



BERKELEY COUNTY STORMWATER MANAGEMENT PROGRAM

POLLUTION PREVENTION/GOOD HOUSEKEEPING MANUAL

Adopted February 23, 2011

**1003 Highway 52
Post Office Box 6122
Moncks Corner, SC 29461-6120
Telephone: 843.719.4127**

TABLE OF CONTENTS

1.0 Introduction	3
2.0 Basics of County/Municipal Pollution Prevention/Good Housekeeping Programs	4
3.0 County/Municipal Operations and Activities Affecting Water Quality	5
3.1 Hotspot Facility Management	6
3.2 Construction Project Management	11
3.3 Post-Construction Stormwater Management	12
3.4 Street Repair and Maintenance.....	15
3.5 Storm Drain Maintenance.....	17
3.6 Park and Landscape Maintenance	18
3.7 Employee Training	20
4.0 References	22

TABLES

Table 3-1: Stormwater Pollutants Associated with County/Municipal Operations and Activities	5
Table 3-2: Pollution Generating Activities Associated with County/Municipal Hotspot Facilities	6
Table 3-3: Stormwater Pollutants Associated with Activities Conducted at Hotspot Facilities.....	7
Table 3-4: Pollution Prevention/Good Housekeeping Practices Commonly Used to Control Stormwater Pollution at County/Municipal Hotspot Facilities	10
Table 3-5: Pollution Prevention/Good Housekeeping Practices Commonly Used to Improve County/Municipal Construction Project Management.....	12
Table 3-6: Pollution Prevention/Good Housekeeping Practices Commonly Used to Improve Post-Construction Stormwater BMPs	14
Table 3-7: Pollution Prevention/Good Housekeeping Practices Commonly Used to Improve County/Municipal Street Repair and Maintenance Activities	16
Table 3-8: Expected Pollutant Removal Rates for Catch Basin Cleanouts (Law et al., 2008).....	17
Table 3-9: Equipment Used for Catch Basin and Inlet Cleaning (from Lager et al. 1979).....	18
Table 3-10: Pollution Prevention/Good Housekeeping Practices Commonly Used to Improve County/Municipal Park and Landscape Maintenance Activities.....	19
Table 3-11: Employee Training Programs – Presenting the Right Information to the Right Audience	21

FIGURES

Figure 2-1: County/Municipal Activities Negatively Impacting Water Quality	4
Figure 2-2: County/Municipal Activities Improve Water Quality.....	4
Figure 3-1: Public Works Yards – Typical Severe Hotspot Facilities in a Community	8
Figure 3-2: Typical Categories of Pollution-Generating Activities to Assess at Hotspot Facilities	9
Figure 3-3: Pollution Prevention/Good Housekeeping Practices Commonly Used at County/Municipal Hotspot Facilities	10
Figure 3-4: Stormwater Best Management Practices (BMPs) – Dry Detention Ponds, Wet Detention Ponds, Bioretention Area and Swales.....	13
Figure 3-5: Roadway Repairs and Maintenance Generating Significant Amounts of Sediment.....	15
Figure 3-6: Catch Basin Detail	17

1.0 INTRODUCTION

Berkeley County must develop a program for pollution prevention/good housekeeping as a condition of their National Pollutant Discharge Elimination System (NPDES) Phase II Small Municipal Separate Storm Sewer Systems (MS4) permit. Minimum Control Measure number six (6) of the County's MS4 permit states that Berkeley County must develop and implement an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from County operations as an integral part of their Stormwater Management Program (SWMP). The Program is to include employee training to prevent and reduce stormwater pollution from activities such as park and open space maintenance, fleet, and building maintenance, new construction and land disturbances, and stormwater system maintenance.

According to the NPDES Phase II regulations, the operator of a regulated MS4 community must develop a pollution prevention/good housekeeping program to:

- Prevent or reduce the amount of stormwater pollution generated by county/municipal operations and conveyed into receiving waters,
- Train employees on how to incorporate pollution prevention/good housekeeping techniques into county/municipal operations, and
- Identify appropriate best management practices and measurable goals for preventing or reducing the amount of stormwater pollution generated by county/municipal operations.

This good housekeeping/pollution control manual is designed to assist Berkeley County staff in addressing potential stormwater runoff issues from County owned and/or operated facilities. This manual is based on the Urban Subwatershed Restoration Manual No. 9: Municipal Pollution Prevention/ Good Housekeeping Practices Version 1.0 produced by the Center for Watershed Protection.

2.0 BASICS OF COUNTY/MUNICIPAL POLLUTION PREVENTION/GOOD HOUSEKEEPING PROGRAMS

Everyday, Berkeley County employees engage in a variety of activities that influence water quality. Some activities, such as County facility management, construction project management, and street repair and maintenance can negatively impact water quality, while others, such as storm drain maintenance and employee training, can help improve it. Whether a pollution prevention/good housekeeping program is designed to reduce the influence of activities that negatively impact water quality (Figure 2-1), or increase the influence of activities that help improve it (Figure 2-2), it should be carefully designed to address local water quality issues.



Figure 2-1: County/Municipal Activities Negatively Impacting Water Quality



Figure 2-2: County/Municipal Activities Improving Water Quality

3.0 COUNTY/MUNICIPAL OPERATIONS AND ACTIVITIES AFFECTING WATER QUALITY

Pollution prevention/good housekeeping involves identifying county/municipal operations and/or activities that may affect stormwater runoff in a community and improving them to better support water quality goals. County/municipal operations and/or activities should be systematically evaluated to determine where improvements can be made in the following areas, at a minimum:

- Hotspot facility management
- Construction project management
- Post-construction stormwater management
- Street repair and maintenance
- Storm drain maintenance
- Park and landscape maintenance
- Employee training

These county/municipal operations/activities can generate or reduce a variety of stormwater pollutants, including sediment, nutrients, metals, hydrocarbons, pesticides, chlorides, bacteria and trash. Typical pollutants expected to be affected by these operations and/or activities are included in Table 3-1.

Table 3-1: Stormwater Pollutants Associated with County/Municipal Operations and Activities

County/Municipal Operations	Sediment	Nutrients	Metals	Hydro-carbons	Toxins	Others
Hotspot Facility Management	●	●	●	●	●	Trash, Organic Matter, Pesticides, Chlorine
Construction Project Management	●	■	○	■	■	Trash
Street Repair and Maintenance	●	■	■	●	■	Trash
Storm Drain Maintenance	■	○	○	○	○	Trash, Organic Matter
Park and Landscape Maintenance	■	●	○	○	■	Pesticides
Post-construction Stormwater Management	■	■	■	○	○	Bacteria
Employee Training	●	●	●	●	●	Chloride, Trash
Key ● = frequently associated with operation ■ = infrequently associated with operation ○ = rarely associated with operation						

Developing an effective pollution prevention/good housekeeping program involves determining which of these operations and/or activities are conducted in Berkeley County and designing a program that will increase or reduce their influence, depending on whether they have a positive or negative impact on water quality.

3.1 HOTSPOT FACILITY MANAGEMENT

County/municipal hotspot facilities are publicly owned and/or operated facilities that produce higher levels of stormwater pollutants and/or present a higher potential risk for spills, leaks or illicit discharges. Common county/municipal hotspot facilities include facilities that handle solid waste, wastewater, road and vehicle maintenance, and yard waste, such as:

- Equipment Storage and Maintenance Yards
- Hazardous Waste Disposal Facilities
- Hazardous Waste Handling and Transfer Facilities
- Landfills
- Materials Storage Yards
- Public Buildings (e.g. Libraries, Police and Fire Departments)
- Public Works Yards
- Solid Waste Handling and Transfer Facilities
- Vehicle Storage and Maintenance Yards
- Water and Wastewater Treatment Facilities
- Facilities such as morgue, mosquito abatement facility, fueling area, etc.
- Boat Landings
- Convenience Sites

If not carefully managed, the activities conducted at county/municipal hotspot facilities can generate a wide variety of stormwater pollutants, including nutrients, hydrocarbons, metals, chlorides, pesticides, bacteria and trash. A summary of the pollution-generating activities typically conducted at county/municipal hotspot facilities and the pollutants associated with those activities are presented in Tables 3-2 and Table 3-3 below.

Table 3-2: Pollution Generating Activities Associated with County/Municipal Hotspot Facilities

County/Municipal Hotspot Facility	Pollution Generating Activities
Public Works Yards	Vehicle Maintenance and Repair, Vehicle Fueling, Vehicle Washing, Vehicle Storage, Outdoor Loading and Unloading, Outdoor Storage, Dumpster/Waste Management, Building Repair, Building Maintenance, Parking Lot Maintenance, Turf Management, Landscaping
Vehicle Storage and Maintenance Yards	Vehicle Maintenance and Repair, Vehicle Fueling, Vehicle Washing, Vehicle Storage, Outdoor Loading and Unloading, Outdoor Storage, Dumpster/Waste Management, Building Repair, Building Maintenance, Parking Lot Maintenance
Equipment Storage and Maintenance Yards	
Materials Storage Yards	Outdoor Loading and Unloading, Outdoor Storage, Dumpster/Waste Management, Parking Lot Maintenance
Water and Wastewater Treatment Facilities	Vehicle Storage, Outdoor Loading and Unloading, Outdoor Storage, Dumpster/Waste Management, Building Repair, Building Maintenance, Parking Lot Maintenance, Turf Management, Landscaping
Landfills	Vehicle Fueling, Vehicle Storage, Outdoor Loading and Unloading, Outdoor Storage, Dumpster/Waste Management
Solid Waste Handling and Transfer Facilities	
Hazardous Waste Disposal Facilities	
Hazardous Waste Handling and Transfer Facilities	
Composting Facilities	

County/Municipal Hotspot Facility	Pollution Generating Activities
Public Buildings	Outdoor Loading and Unloading, Outdoor Storage, Dumpster/Waste Management, Building Repair, Building Maintenance, Parking Lot Maintenance, Turf Management, Landscaping
Public Golf Course	Vehicle Maintenance and Repair, Vehicle Fueling, Vehicle Washing, Vehicle Storage, Outdoor Loading and Unloading, Outdoor Storage, Dumpster/Waste Management, Building Repair, Building Maintenance, Parking Lot Maintenance, Turf Management, Landscaping
Public Swimming Pool	Building Repair, Building Maintenance, Parking Lot Maintenance, Swimming Pool Discharges

Table 3-3: Stormwater Pollutants Associated with Activities Conducted at Hotspot Facilities

Hotspot Operation or Activity	Sediment	Nutrients	Metals	Hydro-carbons	Toxins	Others
Vehicle Repair	○	○	●	●	●	
Vehicle Fueling	X	○	●	●	●	
Vehicle Washing	●	●	■	■	●	
Vehicle Storage	○	X	■	●	○	Trash
Outdoor Loading	●	■	■	○	○	Organic Matter
Outdoor Storage	●	■	■	■	■	
Waste Management	○	■	■	■	●	Trash
Building Repair	●	○	■	■	■	
Building Maintenance	●	X	●	○	■	
Parking Lot Maintenance	●	○	■	●	■	
Turf Management	■	●	X	X	●	Pesticides
Landscaping	○	●	X	X	●	Pesticides
Swimming Pool Discharges	X	X	X	X	X	Chlorine
Key X = not a pollutant source ○ = minor pollutant contribution ■ = moderate pollutant contribution ● = major pollutant contribution						

Of the hotspot facilities listed above, public works yards are often one of the most severe potential pollutant contributors (Figure 3-1). A number of stormwater pollutants are often stored or handled at these facilities and they should be one of the first hotspot facilities to be investigated during the development of a pollution prevention/good housekeeping program.



Figure 3-1: Public Works Yards - Typical Severe Hotspot Facilities in a Community

Inspecting Berkeley County owned and/or operated facilities is necessary to identify potential causes of stormwater pollution. These investigations can be used to systematically evaluate the typical major categories of pollution-generating activities illustrated in Figure 3-2 that commonly contribute to stormwater quality problems at county/municipal facilities:

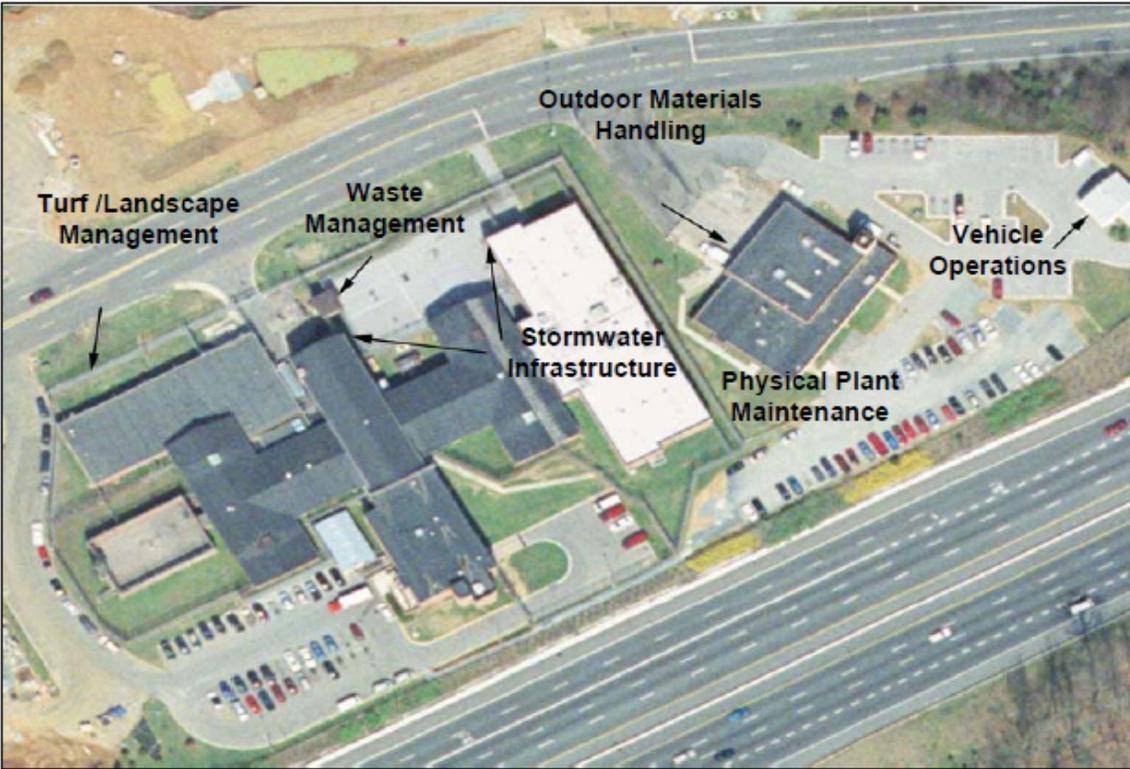


Figure 3-2: Typical Categories of Pollution-Generating Activities to Assess at Hotspot Facilities

Ideally, the individuals who manage or oversee each of the facilities will be present during a site inspection. They should be able to answer questions about the activities that are conducted at their facility and explain any pollution prevention/good housekeeping practices that may already be in place. Participation during site inspections is also an opportunity for facility managers/operators to learn more about the county/municipality’s pollution prevention/good housekeeping efforts and how the activities conducted at their facility can influence stormwater quality.

During a county/municipal facility site inspection it is helpful to have an aerial photograph or site plan on which the locations of proposed pollution prevention/good housekeeping practices or stormwater retrofits can be marked. Digital photos should be taken during any facility inspection to document areas that need improvement and in the identification of stormwater management and pollution prevention/good housekeeping practices. The pictures can also be used to educate the facility manager and other county/municipal staff during employee training sessions.

In May of 2010, an initial Facility Audit was performed on a limited number of Berkeley County facilities. This audit was intended to give the County an overall idea of the condition of the facilities. In addition, the report identifies some pollution prevention/good housekeeping practices that can be used to address the pollution generating activities associated with each hotspot facility. In many cases, pollution prevention/good housekeeping practices can be prescribed using the information that was gathered during initial field investigations. In other cases, however, additional site visits may be required.

A wide range of pollution prevention/good housekeeping practices can be used to address the pollution-generating activities conducted at county/municipal hotspot facilities. Some of the most commonly used practices are listed in Table 3-4.

Table 3-4: Pollution Prevention/Good Housekeeping Practices Commonly Used to Control Stormwater Pollution at County/Municipal Hotspot Facilities

Hotspot Operation or Activity	Pollution Prevention/Good Housekeeping Practices
Vehicle Maintenance and Repair	Drip pans, traps, covered outdoor storage areas, secondary containment, discharge of washwater to sanitary sewer system, proper disposal of used fluids, disconnected storm drains, automatic shutoff nozzles, signs, spill response plans, spill clean up materials, dry clean up methods, employee training, stormwater retrofits
Vehicle Fueling	
Vehicle Washing	
Vehicle Storage	
Outdoor Loading and Unloading	Covered loading and unloading areas, secondary containment, storm drain disconnection or treatment, inventory control, spill response plans, spill clean up materials, dry clean up methods, employee training, stormwater retrofits
Outdoor Storage	
Dumpster/Waste Management	Dumpster/Waste Management, secondary containment, storm drain disconnection or treatment, liquid separation/containment, employee training
Building Repair	Temporary covers/traps, employee training, contractor training, proper cleanup and disposal procedures, disconnected storm drains, dry cleaning methods, stormwater retrofits
Building Maintenance	
Parking Lot Maintenance	
Turf Management	Integrated pest management, reduced non-target irrigation, careful applications, proper disposal and landscaping water, avoid blowing and hosing to storm drain, employee training, stormwater retrofits
Landscaping	

In many cases, the pollution prevention/good housekeeping practices that can be used to address the pollution-generating activities associated with a county/municipal hotspot facility save time and money, reduce liability and do not greatly interfere with normal operations. For example, the pollution prevention/good housekeeping practices applied at a vehicle storage and maintenance yard might include the use of drip pans under vehicles, tarps for covering disabled vehicles, dry clean-up methods for spills, proper disposal of used fluids and covering and providing secondary containment for any outdoor storage area (Figure 3-3). In some cases, however, more costly on-site stormwater retrofit practices may be needed to control and treat stormwater runoff, especially when the facility is rated as a severe hotspot.



Figure 3-3: Pollution Prevention/Good Housekeeping Practices Commonly Used at County/Municipal Hotspot Facilities

Once the inspection is done a brief implementation plan should be developed. The plan should summarize the results of the assessment of the current County pollution prevention/good housekeeping practices and the practices that will be used to reduce the stormwater pollution generated by hotspot facilities. The plan should also include a schedule that describes when the prescribed pollution prevention/good housekeeping practices will be implemented. The contents of the implementation plan should be reviewed with the individual who manages the hotspot facility.

3.2 CONSTRUCTION PROJECT MANAGEMENT

Berkeley County performs a number of capital improvement, development and redevelopment construction projects, which can generate a wide range of stormwater pollutants, including sediment, nutrients, hydrocarbons, pesticides, trash and construction debris.

Common county/municipal construction projects include:

- Public buildings (e.g. libraries, police and fire departments).
- Public works facilities.
- Road construction and widening.
- Utility construction and repair.
- Water and wastewater treatment facilities.

These County funded construction projects can have a number of negative impacts on water quality both during and after construction. From a water quality standpoint, the construction phase is often considered the most damaging phase of the land development cycle particularly in regards to sediment impacts.

County construction project erosion/sediment control plans and procedures should include the following practices, at a minimum:

1. Minimize Clearing;
2. Protect Waterways;
3. Phase Construction;
4. Implement Rapid Soil Stabilization;
5. Protect Steep Slopes;
6. Install Perimeter Controls;
7. Adjust Erosion and Sediment Control Plan for Site Conditions; and
8. Assess Erosion and Sediment Control Plan After Storm Events.

All of these practices should be part of any County construction project and local stormwater management ordinances should ensure that necessary sediment/erosion control practices adequately apply to County projects. Some of the practices most commonly used to improve the way that county/municipal construction projects are managed are listed in Table 3-5.

Table 3-5: Pollution Prevention/Good Housekeeping Practices Commonly Used to Improve County/Municipal Construction Project Management

Existing Conditions	Recommended Improvements
<ul style="list-style-type: none"> No local erosion and sediment control and/or stormwater ordinance in place 	<ul style="list-style-type: none"> Develop a local erosion and sediment control and/or stormwater management ordinance Ensure that county/municipal construction sites are required to meet the provisions of each ordinance
<ul style="list-style-type: none"> County/municipal construction projects are not subject to the requirements of the local erosion and sediment control and/or stormwater management ordinance 	<ul style="list-style-type: none"> Revise the local erosion and sediment control and/or stormwater management ordinance to ensure that county/municipal construction sites are required to meet the provisions of each ordinance
<ul style="list-style-type: none"> County/municipal construction projects are not subject to local plan review and site inspection procedures 	<ul style="list-style-type: none"> Revise the local development review process to ensure that county/municipal construction sites are subject to local plan review and site inspection procedures
<ul style="list-style-type: none"> Existing contractor selection and procurement procedures do not consider erosion and sediment control and/or stormwater management 	<ul style="list-style-type: none"> Revise the selection and procurement procedures to ensure that erosion and sediment control and stormwater management are considered during the selection process
<ul style="list-style-type: none"> Innovative sediment/erosion control practices are not used on county/municipal construction projects 	<ul style="list-style-type: none"> Revise the local sediment/erosion control ordinance to ensure these practices are allowed Promote the use of innovative sediment/erosion control practices on all county/municipal construction projects Provide training to design engineers and contractors on the design and installation of innovative sediment/erosion control practices

3.3 POST-CONSTRUCTION STORMWATER MANAGEMENT

Stormwater Best Management Practices (BMPs) are engineered facilities designed to treat or otherwise manage post-construction stormwater runoff and mitigate the negative impacts of land development. These practices, which include dry detention ponds, wet detention ponds, stormwater wetlands, bioretention areas, swales, filtration practices and infiltration practices (Figure 3-4), provide a number of water quality and water quantity benefits and, if carefully designed, can provide a number of other benefits to the community (e.g. aesthetics, wildlife habitat, etc.).



Figure 3-4: Stormwater Best Management Practices (BMPs): (Clockwise from Top Left) Dry Detention Ponds, Wet Detention Ponds, Bioretention Area and Swales

Under the NPDES Phase II regulations, Berkeley County must ensure adequate long-term operation and maintenance of post-construction stormwater BMPs. Within many communities, the county/municipality as well as homeowners associations and private landowners are responsible for the maintenance and upkeep of stormwater BMPs. Regulated communities can help to ensure that privately owned and - operated facilities are maintained by including enforceable provisions within the local stormwater management ordinance that require regular maintenance of these facilities.

Although not necessary, it is often helpful to create a map showing the location of each publicly owned and/or operated stormwater BMPs. It is important to conduct a site assessment of all county/municipal owned and/or operated stormwater BMPs to determine how well each practice is being maintained. An inspection checklist should be used to compile information during the assessment.

After county/municipal owned/operated post-development stormwater BMPs are assessed, a comparison of the inspection results to determine which stormwater treatment practices are in the worst condition should be formulated. At the completion of each inspection, the local stormwater manager should make a note of any maintenance tasks that need to be performed and how urgent those tasks appear to be. If there are any urgent maintenance needs, the local stormwater manager should immediately notify the individual responsible for the upkeep and maintenance of the stormwater BMPs. These improvements, especially those that are needed to alleviate a safety hazard, should be made as soon as possible. This process should also help to identify any common problems with maintenance, which can result in recommended changes to the county/municipality's inspection and maintenance procedures. Some of the most commonly used practices to improve post-construction stormwater BMPs are listed in Table 3-6.

Table 3-6: Pollution Prevention/Good Housekeeping Practices Commonly Used to Improve Post-Construction Stormwater BMPs

Post-Construction Stormwater BMPs	Recommended Practices
Dry Detention Ponds	<ul style="list-style-type: none"> • Mow side slopes monthly. • Repair undercut or eroded areas as necessary. • Pesticide/ nutrient management. • Remove litter/ debris as necessary. • Inspect for erosion of pond banks or bottom semi-annually. • Seed or sod to restore dead or damaged ground annually (as needed). • Inspect for damage to the embankment annually. • Monitor for sediment accumulation in the facility and forebay annually. • Inspect monthly to ensure that inlet and outlet devices are free of debris and operational. • Removal of sediment from the forebay every 5 to 7 years • Monitor sediment accumulations, and remove sediment when the pond volume has been reduced by 25%.
Wet Detention Ponds	<ul style="list-style-type: none"> • Mow side slopes of the pond monthly. • Since decomposing vegetation captured in the wet pond can release pollutants, especially nutrients, it may be necessary to harvest dead vegetation annually. Otherwise the decaying vegetation can export pollutants out of the pond and also can cause nuisance conditions to occur. • Clear debris from all inlet and outlet structures monthly. • Repair all eroded or undercut areas as needed. • Place a sediment marker in the forebay to determine when sediment removal is required. • Monitor sediment accumulations in the main pond area and remove sediment when the permanent pool volume has been significantly filled and/or the pond becomes eutrophic.
Bioretention Area	<ul style="list-style-type: none"> • Pruning and weeding as needed • Remove trash and debris as needed • Inspect inflow points for clogging semi-annually (every 6-months). • Remove any sediment semi-annually (every 6-months). • Repair eroded areas. Re-seed or sod as necessary semi-annually (every 6-months). • Mulch void areas semi-annually (every 6-months). • Inspect trees and shrubs to evaluate their health semi-annually (every 6-months). • Remove and replace dead or severely diseased vegetation semi-annually (every 6-months). • Remove evasive vegetation semi-annually (every 6-months). • Nutrient and pesticide management. Annual, or as needed. • Water vegetation, shrubs and trees semi-annually (every 6-months). • Remove mulch, reapply new layer annually • Test planting mix for pH annually. • Apply lime if pH < 5.2. as needed. • Add iron sulfate + sulfur if pH > 8.0 as needed. • Place fresh mulch over entire area as needed. • Replace pea gravel diaphragm every 2 to 3 years if needed.
Swales	<ul style="list-style-type: none"> • Mow grass to maintain design height and remove clippings as needed (frequent/seasonally). • Nutrient and pesticide management annually, or as needed • Inspect side slopes for erosion and repair annually, or as needed • Inspect channel bottom for erosion and repair annually, or as needed • Remove trash and debris accumulated in forebay annually. • Annual (semi-annually first year) inspection of vegetation. Plant an alternative grass

	<p>species if original cover is not established.</p> <ul style="list-style-type: none"> • Annual inspection for clogging and correct the problem. • Roto-till or cultivate the surface of the bed if swale does not draw down in 48 hours as needed. • Remove sediment build-up within the bottom of the swale as needed, after 25% of the original design volume has filled.
Stormwater Wetlands	<ul style="list-style-type: none"> • Monitor wetlands after all storm events greater than 2-inches of rainfall during the first year to assess erosion, flow channelization and sediment accumulation. Inspection should be made at least once every six months during the first three years of establishment. • Place a sediment cleanout stake in the forebay area to determine when sediment removal is required. • Debris should be removed from the inlet and outlet structures monthly. • Monitor wetland vegetation and replaced as necessary once every 6-months during the first three years of establishment. • Annually inspect and maintain the depth of the zones within the wetland. • Annually remove invasive vegetation. • Repair all eroded or undercut areas as needed.
Vegetated Filter Strip	<ul style="list-style-type: none"> • Inspect vegetation for rills and gullies annually and correct. Seed or sod bare areas. • Inspect grass after installation to ensure it has established. If not replace with an alternative species. • Inspect to ensure that grass has established annually. If not, replace with an alternative species. • Mow grass to maintain a height of 3- to 4-inches. • Remove sediment build-up from the bottom when it has accumulated to 25% of the original capacity.

3.4 STREET REPAIR AND MAINTENANCE

Public streets and roadways in Berkeley County make up a significant percentage of the urban infrastructure and require regular maintenance to keep them in good condition. Regular County street repair and maintenance activities, such as pavement marking, repair, patching, resurfacing, sealing and right-of-way maintenance, can generate a range of stormwater pollutants, including metals, chlorides, hydrocarbons, nutrients, sediment and trash. If not properly managed, these activities can negatively impact water quality (Figure 3-5).



Figure 3-5: Roadway Repairs and Maintenance Generating Significant Amounts of Sediment

There are three primary county/municipal street repair and maintenance activities that can influence stormwater quality:

- Routine road and bridge maintenance: Re-chipping, grinding, pothole repair, pavement striping, asphalt re-paving, saw cutting.
 - Potential pollutants: Sediment, chloride, cyanide, and phosphorus.
- Winter operations: Sanding, application of deicing compounds.
 - Potential pollutants: Fine particles, creosote and PAH.

- Right-of-way maintenance: Herbicide and pesticide application, vegetation selection.
 - Potential pollutants: Nutrients, herbicides, pesticides.

All streets and roadways have routine maintenance needs such as mowing and sweeping, with other maintenance needs dictated by age, traffic volume or climatic conditions. Recommended pollution prevention/good housekeeping techniques for roadways are applied through county/municipal employee, utility employee and contractor training, as well as county contracting specifications.

Improving the way that county/municipal street repair and maintenance activities are conducted within the community can reduce the amount of stormwater pollution that is conveyed into receiving waters. Some of the practices most commonly used to improve the way that county/municipal street repair and maintenance activities are conducted are listed in Table 3-7.

Table 3-7: Pollution Prevention/Good Housekeeping Practices Commonly Used to Improve County/Municipal Street Repair and Maintenance Activities

Street Repair or Maintenance Activity	Recommended Improvements
Routine Roads and Bridges Maintenance	<ul style="list-style-type: none"> • Prevent paving materials and wastes from entering the storm drain system • Minimize the area of soils left exposed or graded • Collect any loose sand, gravel, asphalt, or other material as soon as possible after construction activities • When placing chip seals, limit spreading aggregate to the sealed surface and sweep up excess aggregate once cured and each day thereafter until aggregate loss is insignificant • Mix road stabilization materials during periods of calm, dry weather, and seal as soon as possible after dressing • Fill and compact soil, gravel, and asphalt in layers • Reuse road spoil in repairs if possible and sweep up and dispose of properly • Eliminate 'edge break' by fully sealing road shoulders • When striping, use water-based paints or thermoplastics rather than solventbased ones • Avoid striping operations while the pavement is wet, during humid conditions, or if rain is likely • Avoid applying thermoplastics at low temperatures, i.e. below 54°F • When possible, use portable drip trays under equipment to catch spills • Use a skirt around the blaster to minimize the spraying of material away from the work site • Coordinate street-sweeping with line removal, so that waste material is picked up before it can be transported by rain, wind, and traffic • Use dry cutting techniques when saw cutting and sweep or vacuum up residue • Construct runoff barriers to protect storm drains from wet saw-cut runoff • Place drip pans or absorbent materials under saw-cut equipment when not in use • Use as little cooling water as possible and switch the water off when the saw is not in use
Vegetative Maintenance	<ul style="list-style-type: none"> • Use mechanical methods of vegetation removal rather than herbicides • Dispose of lawn clippings at a landfill; clippings should not be disposed of in streams or storm drains • Avoid applying herbicides and pesticides if rain is expected • Calibrate equipment to avoid over application

A field investigation should be done to assess current County pollution prevention/good housekeeping practices for street repair and maintenance activities. Once the investigation is done a brief implementation plan should be created. The plan should summarize the results of the assessment of the current County pollution prevention/good housekeeping practices and the practices that will be used to reduce the stormwater pollution generated by County street repair and maintenance activities. The plan should also include a schedule that describes when the prescribed pollution prevention/good housekeeping practices will be implemented. The contents of the implementation plan should be reviewed with the individual who manages the street repair and maintenance activities.

3.5 STORM DRAIN MAINTENANCE

Storm drain maintenance is often the last opportunity to remove pollutants before they enter the storm drain system. The effectiveness of this pollution prevention/good housekeeping practice depends on the basic design of the stormwater conveyance in a subwatershed. Most systems have a catch basin (Figure 3-6) or sump pit located in the storm drain inlet to trap sediment and organic matter and prevent clogging. In some areas, however, conveyance systems were designed to be self-cleansing and thus have no storage. Each catch basin or sump pit tends to be unique in how quickly it fills up, and whether the trapped material is liquid, solid or organic. To this extent, each reflects the conditions and behaviors that occur within the few hundred feet of street it serves.

Storm drain maintenance can be an effective strategy in urban subwatersheds that have few other feasible options to remove pollutants. For many communities, storm drain maintenance is reactive and conducted in response to complaints from residents. Water quality is not a commonly cited reason for a storm drain cleanout program. When performed properly, regular maintenance can improve water quality and prevent clogging and flooding.

Storm drain cleanout effectiveness is impacted by both the frequency and method of cleanout. Table 3-8 provides estimated pollutant removal rates for catch basin cleanouts.

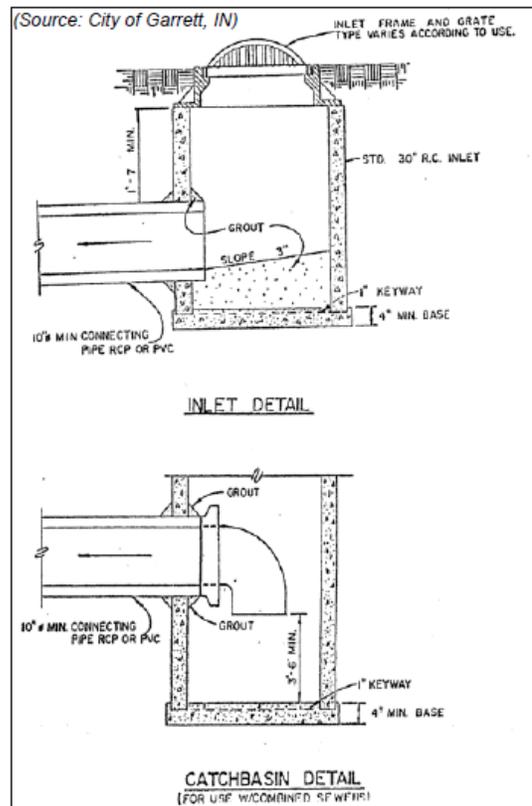


Figure 3-6: Catch Basin Detail

Table 3-8: Expected Pollutant Removal Rates for Catch Basin Cleanouts (Law et al., 2008)

Frequency	Total Suspended Solids	Total Phosphorus	Total Nitrogen
Annual	18%	<1%	3%
Semi-Annual	35%	2%	6%

A storm drain maintenance program should address the following:

- *Tracking* – the location and maintenance of storm drains should be tracked using a database and spatial referencing system (e.g., Global Positioning System, Geographic Information System).

Additionally, knowing the type and era of the storm drain system may be of use since some inlets/catch basins are designed to be self-cleaning while others have some trapping capacity.

- *Frequency* – Catch basins should be inspected and cleaned out according to their priority:
 - Priority A – Catch basins to be cleaned annually.
 - Priority B – Catch basins to be cleaned at least once every two years.
 - Priority C – Catch basins to be cleaned less frequently than A & B.
- *Technology* – the four common methods of cleaning catch basins are described in Table 3-9.
- *Staff Training* - operators need to be properly trained in catch basin maintenance including waste collection and disposal methods. Staff should also be trained to report water quality problems and illicit discharges.
- *Material Disposal* - since catch basin waste may contain hazardous material, it should be tested and disposed of accordingly. Maintenance personnel should keep a log of the amount of sediment collected and the removal date at the catch basin.

Table 3-9: Equipment Used for Catch Basin and Inlet Cleaning (from Lager et al. 1979)

Equipment	Description
Manual cleaning	Bail out sediment-laden water and shovel into street then truck. Or crew enters catch basin and fill buckets with sediment that are then carried to a dump truck. Clean water is used to refill the catch basin.
Eductor cleaning	Eductor truck evacuates the catchment of the sediment-laden water into a settling tank.
Vacuum cleaning	Air blower of the vacuum truck is used to create a vacuum and the air-solid-liquid material is separated in the vacuum truck unit by gravity separation and baffles.
Vacuum combination jet cleaning (e.g. Vaccon)	A vacuum assisted truck that uses a combination of air, water and hydraulic suction. Suction is used to extract material from storm inlets. Water is used to clear material from storm drain pipes that is not removed by the vacuum. The material is stored in the truck holding tank and transported for disposal.

3.6 PARK AND LANDSCAPE MAINTENANCE

A community may own or control as much as 10% of all the land within a subwatershed, when all the parks, schools, golf courses, rights-of-way, easements, open space and county/municipal buildings are combined. It is not uncommon for these areas to be managed as vast expanses of turf. The maintenance of these areas frequently includes mowing, fertilization, pesticide application, and supplemental irrigation. Poor turf management and landscaping practices have the potential to create stormwater pollution, particularly in urban areas where soils are compacted and infiltration is minimized. Potential pollutants generated by landscape and park maintenance include nutrients, herbicides, organic debris, and sediment. Because of their large size and ownership, county/municipal lands are good candidates for pollution prevention/good housekeeping techniques such as riparian reforestation and integrated pest management.

A wide range of pollution prevention/good housekeeping practices can be used to improve the way that park and landscape maintenance activities are conducted within a community. Some of the most commonly used practices are listed in Table 3-10.

Table 3-10: Pollution Prevention/Good Housekeeping Practices Commonly Used to Improve County/Municipal Park and Landscape Maintenance Activities

Activity	Pollution Prevention/Good Housekeeping Practices
Turf Reduction	<ul style="list-style-type: none"> • Plant trees and/or other native vegetation in suitable areas • Consider turf alternatives, such as native or low-water, cool-season turf grass • Allow natural regeneration in suitable areas
Turf Management	<ul style="list-style-type: none"> • Sweep any grass clippings away from paved surfaces after mowing • Use mulching type mowers or dispose of at local composting facility • Use erosion control measures when soils are exposed • Place stockpiled materials away from storm drains
Native Plantings	<ul style="list-style-type: none"> • Provide native and naturalized landscaping guidance and plant lists • Require use of appropriate native and naturalized landscaping on municipally-owned properties
Landscape Management	<ul style="list-style-type: none"> • Collect landscape waste (including grass clippings) and dispose of at a local yard waste recycling/composting facility • Do not use leaf blowers to blow waste into streets, storm drains or ditches
Pesticide/Herbicide Application	<ul style="list-style-type: none"> • Develop an integrated pest management plan that uses pesticides only as a last resort • Apply only when rain is not expected • Do not prepare herbicides or pesticides for application near storm drains • Use manual and/or mechanical methods to remove weeds rather than herbicides • Consider a low or no pesticide approach to maintaining landscaped areas
Fertilizer Application	<ul style="list-style-type: none"> • Never apply fertilizers or pesticides within five feet of pavement, 25 feet of a storm drain inlet, or 50 feet of a stream or water body • Consider a low or no fertilizer approach to maintain turf • Apply only when rain is not expected • Perform a soil test to determine actual fertilization needs and application rate • Calibrate fertilizer spreaders to avoid excessive application • Employ shutoff devices to prevent irrigation after precipitation
Irrigation	<ul style="list-style-type: none"> • Employ shutoff devices to prevent irrigation after precipitation or if a pressure drop occurs due to broken sprinkler heads or lines • Design irrigation systems specific to each landscaped area's water requirements • Select native plant species whenever possible and group together plants with similar water requirements in order to reduce excess irrigation • Use soaker hoses not sprinklers and irrigate in the morning or evening to conserve water
Employee Training	<ul style="list-style-type: none"> • Train employees on the use and appropriate application of pesticides, herbicides and fertilizers • Ensure that designated no mow areas are well advertised • Educate staff on the benefits of trees and native and naturalized species

A field investigation should be done to assess current County pollution prevention/good housekeeping practices for park and landscape maintenance activities. Once the investigation is done a brief implementation plan should be created. The plan should summarize the results of the assessment of the current County pollution prevention/good housekeeping practices and the practices that will be used to reduce any stormwater pollution generated by the County park and landscape maintenance activities. The plan should also include a schedule that describes when the prescribed pollution prevention/good housekeeping practices will be implemented. The contents of the implementation plan should be reviewed with the individual who manages the park and landscape maintenance activities.

3.7 EMPLOYEE TRAINING

County/municipal employees that are educated about the link between their work and stormwater quality can assist in reducing the amount of stormwater pollution that is conveyed into receiving waters. In order for county/municipal pollution prevention/good housekeeping programs to achieve success, employees must be trained on how to incorporate pollution prevention/good housekeeping practices into their everyday activities.

County/municipal employees must be provided with specific information about the actions they can take to prevent or reduce stormwater pollution. Table 3-11 presents the range of training topics that can be provided for each county/municipal operation. If they are not already familiar with the requirements of the NPDES Phase II permit, a general training session is a good opportunity to educate employees about them.

The most effective pollution prevention/good housekeeping training programs are the ones that provide the right information to the right employees. For example, employees engaged in landscape and park maintenance should be trained in landscaping techniques that use less fertilizer and pesticides, while employees responsible for maintaining fleet vehicles should be trained in the proper disposal of waste automotive fluids and how to correctly deal with leaky or disabled vehicles.

There are a variety of methods that can be used to educate county/municipal employees on stormwater pollution prevention/good housekeeping practices, including:

- Annual Performance Reviews
- Brochures
- Conferences
- Meetings
- Training Sessions
- Videos
- Walkthroughs
- Workplace Posters
- Workshops

Employee turnover is an important consideration when developing an employee training and education program. The key to an effective program is to ensure that institutional knowledge about pollution prevention/good housekeeping practices is maintained over time. A tracking system, such as a sign in sheet that identifies the county/municipal staff members that have received training is critical to ensure the effectiveness of a pollution prevention/good housekeeping employee training program.

Table 3-11: Employee Training Programs – Presenting the Right Information to the Right Audience

County/Municipal Operation	Training Targets	Training Topics
Hotspot Facility Management	<ul style="list-style-type: none"> • Facility managers • Building maintenance staff • Fleet maintenance staff 	<ul style="list-style-type: none"> • Vehicle maintenance and repair procedures • Vehicle washing procedures • Materials loading and unloading procedures • Materials storage procedures (outdoor storage) • Spill prevention and response • Dumpster management • Building repair and maintenance procedures
Construction Project Management	<ul style="list-style-type: none"> • Contract administration staff • Building services staff • Plan review staff • Site inspection staff 	<ul style="list-style-type: none"> • Considering erosion and sediment control and stormwater management during contractor selection • Plan review techniques • Erosion and sediment control practices • Ordinance enforcement procedures
Post-Construction Stormwater Management	<ul style="list-style-type: none"> • Storm drain staff • Site inspection staff • Maintenance staff 	<ul style="list-style-type: none"> • Post-Construction stormwater BMP inspection procedures • Post-Construction stormwater BMP maintenance procedures
Street Repair and Maintenance	<ul style="list-style-type: none"> • Street maintenance staff • Vehicle operators 	<ul style="list-style-type: none"> • Road maintenance procedures • Winter road maintenance procedures • Handling and application of pesticides and other chemicals
Storm Drain Maintenance	<ul style="list-style-type: none"> • Storm drain staff • Street maintenance staff • Vehicle operators 	<ul style="list-style-type: none"> • Storm drain maintenance procedures • Materials disposal • Vacuum truck maintenance
Park and Landscape Maintenance	<ul style="list-style-type: none"> • Parks and recreation staff • Community forestry staff • Landscaping staff • Mowing staff 	<ul style="list-style-type: none"> • Use and appropriate application of pesticides, herbicides and fertilizers • No mow areas • Benefits of trees, native and naturalized species

4.0 REFERENCES

- Bannerman, R., D. Owens, R. Dodds and N. Hornewer. 1993. "Sources of Pollutants in Wisconsin Stormwater". *Water Science and Technology*. 28:3-5, 241-259.
- Berryman and Henigar. 2003. *Street Sweeping Study Report*. Prepared for City of Concord, California. Berryman and Henigar. San Diego, CA.
- California Stormwater Quality Association (CASQA). 2003. *California Stormwater BMP Handbook: Municipal*. California Stormwater Quality Association. Livermore, CA.
- Center for Watershed Protection (CWP) and R. Pitt. 2004. *Illicit Discharge Detection and Elimination Manual: A Guidance Manual for Program Development and Technical Assessments*. Center for Watershed Protection. Ellicott City, MD.
- Center for Watershed Protection (CWP). 2006a. *Technical Memorandum 1. Literature Review. Research in Support of an Interim Pollutant Removal Rate for Street Sweeping and Storm Drain Cleanout Activities*. Center for Watershed Protection. Ellicott City, MD.
- CWP. 2006b. *Technical Memorandum 2. Summary of Municipal Practices Survey. Research in Support of an Interim Pollutant Removal Rate for Street Sweeping and Storm Drain Cleanout Activities*. Center for Watershed Protection. Ellicott City, MD.
- Brown, E.W. and D.S. Caraco. 2000. "Muddy Water In, Muddy Water Out". *The Practice of Watershed Protection*. Eds. T. Schueler and H. Holland. Center for Watershed Protection. Ellicott City, MD.
- Lager, J., W. Smith, R. Finn and E. Finnemore. 1997. *Urban Stormwater Management and Technology: Update and Users' Guide*. U.S. Environmental Protection Agency. EPA-600/8-77-014. Washington, DC.
- Law, N.L., K. DiBlasi and U. Ghosh. 2008. *Deriving Reliable Pollutant Removal Rates for Municipal Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin*. Prepared for the Chesapeake Bay Program. Center for Watershed Protection. Ellicott City, MD.
- Maryland Department of the Environment (MDE). *MDE Spill Report Form*. MDE Spill Response Division. Baltimore, MD. Available Online: <http://www.mde.state.md.us/assets/document/emergency/mdespillreport.pdf>
- Mineart, P. and S. Singh. 1994. *Storm Inlet Pilot Study*. Prepared for Alameda County Urban Runoff Clean Water Program. Woodward-Clyde Consultants. Oakland, CA.
- Partland, J. 2001. "A Clean Sweep to Swipe Pollutants". *Stormwater*. 12(4).
- Pitt, R. and P. Bissonette. 1984. *Bellevue Urban Runoff Program. Summary Report. Characterizing and Controlling Urban Runoff Through Street and Sewerage Cleaning*. U.S. Environmental Protection Agency. EPA-600/S2-85/038. Washington, DC.
- South Carolina DHEC OCRM BMP Field Manual, July 2005. Available Online: http://www.scdhec.gov/environment/ocrm/docs/Field_Manual/OCRM_DHEC_FIELD_MANUAL_STRUCTURAL.pdf
- Sutherland, R.C. and S.L. Jelen. 1997. "Contrary to Conventional Wisdom: Street Sweeping can be an Effective BMP". *Advances in Modeling the Management of Stormwater Impacts. Volume 5*. Ed. W. James. Guelph, Canada.

U.S. EPA Office of Emergency and Remedial Response. 1990. *Hazmat Team Planning Guidance*. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. Washington, DC.

U.S. Fire Administration. 1999. *Guide to Developing Effective Standard Operating Procedures for Fire and EMS Departments*. Federal Emergency Management Agency. Washington, DC.

United States Environmental Protection Agency (U.S. EPA). 2000. *Stormwater Phase II Final Rule Fact Sheet 2.8: Pollution Prevention/Good Housekeeping Minimum Control Measure*. EPA-833-F-00-010. U.S. EPA. Office of Water. Washington, DC.

U.S. EPA. 2000. *Stormwater Phase II Final Rule Fact Sheet 2.6: Construction Site Runoff Control Minimum Control Measure*. EPA-833-F-00-008. U.S. EPA. Office of Water. Washington, DC.

Waschbush, R.J. 2003. *Data and Methods of a 1999-2000 Street Sweeping Study on an Urban Freeway in Milwaukee County, Wisconsin*. Open File Report 03-93. U.S. Department of the Interior. U.S. Geological Survey.

Wright, T., C. Swann, K. Cappiella and T. Schueler. 2005. *Urban Subwatershed Restoration Manual 11: Unified Subwatershed and Site Reconnaissance: A User's Manual*. Center for Watershed Protection. Ellicott City, MD. __