SAM
Stormwater Action Monitoring

Project Title
Stormwater Retrofit Monitoring in the Echo Lake Drainage Basin

Effectiveness Study

Lead Entity
King County

Partner
City of Shoreline

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.

Questions about SAM? Send an email to SAMinfo@ecy.wa.gov

Study question
This study evaluated effectiveness of stormwater treatment facilities installed along the Aurora Corridor of State Route 99 where highway, commercial, and residential stormwater runoff discharges to Echo Lake, a small lake that eventually drains to Lake Washington. The study measured how stormwater quality is improved by individual treatment features – bioretention planter boxes (BPBs) and a Filterra planter box (FLT) – as well as system-wide detention tanks. The investigators observed (but did not measure) reduction of peak flows, and intended to compare the quality of stormwater runoff at outfall before and after the retrofit project. The study also assessed changes in water quality in Echo Lake over time, and how these changes correspond to changes in stormwater infrastructure in the contributing basin.

Stormwater management problem
Untreated stormwater is a major contributor of contaminants and habitat degradation in urban water bodies. Highway corridor projects aim to improve traffic safety, traffic flow, and stormwater quality. These projects have limited space in which to place stormwater treatment and therefore tend to use technologies that have small footprints and provide streetscape amenities. Project requirements are based on the amount of roadway being added and replaced, not the expected results in the receiving water body. To select the best technologies, stormwater managers want information about the effectiveness of these treatment facilities in the field and their collective potential to improve water quality in receiving water bodies.

Project findings
Individual BPBs significantly reduced stormwater concentrations of total suspended solids (TSS), ammonia, total metals, polycyclic aromatic hydrocarbons (PAHs), and total lube oil-/diesel-range petroleum hydrocarbons (TPH-Dx). The average percent reduction in stormwater concentration of was greater than 80% for total polychlorinated biphenyls (PCBs). Toxicity was also assessed at one BPB and was always reduced in effluent when initially observed in the influent. Total copper was reduced, and while dissolved copper sometimes increased, effluent concentrations were low (≤6 µg/L). Dissolved cadmium and lead were infrequently detected in both influent and effluent samples. Flow was not measured, but a substantial reduction in stormwater volume was visually observed at each BPB.

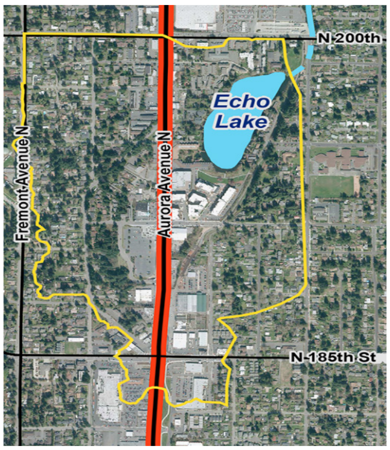
The FLT also significantly reduced concentrations of TSS, total nitrogen, ammonia, total metals, total PAHs, TPH-Dx, and total phosphorus. The average concentrations of dissolved copper and zinc increased in the FLT effluent compared to the influent concentrations. The FLT was very effective at removing ammonia and organic contaminants and performed better than the BPBs for removal of total phosphorus and total nitrogen. However, it was generally less effective than the BPBs at reducing concentrations of metals and TSS.

The system-wide detention tanks provided some additional water quality treatment, reducing TSS and total zinc by <20% on average. Overall, concentrations of other contaminants were comparable between influent and effluent for most events.

	BPB	FLT
Suspended Solids	↓	↓
Dissolved Zinc	↓	↑
Dissolved Copper	mixed	↑
Total Phosphorus	↑	↓
Petroleum Hydrocarbons	↓	↓
PCBs	↓	↓

This study looked for a pattern in Echo Lake water quality concentrations by using existing monitoring data and found no substantial changes in the lake that correspond to the retrofit installations. The retrofits treat only 2.9 acres of impervious surface out of the 207-acre basin. A higher density of stormwater treatment retrofits throughout the watershed may be needed to achieve measurable water quality improvement.

The quality of stormwater runoff at the outfall before and after the retrofits could not be quantified because substantial physical changes in the drainage system made the data incomparable.



Though not directly related to the study objectives, the study discovered important facility maintenance needs. The BPBs required frequent maintenance visits and cleaning because debris often blocked the inlets and prevented stormwater from entering. The FLT inlet was much larger and remained clear of debris; however, facility media replacement has been needed every two-to-three years since installation to address clogging by fine sediments.

Recommendations

The retrofits targeted the arterial road in the basin and reduced concentrations of most pollutants in the stormwater runoff, but further study is needed to identify what density of treatment facilities throughout the basin is required to result in detectable water quality improvements in the lake.

Routine site inspections are needed to ensure treatment installations remain functional. Each BMP site is unique, and it is important for stormwater managers and city-wide programs to plan for inspections to ensure that the anticipated maintenance schedule truly meets the needs of the individual site.

Inlet designs should be larger for BPBs to keep roadway debris from blocking curb cuts and allow facilities to receive the volume of stormwater that matches their capacity. The presence of trash does not appear to affect facility performance.

Why does this study matter?

Highway corridors have limited land area and opportunities for retrofits to improve stormwater treatment. This study provides insight into how to maximize the benefits of retrofit projects in these space-constrained areas. The study area has typical commercial and residential land use along a busy roadway. Some of the treatment facilities were installed more than three years before the study began, allowing for assessment of performance of a more mature installation. The study evaluated the BMPs for their effectiveness to reduce many pollutants common in stormwater, including some like PAHs and PCBs that are rarely included in stormwater treatment studies.

What should we do with this information?

Stormwater managers should use information from this study in deciding what treatment technologies will be most effective and appropriate for their local conditions and evaluate maintenance needs of their existing and future roadside treatment facilities.

What will Ecology do with this information?

This study underscores that downstream water quality improvements cannot be provided by a single retrofit project. Ecology will continue to encourage, support, and fund opportunistic and strategic retrofitting of road corridors using these and other types of treatment facilities to improve the quality of stormwater discharges and reduce flows. Ecology may establish funding priorities for projects that are part of thorough planning processes. Ecology will emphasize in technical guidance that curb cut inlets must be large enough to not be easily clogged by road debris.

For more information

Go to www.ecology.wa.gov/SAM and search for SAM Echo Lake.