

Stormwater Action Monitoring 2022 Annual Report

June 2023



This is the eighth annual report from the Washington State Department of Ecology (Ecology) on implementation of Stormwater Action Monitoring (SAM), a collaborative program funded by more than 90 Western Washington cities and counties, the ports of Seattle and Tacoma, and the Washington State Department of Transportation (WSDOT). Ecology manages SAM's revenues, expenditures, agreements, and communication of findings.



Stormwater Action Monitoring (SAM) is the regional cooperative stormwater monitoring option in the municipal stormwater permits.

SAM is the alternative to outfall monitoring in the permits.

The SAM program funds projects to improve stormwater management, reduce pollution, improve water quality, and reduce flooding. The projects do this by measuring stormwater impacts on the environment, evaluating the effectiveness of stormwater management techniques, and suggesting changes to the stormwater manuals, local practices, and permit requirements. SAM projects also build tools, techniques, and resources for permittees.

All jurisdictions, large and small, can benefit from SAM projects by using findings to protect local lakes, rivers, streams, wetlands, and Puget Sound.

<https://ecology.wa.gov/SAM>

Highlights for 2022

All but one of the Stormwater Work Group (SWG) approved SAM projects that came out of the Round 3 Solicitation were started. The remaining project on permeable pavement will start in 2023.

Still some delays on SAM projects due to global pandemic related impacts

While many of the lead or subcontracted staff have adjusted well to the hybrid field, office, or telework settings, there were still delays in return of laboratory data, or loss of work time due to staff turnovers. Several of the active SAM Effectiveness Studies or Source ID projects needed time extensions and additional resources this last year to meet already approved study goals.

Staffing changes at Ecology

Karen Dinicola, Ecology's lead staff to the Stormwater Work Group retired in August. Karen orchestrated 99 SWG meetings and countless subgroup meetings bringing order and purpose to this important permittee committee on stormwater monitoring. We will miss her!

Keunyea Song, the SAM Scientist, and project manager left Ecology for other opportunities. We wish her well! Ecology was successful in recruiting a new SAM Scientist, Dr. Chelsea Morris. See back page for more information.

Looking ahead

Next year, SAM staff will begin to contract the Round 4 SWG approved projects. These projects will get going as staff time allows which is expected to span into the beginning of the 2024 permit cycle.

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Program Management

Stormwater Work Group

The Stormwater Work Group (SWG) scale is larger, but participates in the Puget Sound Ecosystem Monitoring Program (PSEMP). SWG is a coalition of representatives of local, state, and federal governments, environmental and business organizations, public ports, tribes, and agriculture. SWG formed in 2008 to develop a strategic, coordinated, and integrated approach for monitoring municipal stormwater in Western Washington and evaluating effectiveness of stormwater practices and management activities.

The SWG welcomes participation on the group's sub-committees and caucuses. All meetings are open to the public. See the SWG website:

<https://sites.google.com/site/pugetsoundstormwaterworkgroup/>

What is the connection between SAM and the SWG?

All SAM projects are selected and approved by the SWG. The SWG sets priorities and makes recommendations to support SAM implementation and other stormwater-related monitoring.

The Pooled Resources Oversight Committee (PRO-C), a subgroup of SWG, oversees Ecology's administration of SAM. The PRO-C approves all SAM contracting decisions and spending and also reviews each project's scope of work and amendments. Both the SWG and PRO-C are formal committees whose members represent stakeholder groups.

Permittees, state and federal agencies, and university faculty provide funding and/or leadership on SAM projects. Ecology serves as the administrative entity that manages SAM funds and executes SAM contracts.

Who makes up SAM?

SAM receives annual revenue from Cities, Counties, Ports, WSDOT and the US Navy via an option in the NPDES Municipal stormwater permits.

Cities: Aberdeen, Algona, Anacortes, Arlington, Auburn, Bainbridge Island, Battle Ground, Bellevue, Bellingham, Black Diamond, Bonney Lake, Bothell, Bremerton, Brier, Buckley, Burien, Burlington, Camas, Centralia, Clyde Hill, Covington, Des Moines, DuPont, Duvall, Edgewood, Edmonds, Enumclaw, Everett, Federal Way, Ferndale, Fife, Fircrest, Gig Harbor, Granite Falls, Issaquah, Kelso, Kenmore, Kent, Kirkland, Lacey, Lake Forest Park, Lake Stevens, Lakewood, Longview, Lynden, Lynnwood, Maple Valley, Marysville, Medina, Mercer Island, Mill Creek, Milton, Monroe, Mount Vernon, Mountlake Terrace, Mukilteo, Newcastle, Normandy Park, Oak Harbor, Olympia, Orting, Pacific, Port Angeles, Port Orchard, Poulsbo, Puyallup, Redmond, Renton, Sammamish, SeaTac, Seattle, Sedro-Woolley, Shoreline, Snohomish, Snoqualmie, Steilacoom, Sumner, Tacoma, Tukwila, Tumwater, University Place, Vancouver, Washougal, Woodinville.

Counties: Clark, Cowlitz, King, Kitsap, Pierce, Skagit, Snohomish, Thurston, Whatcom.

Ports: Tacoma and Seattle.

Agencies: Washington Department of Transportation and the United States Navy.

Ecology manages permittees' annual funding receipts in PARIS: <https://apps.ecology.wa.gov/paris>.

- * In-kind funds have been received from: Washington Departments of Ecology, Agriculture, and Fish and Wildlife and the United States Geological Survey
- * In-kind funds have been received by Penn Cove Shellfish and Cedar Grove Composting.

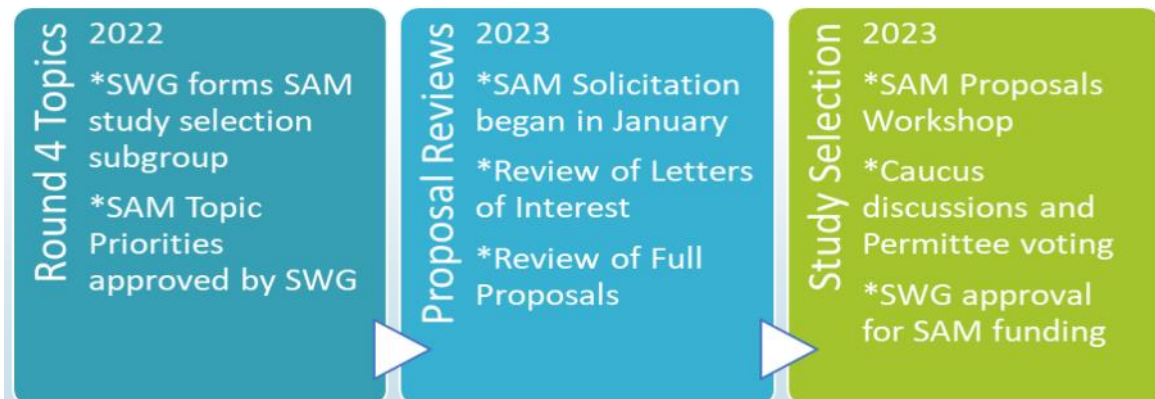
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Administration

Round 4 Solicitation is Underway

The SAM Study Solicitation Subgroup chair Angela Bolton (City of Mill Creek) leads the development of the Round 4 Solicitation Process

- Round 4 Solicitation process will take all of 2023 to complete. The SAM RFP Guidelines are available on the SAM Effectiveness Studies Webpage.
- SAM revenue gathered in 2022 and 2023 will fund new Effectiveness Studies and Source Identification projects, and extend monitoring for the long-term Status and Trends studies. With oversight by SWG, a Round 4 solicitation process will begin in 2022.
- The final Round 3 SWG Approved project to get started under SAM was delayed due to staff capacity at both Ecology and WSU-Puyallup. (FP4) Replacement and lifecycle costs of permeable pavements compared with conventional pavements will begin in 2023.

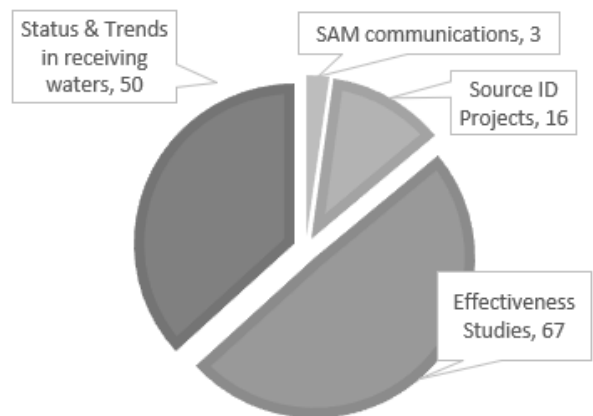


Contracts and Agreements

In 2022, many of SAM's studies were still adjusting to delays caused by the global pandemic and needed contract extensions. Since 2014, SAM staff as well as Ecology's fiscal, management, and contracts section have processed over 130 contracting actions such as initial contracts and amendments.

We continue to try to build in contingencies, time to hire sub-contractors, and time to incorporate review processes that are expected by technical committees and Ecology's SAM staff to minimize the high rate of amendments.

NUMBER OF CONTRACTING ACTIONS SINCE 2014



Receiving Water Status & Trends



Are conditions in receiving waters getting better or worse?

SAM is assessing the impacts of stormwater runoff in urban and urbanizing areas in the Puget Sound and Lower Columbia River watersheds. These studies are long-term and active each year. Reports completed in 2022 are showcased in the blue boxes.

Puget Sound Basin Studies



Two receiving water status and trends monitoring regions: Puget Sound and Lower Columbia River Watersheds

Stormwater managers know that effective and lasting improvements to infrastructure, best management practices, and changing behaviors of Puget Sound residents takes time. Long-term monitoring of key environments help us determine if conditions are getting better in the areas adjacent to urban areas. Two receiving waters studies cover the Puget Sound watershed. Each study monitors 33 randomly selected sites from across four levels of impervious cover and two reference sites.

◆ **Puget Small Streams (PSS):** U.S. Geological Survey (USGS) leads the small urban streams assessment for SAM. Monitoring includes water, sediment, macroinvertebrate sampling and physical habitat assessment. Water level and temperature using sensors are monitored continuously throughout the year. Restrictions related to the pandemic continue to impact field work, chemical analysis, and reporting. The annual reports for water year 2020 and 2021 will now likely be published in mid-2023.



2019-2020 Nearshore Mussels Survey Findings

SAM Fact Sheet #27, September 2022

Biannual monitoring in the marine nearshore is helping us determine if conditions are getting better as stormwater management improves.

The 2019-20 winter survey provided the first opportunity to evaluate changes in contamination of nearshore mussels living inside the urban growth areas (UGAs) of Puget Sound. Mussels in the urban nearshore accumulated organic contaminants (PAHs, PCBs, PBDEs, DDTs) at a greater rate than at the reference site. PAHs, PBDEs, and DDTs had significantly lower central tendency concentrations in mussels from this third survey (2019-20) than the prior two surveys. Results from the 2021-22 survey will be published in winter 2023.

◆ **Puget Sound Nearshore Mussels:** Washington Department of Fish and Wildlife (WDFW) leads the biannual nearshore assessment for SAM. WDFW's next round of monitoring will start in fall of 2023.



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Lower Columbia River Study

The Lower Columbia Urban Streams (LCUS) study monitors small urban streams in Clark and Cowlitz counties. The LCUS study design includes trend sites that will be monitored yearly and status sites that will be sampled at five-year intervals. Trend analyses will be conducted every five years.

Clark County leads this streams assessment for SAM. Monitoring includes water, sediment, macroinvertebrate sampling and physical habitat assessment. Water level and temperature using sensors are monitored continuously throughout the year. Clark County completed the second round of sampling in 2022.

2020 Lower Columbia Urban Streams Findings

Annual Report, August 2022

Monitoring began in late 2020 and the first results identified several important stressors that effect overall stream health:

- Most stream flow measurements met criteria for supporting salmonoid use, while no site met the temperature criteria.
- Benthic Index of Biotic Integrity (BIBI) scores generally declined in subwatersheds with increasing impervious surface and traffic values greater than 10,000 daily trip miles per square mile. BIBI scores in nearly all streams showed severe drought stress.
- Metal concentrations in stream sediments were below the cleanup standards.
- All streams had excessive fine-grained sediment as measured by embeddedness or the amount of fine sediment in gravel beds.

Over time, this study will provide enough data to categorize LCUS streams in good, fair, or poor condition. Trend analyses and risk assessments will be conducted every five years to identify the key stressors causing poor stream conditions in the region.

Source Identification Projects

What are the common sources of illicit discharges and best ways to reduce them?

SAM Source Identification projects identify common problems and propose regional actions on source control to prevent transport of pollutants in stormwater. These projects are active.

- ◆ **Mobile Business:** King County and consultants have worked with the WA Department of Revenue to pull business listing information to help jurisdictions identify mobile business types from business licensing data. A pilot outreach effort in southern King County began mid-year. The goals are to recommend ways to identify mobile businesses and methods to conduct inspections and outreach for the purposes of stormwater source control and pollution prevention. The pilot source control effort will evaluate if the new tools and guidance will be helpful in source control activities among jurisdictions.
- ◆ **Business Source Control:** Washington Stormwater Center (WSC) and consultants have completed a resource webpage on the WSC website, an online guidance manual for stormwater program development, and four in-person business inspection trainings. The contract was extended for two more trainings in 2023 and an online module.



Effectiveness Studies

How well are required or innovative stormwater management practices working?



SAM is measuring the effectiveness of BMPs and stormwater management actions to reduce negative hydrologic impacts and the discharge of pollutants to receiving waters. Bulleted studies were active in 2022, and completed SAM projects are shown in the blue boxes.

Mulch choices for bioretention

SAM Fact Sheet #25, June 2022

Using the 16 experimental bioretention cells at Washington State University (WSU) at the Washington Stormwater Center (WSC) found that all three evaluated mulch types (arborist chips, medium bark, and nuggets) offered significant benefits to bioretention facilities.



Arborist chips



Medium bark



Nugget

In particular, weed suppression, much better soil moisture, and water discharge rates over controls were measured. The nugget mulch also significantly reduced water outflow volumes.

Stormwater maintenance programs utilizing mulches may see reduced O&M costs overall due to reducing watering needs in the summer, improved plant survival, and reduced weeding or the need for herbicides.

Bioretention designers, landscape designers, horticulturists and others should limit use of water loving and easily spreading plants such as 'ninebark' to minimize maintenance needs in bioretention facilities and rain gardens.

Three types of mulch were tested in bioretention systems

Hydrologic benefit of larger individual trees

SAM Fact Sheet #26, August 2022

Washington Department of Natural Resources, Washington Stormwater Center, and Evergreen State College are quantifying the hydrologic benefits of retaining mature trees. Over 60



Mature trees were outfitted with sensors to measure tree transpiration and interception of rainfall

trees were monitored to quantify how much rain and runoff is captured by common native evergreen and deciduous trees in Western Washington.

All four species intercepted and transpired 44-65% of the rainfall landing on their canopies on an annual basis, meaning this rainfall did not become runoff. Differences between tree species were most evident in the winter when the stormwater management needs are highest. Evergreen trees (which keep leaves year-round) continue to transpire and intercept rainfall on their canopies.

These findings reinforce the importance of mature tree retention to intercept rain, transpire moisture, and generally aid in water management on site. Stormwater managers should plant and retain trees and, where feasible, use evergreen trees.

- ◆ **Ongoing Study: Hydrologic benefit of smaller street trees.** WSU was contracted for a second objective to repeat the above study but on much smaller trees of the same species.

Effectiveness Studies (cont'd)

- ◆ **Paired watershed retrofit and restoration:** The City of Redmond paired watershed study is in year 7 of 10. Substantial work was done this year to correct an error in the Aquarius software package used to process the continuous flow data for the entire study. The Annual Report for Water Year 2020 was revised and the 2016-2019 Trend Analysis Report will be revised next year.

Note: A unique source control BMP study within the Watershed Scale Retrofit and Restoration

The City leveraged the ongoing long-term monitoring of the Paired Watershed Study to quantify in-stream benefits of the source control BMP street sweeping in one of the streams. The found a consistent and statistically significant decrease in total suspended solids and total copper concentrations in Monticello Creek that appeared to be related to the increase in street sweeping frequency. (See Trend Analysis Report Water Years 2016-2018 on the SAM project webpage and the Water Year 2020 Data Report).

This effort is being repeated using Ecology's legislative proviso funds in Tosh Creek, another basin already monitored part of this long-term project. Two additional parameters were also added, polycyclic aromatic hydrocarbons (PAHs) and the emergent 6PPD-quinone.

- ◆ **Hydrologic performance of the oldest bioretention:** City of Olympia will find and test the infiltration rate of the oldest facilities to evaluate influential factors on the best designs and maintenance lessons learned.
- ◆ **Evaluation of BMP Maintenance:** The City of Bellevue will evaluate (survey and data review) the maintenance thresholds or conditions for ponds, vaults, trenches, and tanks. A white paper will make suggestions how permittees might adjust BMP maintenance efforts to maximize overall environmental outcomes to meet permit requirements.

- ◆ **Ditch Maintenance for water quality study:** WSU's study to evaluate different grass mixtures for roadside ditch reseeding is underway. The water quality study aspect of reshaping ditches will be removed from the project because safe and suitable locations to conduct roadside ditch sampling could not be found.



- ◆ **Particle size importance for stormwater characterization and BMP effectiveness:** Washington State Department of Natural Resources is leading a literature search and synthesis on particle sizes in stormwater, attached pollutants and load reduction as a function of particle capture.
- ◆ **Guidance for evaluating the effectiveness of public education and outreach programs:** WSU synthesizes and evaluates effective behavior change campaigns for local jurisdictions to use to improve stormwater management success. The final deliverables will be completed in early 2023.
- ◆ **Orifice control of bioretention for water quality treatment:** WSU is evaluating the impacts of small orifice as part of a bioretention underdrain system on water quality and quantity performance improvements. The project was extended into July 2023. Both modelling evaluation and real-time data are now contracted to assess long term runoff volume reduction and pollutant reduction benefits from smaller orifices in underlined bioretention facilities.
- ◆ **Longevity of bioretention soil mix for toxicity reduction:** WSU continues to evaluate coho toxicity reduction by the 60:40 default bioretention soil mix.

Note on this SAM Study: Longevity of bioretention soil mix for toxicity reduction.

Ecology leveraged this existing SAM study to add 3 additional water years for coho toxicity and quantification of the emergent 6PPD-quinone compound using legislative proviso funds.

SAM's 2022 Communications

SAM funded projects were featured at Green Stormwater Infrastructure Summit, local, APWA stormwater managers meetings, PSEMP Freshwater and Toxics workgroup and other meetings in 2022.

Ecology maintains approximately 20 webpages for SAM communication and transparency. Individual project pages exist for each of the active SAM studies. Completed projects are summarized, in the accor-dions, under Effectiveness Studies Source Identification and Status and Trends. SAM communication in-cludes factsheets, SAM newsletters, SAM booklet of completed studies in 2013-2019 and multiple SAM educational videos.

All final reports, scopes of work, and other key deliverables are available on the SAM website under **Completed Studies**. SAM staff and the study lead co-author a two-page fact sheet for each final report.

Hiring and Shifting Workloads

- Ecology hired the new SAM Scientist Dr. Chelsea Morris who will manage all the Status and Trends projects and approximately half of the Effective-ness Studies.
- Ecology is exploring different ways to maintain their commitment to administer SAM, staff SWG, and ensure adequate representation from the agency. The Phase I Municipal Stormwater Permit Writer position was updated to develop agenda content and workplan support for SWG. There was turnover in this position in 2022. Emma Trewhitt pursued other opportunities and we wish her the best. Amy Waterman was hired mid-year in the Phase I permit writer and SWG support position.



Brandi Lubliner, PE, is the SAM Coordinator (left) and Chelsea Morris, PhD, is the SAM Scientist (right).

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STORMWATER-ACTION-MONITORING: a newsletter announcing SAM study findings and upcoming workshops.

SWG-REPORTER: four issues per year to hear about study findings and the process for selecting studies.

STORMWATER-WORK-GROUP: meeting agendas, materials, summaries, and announcements related to SWG.

ADA Accessibility

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