



LOI # 18

Name: Tatiana Dreisbach

Organization: Washington State Department of Transportation (WSDOT)

Study Title: Study of Box of Rain Technology for Effective Removal of 6PPDQ

Which topics from the SWG's priority list (Appendix A) do you propose to address?

14, 15

What type of project is being proposed?

Environmental sampling study

Short description of the proposed project

The Box of Rain (BoR) stormwater treatment technology, developed by Stewardship Partners and evaluated under the Washington State Department of Ecology's Technology Assessment Protocol–Ecology (TAPE), aims to manage urban stormwater runoff and mitigate its harmful effects on aquatic life. The BoR technology fills a gap in stormwater treatment options for bridges and other elevated structures, which currently lack practical and affordable on-bridge stormwater best management practices options. Maximizing treatment efficacy of this open-source stormwater BMP that treats bridge downspouts will benefit WSDOT and local agencies using BoR by reducing pollution and contribute to the overall water quality benefit of aquatic habitats in Washington. This cost-effective technology can help permittees meet National Pollution Discharge Elimination Permit requirements in constrained locations where other stormwater treatment options are lacking.

This study focuses on the effectiveness of BoR technology in removing 6PPDQ, a toxic byproduct of tire wear that poses significant risks to salmonids and other aquatic organisms. Conducted at one of the BoR pilot study locations in Bellevue, Washington, the research will explore how the pretreatment mulch layer influences the removal performance of 6PPDQ and how biochar amendments to the mulch layer may enhance this removal.

In a separate SAM proposal, Ruth Sofield of Western Washington University is proposing to assess different biochar types to determine which may be best for 6PPDQ removal. Our



proposal would complement the Sofield study by deploying the biochar that she determines is best for 6PPDQ removal at field scale.

The primary goal of this study is to verify the performance of the BoR system in removing 6PPDQ under varying mulch conditions. The specific objectives are:

- Evaluate the removal efficiency of 6PPDQ with no mulch, fresh mulch, and biochar-amended mulch.
- Assess the 6PPDQ content of used mulch to understand its retention capabilities.

What type of information will be collected or analyzed for this proposed study?

To achieve these objectives, the study will be conducted at the BoR pilot study location at Mercer Slough under the junction of I-90 and I-405. The experimental design involves monitoring influent and effluent flow and chemistry from three adjacent BoR containers which share a common inlet (paired design). Automated samplers will be used to collect influent flow and chemistry as well as effluent flow and chemistry from each of the three adjacent containers. The first container will contain the BoR media with no mulch, the second will contain the BoR media with fresh mulch, and the last will contain the BoR media with biochar amended mulch. Ten storm events will be targeted for a total of 40 samples.

Flow-weighted composite samples will be collected and analyzed for 6PPDQ content. Continuous flow measurements will be taken at the outlet and bypass pipes, while precipitation depth will be monitored using nearby rain gauges. Influent flows will be assumed equivalent to the sum of bypass and effluent flow. The frequency of sample collection will depend on weather forecasts and targeting qualifying storm events.

When mulch is replaced due to clogging, the mulch will be analyzed for 6PPDQ to compare how much is retained in the fresh mulch versus the biochar mulch.

What are the anticipated measurable outcomes and key deliverables that will be produced by the proposed study and how will they be used by Permittees and the Washington State Department of Ecology?



Effective removal of 6PPDQ from stormwater runoff is critical to protecting aquatic life and improving water quality. The results of this study will advance our understanding of the BoR technology and its potential for widespread implementation in urban areas facing stormwater management challenges. Currently bridges lack affordable and practical on-bridge stormwater treatment options. BoR offers a cost-effective novel solution to treating stormwater from bridges at strategic locations benefiting salmonids and aquatic habitat. Maximizing BoR's effectiveness will benefit NPDES permittees and offer new a option to meet permit requirements in challenging landscape settings.

This study aims to provide valuable insights into optimizing the BoR technology and other bioretention systems which also use mulch prefilter layers by evaluating the effectiveness of different mulch configurations in removing 6PPDQ from stormwater runoff. Both mulch and biochar have been shown to be effective at sorbing 6PPDQ, but only in a lab setting (Hildebrandt et al., 2024). We will be following EPA 1634 as a 6PPD SOP. The findings from this field study will inform future applications of the BoR technology and contribute to the development of more efficient stormwater treatment systems.

This research will offer a comprehensive evaluation of how mulch and biochar amendments can optimize the removal of 6PPDQ, thereby enhancing the overall performance of the BoR system, and any biofilter which uses a mulch prefilter, in mitigating stormwater pollution and safeguarding aquatic ecosystems.

Key project deliverables will include:

1. Status Reports
2. CAD design or 3 box installation
3. Quality Assurance Project Plan
4. Biochar and mulch specifications
5. Final Report
6. Data Submission
7. SAM Fact Sheet



List the permittees or agencies you are proposing to coordinate with.

WSDOT will coordinate on this project with nonprofit organization, Stewardship Partners, and Herrera Environmental Consultants.

WSDOT's team includes Tony Bush (tony.bush@wsdot.wa.gov), Alex Nguyen (alex.nguyen@wsdot.wa.gov), and Tatiana Dreisbach (tatiana.dreisbach@wsdot.wa.gov).

Key partner staff include David Burger (db@stewardshippartners.org) and Soumika Gaddameedi (sg@stewardshippartners.org) from Stewardship Partners and Dylan Ahearn (dahearn@herrerainc.com) from Herrera.

This study will complement the proposal from Ruth Sofield at Western Washington University.