Pooled Monitoring Initiative's Restoration Research Award Program

Project Title

Assessing the effectiveness of green stormwater infrastructure for addressing stormwater management goals at the watershed scale: application of the BACI design

Lead Entity

University of Maryland Center for Environmental Science, Appalachian Laboratory

The Pooled Monitoring Initiative pools resources to support scientists who answer key restoration questions posed by the regulatory and practitioner communities. The research teams then provide the answers back to those who asked the questions for direct application. The goal of the program is to answer these key restoration questions that serve as a barrier to watershed restoration project implementation.

Questions? See cbtrust.org/grants/restoration-research/

Research question

- How effective is modern green stormwater infrastructure (GSI) at mitigating the effects of stormwater runoff and pollution associated with impervious surfaces in a suburbanizing watershed?

Issues addressed

- Aggregated effectiveness of GSI in controlling stormwater runoff and stormwater pollution at the watershed scale
- Treatment effectiveness based on application of the accepted "before-after, control-impact" (BACI) paired-watershed design

Project findings

- Two watersheds in north-central Howard County, MD were instrumented and monitored; runoff responses to more than 200 individual storm events over a 5.5-year period were monitored.
- Statistically significant treatment effects of GSI were found for five primary event-based stormwater metrics: 1) runoff volume; 2) runoff coefficient; 3) peak runoff; 4) direct runoff coefficient; and 5) baseflow coefficient.

Award #22063

Pooled Monitoring Initiative's Restoration Research Award Program

Project Title

Assessing the effectiveness of green stormwater infrastructure for addressing stormwater management goals at the watershed scale: application of the BACI design

Lead Entity

University of Maryland Center for Environmental Science, Appalachian Laboratory

The Pooled Monitoring Initiative pools resources to support scientists who answer key restoration questions posed by the regulatory and practitioner communities. The research teams then provide the answers back to those who asked the questions for direct application. The goal of the program is to answer these key restoration questions that serve as a barrier to watershed restoration project implementation.

Questions? See cbtrust.org/grants/restoration-research/

Project findings

- Consistent reductions (26 – 33%) between the post- and early-development phases were observed for four of the metrics; only baseflow coefficient showed an increase (of 52%) during the post-development phase.
- The results confirm that a very large percentage of overland runoff from the new development was retained by GSI within the developing watershed.
- Relatively few treatment effects of GSI on water quality were detected, although a positive effect on baseflow NO_3-N concentrations in the post phase of development and a negative effect on event loads of NO_3-N in the late phase of development were detected.
- Suitable BACI models could not be developed for any particulate or P-containing pollutants—limiting the applicability of the design.

Award #22063

Pooled Monitoring Initiative's Restoration Research Award Program

Project Title

Assessing the effectiveness of green stormwater infrastructure for addressing stormwater management goals at the watershed scale: application of the BACI design

Lead Entity

University of Maryland Center for Environmental Science, Appalachian Laboratory

The Pooled Monitoring Initiative pools resources to support scientists who answer key restoration questions posed by the regulatory and practitioner communities. The research teams then provide the answers back to those who asked the questions for direct application. The goal of the program is to answer these key restoration questions that serve as a barrier to watershed restoration project implementation.

Questions? See cbtrust.org/grants/restoration-research/

Recommendations

- The impressive reductions in overland runoff from impervious surfaces are explained by the fact that: 1) the bioretention cells were designed and built to infiltrate storms of much greater magnitude than those for which GSI in Maryland has historically been required to address; and 2) the bioretention outfalls were located at the edge of a protected forested floodplain, effectively buffering the stream from the outflows by providing an opportunity for re-infiltration and evapotranspiration.
- Overall, our water quality results represent a cautionary note that GSI is not a panacea; the data from this and other published studies suggest that the term "bioretention" may actually be a misnomer. While there is good evidence for hydrologic (i.e., physical) retention of some aquatic pollutants in the current study and for chemical retention of another important pollutant (PO_4-P) in other studies, we were not able to provide solid empirical evidence for biological retention of these or any other water quality constituents. These findings are not unique, as other experimental studies have demonstrated strong retention of PO_4-P through chemi-sorption onto soil clay particles and minimal (or negative) retention of NO_3-N in bioretention cells.

Award #22063

Pooled Monitoring Initiative's Restoration Research Award Program

Project Title

Comparative analysis of Maryland highway mini-catchments to assess the effectiveness of bioretention in addressing stormwater impacts

Lead Entity

University of Maryland Center for Environmental Science, Appalachian Laboratory

The Pooled Monitoring Initiative pools resources to support scientists who answer key restoration questions posed by the regulatory and practitioner communities. The research teams then provide the answers back to those who asked the questions for direct application. The goal of the program is to answer these key restoration questions that serve as a barrier to watershed restoration project implementation.

Questions? See cbtrust.org/grants/restoration-research/

Why does this study matter?

- This study is one of only a very small number of watershed-scale experimental studies have been carried out in the U.S. to address the effectiveness of GSI in achieving both stormwater runoff and water quality objectives.

What should we do with this information?

- In addition to publication in the scientific and engineering literature, the results of the project should be clearly communicated and translated to the regulatory community and practitioners who are responsible for 1) crediting and permitting stormwater best management practices; 2) incorporating these practices into residential development plans; and 3) advocating for healthy streams and watersheds.

What will the end-user (regulator/manager and practitioner) do with this information?

- The project results are highly relevant in planning future development or potentially in retrofitting existing development to address stormwater management goals at the watershed scale.

Award #22063

Pooled Monitoring Initiative's Restoration Research Award Program

Project Title

Comparative analysis of Maryland highway mini-catchments to assess the effectiveness of bioretention in addressing stormwater impacts

Lead Entity

University of Maryland Center for Environmental Science, Appalachian Laboratory

The Pooled Monitoring Initiative pools resources to support scientists who answer key restoration questions posed by the regulatory and practitioner communities. The research teams then provide the answers back to those who asked the questions for direct application. The goal of the program is to answer these key restoration questions that serve as a barrier to watershed restoration project implementation.

Questions? See cbtrust.org/grants/restoration-research/

For more information:

Please contact Keith Eshleman (301-689-7170; keshleman@umces.edu).

Award #22063