswales, pollutants are removed by the combined effects of filtration, infiltration, settling, and biotransformation. Due to their low-cost and environmental benefits, bioswales and other types of green infrastructure have become an increasingly popular way to address stormwater related issues in recent years.

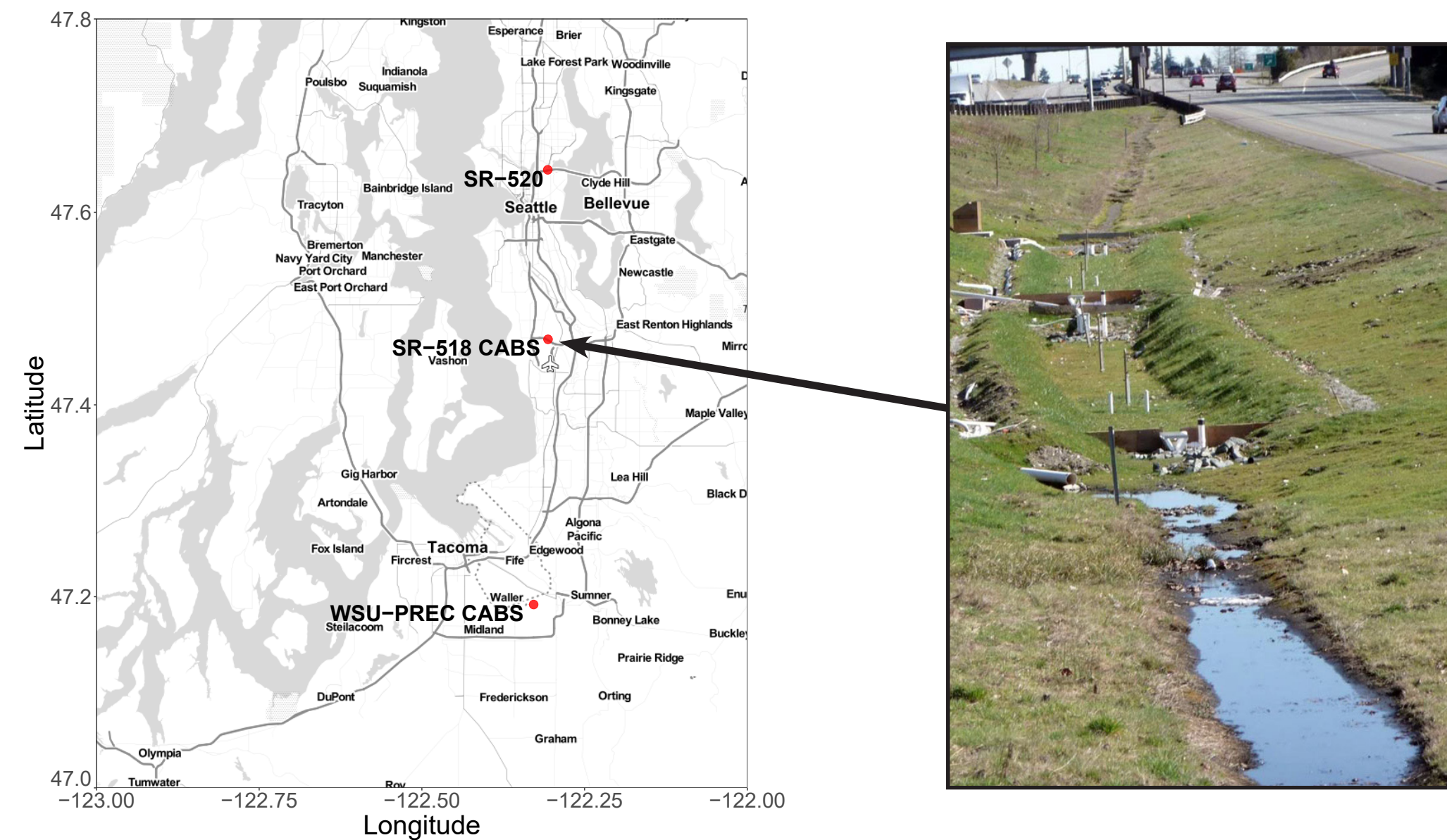
Popularity of Relevant Keywords in Academic Literature



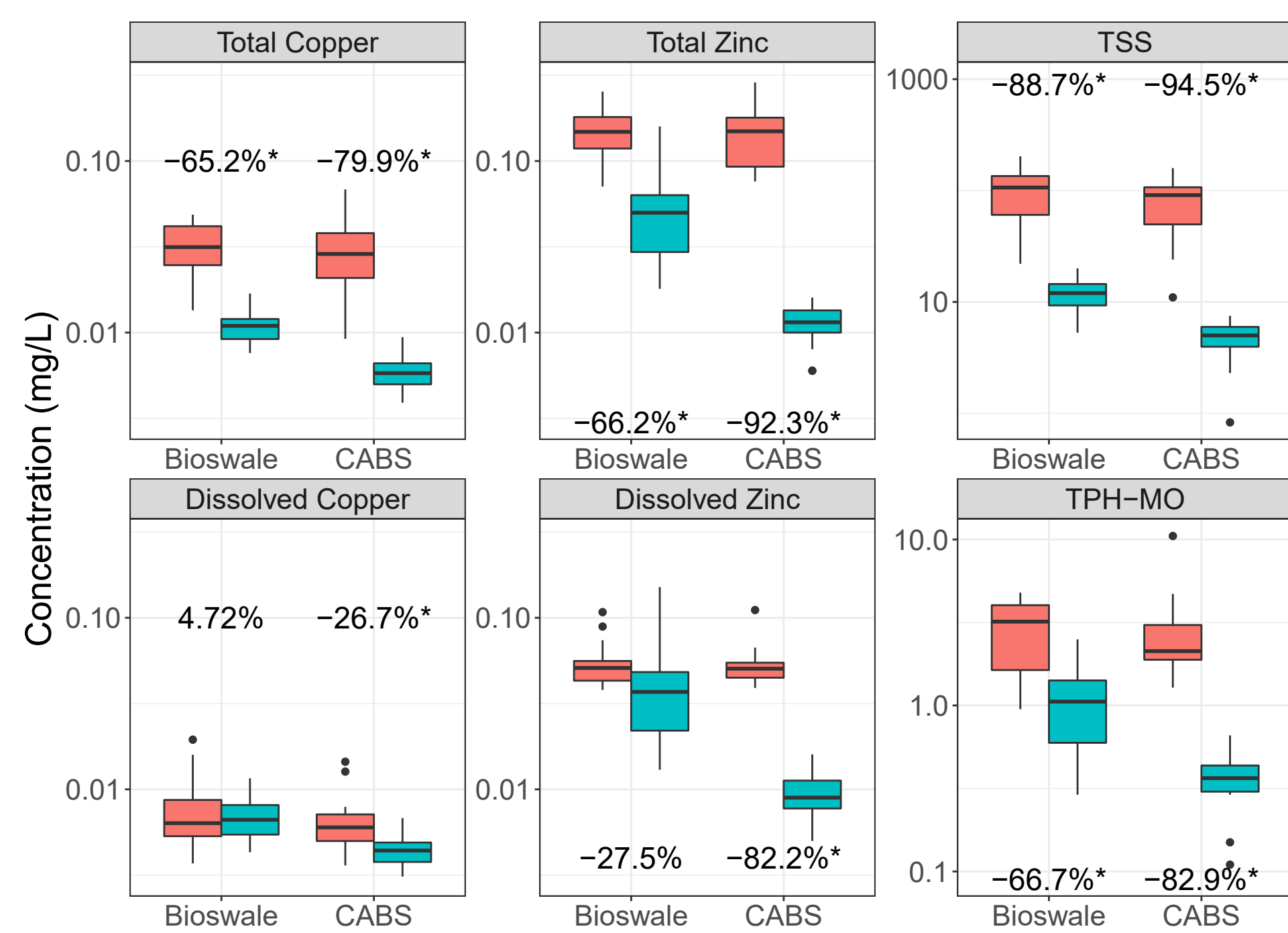
Note: Based on counts provided by Google Scholar search engine.

WSDOT has created guidelines for constructing compost amended biofiltration swales (CABS) and implemented a field test for CABS along Washington State Route (SR) 518 in 2009. Herrera evaluated this system and found it to be more effective than standard bioswales at removing certain pollutants.

Study Area Map



CABS vs. Conventional Biofiltration Swales

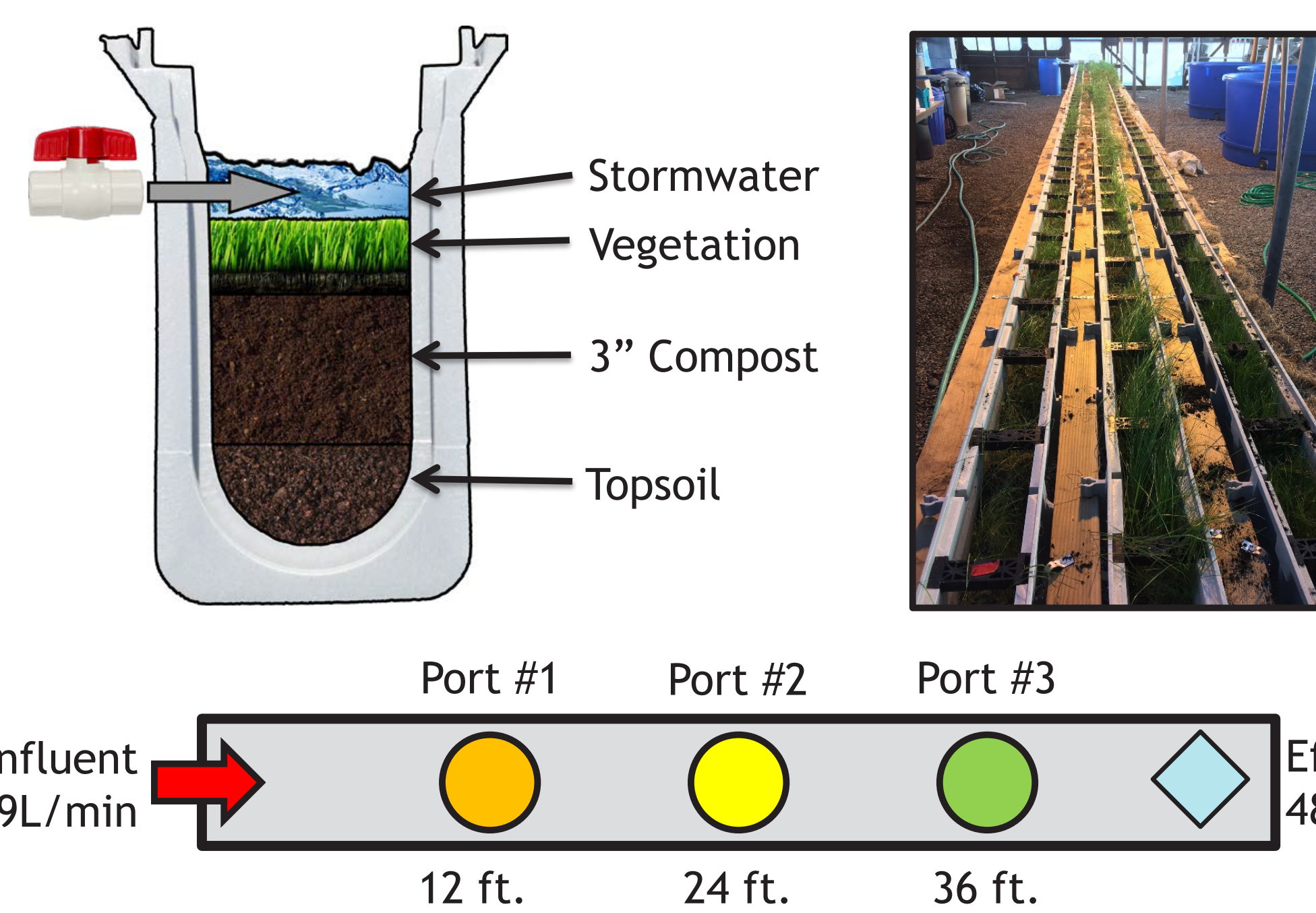


Note: Reanalyzed from Herrera (2011). * Influent and effluent concentrations are significantly different at the $\alpha = 0.05$ level (Wilcoxon signed-rank test).

METHODS

Along with researchers from University of Washington we created a laboratory model for CABS at Washington State University Puyallup to verify field test results in a controlled setting and identify ways that the WSDOT design could be improved. This system is exposed to highway runoff from a previously studied high volume source off SR-520 and can be tested at different flow rates, swale lengths, and slope gradients.

Laboratory CABS



Study Design

Field CABS



SR-518 Highway Runoff
Hydraulic Residence Time (HRT) = 9 minutes

2 Storms:

- January 17, 2017
PAHs, metals, non-target, toxicology
- June 8, 2017
PAHs, metals, non-target, toxicology

Laboratory CABS

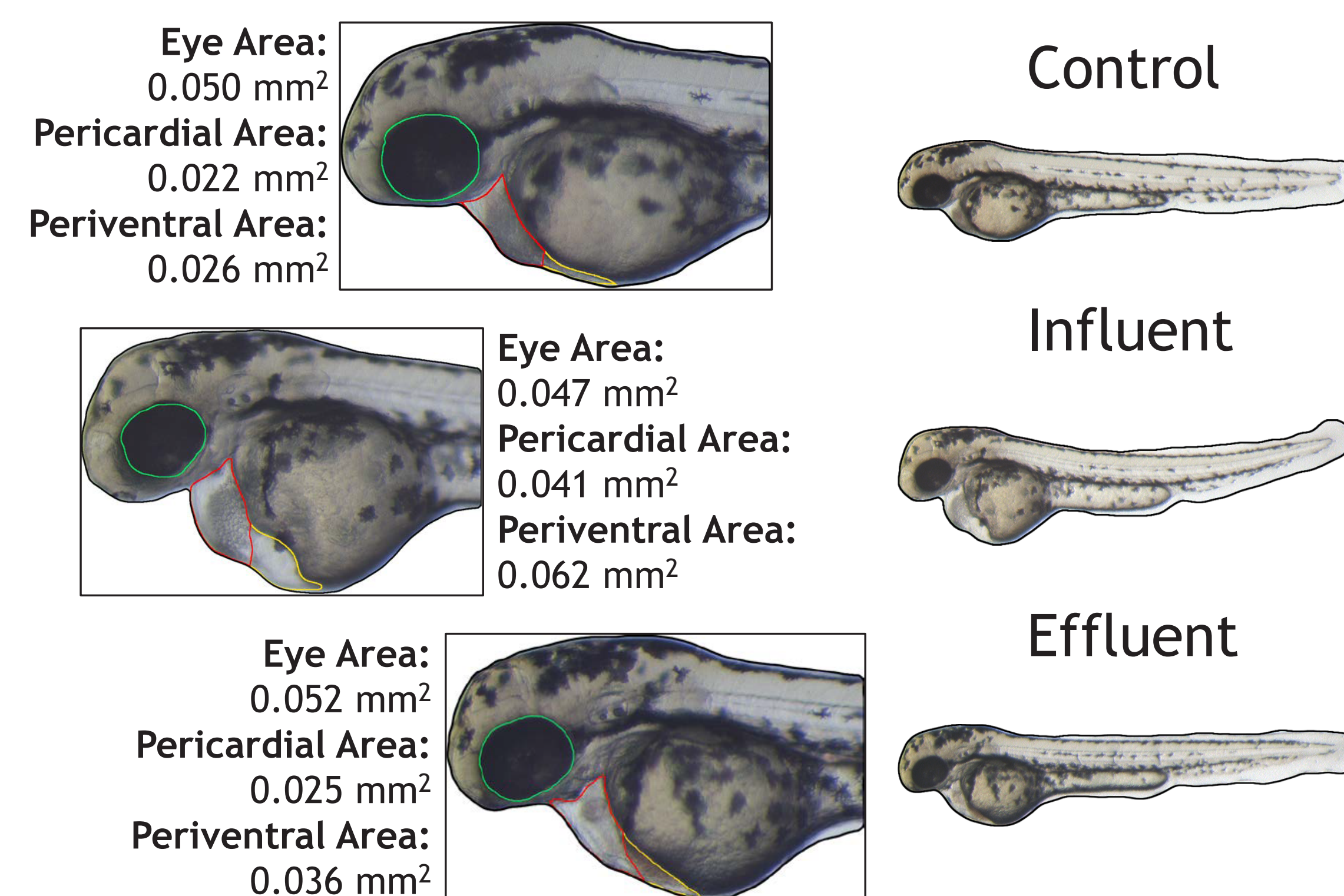


SR-520 Highway Runoff
HRT = 15 minutes

2 Storms:

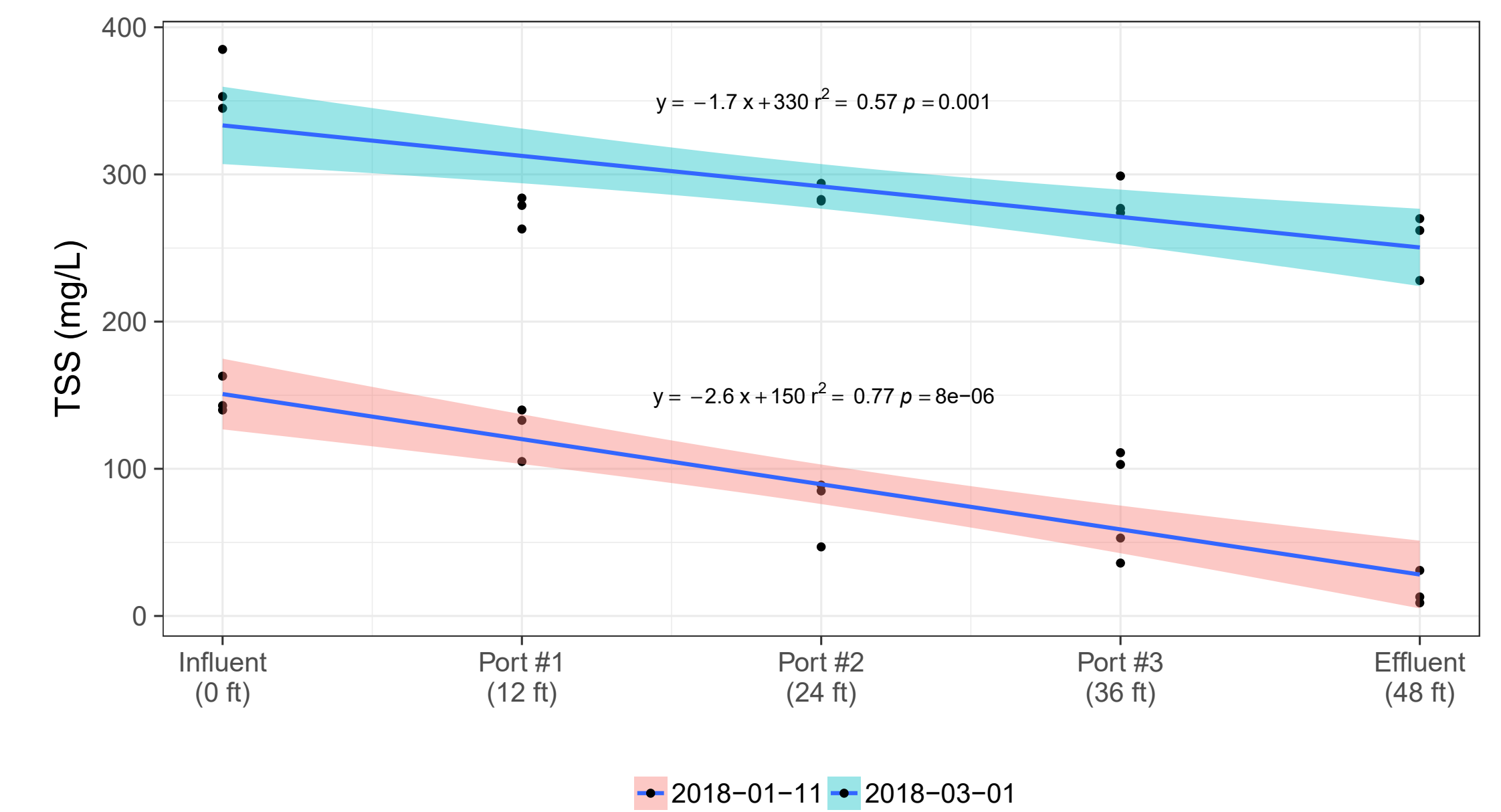
- June 9, 2017
PAHs, metals, non-target, toxicology
- June 16, 2017
PAHs, metals, non-target, toxicology

Zebrafish Embryo 48 Hour Sub-Lethal Toxicity Assay

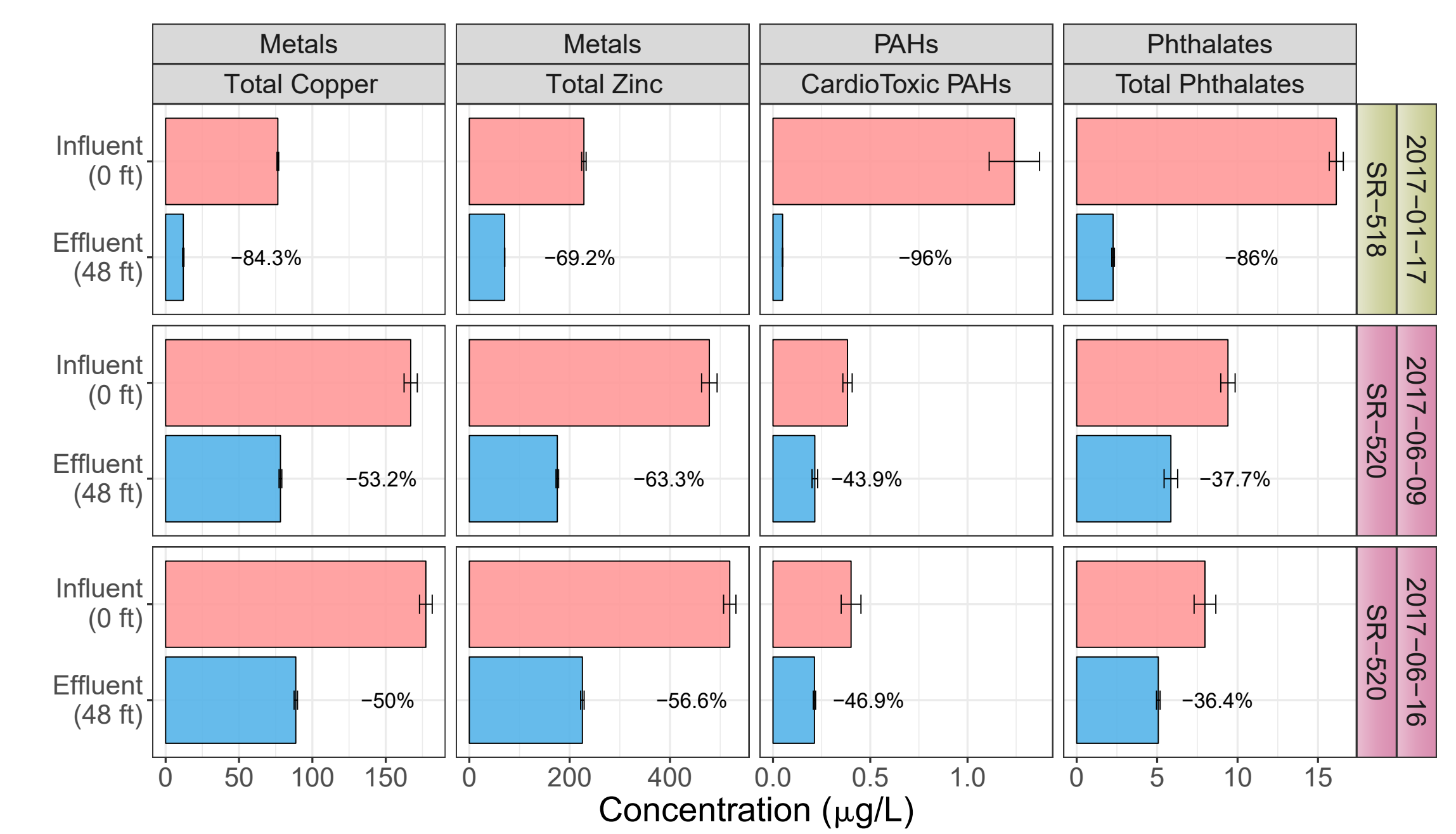


RESULTS

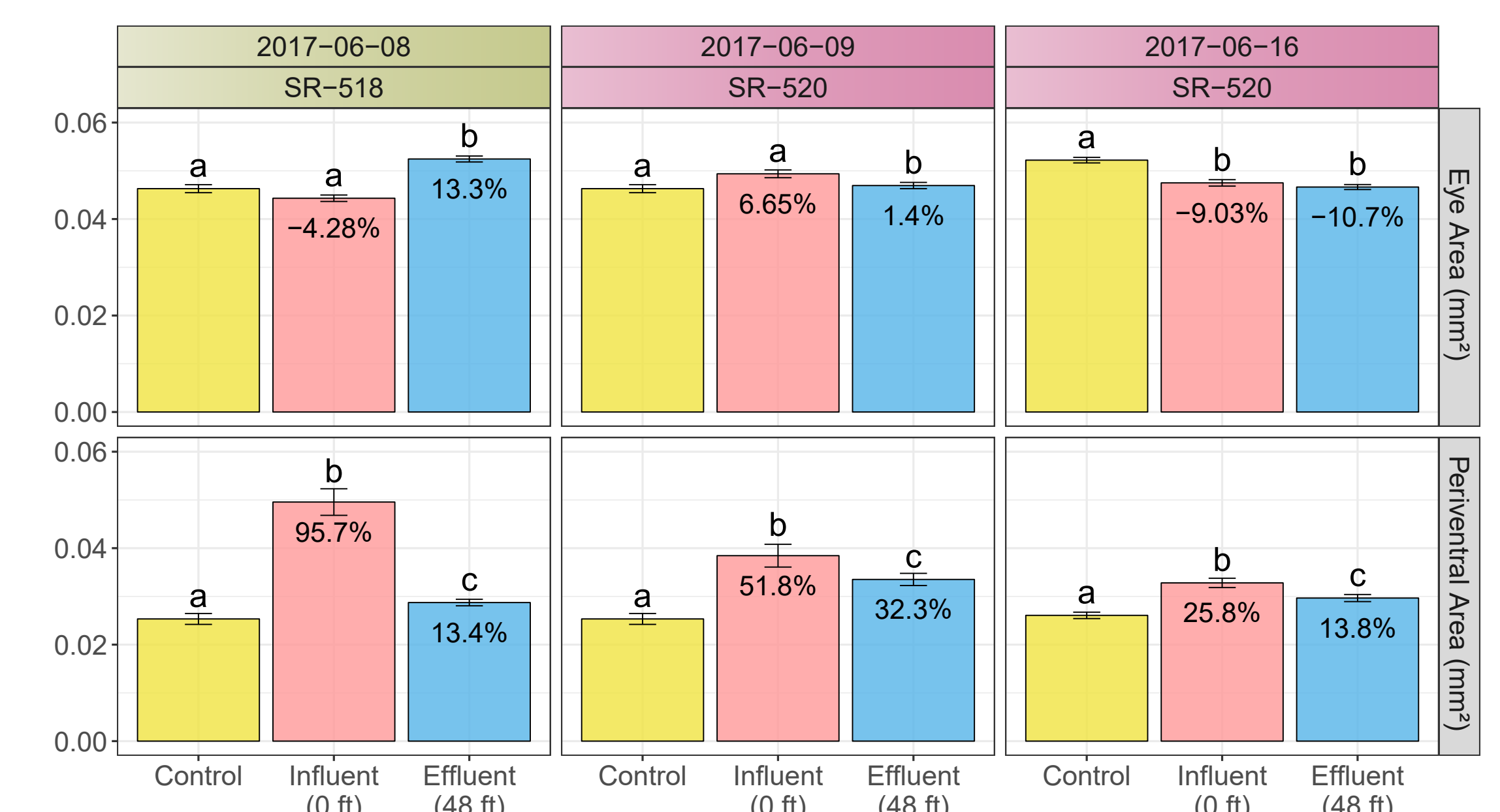
Total Suspended Solids (TSS)



Selected Target Analytes



Zebrafish Morphology



Note: Treatments with different group labels (a, b, c) show significance at the $\alpha = 0.05$ level (ANOVA with post-hoc Tukey HSD Test).

Results show that both laboratory and field CABS were effective at removing pollutants from stormwater run-off and that SR-518 and SR-520 have distinct chemical signatures. CABS were also effective at treating cardiac edema in developing zebrafish exposed to stormwater run-off.

ACKNOWLEDGEMENTS

