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Sweepers



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Help for Stormwater Managers

Advanced online tools help Chesapeake Bay Counties make better informed decisions when it comes to BMP implementation.

BY DAVID HEIGL

As stewards of taxpayer dollars, stormwater managers must implement a portfolio of the most cost effective best management practices (BMPs) that meet the US Environmental Protection Agency's Final MS4 General Permit Remand Rule requiring "clear, specific, and measurable permitting" conditions while also keeping the public informed and involved. To achieve this objective, the Chesapeake Bay Program is leading the way with tools and guides to help stormwater managers. Partners of the program include federal and state agencies, local governments, non-profit organizations and academic institutions.

The Chesapeake Bay Program has developed a comprehensive online tool called the Chesapeake Assessment Scenario Tool, also known as CAST. CAST enables stormwater managers from each county within the six-state Chesapeake Bay region to develop their Phase 3 Watershed Implementation Plans (WIP). It estimates the nitrogen, phosphorus, and sediment loads resulting from selecting one or more BMPs to achieve their goals. The results also quantify the costs and effectiveness of various BMPs. Many of the scenarios break BMPs down to similar units of measure, like cost per acre of treatment, so that stormwater managers can easily compare one BMP to another.

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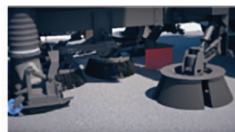


Understanding Street Sweeping Technology

Advanced Air Pure Vacuum Technology



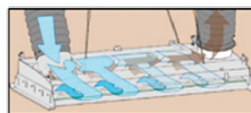
Think vacuum cleaner. Gutter brooms and center brooms sweep debris to a vacuum nozzle. Air and debris are separated in the hopper. Clean air is discharged out of the top of the sweeper into the atmosphere.



Advanced Air Regenerative Air Technology



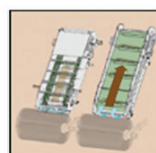
Think pressurized air knife and vacuum head. Gutter brooms sweep debris to a center pick up head. An air knife the width of the head blasts the surface with pressurized air and kicks debris up into an air stream which is then vacuumed into a hopper. Air and debris are separated in the hopper. Clean air is recirculated to the head.



Mechanical Mechanical Broom Technology



Think broom and dust pan. Gutter brooms transfer debris to a large horizontal rear broom that sweeps debris onto a conveyor for discharge into a hopper.



The Chesapeake Bay Program also recently developed a downloadable BMP guide entitled *Chesapeake Bay Program Quick Reference Guide for Best Management Practices (BMPs)*. One objective of the guide is to provide consistent understanding of BMPs that reduce sediment, nitrogen, and phosphorus. A summary for each BMP includes

- general information about the BMP;
- how the BMP functions within the Watershed Model;
- what's needed for the BMP to be reported for annual progress submissions;
- and links to additional information for readers who want more detailed information about the practice.

Street Sweepers with Catch Basin Cleaning Stand Out

Street sweepers with catch basin cleaning capability stands out as one of the most cost effective BMPs.

Within the comprehensive guide are several quick reference guides ranging from stream restoration to street sweeping. The street sweeping guide was developed using Win-SLAMM software modeling. Inputs include default nutrient enrichment factors of .07% phosphorus and .20% nitrogen for street solids. These means were based on several street solid studies across the US and were found to be surprisingly consistent. Rainfall data was entered once every four days which is typical for the Chesapeake Bay region. Other input data included regional street conditions, street types, parking density, and the type of sweeper technology.

The model was used to simulate the reduction for 960 different street cleaning scenarios, but was eventually consolidated into 11 generic scenarios; because 65% of the

The CAST tool can estimate the nitrogen, phosphorus, and sediment loads resulting from selecting BMPs. The results also quantify the costs and effectiveness of various BMPs.

scenarios showed no pollution reduction benefit, they were eliminated. The street sweeping guidelines quantify TMDL reductions based on frequency and the type of sweeping technology used, whether it be mechanical or advanced air sweeping. The guide includes a table that breaks down 11 street cleaning practices (SCPs), examples of which can be seen in Table 1. Emphasis is placed on frequency of sweeping to ensure the removal of accumulated material before precipitation washes it into storm drains or waterways. A general guideline for the MS4 in terms of treatment is one mile of curb lane swept is equal to one impervious acre of treatment. The guide quantifies TMDL reductions in terms of percentages for sediment, phosphorus, and nitrogen. For example, MS4s operating advanced air technology, such as regenerative air or pure vacuum sweepers, earn the maximum credit of 21% Sediment, 4% Nitrogen, and 10% Phosphorus when sweeping routes twice per week, 50 weeks per year. The street sweeping guide can be found at www.chesapeakebay.net/documents/BMP-Guide_D.9_Street-Clean-

Table 3. Comparing the annual cost per pound of sediment, phosphorus, and nitrogen removal of various BMPs

BMP	Unit	Cost (Unit/BMP)	Costs (\$ per pound reduced per year)		
			Nitrogen	Phosphorus	Sediment
Advanced Sweeping Technology: 1 pass/2 weeks	Acres	731.51	3,116.32	23,826.83	4.09
Advanced Sweeping Technology: 1 pass/week	Acres	1,462.17	4,152.67	29,688.92	5.63
Advanced Sweeping Technology: 2 pass/2 weeks	Acres	2,925.18	6,230.80	47,392.81	8.58
Advanced Sweeping Technology: fall 1 pass/1–2 weeks, else monthly	Acres	674.53	2,873.57	21,970.87	4.15
Advanced Sweeping Technology: spring 1 pass/1–2 weeks, else monthly	Acres	506.76	4,317.71	20,579.21	4.46
Mechanical Broom Technology: 1 pass/week	Acres	2,632.92	0	0	324.13
Mechanical Broom Technology: 2 pass/week	Acres	5,266.08	0	0	324.21
Permeable Pavement w/Sand, Vegetation: A/B soils, no underdrain	Acres Treated	14,214.02	2,134.42	25,092.14	18.21
Bioretention/rain gardens: A/B soils, no underdrain	Acres Treated	1,057.67	158.82	1,757.24	1.28
Filter Strip Stormwater Treatment	Acres Treated	4,481.08	0	0	22.18
Infiltration Practices w/Sand, Vegetation: A/B soils, no underdrain	Acres Treated	1,091.56	154.27	1,813.69	1.25
Bioretention/raingardens: C/D soils, underdrain	Acres Treated	1,057.67	508.23	3,319.41	2.09
Dry Detention Ponds and Hydrodynamic Structures	Acres Treated	758.93	1,823.30	10,720.68	8.26
Dry Extended Detention Ponds	Acres Treated	342.06	205.46	2,415.16	0.62
Filter Strip Runoff Reduction	Acres Treated	4,481.08	2,691.57	11,719.87	8.71
Wet Ponds and Wetlands	Acres Treated	329.91	198.16	1,035.39	0.60
Storm Drain Cleaning	Lbs of Sediment	0.62	291.14	1,310.11	0.79

for treatment. What we've calculated is that street sweeping will put us well below that \$20,000 per acre of treatment, and is the quickest and fastest way to get started on the reduction of the 20 percent to meet our goal." Using the CAST guidelines of advanced air sweepers making one pass every two weeks resulted in a cost of \$731 per acre of treatment.

Therefore, the county opted to purchase an A8 Twister regenerative air sweeper from Schwarze Industries. Under the guidelines that one lane-mile of sweeping with a regenerative air sweeper equals one impervious acre treated, the staff separated the county into 45 "sweepable sections" that each will be swept 25 times per year, with a goal of sweeping at least 12 lane-miles per day.

The sweeper provides the county double functionality when it comes to BMPs—in addition to street sweeping, it also has catch basin clean-

ing capabilities. This was a feature that Washington County particularly sought when selecting the A8 Twister, Reed says. Using the CAST guidelines for catch basin cleaning, each pound of sediment removed results in a cost of \$0.62 per pound.

"To make sure we got the right bang for the buck we decided to go

with a sweeper that had a scissor lift option," says Reed. "This enables us to have a dump truck staged in one of the 45 routes we have mapped out and to be able to dump three to four loads. Once the dump truck is full, it can go to the landfill, where it dumps the material into a pile, or to be dewatered and then comes back to



To maximize sweeping time, Washington County chose a sweeper with a scissor lift that could be emptied into a dump truck.

Schwarze Industries

Table 1. Street cleaning practices' sediment, nitrogen, and phosphorus efficiency values at the Phase 6 Watershed model

Type	Practice	Description of passes by sweeper; approximate number of passes per year	Sediment (%)	Nitrogen (%)	Phosphorus (%)
Advanced	SCP-1	2 passes per week; ~100 passes per year	21	4	10
Advanced	SCP-2	1 pass per week; ~50 per year	16	3	8
Advanced	SCP-3	1 pass every 2 weeks; ~25 per year	11	2	5
Advanced	SCP-4	1 pass every 4 weeks; ~10 per year	6	1	3
Advanced	SCP-5	1 pass every 8 weeks; ~6 per year	4	0.7	2
Advanced	SCP-6	1 pass every 12 weeks; ~4 per year	2	0	1
Advanced	SCP-7*	Seasonal scenario 1 or 2; ~15 per year	7	1	4
Advanced	SCP-8*	Seasonal scenario 3 or 4; ~20 per year	10	2	5
Mechanical Broom	SCP-9	2 passes per week; ~100 per year	1	N/A	N/A
Mechanical Broom	SCP-10	1 pass per week; ~50 per year	0.5	N/A	N/A
Mechanical Broom	SCP-11	1 pass every 4 weeks; ~10 per year	0.1	N/A	N/A

ing-Street-Sweeping_.pdf

In the example in Table 2, the stormwater manager records the curbed lane miles swept. Annual TMDL loading is factored based on scenarios offered in CAST or as actually determined by the stormwater manager. Once the percent reduction is applied, the stormwater manager can then determine the actual removal rate. It is also important to note that stormwater managers must collect one high quality sample on one route for each SCP for credit each year.

Applying The Tools to Find the Fastest Way to Reach TMDL Goals

The State of Maryland's Phase 3 Watershed Implementation Plan (WIP) is the state's plan to reduce sediment, nitrogen, and phosphorus TMDLs by 2025. Each county within the state must develop a watershed implementation plan (WIP) which outlines how it will meet TMDL target loads for the urban, wastewater, and septic sectors. Washington County, MD, operates under an NPDES Phase II permit. The County is made up of 22,162 acres with a population of 150,926. Washington County's 2017 to 2025 total reduction responsibility is 10,631 TN pounds and 581 TP pounds. This equates to a 20% reduction by 2025.

In order for Washington County to meet the Chesapeake Bay's plan for both the NPDES permit and EPA total maxi-

mum daily load requirements, early modeling of various BMP scenarios within the CAST tallied up to more than a billion dollars.

"We really had to look at ways to become innovative and creative," says Alex Reed, watershed specialist for Washington County.

Table 2. Example of New Street Cleaning Credit (Phase 6)

Record curbed lane miles swept (assumes 1 curb mile = 1 impervious acre)	200
Record the annual loading rate from the impervious cover	TN: 15.5 lbs/acre/year TP: 1.93 lbs/acre/year TSS: 1,300 pounds/acre/year
Record (SCP) sweeping scenario removal rates based on frequency of sweeping per year	SCP3 (1 pass every 2 weeks) TN: 2% TP: 5% TSS: 11%
Multiply recorded lane miles by loading by SCP removal rate to obtain mass in pounds removed	TN: 62 lbs TP: 19.3 lbs TSS: 28,600 lbs

John Swauger, who serves as the stormwater management coordinator for Washington County, says it comes down to numbers. "We looked at some of the other BMPs and many of those are quite expensive to install. We start by looking at BMPs within the \$20,000 per acre range



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be staged,” he says. “Then we never stop the street sweeper during the day while it’s out and about.”

The Added Benefit of Achieving Community Involvement and Buy-In

Because a sweeper is able to serve an entire county, people from communities across the economic spectrum are able to see it at work in their neighborhoods.

sweeper to promote its Clean County Initiative, a program that aims to ensure taxpayer dollars are used effectively and create awareness of the county’s efforts to improve the environment. The sweeper features the Clean County Initiative logo and its motto, “Clean Streets, Clean Streams, Clean County.”

“People recognize it and they’re starting to associate that brand recognition with good work in the community,” says Reed, adding that it has benefited other BMPs such as stream cleanups and tree plantings at

collected to date can be found on the County’s website at www.bit.ly/2Q4sfh8. County Administrator Rob Slocum said during a recent press release, “Washington County is one million pounds cleaner and closer to its permit requirements with this program.” ♦

References

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Schwarze Industries



Washington County also uses the sweeper to promote the Clean County Initiative.

“A lot of the lower-income places and communities in the county, those are areas that have already been developed,” meaning there is not space for BMPs like storm ponds, explains Reed. A sweeper, however, can get into those communities and make a difference. “The debris is picked up and then all of a sudden these underserved communities aesthetically look better,” he says.

The public response has been overwhelmingly positive. “I’m honestly surprised—happily surprised—how many phone calls we’ve gotten from people calling to thank us,” says Reed.

Washington County also uses the

schools, which have recently experienced higher attendance. “As long as we have that community buy-in, we’re going to be able to continue to reach our goals and, therefore, be one of the counties that actually meets our NPDES goals, and that’s something we’re pretty fired up about. And doing that on limited resources—that’s even better.”

Since the inception of the Clean County street sweeper in January of 2019, over 1 million pounds of debris have been collected from the impervious streets and roadways across Washington County. The latest data on the amount of data

David Heigl is vice president of Schwarze Industries Since the 2017 release of the EPA’s Final MS4 General Permit Reprimand Rule, he has led a campaign to educate stormwater managers on recent third party guidelines for maximizing impervious acre treatment and TMDL reduction credits through the use of advanced street sweeping technology.