STREET SWEEPING FOR POLLUTANT REMOVAL

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I. Purpose

The purpose of this report is to:

- document the current status of street sweeping in Montgomery County;
- evaluate pollutant removal from street sweeping based on a literature review; and
- make recommendations for the County's street sweeping program to maximize pollutant removal at the lowest possible cost.

There are two parts to the County's overall street sweeping program: the Department of Public Works and Transportation (DPWT) program that covers residential roads, arterial roads, and the Piney Branch Central Business District (CBD) and the CBD Program that covers the Bethesda, Silver Spring, and Wheaton CBDs. During the year 2000, these two programs prevented about 2,500 tons of solids from washing into the County's storm drains, stormwater management facilities, and local waterways. An estimated 348 pounds of copper, 468 pounds of lead, and 2,371 pounds of zinc was removed in this solid material and prevented from polluting our waterways. Even though the primary purpose of the street sweeping program has been to maintain neat roadways, it needs to be routinely continued as a best management practice to reduce pollutants.

The Department of Environmental Protection (DEP) initiated the current report after learning that funding for the DPWT street sweeping program had been eliminated from the FY'02 budget. At that time, the County reported annually to Maryland Department of the Environment (MDE) on the status of its street sweeping program as a Federal Clean Water Act permit requirement. The County is one of 10 Maryland jurisdictions that must comply with the requirements for a National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit to control pollutants discharged through its storm drain system. Elimination of the DPWT street sweeping program was technically a violation of the County's permit.

In July 2001, the MDE re-issued the County's permit without the explicit requirement for reporting on street sweeping activities. Instead, the County is now being required to identify potential sources of pollutants from road and roadside maintenance activities, to develop a plan for reducing pollutants from these activities, and to annually report on implementation status of the pollution reduction plan. This plan should include countywide street sweeping.

To maximize pollutant material at the lowest possible cost, the DPWT should evaluate its existing schedule for street sweeping and amount of materials removed by the greatest detailed data available (by district, by road, by season). This information should then be used to develop a written plan, schedule, and periodic re-evalution for street sweeping that would target:

- those roadways with contributing land uses (high level of impervious, high level of industrial activity) that would be expected to show high pollutant concentrations and
- those roadways that have consistently accumulated proportionately greater amounts of materials (pounds per mile swept) between currently scheduled sweeps.

II. Introduction

The esteemed statesman Benjamin Franklin suggested a street sweeping program for the cities of London and Westminster back in the 1700's. His intent was to keep dust from turning paved areas "foul and slippery" when it rained. He had observed that:

> *"the streets, when dry, were never swept, and the light dust carried away; but it was suffer'd to accumulate till wet weather reduc'd it to mud, and then, after lying some days so deep on the pavement that there was no crossing but in paths kept clean by poor people with brooms, it was with great labour rak'd together and thrown up into carts open above, the sides of which suffer'd some of the slush at every jolt on the pavement to shake out and fall, sometimes to the annoyance of foot-passengers."*
> (The Autobiography of Benjamin Franklin, on-line at http://wiretap.spies.com/ftp.items/Library/Classic/franklin.txt).

Today, street sweeping occurs in urban areas across the United States, used routinely throughout the year to keep city streets looking neat and seasonally to remove road salt, sand, and grit applied to roadways during winter months. An internet search turns up dozens of local government sites where information about street sweeping is posted. Most of these sites point out two primary benefits: remove visible debris and remove pollutants before they can get into local waterways.

In 1983, the National Urban Runoff Program (NURP) reported that “street sweeping is generally ineffective as a technique for improving the quality of urban runoff”. This conclusion was based on results from 10 study sites across the country and 277 storm events during periods when streetsweeping was occurring.

However, a variety of subsequent studies have demonstrated that street sweeping can remove a significant amount of pollutants if the right equipment and the right techniques are used.

III. Sweeper Types

Figure 1. on the right summarizes the differences of the three major sweeper types (Partland, 2001). These are mechanical broom, regenerative air, and vacuum filter sweepers.

Figure 1. From: J. P. Partland. 2001. A Clean Sweep to Swipe Pollutants. Stormwater. Vol. 12. No. 4.

Research during the NURP study showed the highest concentrations of pollutants were associated with the smallest particles of road grit. Mechanical broom sweepers, such as those used during the NURP study, proved very inefficient at capturing small particles. In fact, sweeping using mechanical brooms may preferentially expose these smaller particles to runoff by removing the overlying material.

Regenerative air sweepers were developed about 25 years ago by a road builder to clean debris out of the cracks and crevices of road surface. This thorough cleaning was needed to allow the permanent bonding of new pavement on top of the old.

The vacuum filter, or small-micron- particulate sweeper, was developed about 10 years ago for use in railroad yards to pick up spilled coal dust. The most advanced are "self-cleaning" systems, which periodically use compressed air to purge the filters and prevent clogging without having to stop and manually clean the filters.

In California, the Los Angeles Regional Water Quality Control Board has drafted a total maximum daily load (TMDL) for litter in the Los Angeles River. This prompted the California Department of Transportation to assess how to effectively control litter coming from the freeway in the Los Angeles area (Lippner and Moeller, 2001). The three sweeper types were first evaluated to select the most appropriate for the detailed monitoring study. During field tests, the regenerative air sweepers showed a greater tendency than other types to get large debris stuck in the intake line or across the suction head, which then interfered with sweeping efficiency. The

Lake Barcroft Water Improvement District Sweeper Pickup Results

Annandale Road: Mechanical/EV; Total Swept Distance: 3.5 miles

Type of Sweeper	Pounds of Debris Collected	Time Sweeping
M5000 Mechanical Broom Sweeper	1,128	2 hours
EV2 High Efficiency Sweeper (sweeping *behind* broom sweeper)	1,590	3 hours

Annandale Road: Regenerative Air/EV; Swept Distance: 3.5 miles

Type of Sweeper	Pounds of Debris Collected	Time Sweeping
A7000 Regenerative Air Sweeper	4,791	4.5 hours
EV2 High Efficiency Sweeper (sweeping *behind* regenerative air sweeper)	2,110	4.5 hours

Note: Wet sweeper data was reduced by 15.2% to compensate for sweeper water discharge.

Figure 2. From: American Sweeper Magazine. 2000. Virginia Test Further Documents Pickup of High Efficiency Sweepers. Vol. 8. No. 1.

vacuum filter sweepers could not travel faster than 25 miles per hour, which presented considerable logistical problems for traveling to sweeping sites on higher speed roads or at great distances from storage yards. Consequently, the mechanical broom sweeper was selected for the monitoring study.

However, comparison studies have shown consistently that the vacuum filter sweepers remove much greater amounts of materials, and associated pollutants, than the other sweeper types.

In one Northern Virginia study, a vacuum filter sweeper was run in tandem (i.e. following behind) either a mechanical or regenerative air sweeper. As shown in Figure 2., the vacuum filter sweeper (EV2 High Efficiency Sweeper) picked up a significant amount of material that had been missed by the other two sweepers.

IV. Status of County Programs

DPWT Street Sweeping

The DPWT's Division of Highway Services (DHS) is responsible for all routine road maintenance activities and provided all information reported to MDE as required under the County's MS4 permit from 1996-2001. Street sweeping is conducted on a schedule that depends upon area and type of road in the County. Information on the current year's schedule is posted on the DPWT web site at: http://publicworks.dpwt.com/sweep.shtml.

In 1993-94, the DHS sold its streetsweeping equipment and began contract services. The contract required that sweepers be no more than five years old and that they use a regenerative air with vacuum broom system combination. The contract included a clause which allowed disposal at the Oaks Landfill. The material has been used in the past as cover material for the cells at the landfill. No pollutant analysis of collected material has ever been conducted.

1996-2000

The schedule and total number of miles swept from 1996-2000 are shown in Table 1. During 1996, there were a total of 11,157 curb miles swept. This value is much greater than the estimate of 2,176 total road miles in the County. Curb miles differ from road miles in that existing median curbs are counted as well as roadside curbs when calculating coverage. Arterial roads were swept once per month while residential (neighborhood) roads were routinely swept only once per year.

Prior to 1997, the DHS was responsible for sweeping of residential and arterial roads and in the Piney Branch, Silver Spring, and Wheaton Central Business Districts (CBDs). These CBDs were swept 3 times per week to control litter and debris from these heavily used areas. The Bethesda CBD maintained its own contract for street sweeping at a rate of 3 times per week. In 1997, the County's Regional Service Centers took over street sweeping responsibility in the Wheaton and Silver Spring CBDs, while DHS maintained this responsibility in the Piney Branch CBD. Number of curb miles swept by DPWT was reduced to about half (5,883 curb miles) with the shifting of the CBD sweeping from DHS.

During 1998, there was an unusually mild winter which much reduced sand and salt applications and amount of material that needed to be removed. Consequently, there were only about 1,404 curb miles swept during 1998. In 1999, the spring Residential Road program was resumed so that the total increased to about 5,311 curb miles swept. In 2000, some larger roads (e.g., Gude Road and Little Seneca Highway) were moved from the Residential Road program to the Arterial Road program to provide increased sweeping per year. Sweeping frequency of the Arterial Program was reduced from ten to nine times per year but the total number of curb miles swept remained approximately the same as during 1999 (5,561 vs 5,311).

Table 1. Summary of DPWT Street Sweeping Activities From 1996-2000

Road Type/ Location	**# of times swept *(frequency of sweeping)***	**Total Curb miles swept/year**				
		1996	**1997**	**1998**	**1999**	**2000**
Residential	1 (once/year)	3,782.65	3,782.65		3,784.88	3,779.31
Arterial	12 (once/month)	1,275.84	1,690.32			
	9 (1 time/month)			1,267.74		1,644.66
	10 (1 time/month)				1,389.40	
CBDs*	156 (3 times/week)	6,097.82				
Piney Branch CBD	156 (3 times/week)		410.28			
	52 (1 time/week)			136.76	136.76	136.76
Total of all categories:		11,157.31	5,883.25	1,404.50	5,311.04	5,560.73

** CBDs: Central Business Districts include Piney Branch, Wheaton, and Silver Spring. The Bethesda Urban Partnership provided its own sweeping of the Bethesda CBD at 3 times per week for 26.83 curb miles.*

Costs

According to Lew Cutsail of the DPWT, the contract costs for residential roads sweeping for FY2001 was $292,000 and for FY2000 was $277,211. The contract costs was approximately $60,000 each of these years for arterial roads sweeping.

For FY2002, the proposed budget was approximately $300,000 for residential roads sweeping and approximately $56,750 for arterial roads sweeping. The FY02 Approved Budget for the DPWT eliminated the funding for residential and arterial road sweeping. It is possible that some or all of this funding could be returned through a FY02 supplemental budget request (for example, to cover unanticipated costs related to snow removal) but this would depend upon winter weather and the level of road sand/salting activities required.

CBD Street Sweeping

The Bethesda Urban Partnership maintains its own street sweeping program of the Bethesda CBD at three times per week. Since 1998, the Bethesda Urban Partnership has also provided contract services for street sweeping three times per week in the Wheaton and Silver Spring CBDs. That year, the Partnership brought its own street sweeping truck for approximately $75,000. This truck uses a regenerative air, wet-assist system. It is of a small-enough size for easy mobility through smaller streets. The collected materials are taken to Silver Spring and disposed in a dumpster. This dumpster is picked up by a contract hauler who takes it to the County's Transfer Station. A summary of the CBD sweeping is shown in Table 2.

Table 2. Summary of Central Business District Street Sweeping.

Central Business District	Curb Miles
Bethesda	26.83
Silver Spring	18.44
Wheaton	11.22
TOTAL:	56.49
TOTAL per year: *(swept 3 times per week)*	8,812.44

Costs

Funding to pay street sweeping costs is derived from revenues generated from within the CBDs. The annual cost for street sweeping in the CBDs is about $55,000 for Bethesda and about $75,000 for Silver Spring and Wheaton combined. This revenue system is best developed in the Bethesda CBD, where parking lot district revenues, urban district taxes, and developers' "optional method" for streetscaping support are used. In Silver Spring and Wheaton, funding is being provided as a loan from the County's General fund which is to be repaid as revenues are generated from the CBD sources. The expectation is that eventually the revenues from these two CBDs would allow them to be self-supporting for services as it is currently in the Bethesda CBD.

V. Pollutant Removal

Pollutant Reductions

A variety of studies have attempted to document the percent pollutant removal by sweeper type. Average percent pollutant reduction by sweeper type and road type (residential vs major road) is compared with reduction values for 5 major storm water best management practices in Figure 3A. for Total Suspended Solids (TSS) and Figure 3B. for Nitrogen (N). TSS is a measure of all particulate material (dirt, sand, grit) in a sample, while N is a plant fertilizer, too much of which can cause significant stream water quality problems.

The sweeper information is based on data compiled by the Center for Watershed Protection (CWP, 2000). The vacuum assisted sweeper shows notably higher percent reduction for both TSS and N than the other two types. The CWP averages are based on weekly sweeping with parking restrictions and operator training. The CWP literature review indicated that monthly sweeping decreased pollutant reductions to 60% of the weekly sweeping. If cars are parked on the roads being swept, then pollutant reduction capability is decreased to 75% of the rate of the base rate.

The values shown for the urban storm water best management practices (SW BMPs) are based on data compiled by the interagency technical workgroup established for the Patuxent Demonstration Project. This was a federally funded project during the 1990's to identify, construct, and monitor the effectiveness of pollution control demonstration projects throughout the Patuxent River watershed. For the urban SW BMPs, the reduction amount varies by pollutant and by structure type, with the lowest values shown for dry ponds and the highest values shown for infiltration.

For both TSS and N, the reduction factors for infiltration (70% for TSS, 60% for N) are less than those shown for vacuum assisted sweepers (78/79% for TSS, 62/53% for N). Both the TSS and N reduction factors for regenerative air sweepers on residential streets are higher than the TSS and N reduction factors for dry ponds, extended detention dry ponds, and separators/sand filters.

However, reduction factors for regenerative air sweepers on major roads (22% for TSS, 18% for N) are on the low end of pollutant reductions for stormwater management structures (dry ponds: 20% for TSS, 10% for N). This is because the regenerative air sweepers cannot pick up the great amounts of grit and finer particulate materials deposited by the greater number and types of vehicles on non-residential roads.

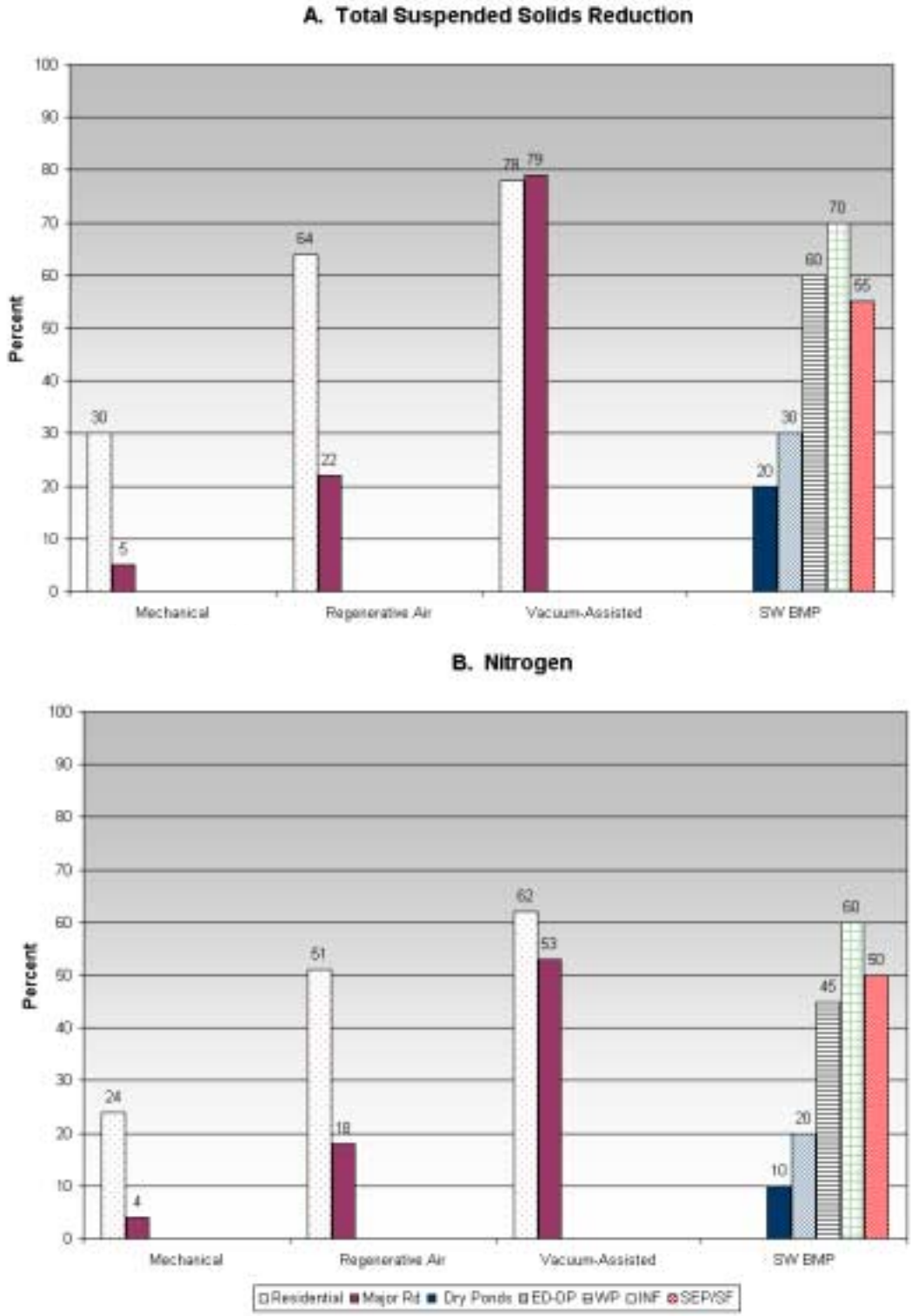

Figure 3. Percent Removal associated with Street Sweeping (for Residential vs Major Roads) and by 5 Storm Water Best Management Practices (SW BMP). ***ED-DP=extended detention dry ponds; WP=wet ponds; INF=infiltration; SEP/SF=separators/sand filters. (Sweeper Type Removal from: <u>The Watershed Treatment Model.</u> March 2001. Center for Watershed Protection. SW-BMP removal from information compiled by Urban BMP Workgroup for Patuxent Demonstration Project, 1994)***

Amount of Pollutants Removed

During the year 2000, there were an estimated 5,561 miles swept by the DHS and 8,812 miles swept by the Bethesda Urban Partnership for a total of 14,373 curb miles. As shown in Table 4, there were 2,464 total tons of materials removed in the year 2000 through the County sweeping program. The amount collected in tons per curb mile ranged from 0.554 in the residential program to 0.011 through the Bethesda Urban Partnership program.

Table 4. Year 2000 Curb Miles Swept and Material Removed in Montgomery County.

Road Type	Curb Miles	Tons collected	Tons/curb mile
Residential	3,779.31	2093.73	0.553998
Arterial	1,644.66	263.15	0.160003
Piney Branch CBD	136.76	6.84	0.050015
Bethesda Urban Partnership (Bethesda, Silver Spring, and Wheaton CBDs)	8,812.44	100	0.011348
TOTAL:	14,373.17	2,463.72	0.171411

The tons removed per curb mile showed an inverse relationship to frequency of sweeping. The tons per mile removed from the once per year residential road sweeping is more than three times greater than that removed from arterial roads (swept about once per month), 10 times greater than in the Piney Branch CBD (swept three times per week) and 50 times greater than that in the areas swept through the Bethesda Urban Partnership (swept three times per week).

A similar pattern in amount removed vs frequency of sweeping was observed in Baltimore County. In the NPDES 2001 Annual Report, Baltimore County reported that from 1991-1995, there was an annual average of 0.597 tons per curb mile removed while from 1996-2000, this was reduced to an annual average of 0.151 tons per curb mile removed. This was correlated to a significant increase in average curb miles swept per year--from 6,869 from 1991-1995 to 19,034 curb miles per year from 1996-2000--and an increased frequency of road sweeping in certain areas of Baltimore County.

As would be expected, materials will accumulate on County roads between street sweepings, and these intervals are greatest for the residential roads. In the Bethesda Urban Partnership program, there is an additional litter control program which removes trash from sidewalks and other areas and thus keeps it from showing up in the tons collected per curb mile swept.

The CWP study mentioned earlier showed that regenerative air sweepers have lower TSS reduction factors for material collected on non-residential roads than for material collected on residential roads. There is more grit on roads in non-residental areas, and since regenerative air sweepers cannot pick grit up as efficiently as larger particles, the reduced tons per curb miles on

arterial roads may reflect this sweeper type's reduced effectiveness as well as less time for acccumulation between intervals.

The NURP study in the 1980's documented the range of pollutants, including nutrients, organic materials, bacteria, heavy metals and priority pollutants commonly found in excess amounts in urban runoff. A more recent study in California included an extensive evaluation of amount and quality of sediments from runoff that were trapped within storm drain inlets. Results for copper, lead, and zinc, heavy metals commonly found in urban storm water runoff, are shown in Table 3 (Mineart and Singh, 1994).

Table 3. Storm Inlet Sediment Quality (Mineart and Singh, 1994).

Land Use Type	Median Concentrations (mg/kg)		
	Copper	Lead	Zinc
Residential	37.9	43.8	215
Commercial	56.7	111	597.5
Industrial	46.6	117	307

The pounds of heavy metals that might have been removed through the County's street sweeping program were estimated based on these median concentrations. The residential land use type concentrations were used for the Residential Road miles swept and the commercial land use type concentrations were used for the Arterial and CBD Road miles swept. With these assumptions, there was an estimated 348 pounds of copper, 468 pounds of lead, and 2,371 pounds of zinc removed in the solid material collected from County streets during the year 2000.

For Montgomery County's NPDES Annual Report in 2000, it was estimated that conventional stormwater management structures removed 2,260 pounds of copper, 488 pounds of lead, and 12,642 pounds of zinc in urban runoff. This represented runoff from developed lands only, about 38.5% of the total county area.

The pounds of pollutants removed using the California study approach cannot be directly compared with the pounds removed using the County's NPDES annual report estimates due to potential significant differences in assumptions about pollutant concentrations in source material. However, it is apparent that routine street sweeping prevents significant amounts of pollutants from entering urban runoff.

Cost-Effectiveness

Sweepers cost from $60,000 to $120,000 for mechanical broom to regenerative air sweepers, and from $240,000 to $310,000 for the high-efficiency vacuum assist sweepers (Partland, 2001). Annual operations and maintenance costs vary widely. in addition to higher purchase costs. the newer technology, high-efficiency sweepers are much better at picking up road grit and associated pollutants, but require more training and skill to operate at optimum effectiveness

It is well-recognized that reducing pollution from already developed urban sources is extremely costly. Figure 4. compares pollutant reductions and costs for a variety of agricultural (CVT, CST, HAY, PAS, and AW), urban BMPs (URB), maintaining forest cover (FOR), and for wastewater treatment plants (PS). These figures are based on modeling runs by the Interstate Commission on the Potomac River Basin during the early-1990's to achieve a 40% reduction in the 1985 nitrogen and phosphorus pollutant loads delivered to the Chesapeake Bay. In this figure, the more cost-effective techniques show higher bars for % treated (left chart) than for costs in million dollars (right chart). Note that the category labeled "URB" is the only type for which the bar for cost is higher than the % treated. Therefore, comparing across types, urban BMPs are not cost-effective nutrient reduction tools.

Street sweeping has not been typically considered for nutrient reduction--it is associated with trash and litter removal. Mechanical broom sweepers have been used for many years to pick up road debris and trash, including items as large as mufflers. If allowed to accumulate in large quantities, this material could clog storm drain inlets and prevent proper road drainage during storm events.

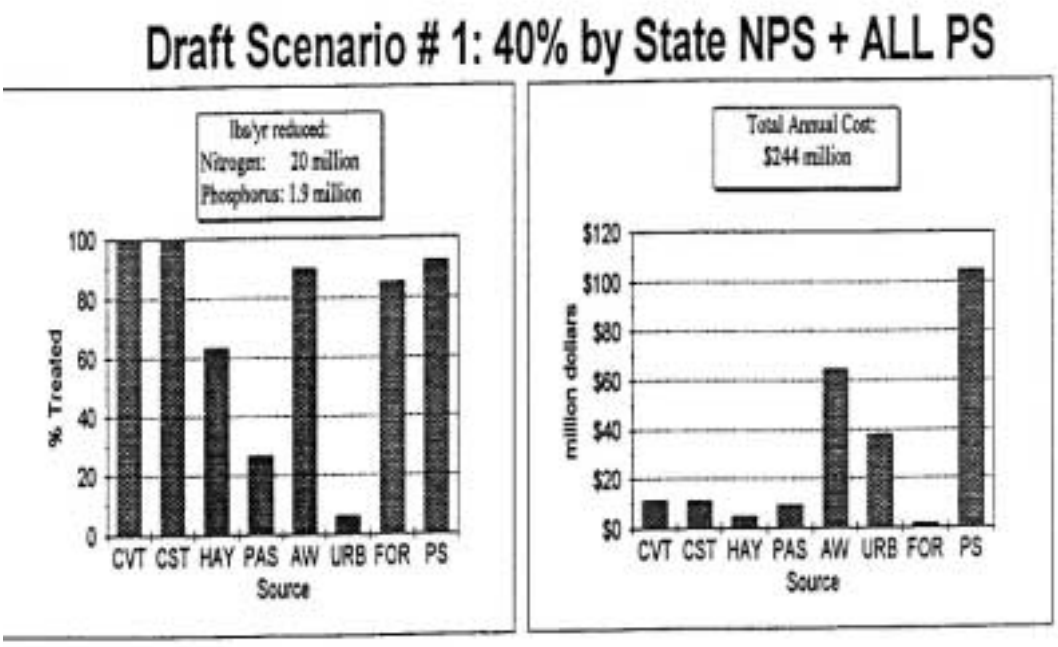

Figure 4. From: Carlton Haywood. 2001. Lessons Learned from the first Potomac Nutrient Strategy. Presentation to the Tributary Strategies Development Workgroup

Street sweeping with regenerative air and vacuum filter sweepers has been proven to remove road grit, sand, dirt, and other particulate materials that accumulate on paved surfaces. Therefore, street sweeping removes sediment, which in excess can bury aquatic habitat and which is now often identified as a pollutant causing known water quality impairments. Sediment, like nitrogen and phosphorus, must be controlled to meet the commitments of the Chesapeake Bay 2000 Agreement.

Montgomery County is subject to regulatory requirements through its NPDES MS4 permit and to its voluntary commitment to the Chesapeake Bay 2000 Agreement to keep pollutants, including sediment, out of runoff to streams and other waterways. In many County urban areas, there are currently no feasible opportunities to build new or to enhance existing stormwater management structures to reduce runoff impacts.

Regardless of absolute cost-effectivenss, street sweeping is one of the few easily implemented practices for use in highly developed urban areas that will clearly reduce sediment, and any associated pollutants, and provide for improved water quality to often severely degraded urban streams.

VI. Recommendations from Other Municipal Areas

Alameda County, CA

In 1994, a consortium of local agencies in Alameda County, CA funded a literature review on street sweeping and storm drain inlet modification to evaluate the water quality benefits associated with these practices . Five street sweeping studies from the early 1980's were reviewed for solids removal and water quality effectiveness. The study summarized the major findings as:

- Particle accumulation rates are highest when the streets are relatively clean and tends to decrease with time.
- Street dirt cannot be reduced below a certain level, referred to as base residual load.
- The highest pollutant concentrations are associated with fine to medium size particles, although 95% of street dirt particles are in the medium to large range.

Based on their literature review and findings, the study recommended the following guidelines to increase the effectiveness of street sweeping as a water pollution control measure:

- Sweep up the smallest particles feasible.
- Implement measures (parking control) that expose the largest travel areas along street edges, which are the areas where dirt tends to collect.
- Sweep near enough before rain events so that particles and pollutants do not have time to accumulate to significant levels before being washed off by the storm.
- Properly maintain sweepers and operate according to manufacturers' directions.
- Sweep the dirtiest appearing streets more frequently than the others.

Metropolitan Council, St. Paul, MN

In July 2001, the St. Paul, Minnesota-based Metroplitan Council published *Minnesota Urban Small Sites Best Management Practices Manual. Stormwater Management Practices for Cold Climates*. This document includes maintenance and operations strategies to minimize pollution from urban sites of less than 5 acres. The manual can be downloaded by chapters from the Environmental Section at www.metrocouncil.org. The recommendations for street sweeping are included in Chapter 3 under Pavement Management.

The manual asserts that sweeping programs can significantly reduce street and parking lot contributions to pollutant loads, when properly designed and implemented. The recommendations for timing, equipment, sweeping techniques, and control of residual material are included as Attachment A to this report. Significant among these are recommendations for site preparation prior to sweeping and the recommendation to use a mechanical broom sweeper in tandem with a regenerative-air sweeper "for heavy loads".

The recommendations for sweeping in the manual are in large part based on results from a 1994 study entitled *Best Practices: Street Sweeping*. This study was summarized in a 1999 article in American Sweeper Magazine, a street sweeping trade publication. The Metropolitan Council conducted this study to find out how its 138 member municipalities provided street sweeping and to make recommendations for increasing the cost-effectiveness of these operations.

Re-use of Sweeping Material

Re-use of sweeping material was considered during thte 1994 study because of concerns about the increasing costs of disposal. In the Minnesota snowbelt at that time, it cost an average of only $2 to $4 per ton to buy the sand, but $6 to $11 per ton to dispose of it in a landfill. This did not include hauling costs. Thus, the resulting manual includes a recommendation for re-use of residual material by screening out the coarser, organic debris for composting and then mixing the finer material with new salt/sand mixture for another year of application. The sweeping residuals are not considered hazardous waste, but caution is warranted because of the unknown variety of pollutants that may be contained in the sweepings.

The 1994 study concluded that recycling the spring sweepings (to remove salt, sand, and grit) would become the most cost-effective disposal approach in the future. However, this has not become a widespread practice. The City of Long Beach CA has been composting its street sweeping material since 1996, using screened leaves with magnetic separation. The State of Oregon Department of Transportation and the City of Portland also have ongoing projects.

In Montgomery County, attempts to separate and re-use street sweeping material have met with little success. The DPWT has deemed the expense and time required for adequate separation of organic from other materials as not cost-effective.

VII. Recommendations for the County Program

The County's current street sweeping program is an important program for litter and road grit control that should be routinely conducted. The road grit left over from winter sand/salt applications needs to be removed before spring rains wash these solids into nearby storm drains and perhaps into stormwater management structures. This road grit will accelerate the filling in of these structures and increase the frequency, and costs over time, for required structure maintenance. However, the DPWT current schedule for street sweeping provides for minimum pollutant removal.

In contrast, the CBD street sweeping and associated litter control conducted through the Bethesda Urban Partnership are much more effective as urban best management practices for pollutant removal. The three times per week sweeping prevents an excess accumulation of road grit. Associated sidewalk sweeping also eliminates larger trash and debris before it gets on to the roads.

Frequency

Minimizing costs and maximizing pollutant removal associated with street sweeping is largely dependent on timing and frequency of the sweeping and care taken to assure that as thorough a job as possible is done. Many sources recommended weekly sweeps with parking controls to achieve maximum water quality benefits. The weekly frequency was a logistic compromise, as studies had shown the real key to maximum pollutant removal was to allow as much accumulation as possible and then sweep right before a rain. Allowing parked cars obviously reduces the total area swept and associated pollutants removed.

Implementing parking controls and weekly sweeps would obviously dramatically increase the total cost for the County program and is not a feasible countywide recommendation at this time. It is suggested that DPWT conduct a more careful tracking of material removed by street sweeping so as to identify the "dirtiest" areas--more likely to be major arterial roads and not residential roads. Those areas of the County where the loads are greatest could be targeted for more frequent sweepings than once per month, while major roads with much less accumulated materials could be swept on a lesser frequency. If the street sweeping contract is negotiated by miles swept, this type of targeting would not produce increased costs.

Equipment

Currently, regenerative air sweepers are used for the County program and by the CBD program. The high-efficiency vacuum filter sweepers remove the greatest amounts of road grit and associated pollutants, but their high cost, slow travel speed, and need for greater operator training and skill make it difficult to recommend them for all sweeping purposes. Within the County, the DPWT should evaluate the use of these new technology sweepers for parking or vehicle storage lots since these are areas where pollutants tend to be very concentrated, where stormwater management facilities need to be protected from excessive solids in runoff, and where slow speed is not an overwhelming logistic issue.

When the technology evolves so that the high-efficiency sweepers become less expensive and able to travel at higher speeds, the DPWT should require their use by the street sweeping contractor at least for non-residential roads. The significantly greater amount of material removed by using these sweepers, particularly for non-residential roads, could slightly offset the minimum frequency of sweeping under the current contract and decrease the pollutants which could run off into nearby storm drains, stormwater management structures, and local streams.

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Street Sweeping for Pollutant Removal **Attachment A.**

Sweeping

Sweeping is a common maintenance activity, often done primarily for aesthetic reasons. Sweeping has important water quality ramifications, however, and should be done in ways that increase its effectiveness for preventing sediment loading of runoff and, whenever possible, decreasing costs. Sweeping is most effective for removing coarse particles, leaves and trash.

Timing

- At minimum, pavement should be swept twice yearly: in early spring, to collect sand, salt and winter debris, and in fall, to capture leaves and other debris.
- Sweep as early in spring as possible (after snow has melted from an area) in order to capture sediment before it is washed away by spring rains.
- An additional sweeping in June, after trees drop seeds and flowers, will prevent a fair amount of phosphorus-laden runoff.
- Sweep after activities or in locations that generate debris, such as at construction entry points.
- When loading or unloading salt, sand, gravel or other granular materials, sweep the loading/unloading areas at the end of each day, as well as along the paths that the trucks use.

Source: Barr Engineering Co.

Excessive winter sanding can mean high sediment loading to runoff.

Figure 1

Equipment

- Broom sweepers are effective at picking up large particulate matter and cleaning wet street surfaces. They also cost less to operate than vacuum sweepers. Broom sweepers generally create airborne dust during their operation, which increases atmospheric loading.
- Vacuum sweepers are more effective for removing fine particles, which is important because many pollutants are adsorbed to them. However, vacuum sweepers have the disadvantage of being ineffective at cleaning wet street surfaces. For heavy loads, use a mechanical sweeper for large particles followed by regenerative-air cleaner.
- Consider equipment that can be converted to other uses, such as sanding and plowing in winter.
- Install an automatic greasing system on sweepers to decrease maintenance time and reduce wear on critical parts, which can cause unscheduled maintenance and missed sweeping opportunities.

Source: American Sweeper Online

Techniques

- Sweep in a pattern that keeps spilled material from being pushed toward catch basin inlets
- Locate storage and disposal sites for the material collected during sweeping so it will not get back to the storm sewer systems.
- Before sweeping, manually rake sand from any adjacent turf areas onto the surface to be swept.
- Use a small pool of highly trained operators.

Residual Material

- Street sweepings may be reused by cleaning out leaves and other debris then mixing the sweepings with new salt/sand mixture for winter application to roads, parking lots or sidewalks. When screening sweepings for reuse in this way, use a small mesh for the final screening to ensure that all of the larger debris has been removed. (A 3/4-inch mesh will screen out much of the debris.)
- Recycle fall leaf sweepings by finding a composting or agricultural facility that will use them.
- Street sweepings may also be reused as daily cover material on sanitary or demolition landfills, but only those that have ground water monitoring systems. While sweeping residuals are not considered hazardous waste, a wide array of inorganic and organic pollutants are contained, so use caution in disposal.

Taken from: Minnesota Urban Small Sites BMP Manual. Stormwater Best Management Practices for Cold Climates. July 2001. Metropolitan Council. www.metrocouncil.org