# Bioretention Hydrologic Performance Study: Assessment of Facilities Ten Years or Older

Stormwater Action Monitoring

Effectiveness Study

*Prepared for Ecology on behalf of the Stormwater Workgroup by* City of Olympia, Raedeke Associates, Associated Earth Sciences, & Clear Creek Solutions

## Study Highlights

- **Infiltration rates overall remained high with no indication of clogging or sediment accumulation except areas near the inflow.**

## Goal & Background

While the use of bioretention facilities in new and re-development is increasing rapidly, there has been little formal scientific assessment of the hydrologic performance of locally-constructed facilities. Local governments want to know the possibility of clogging and soil compaction in bioretention facilities over time, both of which can result in an overall reduction in permeability. Slow draining facilities increase the risk of hydrologic failure and can also create stagnant water, aesthetic problems, and vegetation failures.

This field study assessed 50 bioretention facilities in operation for more than 10 years by measuring infiltration rates, soil composition, vegetation, and comparing maintenance practices. The goal was to provide engineering guidance and recommendations for bioretention system design.


## Project Findings

Overall, findings from this study echoed findings from the previous two bioretention hydrologic performance studies, further strengthening those conclusions. For more background, see Fact Sheet #12: Bioretention Hydrologic Performance Study, Phase 1 and Fact Sheet #20: Bioretention Hydrologic Performance Study, Focus on Current Designs.

Of the 50 sites evaluated 28 were typical design bioretention facilities (i.e., infiltrating to native subgrade) and 22 were underdrained because subsoils drained extremely slowly. Infiltration rates overall remained high with no indication of clogging or sediment accumulation except localized areas near the point of inflow. Underdrained sites showed a generally higher range of infiltration rates than for typical sites.

### *Collectively improving stormwater management*

**Stormwater Action Monitoring (SAM)** is a collaborative, regional stormwater monitoring program that is funded by more than 90 Western Washington cities and counties, the ports of Seattle and Tacoma, and the Washington State Department of Transportation. SAM's goal is to improve stormwater management to reduce pollution, improve water quality, and reduce flooding. We do this by measuring stormwater impacts on the environment and evaluating the effectiveness of stormwater management actions.

The plant species observed in the bioretention facilities shifted from mostly plants adapted to wetter conditions in the original plans to plants adapted to drier conditions currently. There was little correlation between the prevalence of wetland plants and site infiltration rates for both typical and underdrained facilities.

Surveys revealed that most facilities were maintained 1-4 times per year, while some received more frequent maintenance, with visits occurring 1-2 times per month. The most common activities included branch and line trimming, as well as debris and garbage removal. Facilities in public view were maintained more often than those in less visible locations.

## Recommendations

**For jurisdictional designers/engineers/landscape architects:**

- Design to current recommendations: Follow current bioretention modeling recommendations in Ecology's Stormwater Management Manuals.
- Document site conditions before developing planting plan: Note things like drainage, shade, nearby vegetated areas, weather, irrigation, and groundwater to make sure the planting plan matches these conditions.
- Consider the plant list: Use more plants adapted to drier conditions instead of those that only thrive in wetlands.
- Confirm maintenance resources: Have site O&M and capital management staff review the site's management plan to ensure the planting plan fits with the available resources for long-term upkeep.
- Monitor sites: Particularly during large storm events, look for non-engineered outflows, leaking overflow structures and buildup near the overflow that allow bypass of flows before full infiltration. Monitor sites after large storm events to confirm ongoing sufficient infiltration.

**For scientific agencies/Department of Ecology:**

- Conduct sensitivity analyses using WWHM 2012 to determine the magnitude of effect of infiltration rate variability, contributing drainage area, and use of regional rainfall records on facility performance.

## Why does this study matter?

This BHP study demonstrates the continued performance of 50 older bioretention facilities and provides guidance for future installations. The findings show that most bioretention facilities continue to infiltrate stormwater runoff as intended, providing stormwater managers with confidence in requiring their use.

## What should stormwater managers do with this information?

Stormwater managers now have the evidence that early generation bioretention facilities generally perform as expected to control stormwater runoff. Permittees should inspect sites for short-circuited flow paths. When designing and building new bioretention facilities, designers should obtain site-specific information on infiltration rates and develop more drought tolerant planting plans.

## What will Ecology do with this information?

Ecology will continue to encourage regional partners not to use wetland-obligate species when designing bioretention facilities.

For more information, including the final report, see the website at

**ecology.wa.gov/sam**