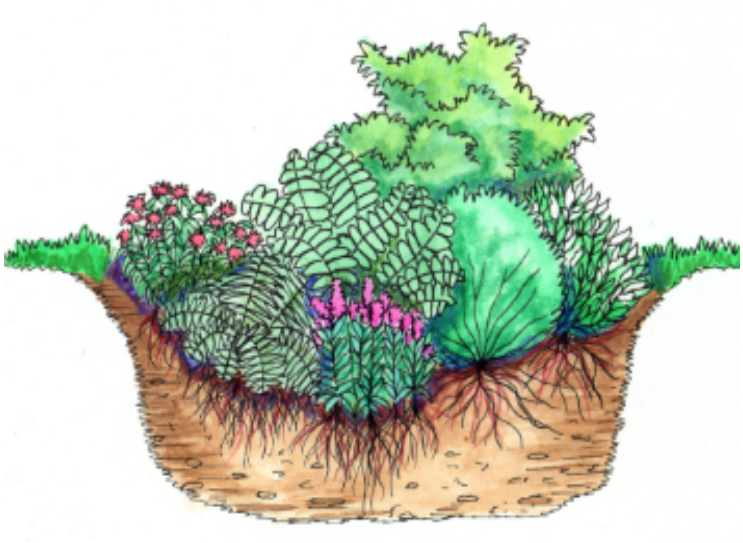
Stormwater Maintenance Assessment and Recommendations



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Executive Summary

Maryland-National Capital Park and Planning (M-NCPPC), which operates under Prince George's County (PGC) Department of Parks and Recreation (DPR), is responsible for approximately 194 stormwater management systems (SWM) throughout the county that range in scale, complexity, and type. The management of these assets is currently overseen by the Maintenance and Development Division, however, their staff lacks the expertise and training to repair and maintain these structures. Furthermore, an updated best management practices (BMP) maintenance manual is not available for staff and many existing structures need upgrading to meet current standards.

Our team aims to assist M-NCPPC in the maintenance and development of its stormwater management structures. To accomplish this, we completed a literature review of best practices for stormwater management, curated customized checklists, and visited nine of the Department's stormwater management assets to assess their condition. We also propose recommendations for improvements of existing structures. This section of our research aims to assist M-NCPPC staff in maintaining existing and potential new SWM structures.

The Department also seeks consolidate its current SWM assets into standardized categories to make forecasting potential maintenance costs and schedules easier. The Department would like to capture best practices used by similar agencies to create standards and start tracking spending metrics of these best practices and become more effective stewards of taxpayer money. This report includes a comparative literature review of national and international SWM BMPs to consolidate the current 16 SWM categories.

Based on our research and on an assessment of the nine sites visited, we were able to identify opportunities for improvement and create maintenance guidelines. We hope this work, along with an assessment by an appropriate specialist, helps M-NCPPC maintain and improve existing structures, and develop new stormwater management structures.

Chapter 1: Introduction

The Prince George's County (PGC) Department of Parks and Recreation (DPR), which oversees the County's stormwater management facilities, faces several ongoing issues: flooding, poor water quality, and damaged or noncompliant stormwater management structures. The damaged and noncompliant structures inhibit the PGC's ability to meet its nutrient reduction targets under the Maryland Watershed Implementation Plan. For example, by 2025, PGC aims to reduce its nitrogen load into the Chesapeake Bay by 20,846 lbs/year from urban sources (MDE et al. 2019). Meeting these targets improves the Bay's water quality, which has deteriorated in part due to increased stormwater runoff as land cover has transformed into impervious urban areas (MDE et al. 2019).

The Maryland-National Capital Park and Planning Commission (M-NCPPC) plays a critical role in ensuring the success of the Maryland Watershed Implementation Plan because it is responsible for maintaining approximately 194 SWM structures within PGC (M-NCPPC, 2019). The structures' variety of size, scope, and type poses significant challenges to establishing standardized maintenance practices. Specifically, M-NCPPC manages 16 types of SWM structures, including wet ponds, dry ponds, or bioretention areas (Table 1).

This report proposes reclassifying M-NCPPC's SWM structures to be consistent with international guidelines, which can help M-NCPPC use best practices developed in cities and agencies that are leaders in stormwater management techniques. Furthermore, this report provides improved stormwater maintenance guideline checklists based on each type of SWM structure within PGC. The checklists are intended to be easy to use and easy to update as stormwater management regulations change.

Table 1: Distribution of SWM structures within PGC according to M-NCPPC classification

SWM Type	Count
Wet Pond	67
Bioretention Area	38
Dry Pond	33
Rain Garden	16

SWM Type	Count
Swale	12
Trench	6
Culvert	5
Marsh	4

SWM Type	Count
Underground Structure	3
Pervious Surface	2
Drywell	2
Inlet	2

SWM Type	Count
Dam	1
Flow Splitter	1
Riser	1
Sand Filter	1

Chapter 2: Goals and Objectives

Goals

This project's mission is to assist M-NCPPC, in maintaining and developing its SWM systems with research that can be used to reach the department's goal of creating standardized processes for maintenance of SWM structures by category. This research and the proposed standardized process should be used as a starting point by M-NCPPC DPR. To accomplish this goal, we pursued three objectives.

Objective 1: Grouping Structures

The detailed maintenance and management report includes the type and timeline for maintenance of each structure. With this information, a standard checklist and SWM-specific checklists were created to assess a sampling of SWM sites. These checklists include a site description and are used to determine a structure's condition.

Objective 2: Assessing Structures

Using the specific checklists, we assessed the status, condition, necessary maintenance, and potential recommendations at nine SWM locations. If checklist findings indicated a SWM system in poor condition, we provided recommendations to improve BMPs. Based on findings, including conditions, maintenance, and maintenance time, we provided a list of recommended BMPs for SWM infrastructure, as well as a broad assessment of all of the combined assets.

Objective 3: Comparative Review of National and International SWM BMPs

A brief comparative analysis of county, state, national, and governmental standards provides a review of international solutions for stormwater management.

Chapter 3: Methodology

SWM General Research

To familiarize ourselves with the basics of SWM application and maintenance, we reviewed the existing SWM classifications provided by M-NCPPC (Table 1). Each team member was assigned classifications and researched maintenance schedule and applicability by SWM type. M-NCPPC also provided initial research resources including New York City's plans for sustainability and resilience, as well as Chicago Parks District's Sustainability Plan (Bloomberg, 2008 and Emanuel, 2014). These documents guided our understanding of SWM as well as direction to expand the research. Search criteria included successful SWM manuals from organizations and governments in UMD library materials, scholarly journals, and technical manuals.

Manual Development

After researching the various SWM types, a checklist template was designed to maintain consistency throughout the manual. The checklist is based on existing maintenance checklists, problems identified by the research, and feedback from M-NCPPC staff experience. Also, specific checklists were developed for each SWM researched.

M-NCPPC's SWM Assessment

To assess existing SWM structures, we visited nine sites throughout the County with M-NCPPC staff members. Using the checklists, we assessed the factors that could impact the structures' functionality. We took notes, documented physical factors with photographs, and

followed up with staff for additional information—particularly on invasive plant species and maintenance history. The compiled results include recommendations on how M-NCPPC could improve the function of a given site.

Research into National and International SWM BMPs

To develop a new classification system, a comparative analysis of international, US national, EPA, and Maryland state standards was undertaken to find similarities in categories and definitions. The research into international categorization standards, included Copenhagen's Cloudburst Formula, which is among the most comprehensive SWM plans available in English (Ramboll Studio Dreiseitl, 2016).

The proposed standardized categorization is recognized by all levels of the US government as well as the international community.

Chapter 4: Findings

Checklist Development

The primary purpose of the checklists is to standardize how sites are assessed. Consistent assessment allows a comparison of SWM structures performance. Checklist development began with researching the work of other agencies that could provide a model, in particular, the checklist developed by the Northeast Ohio Stormwater Training Council (NEOSWTC) (Image 1).

Instead of dividing the checklist into structure components, such as pretreatment area, inlet, and slopes, this template checklist has sections on structure, debris/pollution, and vegetation. These three categories are simple to understand and applies to PGC's SWM structures. Based on the NEOSWTC model, the first draft checklists was presented in a tabular format, and included a frequency column, marking how often SWM components should be checked (Image 2). A solution matrix helps troubleshoot problems identified on-site; it was intended to accompany the checklists and describe how identified problems should be resolved.

Bioretention Area Inspection and Maintenance Checklist

Facility:			
Location/Address:			
Date:	**Time:**	**Weather Conditions:**	**Date of Last Inspection:**
Inspector:		**Title:**	
Rain in Last 48 Hours □ **Yes** □ **No**		**If yes, list amount and timing:**	
Pretreatment: □ **vegetated filter strip** □ **swale** □ **turf grass** □ **forebay** □ **other, specify:**			□ **no**
Site Plan or As-Built Plan Available: □ **Yes** □ **No**			

Inspection Item		**Comment**	**Action Needed**
1. PRETREATMENT			
Sediment has accumulated.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Trash and debris have accumulated.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
2. DEWATERING			
Standing water is present after 48 hours. If yes, describe sheen, color, or smell.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
3. INLETS			
Inlets are in poor structural condition.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Sediment and debris have accumulated and/or is blocking the inlets.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Erosion is occurring around the inlets.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
3. VEGETATION			
Vegetation is wilting, discolored, or dying due to disease or stress.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Vegetation needs to be controlled through mowing or manual removal.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
4. BIORETENTION MAIN INFILTRATION AREA			
Trash and debris have accumulated.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Sediment has accumulated at the surface.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Topmost layer is caked or crusted over with sediment.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Erosion is evident.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Mulch is compacted.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Sinkholes or animal borrows are present.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
5. SIDE SLOPES AND EMBANKMENT			
Erosion is evident.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Sinkholes or instability is evident.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
6. OUTLETS AND OVERFLOW STRUCTURE (i.e., catch basin)			
Outlets or overflow structures in poor structural condition.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Sediment, trash or debris is blocking the outlets or overflow structure.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Erosion is occurring around the outlets or overflow structure.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐
Height from surface of practice to top of overflow structure is insufficient to allow for ponding during rain events.	☐**Yes** ☐**No** ☐**N/A**		☐**Yes** ☐

Image 1: NEOSWTC bioretention inspection checklist

Stormwater Management Practice:

Site Visit Date: _____ BMP Category / Type: _____

Present On Site: _____ Site Reviewer: _____

Site Address / Location: _____

Debris / Pollution

❑

Additional Notes

Structure

❑

Additional Notes

Vegetation

❑

Additional Notes

Image 2: First draft of initial checklist template

Bioretention

A bioretention area is a large shallow pit filled with engineered media, soil, mulch, and (preferably native) vegetation. They are designed to temporarily hold and treat stormwater runoff by filtering pollutants through the pit components before it is discharged. Bioretention areas are made to be "easily integrated throughout a proposed site design" (Environmental Services Division, 2). When building a bioretention area, factors to consider include the soil type and moisture, site conditions, and plant types.

Bioretention areas do not need intense maintenance, but proper maintenance ensures their longevity and effectiveness. Maintenance includes weeding, watering, fertilization, mulching, replanting, mowing/trimming, and removing pollution such as litter and pet waste (Environmental Services Division, 137-139). Pipes should be monitored to ensure they are not damaged or blocked. To maintain water flow and quality, soil erosion should be monitored at least four times annually. It is worth noting that bioretention areas are similar to rain gardens in planting and structure. However, bioretention areas "include underdrains, [and] are larger engineered systems [that] treat higher amounts of impervious surface." (University of Maryland Extension, n.d.).

Overall, Prince George's County's bioretention areas have flexible design features and relatively small footprints They can be adjusted to accommodate utilities and other conflicts allowing them to easily fit into the landscape. Common variants include rain gardens, micro-bioretention areas, stormwater planters, and tree box filters.

Culvert

A culvert is a pipe that can vary in size and material. It is built underground, frequently under roads or railways, and carries water to control its flow. Culverts are used to direct stormwater flow and road drainage to areas where the water can be discharged. There are two types of culverts. A stream crossing culvert has pre-established flows of water and a runoff management culvert is placed to help manage water (Shurtleff Stormwater Solutions Environmental Products and Systems, n.d.). Culverts are occasionally built with riprap, a large pile of rocks on top of a geotextile membrane that prevents the rocks from sinking into the ground, provides structural stability, and provides some filtration by catching debris before it goes into the ground below the membrane. Riprap is used to slow the flow of water and its use riprap depends on the area. Culverts can drain into a natural or constructed water channel (FEMA National Flood Insurance Program, 9).

Culvert maintenance includes pipe repairs and litter removal. Larger culverts tend to accumulate more debris and sediment, which can block water flow and should be cleaned out to maintain flow. Smaller culverts can be more susceptible to clogs and should be thoroughly checked. Excess vegetation should be removed to ensure it doesn't block culvert entrances. A riprap area should be cleaned of litter or trash.

Check Dam

Check dams are temporary or permanent, small, linear structures placed across drainage ditches, channels, and swales. They are built of different materials including rock, fiber logs, triangular sediment dikes, and sandbags (Minnesota Stormwater Manual, 2019). Their main

purpose is to reduce the velocity of concentrated stormwater flows to prevent erosion and to trap sediment during low flows (Springville City Corporation Public Works Department Engineering Division, 2002). Under low-flow conditions, water accumulates and drains, infiltrates, or evaporates. Under high-flow conditions, rainwater flows over or through the structure. During high-flows, a check dam slows the flow of rainwater to allow infiltration while trapping sediment (Minnesota Stormwater Manual, 2019).

Check dams should be inspected regularly, particularly after rainfalls over 0.5 inches or a runoff event such as snowmelt (Springville City Corporation Public Works Department Engineering Division, 2002). During prolonged rainfall events, the dam should be checked daily for erosion and sediment build-up. They should be maintained once a month, removing debris in and around the dam, reporting and repairing damage, and removing sediment when it reaches half the height of the dam (Springville City Corporation Public Works Department Engineering Division, 2002).

Dry Pond

A dry pond is an excavated area installed on or adjacent to tributaries of rivers, streams, lakes, or bays to protect against flooding and downstream erosion by storing water for a limited period of time (Pennsylvania stormwater management plan, 2005). These basins are also referred to as "holding ponds," "dry detention basins," or "stormwater detention ponds." They are a commonly implemented best management practice (BMPs), serving as an effective way to reduce high-volume discharge and provide water quality enhancement. Dry ponds generally provide flood protection and can also help control an extreme flood event. They manage urban runoff generated by impervious surfaces such as roads, parking lots, and rooftops. Basic ponds

are designed to empty within six to 12 hours after a storm (Pennsylvania stormwater management plan, 2005). In practice, a pond's type and configuration, including the physical mechanisms of pollutant removal, will impact its performance. A variant design, known as an extended detention basin, holds water for 24 to 48 hours. Longer storage times can remove suspended solids, result in improved water quality. Designing a dry pond design requires balancing costs with storage capacity and release rate to achieve the desired performance level.

The maintenance requirements, described in the Pennsylvania plan, pertain to vegetation upkeep and management. Debris and sediment collect at the bottom of the basin and often becomes trapped or creates clogs. Basin structures should be inspected for clogs and excessive debris and sediment accumulation throughout the year and after heavy storm events.

Dry Well

A dry well, sometimes referred to as a seepage pit, is a subsurface storage facility that temporarily stores and infiltrates stormwater runoff from roofs. Roof leaders connect directly into the dry well, built as either an excavated pit filled with uniform geotextile or a prefabricated storage chamber or pipe segment. Dry wells discharge stored runoff by infiltration into surrounding soils. If the dry well is overwhelmed in an intense storm, an overflow mechanism, such as a pipe to a larger infiltration area, will ensure that additional runoff is safely conveyed downstream. By capturing runoff at the source, dry wells can dramatically reduce the increased volume of stormwater generated off roofs (NJ Stormwater Best Management Practices Manual, 2020). Though roofs are generally not a significant source of runoff pollution, in developed areas they are still an important source of new or increased runoff volume. By decreasing the volume of stormwater runoff, dry wells can effectively reduce the runoff rate and improve water quality.

Dry well maintenance should be done throughout the year and after every storm event, which requires adequate inspection and maintenance. The main focus of maintenance is the disposal of debris, trash, and sediment, as well as other waste materials (NJ Stormwater Best Management Practices Manual, 2020).

Flow Splitter

Flow splitters help divide the flow of water into two separate areas (PGC Department of Environmental Resources, 2009). The water is typically diverted to another SWM facility such as a bioretention cell, dry well, infiltration trench, or wet pond (PGC Department of Environmental Resources, 2009). Water flow is directed by a pipe or tube within the structure to bypass and move into a nearby SWM facility. Flow splitters are used to direct water in one area into another area. However, they can sometimes reverse and cause an overflow of water, greatly reducing its originally intended impacts.

A flow splitter should be checked after every major storm as well as monthly for routine maintenance. Some issues to look for are damages to the physical structure itself, an overflow of water, and buildup of debris within the pipes. The physical structure is made from concrete, and cracks should be repaired promptly to avoid further damage (PGC Department of Environmental Resources, 2009). Typical maintenance should include removing debris or vegetation and the removal of any plants that inhibit the operation. Like all SWM structures, if not properly maintained, the flow splitter can't operate properly, which can cause even greater damage.

Inlet

Inlets work by trapping sediment before it flows elsewhere. For example, an inlet can capture flow coming off a construction site toward a larger water body (Minnesota Stormwater Manual, 2019). To be effective, the inlet should be constructed before any other construction on the site. Inlets can also prevent large sediment clogs in storm sewers but to work at full capacity, the inlets should be inspected and emptied of sediment after every rainfall (Minnesota Stormwater Manual, 2019). Inlets can be built of rock, compost logs, and sand or gravel bags (Minnesota Stormwater Manual, 2019). While inlets may seem like a large investment of time and manpower, the equipment itself is relatively inexpensive and effective; upkeep and maintenance are crucial for its success.

Inlets properly working should be checked monthly and after every rainfall to determine whether or not sediment needs to be removed. Sediment build-up can greatly inhibit the inlet's function. If sediment can't be removed after a rainfall, the site should at least be visited monthly to remove excess sediment and prevent clogging and overflow. The structures should also be cleared of debris such as leaves and branches that may flow into the inlet during large storm events.

Marsh

A marsh is a permanent shallow pool planted with wetland vegetation designed to provide extended detention. Marsh wetlands consist of zones of standing water with depths up to 18 inches (NJ Stormwater, 2004). These zones are classified as either low or high marsh systems based on the normal standing water depth. A low marsh has a standing water depth of six to 18

inches and is suitable for several emergent wetland plant species (NJ Stormwater, 2004). A high marsh has a maximum standing water depth of six inches. Due to its shallower depth, it will have a higher standing water surface area to volume ratio than a low marsh. It can also support a greater density and diversity of emergent wetland species than a low marsh (NJ Stormwater, 2004). Marshes provide additional treatment of runoff, particularly for dissolved pollutants. These systems require less space and generally achieve a higher pollutant removal rate than other stormwater wetland systems (Boston Water and Sewer Commission, 2013).

Marshes operate best when left alone. However, some management activities should be conducted annually and seasonally to protect and restore damaged areas. Draining, filling, logging, and dumping should be avoided to preserve desirable natural conditions. Marshes contain many water-loving plants, mammals, and waterfowl and management practices should include removing invasive species and planting native grasses. Maintenance activities should be careful not to disturb nesting structures and wildlife. To protect wildlife, a buffer zone of at least 100 feet must be maintained and fences should be installed for additional safety.

Pervious Surface

Pervious surfaces are porous pavements composed of open-pore concrete, asphalt, or interlocking pavers. They catch precipitation and surface runoff, allowing water to slowly filter through voids in the pavement surface into an underlying reservoir, where it is temporarily stored and eventually infiltrated (USGS, 2018). Permeable pavement promotes a high degree of runoff volume reduction and nutrient removal (Virginia DEQ, 2011). Pervious surfaces are commonly used in parking lots, low-traffic residential roads, sidewalks, and driveways. Thet are designed to treat stormwater that falls on the pavement surface area but can also accept run-on from small

adjacent impervious areas, such as driving lanes or roofs (Virginia DEQ, 2011). Since pervious surfaces have a very high runoff reduction capability, they are an excellent alternative to conventional pavement.

When properly maintained, the longevity of pervious surface pavements is very viable. Maintenance is driven by annual inspections that evaluate their condition and performance (Virginia DEQ, 2011). Annual inspections should be conducted in the spring to ensure optimal performance. They should also be checked for deterioration and to ensure water is draining between storms. The pavement reservoir should drain completely within 72 hours of the end of a storm (CVC, 2012). Inspections should also assess drawdown rate for signs of clogging, pavement surface for sediment deposition and debris, structural integrity for signs of cracked or broken pavers, inlets and flow diversion for sediment buildup, and surrounding vegetation for signs of erosion and overgrowth (Virginia DEQ, 2011). Commercial vacuuming or sweeping should be conducted once or twice a year. Grid paver systems planted with grass should be mowed regularly and the clippings removed; they may require periodic watering and fertilization to establish and maintain healthy vegetation (CVC, 2012). Pervious surfaces can operate efficiently in cold climates and winter conditions. Studies have shown that these surfaces increase meltwater rates compared to the conventional pavement, reducing the need for deicing chemicals (CVC, 2012). However, management practices should be modified to maintain the pavement's hydrologic function. Sand should not be spread on the surface as it can quickly lead to clogging and deicers should only be used in moderation and only when necessary. Snowplow operators should also be informed to be cautious of blades damaging the pavement's surface (Virginia DEQ, 2011).

Rain Garden

Rain gardens are typically small, circular bioretention areas that retain pollutants in carried in stormwater runoff (Dauphin County Conservation District, n.d.). They are constructed and planted with vegetation that would be typically found in local forests to naturally filter pollutants from stormwater runoff (Dauphin County Conservation District, n.d.). To filter pollutants, rain gardens are built in layers—a vegetated or stone surface ponding area, a mulch layer, a planting soil layer, a sand bed, and a gravel base. The surface layer slows the velocity of water and temporarily stores it. Together, the layers filter contaminants and release filtered water to infiltrate into the groundwater supply (Dauphin County Conservation District, n.d.).

Rain gardens are simple stormwater management structures that need minimal maintenance. They should be inspected monthly for erosion or structural damage and weeds or invasive plants should be removed. After a storm, rain gardens should be checked for erosion, structural damage, and vegetation damage (Department of Environmental Protection, n.d.). Two days after a storm, rain gardens should also be inspected to ensure there is no standing water. Rain gardens should be watered if it has not rained for more than 10 days. AS needed, mulch should be checked and replenished, and organic matter, such as fallen leaves, should be removed. New plants need to be watered for the first 18 months of initial plant growth (Department of Environmental Protection, n.d.).

Riser

Risers are vertical pipes topped with a dome-shaped grated top, often used in bioretention basins, ponds, and wet basins (Philadelphia Water Department, 2018). They are designed as

outlet control for stormwater, specifically to regulate the release of stormwater. Risers often control water ponded within an SWM facility, providing depth control and releasing water at a reduced rate. They can be used alongside other SWMs, including orifices, weirs, or underdrains. The riser's location is crucial to ensure easy maintenance and to prevent shortcutting treatment by placing them away from inflow structures (Philadelphia Water Department, 2018). Unmaintained risers may stop controlling ponded water, and if used alongside another SWM, can reduce its efficacy as well. The relevant checklist was compiled from resources including the U.S. EPA (Licher, 2016) and the Philadelphia Water Department (Philadelphia Water Department, 2018; Licher, 2016; U.S. EPA, 2009).

Structural components should be assessed once a year, as they are built to withstand weathering. Ensuring that no components are cracked, damaged, misaligned, or deteriorated is key to securing the longevity of the SWM. Additionally, an annual review of the state of the trash grate atop the pipe is key to maintaining function. The system should be checked seasonally for standing water, as well as after a storm. If water is present 48 hours after a storm, the riser isn't working properly and should be tested. Monthly maintenance should include removal of trash, grass and leaf debris, signage (designating it as a conservation area), excessive vegetation, and bare soil or other signs of erosion.

Sand Filter

Sand filters are a pretreatment basin and main filter bed with sand media. As water flows through the sand filter, large particles settle in the pretreatment facility, and smaller particles that carry pollutants are caught within the sand media (PGC DER, 2009). Sand filters also include an underdrain to prevent the system from flooding in the event of heavy rainfall.

Sand filters need to be regularly cleaned of sediment after two to ten years of service (California Stormwater Quality Association, 2003). They should be inspected seasonally and after a major storm to ensure there is no erosion, sediment build-up, or water ponding. An indicator of sediment build-up is discoloration within the sand media. If the sand filter does not drain completely within 72 hours after a major storm, or if there is sediment build-up, the top two to three inches of filter media should be removed and replaced with fresh sand (California Stormwater Quality Association, 2003). As sand is replaced, the depth can be reduced; if the overall media depth drops below 12 inches, it should be restored to a minimum depth of 18 inches (California Stormwater Quality Association, 2003). In the settling basin where pretreatment occurs, sediment should be removed every ten years or when the sediment occupies ten percent of the basin volume (California Stormwater Quality Association, 2003). Any planted vegetation or grass cover within the sand filter should be inspected seasonally, and dead vegetation should be removed.

Swale

A swale is an open channel with side slopes and a bottom covered with grass that collects water from impervious surfaces, filtering it into the ground while reducing the flow velocity and the amount of runoff overall (Anne Arundel County, n.d.). They are often installed along parking lots, between properties, and in the verge of large roads. In steeper areas, swales incorporate stone or concrete dams across their width to help slow the flow rate, promote infiltration, and prevent erosion. Swales are different than other bioretention practices in that they are designed to be conveyance treatment devices, not storage devices. Water does not pool and slowly infiltrate in bioswales. Instead, treatment and retention are provided as stormwater moves through the

swale. As linear features, they are particularly well suited along streets, sidewalks, and parking lots.

Unmaintained swales may stop filtering stormwater, allow trash and pollutants to enter waterways, block rainwater flow, cause flooding events, and even allow water to pool for longer than 48 hours, long enough to allow insects to breed (Anne Arundel County, n.d.). Structural components should be reviewed once a year, as they are built to withstand weathering. Ensuring that no components are cracked, damaged, misaligned, or deteriorated is key to securing longevity. An annual review should also ensure that trees aren't forming an overhead canopy, which can create leaf litter and impede the function. Standing water requires seasonal maintenance, specifically after a storm. If water is still present 48 hours after a storm, the swale is not working and should be tested. Monthly maintenance should include removing trash, debris, sediment, and invasive species, controlling odor, and assessing the health of native vegetation.

Infiltration Trench

An infiltration trench is a long and narrow linear system consisting of a continuously perforated pipe in stone or a vegetated filled trench with a level bottom. The function of an infiltration system is to collect and temporarily store rainwater and to infiltrate stormwater runoff to groundwater (Pennsylvania Stormwater Best Management Practices Manual, 2005). They are usually constructed alongside roadways or impervious paved surfaces where high amounts of runoff occur. The drainage direction of the trench should be to the downhill side of where water accumulates or of the road it is constructed next to. Infiltration trenches are usually just one component of a larger stormwater system called a conveyance system. The purpose of this system is to reduce runoff during both large and small rainfall events by conveying rainwater

through the pipe, therefore reducing runoff (Pennsylvania Stormwater Best Management Practices Manual, 2005).

Infiltration trenches need to be inspected monthly and after large rainfall events. The build-up of sediment and/or debris should be checked for and manually removed if visible. The area surrounding the pipe should also be inspected to ensure it's not being blocked. Seasonally, infiltration trenches should be maintained by mowing surrounding grass and removing invasive vegetation (Minnesota Stormwater Manual, 2019).

Underground Structure

Underground SWM structures can provide full water quality treatment and infiltration or minimal treatment and underground water storage. Water quality is treated through sedimentation, screening, filtration, or other physical and chemical processes (California Stormwater Quality Association, 2003). Underground structures not intended to provide treatment are often called underground stormwater storage facilities. They slowly release captured stormwater into surface water or surrounding soils (PGC DER, 2009). Underground structures can be supplemented with surface SWM structures, for example, sand filters can be adapted into underground structures where space is limited. The main benefit of underground SWM structures, is that they occupy less space and can be appropriate in high-density urban areas. However, they are generally more expensive and difficult to access for maintenance compared to surface designs (California Stormwater Quality Association, 2003, PGC DER, 2009).

Regular inspections should be conducted quarterly; however, if the structure is sited and designed correctly, maintenance should not be required more than once a year (California Stormwater Quality Association, 2003). Routes to the structure should always be clear of

obstructions and the condition of structural components, including any pumps, should be checked annually. Evidence of sediment buildup, water ponding, and trash should be checked and cleaned quarterly (California Stormwater Quality Association, 2003). If the underground structure includes a pump system, inspection and maintenance records should be included (California Stormwater Quality Association, 2003).

Wet pond

A wet pond is a standing pool of water that with the capacity to retain more water when needed. They fill with stormwater that is held for several days and released, returning the pond to its normal level of water (PGC Department of Environmental Resources, 2009). Wet ponds habitats for several types of plants and animals and can help increase native populations within an area. However, wet ponds can retain too much or too little water, which can harm populations.

To ensure proper maintenance, wet ponds should be assessed after a rainstorm and again within the following two to three days (PGC Department of Environmental Resources, 2009). Water levels should not remain higher than normal within that time period; high levels indicate that the pond is not operating correctly. Low water can be a sign that further maintenance is needed. With appropriate water levels, the safety of the pond species as well as the proper functionality of the wet pond can be ensured. In addition to checks after storms, these sites should be checked monthly for clogging, pipe repairs, and other issues. Clogging can increase the water level, altering the wet pond. Broken pipes can lead low water levels. Excess vegetation should also be removed. Muck removal may also be needed to remove suspended solids such as litter, yard waste, asphalt grit, and construction sediment. Routine maintenance can ensure the pond functions properly.

While wet ponds can handle stormwater, they can also become a nuisance if not properly maintained (U.S. EPA, 2009). Waterfowl can become undesirable over time and allow the proliferation of invasive species. Mosquitoes can breed in the pond, inhibiting enjoyment of the surrounding area. Children's safety from drowning is a serious issue and barriers should be erected as a safety measure. While these issues may not always be the client's responsibility, they should be noted and handled appropriately.

Site Visits

March 3, 2020

This visit covered three areas, and a review of five SWM structures: College Park Airport, College Park Community Center, and Bladensburg Community Center.

College Park Airport

The College Park Airport contains a "treatment train," which begins in a wet pond and ends in a culvert. According to the M-NCPPC staff, the overall train should be able to absorb and treat a 100-year storm. The site includes two tennis courts, a parking lot, and a major road.

Image 3 shows the wet pond where the "treatment train" begins, with a filter, built to handle a 10-year storm. We observed that the *Juncus* (rush grass) is bright green, a good indicator of a wet area, as they absorb a lot of water, making them a good plant for SWM facilities. We did not observe many invasive species, primarily *Phragmites* (common reed), *Morus* (mulberry tree), and *Typha* (cattails). While cattails are native, they grow fast and can easily become invasive. The vegetation is not actively maintained because the staff wants it to mimic a natural wetland, but they seasonally remove litter and mow the grass.

Image 3: Wet pond, College Park Airport

Image 4: Secondary catchment, College Park Airport

The secondary catchment (Image 4) is riprap, which was installed to slow water flow and absorb overflow when the wetland is saturated during a 50-year storm. There is a high-water table in the area, making it hard to filter additional water. This structure has received minimal maintenance, such as removing litter and invasive species, and is not on a maintenance schedule.

Image 5: Culvert, College Park Airport

The culvert at the Airport (Image 5) is the last step in the "treatment train." It has received minimal maintenance, such as removing litter, excess and invasive vegetation, and is not on a maintenance schedule. Some nearby *Salix babylonica*, (weeping willows) are excellent for absorbing water but are a menace to sewers, pipelines, and culverts.

With the assistance of M-NCPPC staff, to minimize environmental risks, critical environmental and ecological services should be returned to functionality after an event and lessons learned can reduce future vulnerabilities and risks. Culverts should be designed to be flexible and sturdy enough to accommodate large amounts of water.

College Park Community Center

The College Park Community Center has a high percentage of impervious surface coverage. This area also has a high-water table, making the SWM here less effective. Additionally, many trees were trimmed due to airport concerns and hazards.

Image 6: Wetland, College Park Community Center

The forested wetland at the College Park Community Center (Image 6) was built in 2019 behind a riprap that was completed the day we visited. A geotextile membrane under the riprap prevents the rocks from sinking down. The wetland presented some invasive species, including *Rosa multiflora* (multiflora rose). There has been no maintenance, as the M-NCPPC staff want the area to mimic a natural wetland. There were, however, limits to the extent that trees could be disturbed to maintain a specific amount of tree coverage. Additionally, a concrete channel funnels runoff into the riprap and wetland from the large parking lot surrounding the Community Center.

Image 7: Rain garden, College Park Community Center

The Community Center's new rain garden is relatively new (Image 7), installed in 2019. Itwas constructed to absorb 4,000 gallons of stormwater. There is a riverstone bed, not a riprap, which serves the same purpose of slowing down the water flow's speed into the SWM. Native plants include *Echinacea purpurea* (coneflower), *Asclepias tuberosa* (butterfly flower), *Acer* (maple tree), *Rudbeckia hirta* (black-eyed Susans), and *Cornus sericea* (redtwig dogwood). The site has been maintained, especially compared to the previous sites. The soil has been tilled with leaf barrels and mulched once a year, litter is removed, and invasive species are monitored and removed.

Bladensburg Community Center

The Bladensburg Community Center has one dry pond in the field outside the community center near a basketball court, allowing for the water drainage from the parking lot and basketball court. It is expected to withstand a 10-year storm. There was one significant maintenance issue, erosion present beneath the sidewalk. This site is maintained as needed and

was inspected and maintained in summer 2019 when staff cleaned and removed vegetation and litter.

Images 8 and 9: Bladensburg Community Center Dry Pond Area

Images 8 and 9 show the dry pond area's two-tier stormwater drain. A large amount of trash was present in the dry pond, and it should be removed maintain function. Adding more waste bins in the area might decrease trash volume in the dry pond. The pond has a variety of vegetation, including the native *Juncus* grass (an indicator that the area receives water), *Typha* (cattails), thorny plants, and branches. The thorny plants should gradually be removed so that they don't hinder maintenance inspections. Very few trees were present in this area but can be found down the hill from the dry pond. The grass around the dry pond is well maintained but there are many invasive species in the area including *Rubus phoenicolasius* (wineberry), *Pyrus calleryana* (callery pear), *Phragmites australis* (a significant amount), and *Ligustrum* (privet). While these invasive species are present and haven't negatively impacted dry pond operations, they should be monitored and maintained to ensure that native species are not overrun.

Typha (cattails) are known as "aggressive natives," indicating that even though the plant species is indigenous, it spreads rapidly and overpowers other native plants, effectively acting as

an invasive. Some *Typha* should be removed to decrease its population density. During last year's maintenance inspection, *Typha* were targeted and removed. This practice should continue at the same frequency to keep the *Typha* populations under control.



Images 10, 11, 12: Bladensburg Community Center stormwater drain and sidewalk erosion

Images 10, 11, and 12 depict the two-tiered stormwater drain; the first tier connects to a hill where the dry pond area is located. They are connected by a pipe that leads to a downhill area where the water can sit and gradually drain (Image 10). This area has many trees (Image 11), as well as a lot of leaf litter. Because it was raining during the site visit, the erosion beneath the sidewalk was visible (Image 12). The erosion beneath the sidewalk can potentially damage the sidewalk and pose a threat to public safety. Immediate maintenance is needed to divert water from the sidewalk area and repair the erosion. Water-absorbing plants in the second-tier area can help slow water flow outside of the pond, especially because the water flows downhill. Riprap could also be added outside of the pipe drainage area to help slow the flow of water there. The erosion under the sidewalk should be the highest priority for inspection to prevent further damage.

March 6, 2020

Colmar Manor Park

The Colmar Manor Park sites are several bioretention filter strips. One gulley was completely dry and lacked grass. Closer inspection, revealed a root-bound sample in the gulley, left by contractors who were hired to fill the strip with vegetation. The contractor had planted several different grasses, but they had all died due to improper care (Image 13).

This SWM system's function could be optimized by creating assigning a task to plant appropriate grasses and vegetation. Once this task is complete, maintenance and watering should be a priority to ensure the system can function properly. Following initial maintenance, the structure should be regularly watered and debris and vegetative overgrowth removed.

Image 13: Bioretention filter strip, Colmar Manor Park

March 9, 2020

Fairfield Center

This SWM site was installed and is maintained by the Clean Water Partnership. The culvert ends in a marsh with numerous vegetation types in the culvert (Image 14), including several invasive species such as *Lonicera japonica* (Japanese honeysuckle), *Iris germanica* (iris), *Ranunculus ficaria* (lesser celandine), and *Pyrus calleryana* (Bradford pear trees). The culvert is not easily accessible due to a large amount of overgrowth (Image 15). Most noteworthy are the two deep eroded channels leading to the marsh.

The overgrowth should be cut back and invasive species removed. The area appears to be overrun by invasive plants that should be replaced with native species. The erosion should be addressed directly. Since the culvert is steep and very eroded, safety fencing should be considered.

Image 14: Marsh at bottom of culvert, Fairfield Center

Image 15: Culvert with overgrowth, Fairfield Center

The most prominent SWM site at Fairfield Center is a wet pond at the bottom of a steep and unguarded hill; the low-lying sidewalk seems to be crumbling into the water. Both of these elements pose safety risks; a visitor could fall down the hill and into the water or lose their footing on the crumbling sidewalk. This is a constructed lake that contains a concrete overflow grate, which appeared blocked by grasses at the time of inspection. Shallower sections of water were covered with algae and the *Iris germanica* (iris) in the water is invasive. Nonetheless, the overflow pipe appears to be in good condition.

Additional concerns include the ice rink located on a hill above the wet pond. Ice removed from the rink is pushed outside where it eventually melts and flows into the pond. Ice is removed numerous times a day for ice skating and hockey practices and games, which require the ice to be treated every 30 minutes to an hour when in use.

The long path leading to the wet pond begins with a dry wetland that is higher than the wet pond. It continues into a long channel with riprap and weirs. Some areas were completely

dry while others had standing water with algae and a brownish tint. Overall, the area is overgrown and dry, but the outflow creek is acceptable.

Some of the grasses should be from the pond's grate and the algae's source should be found and eliminated. Installing a barrier on the steepest parts of the hills could improve safety for walkers around the wet pond. Lastly, repairing the sidewalk is of utmost importance.

Snow Hill Manor

The bioretention ponds at Snow Hill Manor (Images 16 and 17) has received some maintenance, including removal of overgrown vegetation and invasive species. One of the ponds has a higher border, which reduces the downhill runoff, supporting the goal of treating and absorbing the stormwater on-site. There are minimal invasive plants, however, we documented *Glechoma hederacea* (ground ivy) and *Typha* (cattails). There is also tree canopy over the pond, which could produce leaf litter if not maintained.

Image 16: First bioretention pond, Snow Hill Manor

Image 17: Second bioretention pond, Snow Hill Manor

The second bioretention pond (Image 17) at Snow Hill Manor has no underground drain, and the current sand filter appears outdated. In 2018, a 100-year storm poured 51 inches of water in the area, which could not be absorbed and was left standing for days. DEP advised M-NCPPC staff to replace the sand filter, but testing determined that filtering speed, was two inches per hour, which was deemed adequate. The decision not to replace was made for financial reasons. The vegetation in the second pond is sparser and drier than the first pond and has significant erosion due to the presence of a parking lot.

March 10, 2020

The last site visit was to the Fort Washington, William Beanes, and Suitland Community Centers to see six SWM structures: two bioretention areas at Fort Washington, two dry ponds and one bioretention area at William Beanes, and one wet pond at Suitland.

Fort Washington Community Center

The Fort Washington Community Center's bioretention areas were in good condition. Both are designed to withstand a 10-year storm, and both were inspected within the last year. The first bioretention area is on the side of the community center, next to a large field, designed to treat water runoff from the small parking lot. The second bioretention area is in front of the community center, designed to treat runoff from the sidewalks and front driveway.

Image 18: Bioretention Area #1, Burning Bush

Image 19: Bioretention Area #1, storm drain

In both areas, we recorded little trash, no debris, or excess sediment. The mulch was in decent condition and there was no dead or overgrown vegetation; however, some planted

vegetation, including the *Euonymus alatus* (Burning Bush), is invasive and should be removed (Image 18). We noted low-lying overflow drains in both structures, which can inhibit a bioretention area's ability to treat and infiltrate runoff (Image 19). Capping the lower holes of the overflow drain can address this issue. Furthermore, the edges of each bioretention area are intentionally carved out, which increases erosion, and should be discontinued. Overall, both bioretention areas were in decent condition with only minor problems (see Appendix 2 for completed checklists).

William Beanes Community Center

At the William Beanes Community Center there are two dry ponds in the parking lot and one bioswale downhill of the parking lot. The dry ponds are in relatively good condition, but they haven't been inspected in the three years since the new Beanes Recreation Center was built. The dry ponds were built to withstand 10- or 20-year storms and are drainage areas for the parking lots. The bioswale is also relatively new, has not been inspected, and is designed to handle a 20-year storm. It is a second drainage area for the parking lots and bordering properties. There is also a tertiary catchment area adjacent to the bioswale that was planted with grass seed within the past year. After the grass takes root, the black tarp lining should be removed.

In both the dry ponds and the bioswale, the vegetation is healthy and not overgrown, through there is invasive *Miscantus sinensis* (Chinese Silvergrass) in the dry ponds. Both the dry ponds and the bioswale had trash that should be removed. We documented minor erosion and sediment deposits at the bioswale's inlet (image 23). To address these issues, lowering the weir will allow water at the inlet to move into the bioretention area. Additionally, the hill next to the bioswale could be converted into a naturalized meadow which doesn't need to be mowed. This

will reduce maintenance costs and also help slow the water flow into the bioretention area. Overall the SWM structures at William Beanes Community Center need minor maintenance but are in good condition (see Appendix 2 for a completed checklist).

Image 20: Dry pond next to parking lot

Image 21: Bioretention area at base of hill

Image 22: Tertiary catchment area

Image 23: Inlet of bioretention area

Suitland Community Center

The Suitland Community Center has one large wet pond that receives runoff from the parking lot, tennis courts, and baseball field. This pond was built to withstand a 10- to 15-year storm. This wet pond contained an excessive amount of trash (Image 25), perhaps from visitors not properly disposing of their garbage. This trash should be removed to maximize the pond's function. Additional trash cans near the parking lot, tennis court, and especially the baseball field could help.

The pond also has multiple species of invasive vegetation such as *Pyrus communis* (pear trees) and *Lonicera japonica* (Japanese honeysuckle). No immediate maintenance is required for these plants; however, they should be monitored to ensure they do not spread. Conversely, native cattails (*Typha*) can crowd out other native species and their density should be reduced *Typha*. Additionally, the excess amount of dead vegetation and weeds should be removed.

The most concerning issue in this wet pond was the damaged weir at the outlet. It was capped to prevent water flow from the outlet as designed. Subsequently, the water carved its own path by flowing around it and significantly eroding the banks beyond the outlet (Image 24). There is also erosion along the stream caused by the dysfunctional concrete weir. The weir should be closely inspected and repaired, including removing the cap (Image 26) to allow water flow. Dead vegetation should be removed and native vegetation planted along the stream banks to reduce soil erosion. Overall, this SWM structure needs serious attention, especially trash removal, weir repair, and vegetation remediation, to function properly and capture stormwater effectively (see Appendix 2 for a completed checklist).

Image 24: Excessive streambank erosion

Image 25: Trash in the wet pond

Image 26: Capped and damaged weir

A Broad Assessment of M-NCPPC's Combined SWM Assets

In four site visits, the team inspected 18 SWM structures at various sites—five bioretention areas, one bioswale, two culverts, three dry ponds, one rain garden, two ripraps, one wetland, and three wet ponds (Table 2). Ff the five bioretention SWM areas, two were classified in poor condition using the checklists. The bioswale inspected at Williams Beanes was working but classified in poor condition due to erosion and a lack of inspection. Of the two culverts, one is in poor condition due to erosion and invasive species. Out of the three dry ponds, one was considered to be in poor condition due to the presence of trash and erosion. The rain garden at the College Park Community Center is in good condition. Of the two ripraps, both are in good condition. The wetland is in good working condition although no maintenance schedule is being followed. Lastly, out of the three wet ponds, two are in poor condition based on the checklists.

Overall, of the 18 SWM structures inspected using the checklists, seven were found to be in poor condition. Although only seven SWM structures were classified in poor condition, all of the SWM structures visited were found to have had little maintenance and no maintenance schedule.

Table 2: Broad assessment of M-NCPPC's SWM assets

SWM Type	Number Visited	Condition	
		Good	Poor
Bioretention	5	3	2
Bioswale	1	0	1
Culvert	2	1	1
Dry pond	3	2	1
Rain garden	1	1	0
Riprap	2	2	0
Wetland	1	1	0
Wet pond	3	1	2

We recommend that maintenance schedules for each SWM type should be developed and implemented to address the issues of the systems in poor condition. A maintenance schedule will also help to preserve those found to be in good condition. The checklists and maintenance guidelines in Appendix 1 for each type of SWM system can be used by M-NCPPC staff to inspect these sites. They help identify the SWM systems that are in poor or good condition. The checklists also specify how frequently each SWM type should be inspected. For the SWM systems that are found to be in poor condition, Appendix 1 provides a maintenance guideline table is provided (to help address the issues identified. With the checklists and maintenance tables, we believe the M-NCPPC staff can better manage the SWM structures in PGC, which will help preserve these structures, save money, and and benefit the surrounding environment.

Review of National and International SWM BMPs

Comparative analysis of county, state, national, and government standards

PGC has 15 SWM structure categories, standards which M-NCPPC also follows: bioretention area, culverts, dams, dry ponds, flow splitters, inlets, marshes, pervious surfaces, rain gardens, risers, sand filters, swales, trenches, underground structures, and wet ponds.

According to the Maryland Department of Energy, the state has numerous SWM site categories that are divided into three categories (Glossary of Stormwater BMP Structure Types, n.d.).

Maryland Department of Energy Organizational Titles of SWM Structures	
Category	**Description**
BMP structure types	28 substructure types
Environmental site design practices and techniques	3 overarching categories
Nonstructural practices	8 substructure types

Each of the 16 categories used by PGC are listed in MDE's breakdown but in different categories. For example, a bioretention area is listed under BMPs while a swale is listed under both the BMP and Environmental Site Design Practices and Techniques.

Montgomery County's Department of Environmental Protection (Department of Environmental Protection, n.d.) use the following categories.

Montgomery County Organizational Titles of Best SWM Structures				
Dry wells	Nonstructural drainage practices	Rain gardens, bioswales, and bioretention	Underground flow splitters	Underground storage structures
Grass drainage swales	Porous (permeable) pavement	Sand filters	Underground hydrodynamic separators	Wet and dry ponds
Green roofs	Rain barrels and cisterns	Underground filtering facilities	Underground sand filter	

Montgomery County has a similar number of techniques as PGC but categorizes them differently. Most of the categories are consistent between PGC and MDE.

Across the country, states have different categorical groupings, but similar names. For example, the Center for Watershed Protection and the New York Department of Environmental Conservation organizes SWM into categories with specific practices under each (Center for Watershed Protection et. al., 3-8).

New York Department of Environmental Conservation Organizational Titles of SWM Structures				
Filtering practices	Infiltration practices	Open channel practices	Stormwater ponds	Stormwater wetlands

In contrast, the state of New York takes a different approach to categorization. For example, a bioretention area is considered a filtering practice. However, many sub-category practices remain consistent including wet/dry ponds, swales, and bioretention areas. Closer to Maryland, The Center for Watershed Protection in Washington, D.C. has 13 BMP categories used to manage peak flow (Center for Watershed Protection, 23).

The Center for Watershed Protection (D.C.) Organizational Titles of SWM Structures				
Bioretention	Impervious surface disconnection	Permeable pavement systems	Rainwater harvesting	Wetlands
Filtering systems	Infiltration	Ponds	Storage practices	
Green roofs	Open channel systems	Proprietary practices	Tree planting and preservation	

The city has many categories in common with PGC. A notable difference is that D.C. takes into account green roofs and tree planting. There is also a category for rainwater harvesting such as rain barrels. The state of Delaware's Division of Watershed Stewardship also has 13 categories, similar to D.C. (State of Delaware Division of Watershed Stewardship, n.d.).

Division of Watershed Stewardship (DE) Organizational Titles of SWM Structures				
Bioretention	Dry detention	Permeable pavement	Sheet flow	Vegetated roofs
Constructed wetlands	Filtering systems	Rainwater harvesting	Underground detention	
Detention practice	Infiltration	Rooftop disconnection	Vegetated channels	

While the EPA is used as a point of reference for governmental practices there is no official national standard. However, EPA lists the practices used at their Washington, D.C. facility (in alphabetical order vertically) (EPA, n.d.).

EPA Organizational Titles of SWM Structures				
Bioretention areas	Curb and gutter elimination	Permeable pavers	Riparian buffers	Vegetated filter strips
Constructed wetlands	Green roofs	Rain barrels and cisterns	Sand and organic filters	Vegetated swales/dry swales

These ten practices are used on EPA sites, and it can be assumed that these categories are consistent with EPA practices and approved by the EPA, which is charged with oversight of environmental protection practices across the country. Obviously, individual sites are much smaller than a county or state, and these practices vary by office location. The EPA also lists states practices that can be referenced for stormwater management; Delaware is on that list (EPA, n.d.).

To conclude, many county, state, national, and governmental SWM standards are consistent. The terms that are most consistent (excluding MDE's due to lack of specifically-related categorization) include bioretention areas (five of six places), filtering systems (four of six places), ponds (four of six places), rainwater harvesting (four of six places), green roofs (three of six places), and underground practices and structures (three of six places).

SWM	Count (of 6)	SWM	Count (of 6)
Bioretention	5	Ponds	4
Filtering systems	4	Green roofs	3
Rainwater harvesting	4	Underground practices/ structures	3

Listed categories that are not in Prince George's categorization are filtering systems: green roofs, and rainwater harvesting. What remained consistent is the number of categories for SWM practices. If PGC opts to re-categorize, maintaining the current categories and adding new ones would be the easiest way, not requiring a complete structural change. If PGC chooses to condense the categories, New York state's framework provides a good model, one with the least interruption to the current categorization system.

International Solutions for Stormwater Management

In 2011, Copenhagen suffered an extreme storm, now known as a Cloudburst, which produced 150mm of rain within two hours, leaving entire areas under one meter of water (ASLA Professional Awards, 2016). The 1,000-year storm caused damages valued at $1 billion USD and the city realized that this event was a consequence of climate change, which could only be expected to worsen in coming years (ASLA Professional Awards, 2016).

Rather than use funds for repeated repairs after superstorms, the city created the Copenhagen Cloudburst Formula, a six-step approach to building climate adaptation solutions for urban spaces (ASLA Professional Awards, 2016). The first step was data investigation that ranked areas by property value and vulnerability to a Cloudburst. The second step used the data to generate GIS models and maps for visualizing vulnerable areas. The third step, titled the "Cost of Doing Nothing," assesses how much the city would have to pay each year to respond to weather events if no preventative actions were taken. The fourth step identifies hotspots and created a "Cloudburst Toolkit" to be "universally applicable, multi-functional and have several flexible elements" (ASLA Professional Awards, 2016). Officials recognized that the Cloudburst's impacts would reach all parts of the city, and in the fifth step they determined the needs of citizens who would be affected by these storms. The final step was "Cloudburst Economics," a cost-benefit analysis that compares and weighs the pros and cons of making drastic changes to current stormwater management practices. The Copenhagen Cloudburst Formula has been extremely successful in improving stormwater management practices and more than 300 citywide pilot projects have been identified throughout Europe, the Americas, and Asia (ASLA Professional Awards, 2016).

Recommendations for SWM Classification

Based on our findings, we recommended that PGC to continue to follow the current SWM classification system of bioretention areas, culverts, dams, dry ponds, flow splitters, inlets, marshes, pervious surfaces, rain gardens, risers, sand filters, swales, trenches, underground structures, and wet ponds. The County should consider adding categories for green roofs and rain barrels.

Currently, these are the best classification practices since there is no national or international standardized labeling and categorization. The County should continue its ongoing practices and be receptive to changes.

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Appendix 1:
SWM Maintenance Checklists and Solution Matrix

Bioretention

Bioretention Area Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Pipes are broken or damaged.	❑ Yes ❑ No ❑ N/A	When needed
Sediment found in pretreatment cells and inflow points.	❑ Yes ❑ No ❑ N/A	Annually
There are signs of erosion.	❑ Yes ❑ No ❑ N/A	4x annually / when needed
There are areas prone to erosion.	❑ Yes ❑ No ❑ N/A	4x annually/ when needed
Contributing drainage area is stabilized to prevent erosion.	❑ Yes ❑ No ❑ N/A	When Needed
For a wet site visit - the water has sat for over 48 hours.	❑ Yes ❑ No ❑ N/A	When Needed
Debris / Pollution		
Pollution is blocking inlets or curb cuts.	❑ Yes ❑ No ❑ N/A	4x annually

A lot of litter and trash present.	❑ Yes ❑ No ❑ N/A	2x every growing season / when necessary
Excess sediment present.	❑ Yes ❑ No ❑ N/A	Annually or when needed
Vegetation		
Grass filter strips and bioretention turf cover are mowed.	❑ Yes ❑ No ❑ N/A	4x annually
Mulch is in poor condition.	❑ Yes ❑ No ❑ N/A	2x a growing season
Mulch needs replacement (3-inch layer) And refilled in areas lacking mulch.	❑ Yes ❑ No ❑ N/A	Annually
Weeds and invasive, diseased, or dead plants need to be removed.	❑ Yes ❑ No ❑ N/A	2x a growing season / when necessary
Trees and shrubs are overgrown.	❑ Yes ❑ No ❑ N/A	Annually
Maintain vegetation density by adding extra plantings/vegetation.	❑ Yes ❑ No ❑ N/A	When needed

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Bioretention Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Facility Structure	Signs of erosion and damage from erosion	Take necessary steps to prevent further erosion (adding more vegetation, soil, diverting water flow, etc.; erosion level and methods vary by location).
Entire Facility	Debris/pollution present	Remove pollution/excess sediment present.
Vegetation	Grass and filter strips are not mowed	Mow surrounding areas as soon as possible to ensure usage of area is not hindered.
Vegetation	Low levels of mulch and/or in poor condition	Add and maintain at least 3 inches of mulch to ensure there is proper filtration and protection.
Vegetation	Excess invasive and dead vegetation	Monitor invasives and aggressive natives to ensure they are not overpowering native plants. Remove any that are harming natives Remove dead vegetation and (potentially) replace it with newer native ones. Allows space for other species to grow and thrive and increases water filtration capacity.
Vegetation	Overgrown vegetation	Trim down shrubs or trees that are overgrown, mow excess grassy areas to ensure there is space for other vegetation to grow.

Culvert

Culvert Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Excess sediment and/or sediment is blocking the openings and/or water flow.	❑ Yes ❑ No ❑ N/A	When needed
There are damages observed in the culvert/on the culvert ends.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Rock riprap at culvert ends in workable condition.	❑ Yes ❑ No ❑ N/A	When needed/ after a major storm
Geotextile membrane is in good condition (if applicable).	❑ Yes ❑ No ❑ N/A	When needed
Debris / Pollution		
Debris and pollution blocking culvert openings.	❑ Yes ❑ No ❑ N/A	When needed/ after a major storm
Debris and pollution inside the culvert.	❑ Yes ❑ No ❑ N/A	When needed/ after a major storm
Vegetation		
Vegetation is not inhibiting water flow.	❑ Yes ❑ No ❑ N/A	When needed
Excess vegetation buildup is blocking the culvert openings.	❑ Yes ❑ No	When needed

	❑ N/A	

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Culvert Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Facility Structure	Excess sediment is blocking the culvert openings and/or waterflow	Remove and clean excess sediment (shovel, hands, etc.), monitor waterflow.
Facility Structure	Damage to culvert pipe	Dependent on culvert material, monitor closely and frequently to ensure no further damage. If damaged, replace or repair.
Facility Structure	Riprap not in workable condition	Remove excess trash/litter/debris, add rocks if water flow is too fast, reduce if water flow is too slow.
Facility structure	Geotextile membrane is in bad condition	Replace if damaged.
Entire Facility	Debris and pollution inside/outside culvert and are blocking openings and/or waterflow	Remove debris and pollution both inside/outside the pipe.
Vegetation	Excess vegetation is blocking openings and/or waterflow	Trim, remove, or mow excess vegetation by openings, completely remove vegetation within culvert.

Check Dam

Check Dam Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check especially the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Structure is intact- center of SWM is lower than the edges.	❑ Yes ❑ No ❑ N/A	Annually, after major storm
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup exceeding one half the height of the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No ❑ N/A	Monthly

There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Check Dam Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Entire Facility	There is excessive erosion in or around the SWM	Provide erosion control devices such as reinforced turf matting or riprap.
Facility Structure	Structure shape is not intact- center of SWM is not lower than the edges	Stabilize the banks. If rocks are used for structure, replace any missing or add rocks if needed.
Entire Facility	Trash and/or debris is present in and surrounding the SWM that blocks water flow into the structure	Remove trash and/or debris.
Entire Facility	There is sediment buildup exceeding one half the height of the SWM	Clean out sediment.
Vegetation	Planted vegetation is dead or in poor condition	Remove dead or dying vegetation and re-plant new. New plants should be watered for the first 18 months if rain events do not occur for over 10 days.
Vegetation	Weeds and/or invasive species present	Mow, trim, and/or remove unwanted vegetation.

Dry Pond

Dry Pond Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check especially the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
mechanical devices, valves, etc. working properly.	❑ Yes ❑ No ❑ N/A	Annually
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No	Monthly

	❑ N/A	
There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Monthly
There is an overgrowth of vegetation.	❑ Yes ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Dry Pond Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Facility Structure	Signs of structural damage, misalign, or deterioration	Repair damage. Prevent further damage by planting more vegetation and ensure proper dissipation of water.
Entire Facility	Debris and/ or pollution present	Remove litter and excess sediment.
Vegetation	Overgrowth of vegetation	Mow surrounding area.
Vegetation	Overabundance of invasive and dead vegetation	Remove dead vegetation and monitor invasive species. Replant with native species.

Dry Well

Dry Well Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are damaged or water leakage.	❑ Yes ❑ No ❑ N/A	Annually
Mechanical devices, valves, etc. working properly.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
The drain-down time of the Dry Well exceed 72- hours.	❑ Yes ❑ No ❑ N/A	Seasonally, after a storm
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
Excessive accumulation of sediment he SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No	Monthly

	❑ N/A	
There is an overgrowth of vegetation or invasive species present.	❑ Yes ❑ No	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Dry Well Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Facility structure	Structural damage and/or water leakage	Repair damage, ensure the well's drain-down time exceeds 72-hours.
Entire Facility	Clogged valves	Clear out the valves. If possible, assess the reason for clogging to prevent future ones.
Entire Facility	Excessive accumulation of debris and sediment	Remove litter and excess amounts of sediment.
Vegetation	Condition of vegetation and presences of dead/invasive species	Mow the grass area. Remove dead vegetation and monitor invasive species. Replant withnative species.

Flow Splitter

Flow Splitter Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check especially the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally, after a major storm
There is a large amount of standing water 72 Hours after a rain event.	❑ Yes ❑ No ❑ N/A	Seasonally, after a major storm
There are clogs within the structure that prevent water flow.	❑ Yes ❑ No ❑ N/A	Annually
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
Vegetation		
There is an overgrowth of vegetation.	❑ Yes ❑ No ❑ N/A	Monthly

There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Monthly
There are animal problems nearby, such as beaver dams, that may damage the structure.	❑ Yes ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Flow Splitter Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Facility structure	Structural damage and/or water leakage	Repair damage.
Entire Facility	Clogged pipes	Clear out pipes. If possible, assess the reason for clogging to prevent future ones.
Entire Facility	Excessive accumulation of debris and sediment	Remove litter and excess amounts of sediment.
Vegetation	Condition of vegetation and presences of dead/invasive species	Mow the grass area. Remove dead vegetation and monitor invasive species. Replant with native species.

Inlet

Inlet Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is a buildup of sediment/debris in the inlet.	❑ Yes ❑ No ❑ N/A	Monthly, after a major storm
There is a large amount of standing water 72 Hours after a rain event.	❑ Yes ❑ No ❑ N/A	Monthly, after a major storm
There are clogs within the structure that prevent water flow.	❑ Yes ❑ No ❑ N/A	Annually
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after a major storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes	Monthly

	❑ No ❑ N/A	
There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Inlet Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Facility structure	Structural damage and/or water leakage	Repair damage.
Entire Facility	Clogged structure	Clear out structure.
Entire Facility	Excessive accumulation of debris and sediment	Remove litter and excess sediment as soon as possible.
Vegetation	Condition of vegetation and presences of dead/invasive species	Mow the grass area. Remove dead vegetation and monitor invasive species. Replant with native species.

Marsh

Marsh Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Standing water greater than 1 foot.	❑ Yes ❑ No ❑ N/A	Annually
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No ❑ N/A	Monthly

There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Monthly
Plant material able to withstand constant inundation of water to depths between six inches and one foot deep.	❑ Yes ❑ No ❑ N/A	Annually
Plants provide adequate food and cover for waterfowl, desirable insects and other aquatic life.	❑ Yes ❑ No ❑ N/A	Seasonally

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Marsh Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Entire Structure	Sediment buildup	Remove accumulated sediment once 50% of original volume has been lost.
Vegetation	Overgrown vegetation	Harvest vegetation when reduced by 50% in the original open water surface area.
Wildlife	Invasive species & decline in native wildlife populations	Record and monitor wildlife populations, remove invasive species, maintain 100-foot buffer zone, plant native vegetation.
Pollution	Accumulation of debris and pollution	Clean and remove debris after major storm event.

Pervious Surface

Pervious Surface Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:			Rain in Last 48 Hours: YES NO
Date of Last Inspection:			If yes, list amount and timing:
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check especially the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally and/or after a major storm
There is evidence of ponding or clogging, excessive water build-up accompanied by observation of low flow in observation well (connected to the underdrain system).	❑ Yes ❑ No ❑ N/A	Seasonally and/or after a major storm
Observation well is in good condition and is capped.	❑ Yes ❑ No ❑ N/A	Seasonally and/or after a major storm
Debris / Pollution		
Area free of construction or hazardous materials.	❑ Yes ❑ No ❑ N/A	Annually
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside or on the surface of the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally and/or after a major storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No	Seasonally and/or after a major storm

	❑ N/A	
There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Annually (Spring)
Check that tree roots have not penetrated the pavement and vegetation does not interfere with permeable pavement operation.	❑ Yes ❑ No ❑ N/A	Annually (Spring)
Flows from any landscaped areas are diverted away from the pavement or well stabilized with vegetation.	❑ Yes ❑ No ❑ N/A	Annually

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Pervious Surface Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Structure	Check for evidence of ponding or clogging	Clean draining pipes and subsurface at regular intervals. Commercial vacuuming twice a year.
Structure	Structural components are not cracked, damaged, or misaligned	Repair as needed.
Vegetation	Roots have not penetrated pavement, vegetation is not overgrown	Adjacent landscaped areas should drain away from permeable pavement to pre-vent sediments running onto the surface.
Debris/ Pollution	Sediment buildup, trash and debris on the surface or around the area	Regularly sweep to clear litter and debris.

Rain Garden

Rain Garden Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check especially the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally, After a major storm
Standing water is present 48 hours after storm event.	❑ Yes ❑ No ❑ N/A	After a major storm
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after major a storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No ❑ N/A	Monthly
There are weeds or invasive species present.	❑ Yes	Monthly

	❑ No ❑ N/A	
Mulch is not at required depth of at least 3 inches.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Rain Garden Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Facility Structure	Structure and shape are not intact	Fix and reinforce structure using a barrier or perimeter planting.
Entire Facility	There is excessive erosion in or around the SWM	Provide erosion control devices such as reinforced turf matting or riprap.
Entire Facility	Standing water present 48 hours after storm	Drain water and correct drainage and/or infiltration issue.
Entire Facility	There is sediment buildup inside the SWM	Remove sediment.
Vegetation	Planted vegetation is dead or in poor condition	Remove dead or dying vegetation and re-plant. Water new plants for the first 18 months if rain events do not occur for over 10 days.
Vegetation	There are weeds or invasive species present	Mow, trim, and/or remove unwanted vegetation.
Vegetation	Mulch is not at required depth of at least 3 inches	Add and distribute mulch to needed areas.

Riser

Riser Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is no trash grate over the vertical pipe.	❑ Yes ❑ No ❑ N/A	Annually
48 hours after a rainfall event, there is standing water.	❑ Yes ❑ No ❑ N/A	Seasonally, after a storm
There are no signs designating the SWM as a conservation area.	❑ Yes ❑ No ❑ N/A	Monthly
Pollution		
There is trash, or grass or leaf litter in or around the overflow grate.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash, or grass or leaf litter in or around the low-flow orifice.	❑ Yes ❑ No ❑ N/A	Monthly
There is excess material (debris, trash, rocks, grass or leaf litter) around the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
Vegetation		
There is excessive vegetation within 10 inches of the SWM.	❑ Yes ❑ No	Monthly

	❑ N/A	
There is excessive erosion in or around the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is bare soil in or around the SWM.	❑ Yes ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Riser Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Structure	Structural components are cracked, damaged, or misaligned. There is no trash grate over the vertical pipe	Repair or replace the component.
Debris	There is trash, grass, or leaf litter, in or around the overflow grate or low-flow orifice	Remove debris. Implement initiatives to reduce debris (trash cans, fences, signs).
Debris	There is sediment build-up, excessive erosion or bare soil in or around the SWM	Plant native vegetation to hold the soil.
Vegetation	There is excessive vegetation within 10 inches of the SWM	Reduce vegetation density by mowing or removing.

Sand Filter

Sand Filters Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check especially the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Water is ponding at the top of the sand filter.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
The top layer of the sand filter is discolored or has oil or grease on it.	❑ Yes ❑ No ❑ N/A	Annually
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No	Monthly

	❑ N/A	
There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Monthly
Vegetation in the sand filter is taller than 12 inches.	❑ Yes ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Sand Filter Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Entire facility	Excessive erosion in or around the SWM	If the filtration sand media depth drops below 12 inches, it should be restored to a minimum depth of 18 inches.
Filter Surface	Water is ponding at the top of the sand filter	Remove and replace the top 2-3 inches of sand.
Entire facility	Sediment buildup inside the SWM	Clean sediment out of the pretreatment settling chamber when it accumulates to a depth of more than 6 inches or when sediment occupies 10% of the chamber volume.
Vegetation	Vegetation in the sand filter is taller than 12 inches	Sand filters that have grass cover should be mowed three times per growing season. Thin vegetation within the sand filter.
Vegetation	There are weeds, invasive species, or dead plants present	Remove weeds, invasive species, and dead plants.

Swale

Swale Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
48 hours after a rainfall event, there is standing water.	❑ Yes ❑ No ❑ N/A	Seasonally, after a storm
The inlet provides a stable conveyance into the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is a noticeable odor coming from or near the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
The check dam is not functioning properly.	❑ Yes ❑ No ❑ N/A	Monthly
The perforated pipe is not conveying water as designated.	❑ Yes ❑ No ❑ N/A	Monthly
The outlet is obstructed.	❑ Yes ❑ No ❑ N/A	Monthly
There are no signs designating the SWM as a conservation area.	❑ Yes ❑ No ❑ N/A	Monthly
Pollution		

There is trash or grass or leaf litter in or around the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup in or around the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No ❑ N/A	Monthly
There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Monthly
There is excessive erosion in or around the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
The grass is longer than 3 inches but shorter than 6 inches.	❑ Yes ❑ No ❑ N/A	Monthly
Fertilizers, pesticides, and/or oils are used in or around the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There are trees forming an overhead canopy over the SWM.	❑ Yes ❑ No ❑ N/A	Annually
There is bare soil in or around the SWM.	❑ Yes ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Swale Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Structure	Structural components are cracked, damaged, or misaligned. The perforated pipe, inlet, or check dam are not conveying water	Repair or replace the component.
Debris	Trash, grass/leaf litter, or an obstruction in or around the SWM or in the outlet	Remove debris. Implement initiatives to reduce debris (trash cans, fences, signs).
Debris	Sediment build-up, excessive erosion or bare soil in or around the SWM	Plant native vegetation to hold the soil.
Vegetation	The grass is longer than 3 inches but shorter than 6 inches or trees forming an overhead canopy	Mow grass between 3-6 inches and trim trees so they do not form a canopy over the SWM.
Vegetation	Vegetation is dead/in poor condition, or weeds/invasive species are present	Remove and replace dead vegetation. Rehabilitate vegetation in poor condition.

Trench

Infiltration Trench Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check especially the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Gravel/ rocks are present and there are no bare spots.	❑ Yes ❑ No ❑ N/A	Monthly, after major storm
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No ❑ N/A	Monthly
There are weeds or invasive species present.	❑ Yes ❑ No	Monthly

	❑ N/A	
Surrounding vegetation is maintained/mowed.	❑ Yes ❑ No ❑ N/A	Seasonally

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. **→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Trench Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Entire Facility	Excessive erosion in or around the SWM, especially around the inlet and outlet	Correct earthwork to promote evenly distributed, non-erosive flows and correct drainage issues to prevent further erosion.
Facility Structure	Gravel or rocks are missing	Fill in bare spots with gravel/rocks to fix structure.
Entire Facility	Trash or debris inside the SWM	Remove trash or debris.
Entire Facility	Sediment buildup inside the SWM	Scrape bottom of basin and remove sediment.
Vegetation	Planted vegetation is dead or in poor condition	Remove and replace dead or dying vegetation. New plants should be watered for the first 18 months if rain events do not occur for over 10 days.
Vegetation	Weeds or invasive species	Limit noxious weed establishment by mowing, mulching, herbicide application, or hand weeding. Remove invasive species.
Vegetation	Overgrowth of surrounding vegetation	Mow area surrounding SWM structure to ensure proper drainage.

Underground Structure

Underground SWM Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
Pumps or hydraulic mechanical systems are damaged or not working.	❑ Yes ❑ No ❑ N/A	Annually
A maintenance route to the underground structure is blocked or not clear.	❑ Yes ❑ No ❑ N/A	Annually
There is water ponding at the top of the underground structure.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm
Debris / Pollution		
There is trash or debris inside the underground structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the structure that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside the underground structure.	❑ Yes ❑ No ❑ N/A	Seasonally, after major storm

Inspection Results
❑ Pass. No apparent problems observed

❑ Maintenance recommended. Minor problems observed.
❑ Fail, immediate maintenance required. Major problems observed.

→ See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems

Additional Notes - Provide details on any item marked yes in the table above

Underground Structure Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Inlet	Water ponding at the top of the underground	Perform a thorough inspection of the entire facility to identify the blockage. Check for sediment/trash build up, or structural elements, including pumps, limiting water flow. Check that the underground structure is sized correctly by examining design documents.
Entire facility	Maintenance route to the structure is blocked	Maintenance routes should be clear at all times. Any trash, debris, or other blockage of the maintenance route should be removed. Additionally, maintenance entrances should be clearly marked.
Entire facility	There is sediment or trash buildup inside the structure	Remove excess sediment or trash.

Wet Pond

Wet Pond Inspection and Maintenance Checklist			
Facility:			
Location/Address:			
Date:	Time:	Weather Conditions:	
Inspector:		Rain in Last 48 Hours: YES NO	
Date of Last Inspection:		If yes, list amount and timing:	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit:			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SWM. Check especially the inlet and outlet.	❑ Yes ❑ No ❑ N/A	Seasonally, after a major storm
There is a large amount of standing water 48 Hours after a rain event.	❑ Yes ❑ No ❑ N/A	Seasonally, after a major storm
There are clogs within the structure that prevent water flow.	❑ Yes ❑ No ❑ N/A	Annually
Debris / Pollution		
There is trash or debris inside the SWM.	❑ Yes ❑ No ❑ N/A	Monthly
There is trash or debris outside the SWM that blocks water flow into the structure.	❑ Yes ❑ No ❑ N/A	Monthly
There is sediment buildup inside the SWM.	❑ Yes ❑ No ❑ N/A	Seasonally, after a major storm
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ No	Monthly

	❑ N/A	
There are weeds or invasive species present.	❑ Yes ❑ No ❑ N/A	Monthly
There are animal problems nearby, such as beaver dams, that may damage the structure.	❑ Yes ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above

Wet pond Solution Matrix		
BMP Element	**Inspection**	**Maintenance Action**
Facility structure	Structural damage and/or water leakage	Repair damage.
Entire Facility	Excessive accumulation of debris and sediment	Remove litter and excess sediment as soon as possible.
Vegetation	Condition of vegetation and presences of dead/ invasive species	Mow grass area. Remove and replace dead vegetation. Monitor invasive species replant native species.
Animals	Presence of hindering animal habitats	Monitor animal presence and contact professionals if needed.

Appendix 2:
Completed SWM Checklist Examples

Bioretention Area Inspection and Maintenance Checklist			
Facility: **Fort Washington Community Center Bioretention Area 1**			
Location/Address: **1200 Fillmore Rd, Fort Washington, MD 20744 - Near tennis courts**			
Date: **3-10-2020**	Time: **10am**	Weather Conditions: **Cloudy, light rain**	
Inspector: **Zack Bishop, Emma Lipsky**		Rain in Last 48 Hours: **YES** NO	
Date of Last Inspection: **Last Year**		If yes, list amount and timing: **0.02" in 24 hours**	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit: **Routine Inspection**			

Inspection Item	Status	Frequency
Structure		
Pipes are broken or damaged.	❑ Yes ❑ **No** ❑ N/A	When needed
Sediment found in pretreatment cells and inflow points.	❑ Yes ❑ **No** ❑ N/A	Annually
There are signs of erosion.	❑ **Yes** ❑ No ❑ N/A	4x annually / when needed
There are areas prone to erosion.	❑ **Yes** ❑ No ❑ N/A	4x annually/ when needed
Stabilize the contributing drainage area to prevent erosion.	❑ Yes ❑ **No** ❑ N/A	When Needed
For a wet site visit - the water has sat for over 48 hours.	❑ Yes ❑ **No** ❑ N/A	When Needed
Debris / Pollution		
Pollution is blocking inlets or curb cuts.	❑ Yes ❑ **No**	4x annually

	❑ N/A	
A lot of litter and trash present.	❑ Yes ❑ **No** ❑ N/A	2x every growing season / when necessary
Excess sediment present.	❑ Yes ❑ **No** ❑ N/A	Annually or when needed
Vegetation		
Grass filter strips and bioretention turf cover are mowed.	❑ Yes ❑ No ❑ **N/A**	4x annually
Mulch is in poor quality.	❑ Yes ❑ **No** ❑ N/A	2x a growing season
Mulch needs replacement (3 inch layer) And refilled in areas lacking mulch.	❑ Yes ❑ **No** ❑ N/A	Annually
Weeds and invasive, diseased, or dead plants need to be removed.	❑ **Yes** ❑ No ❑ N/A	2x a growing season / when necessary
Trees and shrubs are overgrown.	❑ Yes ❑ **No** ❑ N/A	Annually
Maintain vegetation density by adding extra plantings/vegetation.	❑ Yes ❑ **No** ❑ N/A	When needed

Inspection Results
❑ Pass. No apparent problems observed ❑ **Maintenance recommended. Minor problems observed.** ❑ Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above • The edges of the bioretention area have exposed barren soil and soil erosion. ○ Recommendation: discontinue edge to the bioretention area when mulching. This structure was last mulched in the fall. • Overflow drain is too low for most water to infiltrate into the ground. ○ Recommend filling in lower holes of overflow drain.

- Burning Bush vegetation is invasive and should be replaced with a native alternative.
- It is estimated that this structure was designed for a 10 year storm.

Bioretention Area Inspection and Maintenance Checklist			
Facility: **Fort Washington Community Center Bioretention Area 2**			
Location/Address: **1200 Fillmore Rd, Fort Washington, MD 20744 - by community center**			
Date: **3-10-2020**	Time: **10 am**	Weather Conditions: **Cloudy, light rain**	
Inspector: **Zack Bishop, Emma Lipsky**		Rain in Last 48 Hours: **YES** NO	
Date of Last Inspection: **Last Year**		If yes, list amount and timing: **0.02" in 24 hours**	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit: **Routine Inspection**			

Inspection Item	Status	Frequency
Structure		
Pipes are broken or damaged.	❑ Yes ❑ **No** ❑ N/A	When needed
Sediment found in pretreatment cells and inflow points.	❑ **Yes** ❑ No ❑ N/A	Annually
There are signs of erosion.	❑ Yes ❑ **No** ❑ N/A	4x annually / when needed
There are areas prone to erosion.	❑ Yes ❑ **No** ❑ N/A	4x annually/ when needed
Stabilize the contributing drainage area to prevent erosion.	❑ Yes ❑ No ❑ **N/A**	When Needed
For a wet site visit - the water has sat for over 48 hours.	❑ Yes ❑ **No** ❑ N/A	When Needed
Debris / Pollution		
Pollution is blocking inlets or curb cuts.	❑ Yes ❑ **No** ❑ N/A	4x annually
A lot of litter and trash present.	❑ Yes ❑ **No** ❑ N/A	2x every growing season / when necessary

Excess sediment present.	❑ Yes ❑ **No** ❑ N/A	Annually or when needed
Vegetation		
Grass filter strips and bioretention turf cover are mowed.	❑ Yes ❑ No ❑ **N/A**	4x annually
Mulch is in poor quality.	❑ Yes ❑ **No** ❑ N/A	2x a growing season
Mulch needs replacement (3-inch layer) And refilled in areas lacking mulch.	❑ **Yes** ❑ No ❑ N/A	Annually
Weeds and invasive, diseased, or dead plants need to be removed.	❑ **Yes** ❑ No ❑ N/A	2x a growing season / when necessary
Trees and shrubs are overgrown.	❑ Yes ❑ **No** ❑ N/A	Annually
Maintain vegetation density by adding extra plantings/vegetation.	❑ Yes ❑ **No** ❑ N/A	When needed

Inspection Results

❑ Pass. No apparent problems observed
❑ **Maintenance recommended. Minor problems observed.**
❑ Fail, immediate maintenance required. Major problems observed.

→ See appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems

Additional Notes - Provide details on any item marked yes in the table above

- The inlet has a minor amount of sediment buildup
- Mulch coverage should be improved near the inlet
- Burning bush is invasive and should be replaced with non invasive alternative
- It is estimated that this SMP was designed for a 10 year storm
- This SMP is mulched approximately 2 times per year and was mulched this fall

Swale Inspection and Maintenance Checklist			
Facility: **William Beanes Community Center Swale**			
Location/Address: **5108 Dianna Dr, Suitland-Silver Hill, MD 20746 - below parking lot**			
Date: **3-10-2020**	Time: **11 am**	Weather Conditions: **Cloudy, light rain**	
Inspector: **Zack Bishop, Emma Lipsky**		Rain in Last 48 Hours: **YES** NO	
Date of Last Inspection: **3 years ago**		If yes, list amount and timing: **0.02" in 24 hours**	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit: **Routine Inspection**			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ Yes ❑ **No** ❑ N/A	Annually
It is hard to access the SMP.	❑ Yes ❑ **No** ❑ N/A	Monthly
48 hours after a rainfall event, there is standing water.	❑ Yes ❑ **No** ❑ N/A	Seasonally, after a storm
Buildings and other structures encroach on the SMP.	❑ Yes ❑ **No** ❑ N/A	Monthly
The inlet provides a stable conveyance into the SMP.	❑ Yes ❑ **No** ❑ N/A	Monthly
There is a noticeable odor coming from or near the SMP.	❑ Yes ❑ **No** ❑ N/A	Monthly
The check dam is not functioning properly.	❑ **Yes** ❑ No ❑ N/A	Monthly
The perforated pipe is not conveying water as designated.	❑ Yes ❑ **No** ❑ N/A	Monthly
The outlet is obstructed.	❑ Yes ❑ **No** ❑ N/A	Monthly

There is erosion or bare soil below the outlet.	❑ Yes ❑ **No** ❑ N/A	Monthly
There are no signs designating the SMP as a conservation area.	❑ Yes ❑ No ❑ **N/A**	Monthly
Debris / Pollution		
There is trash or debris in or around the SMP.	❑ **Yes** ❑ No ❑ N/A	Monthly
There is sediment buildup in or around the SMP.	❑ **Yes** ❑ No ❑ N/A	Monthly
There are excess grass clippings in or around the SMP.	❑ Yes ❑ **No** ❑ N/A	Monthly
There is leaf litter in or around the SMP.	❑ **Yes** ❑ No ❑ N/A	Monthly
Vegetation		
Planted vegetation is dead or in poor condition.	❑ Yes ❑ **No** ❑ N/A	Monthly
There are weeds or invasive species present.	❑ Yes ❑ **No** ❑ N/A	Monthly
There is excessive erosion in or around the SMP.	❑ Yes ❑ **No** ❑ N/A	Monthly
The grass is shorter than 3 inches.	❑ Yes ❑ **No** ❑ N/A	Monthly
The grass is longer than 6 inches.	❑ Yes ❑ **No** ❑ N/A	Monthly
Fertilizers, pesticides, and/or oils are used in or around the SMP.	❑ **Yes** ❑ No ❑ N/A	Monthly

There are trees forming an overhead canopy over the SMP.	❑ Yes ❑ **No** ❑ N/A	Annually
There is bare soil in or around the SMP.	❑ **Yes** ❑ No ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ **Maintenance recommended. Minor problems observed.** ❑ Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above • There is trash inside the SMP that needs to be cleaned up • The adjacent hillside between the SMP and the parking lot is mowed but it does not have to be. It should be converted into a naturalized meadow • There is sediment buildup at the inlet of the SMP because the weir may be too high. • There is a tertiary catchment area nearby that feeds into this swale. The tertiary catchment area was put in about a year ago and seeded with grass, fertilizer and pesticide. • The inner tarp within the tertiary catchment area should be removed in about a year once the grass has rooted in

Wet Pond Inspection and Maintenance Checklist			
Facility: **Suitland Community Center Wet Pond**			
Location/Address: **5600 Regency Ln, Forestville, MD 20747**			
Date: **3-10-2020**	Time: **12 pm**	Weather Conditions: **Cloudy, light rain**	
Inspector: **Zack Bishop, Emma Lipsky**		Rain in Last 48 Hours: **YES** NO	
Date of Last Inspection: **Unknown**		If yes, list amount and timing: **0.02 in 24 hours**	
Site Plan or As-Built Plan Available: YES NO			
Reason for Visit: **Routine Inspection**			

Inspection Item	Status	Frequency
Structure		
Structural components are cracked, damaged, misaligned, or deteriorated.	❑ **Yes** ❑ No ❑ N/A	Annually
There is excessive erosion in or around the SMP. Check especially the inlet and outlet.	❑ **Yes** ❑ No ❑ N/A	Seasonally, after a major storm
There is a large amount of standing water 72 hours after a rain event.	❑ Yes ❑ **No** ❑ N/A	Seasonally, after a major storm
There are clogs within the structure that prevent water flow.	❑ **Yes** ❑ No ❑ N/A	Annually
Debris / Pollution		
There is trash or debris inside the SMP.	❑ **Yes** ❑ No ❑ N/A	Monthly
There is trash or debris outside the SMP that blocks water flow into the structure.	❑ **Yes** ❑ No ❑ N/A	Monthly
There is sediment buildup inside the SMP.	❑ **Yes** ❑ No ❑ N/A	Seasonally, after a major storm
Vegetation		

Planted vegetation is dead or in poor condition.	❑ Yes ❑ **No** ❑ N/A	Monthly
There are weeds or invasive species present.	❑ **Yes** ❑ No ❑ N/A	Monthly
There are animal problems nearby, such as beaver dams, that may damage the structure.	❑ Yes ❑ **No** ❑ N/A	Monthly

Inspection Results
❑ Pass. No apparent problems observed ❑ Maintenance recommended. Minor problems observed. ❑ Fail, immediate maintenance required. Major problems observed. → **See Appendix 1 in Stormwater Maintenance Assessment and Recommendations Report for solutions to identified problems**
Additional Notes - Provide details on any item marked yes in the table above • There is a large amount of trash inside the wet pond that has clogged water flow and built up a trash berm near the inlet of the SMP. • The weir at the outlet of the wet pond is capped off which prevents water from flowing through. The water instead flows around the weir causing significant erosion along the banks after the outlet of the SMP. • There are weeds and invasive plants in the wet pond, especially on the side near the sports field. Invasive species identified were English ivy, pear tree, and Japanese honeysuckle.