

**City of Grand Haven  
Good Housekeeping  
And Pollution Prevention  
Best Management Practices  
Operation and Maintenance  
Manual**

**For Stormwater Controls**

**Prepared by:**

**GVMC**

**Department of Environmental Programs**

**In Cooperation with:**

**The MS4 Permitted Communities**

**Of The Lower Grand River Watershed**

# Contents

Introduction.....	1
Background.....	1
Manual Organization .....	1
Partners.....	2
Structural Control BMPs.....	3
Catch Basins .....	4
Vegetated Swales .....	8
Constructed Wetlands.....	11
Porous Pavement.....	14
Pump Stations .....	17
Secondary Containment.....	18
Underground Storage Vaults or Tanks .....	21
Vegetated Buffer Strips.....	24
Detention Ponds .....	27
Bioretention & Rain Gardens, .....	31
Infiltration Basins and Trenches.....	34
Oil/Water or Grit Separator.....	37
Operational BMPs .....	40
Road, Sidewalk, Parking Lot and Bridge Maintenance .....	42
Right-Of-Way (ROW) & Vegetated Property Maintenance .....	45
Unpaved Road Maintenance .....	48
Cold Weather Operations .....	49
Fleet Maintenance .....	50
Inspection .....	50
Vehicle and Equipment Fueling.....	50
Vehicle and Equipment Cleaning .....	51
Vehicle and Equipment Repair.....	52
Solid Waste Handling and Disposal.....	55
Materials Storage.....	56
Spill Response and Prevention.....	57
References: .....	58

## Introduction

### Background

As the owner and operator of a municipal separate storm sewer system (MS4) City of Grand Haven, must implement stormwater pollution prevention on their properties as well as within their MS4. The State of Michigan regulates the City of Grand Haven, through a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit program identifies six minimum control measures that operators of regulated small MS4s must incorporate into stormwater management programs. These measures are expected to result in significant reductions of pollutants discharged into receiving waterbodies. This manual identifies the Best Management Practices (BMPs) implemented by the City of Grand Haven to address pollution prevention and good housekeeping.

This manual is intended to provide the staff at the City of Grand Haven and regulators with information necessary to ensure uniform and correct implementation of procedures and maintenance related to structural and operational stormwater controls at municipally owned and operated facilities. A complete inventory of these facilities is provided in Appendix 6 of the Stormwater Management plan. The procedures in this will be reviewed annually for effectiveness and accuracy. In the event that a new facility or structural control is added it will be reviewed and added to the inventory within 30 days. Relevant portions of this manual will also be provided to contractors working on behalf of the City of Grand Haven to ensure they are complying with the approved procedures, inspections, and maintenance intervals.

### Manual Organization

The manual is divided into two sections: Structural BMPs and Operational BMPs.

Structural BMPs identify devices that are constructed to protect, treat, convey, control or infiltrate stormwater. Each BMP includes a brief description, a sample design, and inspection and maintenance guidance including a tracking tool. Specific inspection and maintenance intervals are identified in the SWMP. The estimated number of stormwater structural controls is identified in the facility inventory included in Appendix 6.

Operational BMPs are activities that have the potential to impact stormwater quality such as cutting lawns, applying fertilizer, and washing vehicles. Operational BMPs provide guidelines for conducting these activities in a manner that prevents stormwater pollution. Each operational BMP identifies a procedure, and any maintenance, if applicable.

## Partners

This manual was prepared as a cooperative effort by the MS4 permitted members of the Lower Grand River Watershed identified below and the Department of Environmental Programs at the Grand Valley Metropolitan Council. Individual procedures and tracking tools have been customized to meet the needs of each City of Grand Haven.

<b>Kent County</b>	<b>Ottawa County</b>
Cascade Charter Township	City of Ferrysburg
City of East Grand Rapids	City of Grand Haven
City of Grand Rapids	City of Hudsonville
City of Grandville	Georgetown Charter Township
City of Kentwood	Grand Valley State University
City of Rockford	Ottawa County Water Resource Commissioner
City of Walker	Ottawa County Road Commission
City of Wyoming	Village of Spring Lake
Forest Hills Public Schools	
Grand Rapids Charter Township	
Kent County Drain Commissioner	
Kent County Road Commission	
Plainfield Charter Township	
Village of Sparta	

# **Structural Control BMPs**

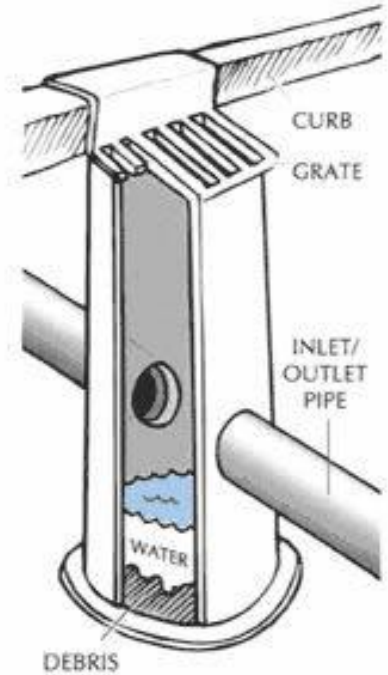
## Catch Basins

A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid (commonly called a manhole).

Catch basins typically provide a storage volume (sump) below the outlet pipe to allow sediment and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils. Stormwater manholes are not designed to allow for the removal of sediment but, nonetheless, are important components of the stormwater conveyance system.

A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should only be conducted by an individual trained and certified to work in hazardous confined spaces.

After basins are cleaned, the collected waste is disposed of in accordance with Parts 115 and 121 of Act 451 of 1994 (Natural Resources and Environment Protection Act).



Page Reserved for existing SWPPI Catch Basin Cleaning Procedure

<b>Catch Basins</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Results Expected When Maintenance Is Performed Or Not Needed</b>
General	Trash and Debris	Trash or debris is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin.	No trash or debris located immediately in front of catch basin or on grate opening.
	Sediment	Sediment (in the basin) impedes the functionality of the catch basin.	No sediment in the catch basin.
	Structure Damage to Frame and/or Top Slab	Top slab has large holes or cracks; trash or debris material is running into basin.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab or not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has significantly separated or cracked or any evidence of soil particles entering catch basin through cracks.	Pipe is re-grouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 50% of the basin opening.	No vegetation blocking opening to basin.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.
	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
	Grate Opening Unsafe	Grate with opening wider than design standard.	Grate opening meets design standards.
	Grate Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.



# CATCH BASIN INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

Basin Location: \_\_\_\_\_

- Trash or debris present? Yes  No
- Sediment accumulating? Yes  No
- Exterior structural damage? Yes  No
- Interior structural damage? Yes  No
- Settlement/misalignment? Yes  No
- Vegetation? Yes  No
- Pollution (paint, oil, gas)? Yes  No
- Missing/damaged cover/grate? Yes  No
- Unsafe ladder rungs? Yes  No
- Maintenance required? Yes  No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_ or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Basin Location: \_\_\_\_\_

- Trash or debris present? Yes  No
- Sediment accumulating? Yes  No
- Exterior structural damage? Yes  No
- Interior structural damage? Yes  No
- Settlement/misalignment? Yes  No
- Vegetation? Yes  No
- Pollution (paint, oil, gas)? Yes  No
- Missing/damaged cover/grate? Yes  No
- Unsafe ladder rungs? Yes  No
- Maintenance required? Yes  No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_ or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Basin Location: \_\_\_\_\_

- Trash or debris present? Yes  No
- Sediment accumulating? Yes  No
- Exterior structural damage? Yes  No
- Interior structural damage? Yes  No
- Settlement/misalignment? Yes  No
- Vegetation? Yes  No
- Pollution (paint, oil, gas)? Yes  No
- Missing/ damaged cover/grate? Yes  No
- Unsafe ladder rungs? Yes  No
- Maintenance required? Yes  No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_ or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Basin Location: \_\_\_\_\_

- Trash or debris present? Yes  No
- Sediment accumulating? Yes  No
- Exterior structural damage? Yes  No
- Interior structural damage? Yes  No
- Settlement/misalignment? Yes  No
- Vegetation? Yes  No
- Pollution (paint, oil, gas)? Yes  No
- Missing/damaged cover/grate? Yes  No
- Unsafe ladder rungs? Yes  No
- Maintenance required? Yes  No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_ or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_ or n/a

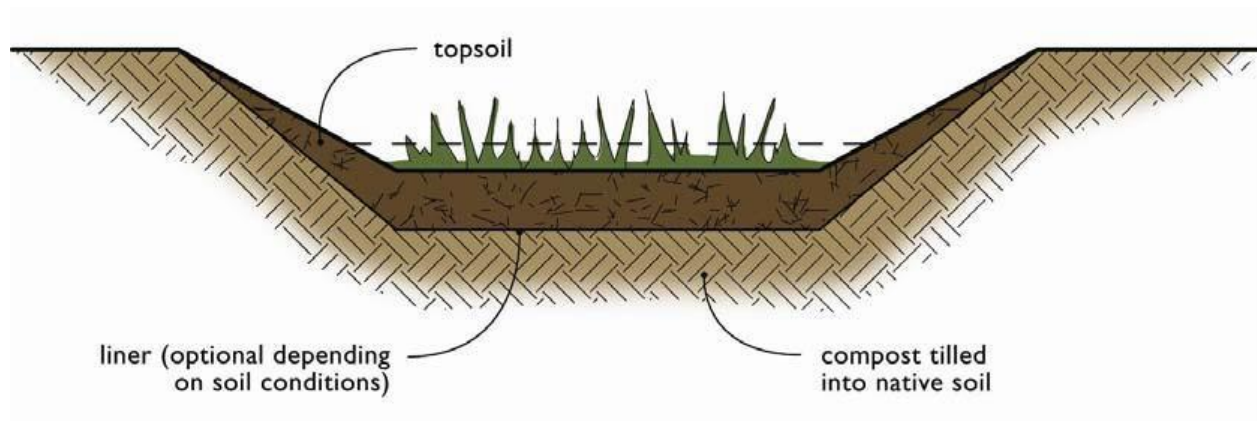
Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Vegetated Swales

A vegetated swale (also called a biofiltration swale) uses grass or other dense vegetation to filter sediment and oily materials out of stormwater. Vegetated swales usually look like flat-bottomed channels with grass growing in them. This method of stormwater management uses vegetation in conjunction with slow and shallow-depth flow for runoff treatment. As runoff passes through the vegetation pollutants are removed through the combined effects of filtration, infiltration, and settling. These effects are aided by the reduction of the velocity of stormwater as it passes through the swale. Vegetated swales can replace traditional curb and gutter systems.

Vegetated swales provide stormwater quality control (treatment) but do not provide stormwater quantity control (detention/retention). Swales are stormwater treatment devices that must be properly maintained to sustain pollutant removal capacity.

Typical pollutants that are removed by vegetated swales include sediment, nutrients, trash, metals, bacteria, and oils and greases.



<b>Typical Vegetated Swale</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the bio-swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
	Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or re-seed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 12-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from bioswale.
	Erosion/ Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be re-graded and re-seeded. For smaller bare areas, over seed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

# VEGETATED SWALE INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

Location: \_\_\_\_\_

- Sediment over 2"?            Yes     No
- Standing water?            Yes     No
- Flow spreader clogged?    Yes     No
- Poor vegetative growth?    Yes     No
- Excessive vegetation?    Yes     No
- Inlet/outlet clogged?    Yes     No
- Trash or debris present?    Yes     No
- Erosion occurring?        Yes     No
- Maintenance required?    Yes     No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_ or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_ or n/a

Maintenance description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Location: \_\_\_\_\_

- Sediment over 2"?            Yes     No
- Standing water?            Yes     No
- Flow spreader clogged?    Yes     No
- Poor vegetative growth?    Yes     No
- Excessive vegetation?    Yes     No
- Inlet/outlet clogged?    Yes     No
- Trash or debris present ?    Yes     No
- Erosion occurring?        Yes     No
- Maintenance required?    Yes     No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_ or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_ or n/a

Maintenance description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Location: \_\_\_\_\_

- Sediment over 2"?            Yes     No
- Standing water?            Yes     No
- Flow spreader clogged?    Yes     No
- Poor vegetative growth?    Yes     No
- Excessive vegetation?    Yes     No
- Inlet/outlet clogged?    Yes     No
- Trash or debris present?    Yes     No
- Erosion occurring?        Yes     No
- Maintenance required?    Yes     No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_ or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_ or n/a

Maintenance description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Location: \_\_\_\_\_

- Sediment over 2"?            Yes     No
- Standing water?            Yes     No
- Flow spreader clogged?    Yes     No
- Poor vegetative growth?    Yes     No
- Excessive vegetation?    Yes     No
- Inlet/outlet clogged?    Yes     No
- Trash or debris present?    Yes     No
- Erosion occurring?        Yes     No
- Maintenance required?    Yes     No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_ or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_ or n/a

Maintenance description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Constructed Wetlands

Constructed Wetlands are shallow marsh systems planted with emergent vegetation that are designed to treat stormwater runoff. Constructed wetlands can be designed as a new system or a retrofit for an existing stormwater treatment facility and can work in combination with other BMPs for even more effective pollutant removal. The design of the wetland will affect where and how much sediment may accumulate, typically with a design including a forebay sediment should be removed every 3-10 years depending on when it reaches the threshold of 50% of the total volume. Areas prone to sediment accumulation should be regularly inspected and cleaned as necessary to ensure the system is functioning as designed.



<b>Constructed Wetland</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
General	Sediment Accumulation	Sediment deposits in excess of 50% of the total volume the forebay	Remove sediment deposits, minimizing disturbance to banks and vegetation.
	Vegetation	When shrubs or seedlings become sufficiently large to impede function according to the design; when nuisance weeds or invasive species start to take over.	Remove large trees, shrubs, invasive species or nuisance weeds and restore the area to grade and provide additional plantings if necessary.
	Trash and Debris Accumulation	Trash and debris accumulated in the wetland.	Remove trash and debris from filter.
	Erosion/ Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	For large rills gullies, or channelization, restore the area to grade and install a turf reinforcement mat designed to withstand the flow conditions. Install additional plantings if necessary. IF the issue continues design modifications may be necessary to reduce the flow velocity to a non-erosive speed.
	Outlet Structure	Clogging so that discharge is obstructed	Remove obstruction to restore designed discharge flow

# CONSTRUCTED WETLAND INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_/\_\_/\_\_

Location: \_\_\_\_\_

- Sediment > 50% of forebay?    Yes     No
- Forebay in good condition?    Yes     No
- Invasive or nuisance species?    Yes     No
- Large trees or shrubs?    Yes     No
- Additional plantings needed?    Yes     No
- Outlet obstructed ?    Yes     No
- Trash or debris present?    Yes     No
- Erosion occurring?    Yes     No
- Maintenance required?    Yes     No
- Scheduled on: \_\_/\_\_/\_\_ or n/a
- Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Location: \_\_\_\_\_

- Sediment > 50% of forebay?    Yes     No
- Forebay in good condition?    Yes     No
- Invasive or nuisance species?    Yes     No
- Large trees or shrubs?    Yes     No
- Additional plantings needed?    Yes     No
- Outlet obstructed ?    Yes     No
- Trash or debris present?    Yes     No
- Erosion occurring?    Yes     No
- Maintenance required?    Yes     No
- Scheduled on: \_\_/\_\_/\_\_ or n/a
- Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Location: \_\_\_\_\_

- Sediment > 50% of forebay?    Yes     No
- Forebay in good condition?    Yes     No
- Invasive or nuisance species?    Yes     No
- Large trees or shrubs?    Yes     No
- Additional plantings needed?    Yes     No
- Outlet obstructed ?    Yes     No
- Trash or debris present?    Yes     No
- Erosion occurring?    Yes     No
- Maintenance required?    Yes     No
- Scheduled on: \_\_/\_\_/\_\_ or n/a
- Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Location: \_\_\_\_\_

- Sediment > 50% of forebay?    Yes     No
- Forebay in good condition?    Yes     No
- Invasive or nuisance species?    Yes     No
- Large trees or shrubs?    Yes     No
- Additional plantings needed?    Yes     No
- Outlet obstructed ?    Yes     No
- Trash or debris present?    Yes     No
- Erosion occurring?    Yes     No
- Maintenance required?    Yes     No
- Scheduled on: \_\_/\_\_/\_\_ or n/a
- Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

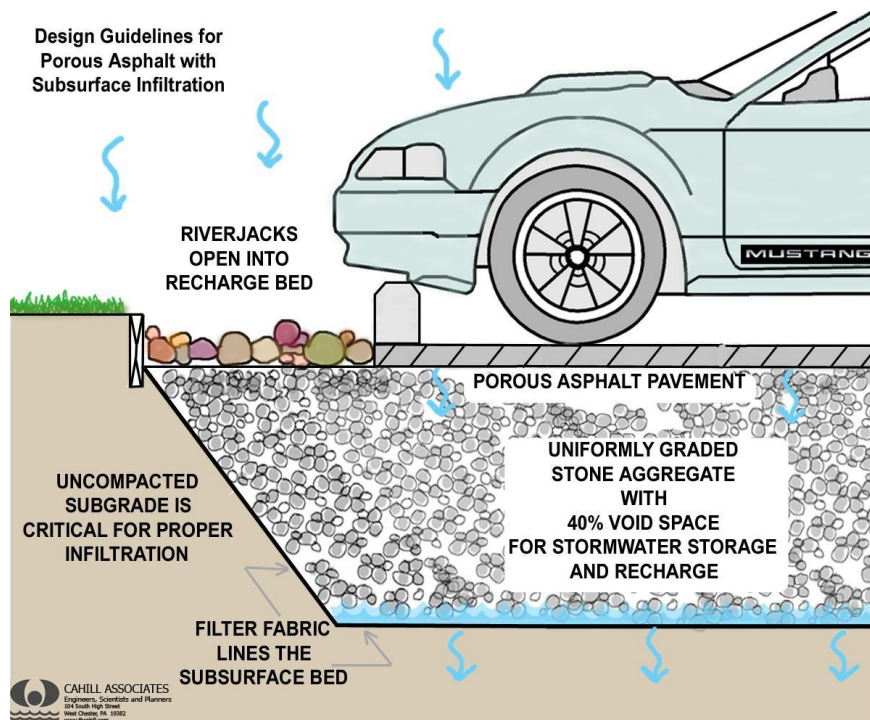
Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Porous Pavement

Porous pavement is an infiltration technique that combines stormwater infiltration, storage, and structural pavement consisting of a permeable surface underlain by a storage reservoir. Stormwater drains through the surface course where it is temporarily held in the voids of the stone bed and then slowly infiltrates into the underlying, uncompacted soil. Pervious pavement is well suited for parking lots, walking paths, sidewalks, playgrounds, plazas tennis courts and other similar uses. The storage reservoir typically consists of a stone bed of uniformly graded, clean and washed coarse aggregate with a void space of approximately 40%. A layer of nonwoven geotextile filter fabric typically separates the aggregate from the underlying soil.





<b>Porous Pavement</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
General	Pavement Clogged	Pavement is not draining properly	Vacuum lot regularly to prevent clogging Additional vacuuming may be required in the event that water is not draining
	Underdrain Clogged	Pavement is not draining properly	Clear the blockage from the underdrain to achieve positive drainage
	Damaged Pavement Surface	Potholes or settling in pavement	For areas of 50 sq. ft. or less patch the affected area. For larger areas review needed repairs with a design engineer.

# POROUS PAVEMENT INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_/\_\_/\_\_

Location: \_\_\_\_\_

Draining properly?            Yes     No   
Evidence of clogging?        Yes     No   
Sediment accumulation?      Yes     No   
Damage to surface?            Yes     No   
Damaged underdrain?         Yes     No  n/a   
Maintenance required?       Yes     No   
Scheduled on: \_\_/\_\_/\_\_        or n/a   
Completed on: \_\_/\_\_/\_\_        or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Draining properly?            Yes     No   
Evidence of clogging?        Yes     No   
Sediment accumulation?      Yes     No   
Damage to surface?            Yes     No   
Damaged underdrain?         Yes     No  n/a   
Maintenance required?       Yes     No   
Scheduled on: \_\_/\_\_/\_\_        or n/a   
Completed on: \_\_/\_\_/\_\_        or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Draining properly?            Yes     No   
Evidence of clogging?        Yes     No   
Sediment accumulation?      Yes     No   
Damage to surface?            Yes     No   
Damaged underdrain?         Yes     No  n/a   
Maintenance required?       Yes     No   
Scheduled on: \_\_/\_\_/\_\_        or n/a   
Completed on: \_\_/\_\_/\_\_        or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Draining properly?            Yes     No   
Evidence of clogging?        Yes     No   
Sediment accumulation?      Yes     No   
Damage to surface?            Yes     No   
Damaged underdrain?         Yes     No  n/a   
Maintenance required?       Yes     No   
Scheduled on: \_\_/\_\_/\_\_        or n/a   
Completed on: \_\_/\_\_/\_\_        or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Pump Stations

Pump stations can be designed to remove stormwater from areas that cannot be drained by gravity and are not good candidates for stormwater infiltration either because of prohibitive onsite conditions or inadequate space to address the necessary volume. They are typically sized to accommodate a specified design storm and may or may not include additional storage depending upon the area needs and drainage characteristics. The release rate of the pump station is determined by the outlet capacity and conditions. Pump stations are classified as confined spaces and per MIOSHA requirements, anyone entering a "confined space" must be equipped with the proper safety equipment and training. Regular inspections are critical to identify the need for debris and sediment removal, and to confirm proper mechanical function.

## Secondary Containment

Secondary containment is a second barrier or an outer wall of a double enclosure which will contain any leak or spill from a storage container. Secondary containment helps protect the surface water, groundwater, and soils and reduce worker exposure to regulated substances. This enclosure is usually needed wherever regulated substances are being handled and stored in tanks, totes, drums, small pails, or other containers. The MDEQ has prepared a comprehensive guidance document on secondary containment requirements in the State of Michigan. It is available at:

[http://www.michigan.gov/documents/deq/deq-whm-hwp-Undrstnd-SC-Rqrmnts\\_248135\\_7.pdf](http://www.michigan.gov/documents/deq/deq-whm-hwp-Undrstnd-SC-Rqrmnts_248135_7.pdf). Tanks with secondary containment need to be inspected regularly for damage, corrosion and leaks.



<b>Secondary Containment</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
General	Leaks or drips	Evidence of tank contents within the secondary containment reservoir or outside the tank	Observe the tank to determine the origin of the leak and repair it. If drips are occurring when materials are added or removed review and revise procedure as necessary.
	Corrosion	Evidence of tank contents within the secondary containment reservoir or outside the tank	Conduct a comprehensive tank inspection to determine the cause of the corrosion and repair or replace the tank.
	Structural Damage	Evidence of tank contents within the secondary containment reservoir or outside the tank	Conduct a comprehensive tank inspection to determine the cause of the damage and repair or replace the tank. If damage occurred when materials were added or removed review and revise procedure as necessary.

# SECONDARY CONTAINMENT INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_/\_\_/\_\_

Location: \_\_\_\_\_

- |                              |                                 |                             |
|------------------------------|---------------------------------|-----------------------------|
| Functioning properly?        | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Evidence of leaks or drips?  | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Evidence of corrosion?       | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Visible trash or debris?     | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Damaged pipes?               | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Damage to tank or lining?    | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Drain system block in place? | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Adequate signage or labeling | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Maintenance required?        | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Scheduled on: __/__/__       | or n/a <input type="checkbox"/> |                             |
| Completed on: __/__/__       | or n/a <input type="checkbox"/> |                             |

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

- |                              |                                 |                             |
|------------------------------|---------------------------------|-----------------------------|
| Functioning properly?        | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Evidence of leaks or drips?  | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Evidence of corrosion?       | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Visible trash or debris?     | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Damaged pipes?               | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Damage to tank or lining?    | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Drain system block in place? | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Adequate signage or labeling | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Maintenance required?        | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Scheduled on: __/__/__       | or n/a <input type="checkbox"/> |                             |
| Completed on: __/__/__       | or n/a <input type="checkbox"/> |                             |

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

- |                              |                                 |                             |
|------------------------------|---------------------------------|-----------------------------|
| Functioning properly?        | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Evidence of leaks or drips?  | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Evidence of corrosion?       | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Visible trash or debris?     | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Damaged pipes?               | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Damage to tank or lining?    | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Drain system block in place? | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Adequate signage or labeling | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Maintenance required?        | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Scheduled on: __/__/__       | or n/a <input type="checkbox"/> |                             |
| Completed on: __/__/__       | or n/a <input type="checkbox"/> |                             |

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

- |                              |                                 |                             |
|------------------------------|---------------------------------|-----------------------------|
| Functioning properly?        | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Evidence of leaks or drips?  | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Evidence of corrosion?       | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Visible trash or debris?     | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Damaged pipes?               | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Damage to tank or lining?    | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Drain system block in place? | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Adequate signage or labeling | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Maintenance required?        | Yes <input type="checkbox"/>    | No <input type="checkbox"/> |
| Scheduled on: __/__/__       | or n/a <input type="checkbox"/> |                             |
| Completed on: __/__/__       | or n/a <input type="checkbox"/> |                             |

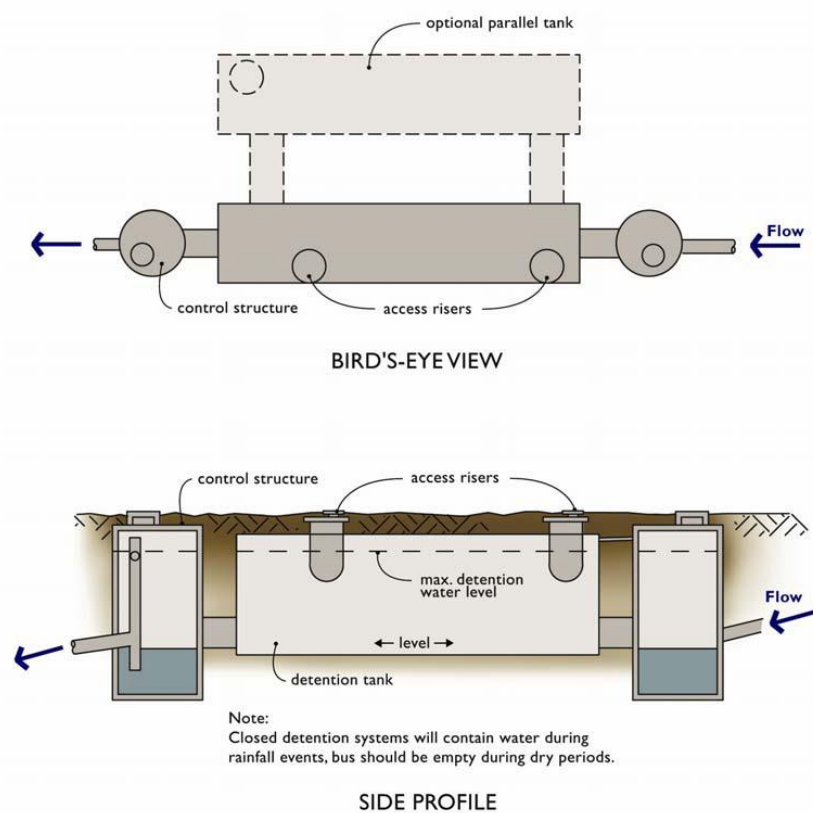
Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Underground Storage Vaults or Tanks

Underground vaults are stormwater storage facilities usually constructed of precast reinforced concrete or a structural high density polyethylene plastic system. Tanks are usually constructed of large diameter metal or plastic pipe.

Underground detention beds can be used where space is limited but subsurface infiltration is not feasible. Underground vaults provide minimal water quality treatment and should be used in combination with pretreatment. Maintenance needs to include regular sediment and debris removal.



<b>Underground Storage Vaults or Tanks</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
Vault or Tank	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants at the outlet	Contaminants or pollutants vactored out of structure or cleaned out of inlet/outlet No contaminants or pollutants present.
	Sediment	Accumulated sediment that affects inlet, outlet or capacity of the facility.	Sediment vactored out of structure or cleaned out of inlet/outlet. System holds design capacity



# UNDERGROUND STORAGE INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_/\_\_/\_\_

Location: \_\_\_\_\_

Type: Vault  Tank   
Functioning properly? Yes  No   
Inlet blocked? Yes  No   
Outlet blocked? Yes  No   
Sediment accumulation? Yes  No   
Trash or debris? Yes  No   
Pollution (oils, gas, etc.)? Yes  No   
Maintenance required? Yes  No   
Scheduled on: \_\_/\_\_/\_\_ or n/a   
Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Type: Vault  Tank   
Functioning properly? Yes  No   
Inlet blocked? Yes  No   
Outlet blocked? Yes  No   
Sediment accumulation? Yes  No   
Trash or debris? Yes  No   
Pollution (oils, gas, etc.)? Yes  No   
Maintenance required? Yes  No   
Scheduled on: \_\_/\_\_/\_\_ or n/a   
Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Type: Vault  Tank   
Functioning properly? Yes  No   
Inlet blocked? Yes  No   
Outlet blocked? Yes  No   
Sediment accumulation? Yes  No   
Trash or debris? Yes  No   
Pollution (oils, gas, etc.)? Yes  No   
Maintenance required? Yes  No   
Scheduled on: \_\_/\_\_/\_\_ or n/a   
Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

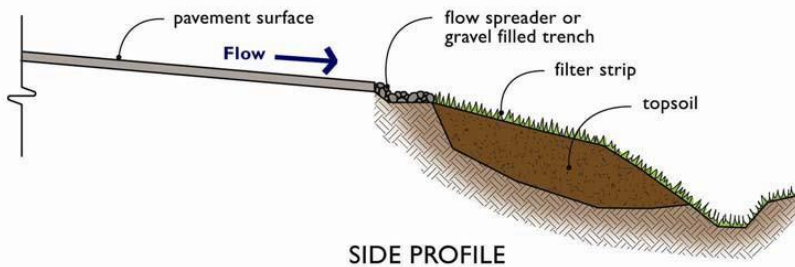
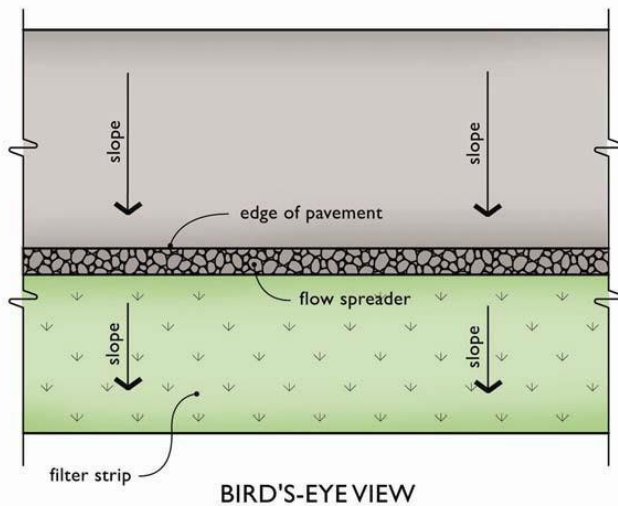
Type: Vault  Tank   
Functioning properly? Yes  No   
Inlet blocked? Yes  No   
Outlet blocked? Yes  No   
Sediment accumulation? Yes  No   
Trash or debris? Yes  No   
Pollution (oils, gas, etc.)? Yes  No   
Maintenance required? Yes  No   
Scheduled on: \_\_/\_\_/\_\_ or n/a   
Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Vegetated Buffer Strips

A buffer strip (also known as a filter strip or vegetated filter strip) is a linear strip of grass that removes sediment and oils from stormwater by filtering it. Stormwater is treated as it runs across the filter. Usually, filter strips are placed along the edge of linear paved areas such as parking lots and roads and where a flow spreader is installed to ensure that water flows eventually across the strip in sheet flow. Where designed filter strips are installed, road shoulders should only be graded to maintain level flow off the road.

Typical pollutants that are removed by vegetated swales include sediment, nutrients, trash, metals, bacteria, and oils and greases.



<b>Buffer Strip</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits, re-level so slope is even and flows pass evenly through strip.
	Vegetation	When the grass becomes excessively tall (greater than 12-inches); when nuisance weeds and other vegetation starts to take over.	Mow grass, control nuisance vegetation, such that flow not impeded. Grass should be mowed to a height between 3-4 inches.
	Trash and Debris Accumulation	Trash and debris accumulated on the filter strip.	Remove trash and debris from filter.
	Erosion/ Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be re- graded and re-seeded. For smaller bare areas, over seed when bare spots are evident.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter	Level the spreader and clean so that flows are spread evenly over entire filter width.

# BUFFER STRIP/VEGETATED FILTER INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_/\_\_/\_\_\_\_

Location: \_\_\_\_\_

Sediment over 2"? Yes  No   
Grass >12"? Yes  No   
Poor vegetative growth? Yes  No   
Trash or debris present? Yes  No   
Erosion occurring? Yes  No   
Flow spreader clogged? Yes  No   
Maintenance required? Yes  No   
Scheduled on: \_\_/\_\_/\_\_\_\_ or n/a   
Completed on: \_\_/\_\_/\_\_\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Sediment over 2"? Yes  No   
Grass >12"? Yes  No   
Poor vegetative growth? Yes  No   
Trash or debris present? Yes  No   
Erosion occurring? Yes  No   
Flow Spreader clogged? Yes  No   
Maintenance required? Yes  No   
Scheduled on: \_\_/\_\_/\_\_\_\_ or n/a   
Completed on: \_\_/\_\_/\_\_\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Sediment over 2"? Yes  No   
Grass >12"? Yes  No   
Poor vegetative growth? Yes  No   
Trash or debris present? Yes  No   
Erosion occurring? Yes  No   
Flow spreader clogged? Yes  No   
Maintenance required? Yes  No   
Scheduled on: \_\_/\_\_/\_\_\_\_ or n/a   
Completed on: \_\_/\_\_/\_\_\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

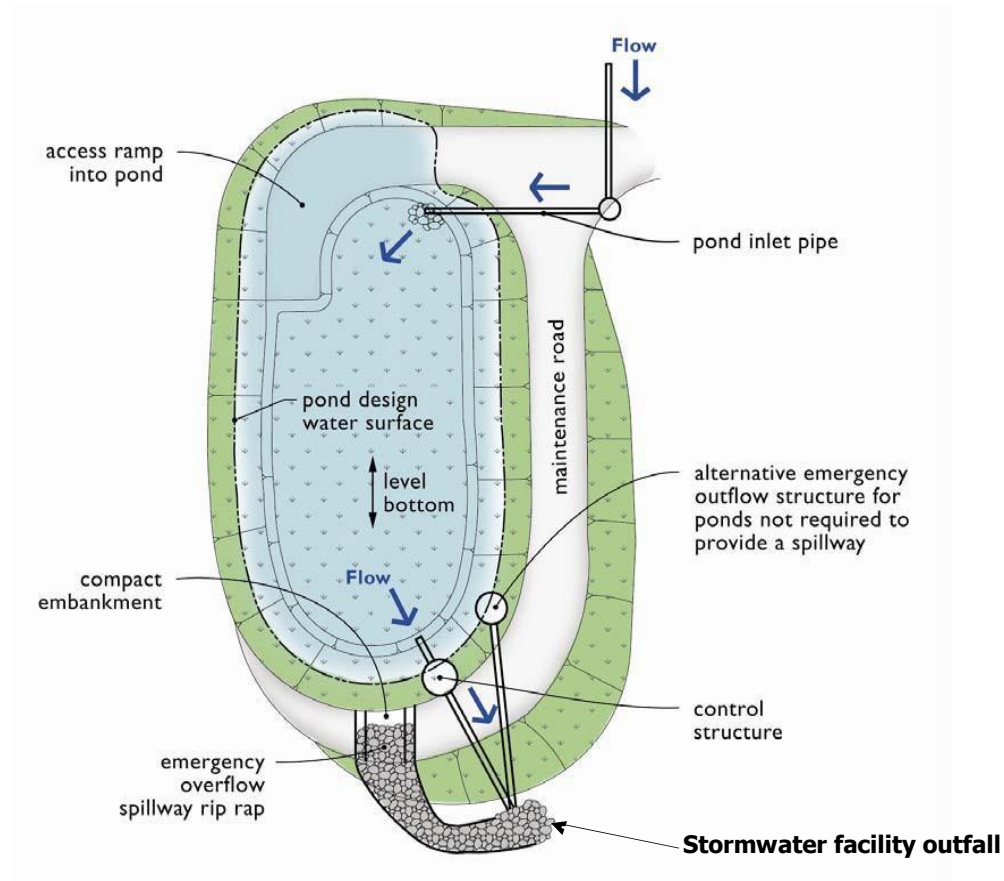
Location: \_\_\_\_\_

Sediment over 2"? Yes  No   
Grass >12"? Yes  No   
Poor vegetative growth? Yes  No   
Trash or debris present? Yes  No   
Erosion occurring? Yes  No   
Flow spreader clogged? Yes  No   
Maintenance required? Yes  No   
Scheduled on: \_\_/\_\_/\_\_\_\_ or n/a   
Completed on: \_\_/\_\_/\_\_\_\_ or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Detention Ponds

A stormwater detention pond is an open basin built by excavating below existing ground or by constructing above-ground berms (embankments). The detention pond temporarily stores stormwater runoff during rain events and slowly releases it through an outlet (control structure). The primary purpose of detention ponds is to reduce stormwater runoff peaks. Detention ponds are typically designed to completely drain within 24 hours after the completion of a storm event. Styles vary greatly from well manicured to natural appearing. Generally, more natural-appearing vegetation is preferred for reduced maintenance and enhanced wildlife habitat. Some facilities are designed to appear as natural water bodies or are in park-like areas.



<b>Detention Pond</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
General	Trash and Debris	Any trash and debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can in a 10 foot wide by 100 foot long area). In general, there should be no visual evidence of dumping.  If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired.
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove.  If dead, diseased, or dying trees are identified that inhibit functionality, remove.	Trees do not hinder maintenance activities.
Side Slopes of Pond	Erosion	Eroded damage where cause of damage is still present or where there is potential for continued erosion.  Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.  If erosion is occurring on compacted berms, the City Engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment exceeding maintenance specifications or affecting inletting or out-letting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.

<b>Detention Pond (Continued)</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
Pond Berms (Dikes)	Settlements	<p>Any part of berm which has settled significantly lower than the design elevation.</p> <p>If settlement is apparent, measure berm to determine amount of settlement.</p> <p>Settling can be an indication of more severe problems with the berm or outlet works. Consult with the City Engineer to determine the source of the settlement.</p>	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway and Berms Over 4 Feet in Height.	Tree Growth	<p>Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.</p> <p>Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.</p>	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. The City Engineer should be consulted for proper berm/spillway restoration.
	Piping	<p>Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue.</p> <p>(Recommend the City Engineer be called to inspect and evaluate condition and recommend repair of condition.)</p>	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Rock Missing	<p>Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out-flow path of spillway.</p> <p>(Rip-rap on inside slopes need not be replaced.)</p>	Rocks and pad depth are restored to design standards.
	Erosion	<p>Eroded damage where cause of damage is still present or where there is potential for continued erosion.</p> <p>Any erosion observed on a compacted berm embankment.</p>	<p>Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.</p> <p>If erosion is occurring on compacted berms, the City Engineer should be consulted to resolve source of erosion.</p>

# DETENTION POND INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

Pond Location: \_\_\_\_\_

- Functioning properly?      Yes     No
- Inlet blocked?            Yes     No
- Outlet blocked?          Yes     No
- Sediment accumulating?    Yes     No
- Vegetation accumulating?    Yes     No
- Erosion or slope instability?    Yes     No
- Excessive tree growth?      Yes     No
- Trash or debris?            Yes     No
- Pollution (oils, gas, etc.)?    Yes     No
- Maintenance required?      Yes     No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_      or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_      or n/a

Maintenance description: \_\_\_\_\_

---

---

---

---

Pond Location: \_\_\_\_\_

- Functioning properly?      Yes     No
- Inlet blocked?            Yes     No
- Outlet blocked?          Yes     No
- Sediment accumulating?    Yes     No
- Vegetation accumulating?    Yes     No
- Erosion or slope instability?    Yes     No
- Excessive tree growth?      Yes     No
- Trash or debris?            Yes     No
- Pollution (oils, gas, etc.)?    Yes     No
- Maintenance required?      Yes     No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_      or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_      or n/a

Maintenance description: \_\_\_\_\_

---

---

---

---

Pond Location: \_\_\_\_\_

- Functioning properly?      Yes     No
- Inlet blocked?            Yes     No
- Outlet blocked?          Yes     No
- Sediment accumulating?    Yes     No
- Vegetation accumulating?    Yes     No
- Erosion or slope instability?    Yes     No
- Excessive tree growth?      Yes     No
- Trash or debris?            Yes     No
- Pollution (oils, gas, etc.)?    Yes     No
- Maintenance required?      Yes     No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_      or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_      or n/a

Maintenance description: \_\_\_\_\_

---

---

---

---

Pond Location: \_\_\_\_\_

- Functioning properly?      Yes     No
- Inlet blocked?            Yes     No
- Outlet blocked?          Yes     No
- Sediment accumulating?    Yes     No
- Vegetation accumulating?    Yes     No
- Erosion or slope instability?    Yes     No
- Excessive tree growth?      Yes     No
- Trash or debris?            Yes     No
- Pollution (oils, gas, etc.)?    Yes     No
- Maintenance required?      Yes     No
- Scheduled on: \_\_\_/\_\_\_/\_\_\_      or n/a
- Completed on: \_\_\_/\_\_\_/\_\_\_      or n/a

Maintenance description: \_\_\_\_\_

---

---

---

---

Comments: \_\_\_\_\_

---

---

---



## Bioretention & Rain Gardens,

Bioretention areas are designed and constructed to capture, store and infiltrate stormwater runoff into the surrounding, permeable soils over a period of several days. They can be designed with or without underdrains and depending on the soil conditions and the proposed drainage area. Pretreatment for sediment removal is required to prevent clogging. Bioretention designs include rain gardens which are depressions designed with, highly permeable soils and specialized, native vegetation to capture and treat stormwater runoff from impervious areas including rooftops, streets and parking lots.

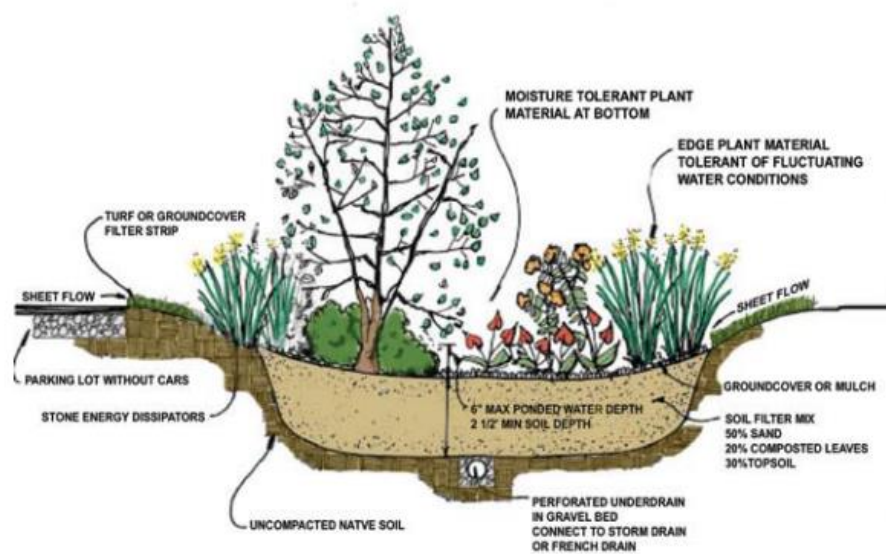
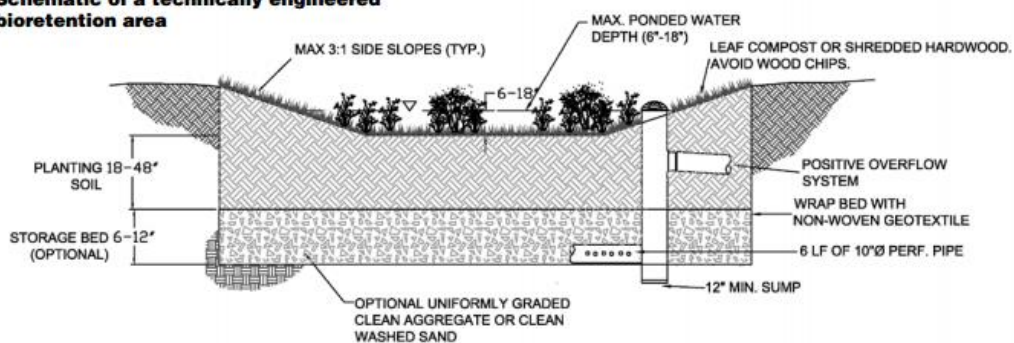


Figure 7.6  
**Schematic of a technically engineered bioretention area**



Source: Prince George's County Bioretention Manual with modifications by Cahill Associates, 2004

<b>Bioretention</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
General	Sediment Accumulation	Sediment depth exceeds 2 inches.	Remove sediment deposits while minimizing disturbance to vegetated areas. If depositions persist review the site conditions to determine the source and if pretreatment is necessary. Area should infiltrate water according to the design standard.
	Poor Vegetation Coverage	Plantings are insufficient to stabilize the bioretention area	Determine why plant growth is poor and correct that condition. Re-plant according to the planting design and provide additional water if necessary to allow the vegetation to reestablish.
	Vegetation	When the grass becomes excessively tall (greater than 12-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Underdrain	Underdrain inlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated	Remove trash and debris
	Erosion/Scouring	Bank slumping or rills forming due to erosion. Eroded or scoured bottom in linear devices due to flow channelization, or higher flows.	Slopes should be restored stabilized using appropriate erosion control measures. Channelized erosion or scouring may require the installation of turf reinforcement mat if conditions warrant.

# BIORETENTION INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_/\_\_/\_\_

Location: \_\_\_\_\_

Type:                      Rain Garden     Other

Functioning properly?            Yes     No

Inlet blocked?                    Yes     No

Sediment accumulating?        Yes     No

Vegetation accumulating?      Yes     No

Erosion or slope instability?    Yes     No

Excessive tree growth?         Yes     No

Trash or debris?                 Yes     No

Pollution (oils, gas, etc.)?    Yes     No

Underdrain blocked?            Yes     No  n/a

Maintenance required?         Yes     No

Scheduled on: \_\_/\_\_/\_\_         or n/a

Completed on: \_\_/\_\_/\_\_         or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Type:                      Rain Garden     Other

Functioning properly?            Yes     No

Inlet blocked?                    Yes     No

Sediment accumulating?        Yes     No

Vegetation accumulating?      Yes     No

Erosion or slope instability?    Yes     No

Excessive tree growth?         Yes     No

Trash or debris?                 Yes     No

Pollution (oils, gas, etc.)?    Yes     No

Underdrain blocked?            Yes     No  n/a

Maintenance required?         Yes     No

Scheduled on: \_\_/\_\_/\_\_         or n/a

Completed on: \_\_/\_\_/\_\_         or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Type:                      Rain Garden     Other

Functioning properly?            Yes     No

Inlet blocked?                    Yes     No

Sediment accumulating?        Yes     No

Vegetation accumulating?      Yes     No

Erosion or slope instability?    Yes     No

Excessive tree growth?         Yes     No

Trash or debris?                 Yes     No

Pollution (oils, gas, etc.)?    Yes     No

Underdrain blocked?            Yes     No  n/a

Maintenance required?         Yes     No

Scheduled on: \_\_/\_\_/\_\_         or n/a

Completed on: \_\_/\_\_/\_\_         or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Location: \_\_\_\_\_

Type:                      Rain Garden     Other

Functioning properly?            Yes     No

Inlet blocked?                    Yes     No

Sediment accumulating?        Yes     No

Vegetation accumulating?      Yes     No

Erosion or slope instability?    Yes     No

Excessive tree growth?         Yes     No

Trash or debris?                 Yes     No

Pollution (oils, gas, etc.)?    Yes     No

Underdrain blocked?            Yes     No  n/a

Maintenance required?         Yes     No

Scheduled on: \_\_/\_\_/\_\_         or n/a

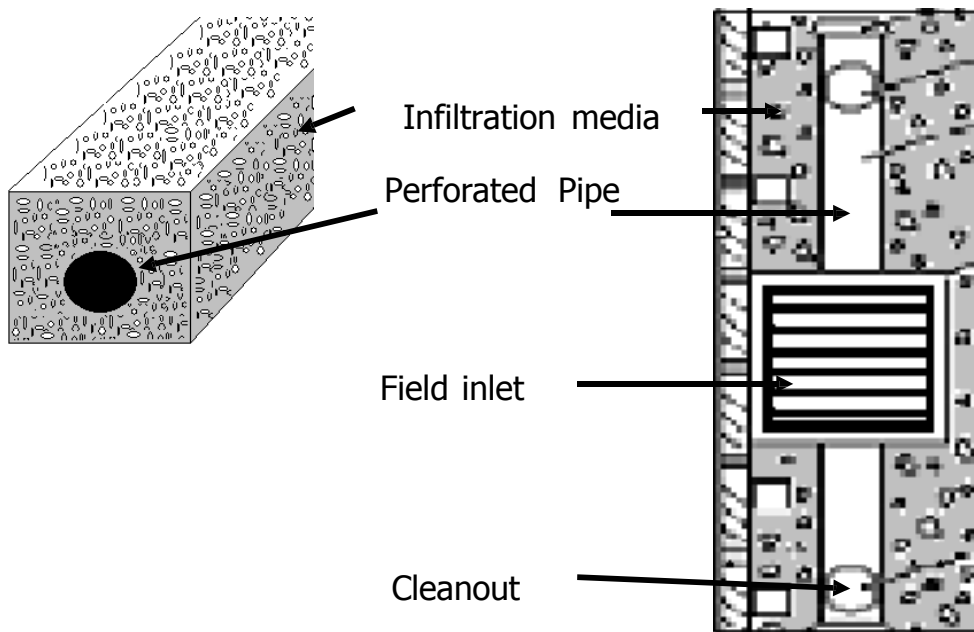
Completed on: \_\_/\_\_/\_\_         or n/a

Maintenance description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Infiltration Basins and Trenches

Infiltration basins are shallow surface impoundments that temporarily store, capture and infiltration runoff over a period of several days on a level and uncompacted surface. A stormwater infiltration trench is a closed basin built by excavating below existing ground. Infiltration trenches temporarily store stormwater runoff during rain events. Infiltration trenches do not discharge to a downstream conveyance system or nearby surface water. Instead, infiltration trenches rely on the ability of the site's soils to infiltrate the stormwater into the ground.



<b>Infiltration Basins &amp; Trenches</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance And Expected Results</b>
General	Sediment Accumulation	Sediment depth exceeds 2 inches.	Remove sediment deposits while minimizing disturbance to vegetated areas. If depositions persist review the site conditions to determine the source and if pretreatment is necessary. Area should infiltrate water according to the design standard.
	Poor Vegetation Coverage	Plantings are insufficient to stabilize the infiltration area	Determine why plant growth is poor and correct that condition. Re-plant according to the planting design and provide additional water if necessary to allow the vegetation to reestablish.
	Vegetation	When the grass becomes excessively tall (greater than 12-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Underdrain	Underdrain inlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris
	Erosion/Scouring	Eroded or scoured bottom in linear devices due to flow channelization, or higher flows.	Slopes should be restored stabilized using appropriate erosion control measures. Channelized erosion or scouring may require the installation of turf reinforcement mat if conditions warrant.
	Stone washouts	Areas covered with stone or other hard-scaping have exposed soils or substrate showing through	Replace missing material to design condition so that no underlying substrate is exposed.

# INFILTRATION TRENCH OR BASIN INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_/\_\_/\_\_

Location: \_\_\_\_\_

Type:	Basin <input type="checkbox"/>	Trench <input type="checkbox"/>	
Functioning properly?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Inlet blocked?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Sediment accumulating?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Vegetation accumulating?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Erosion or slope instability?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Excessive tree growth?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Trash or debris?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Pollution (oils, gas, etc.)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Underdrain blocked?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	n/a <input type="checkbox"/>
Maintenance required?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Scheduled on: __/__/__	or n/a <input type="checkbox"/>		
Completed on: __/__/__	or n/a <input type="checkbox"/>		

Maintenance description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Location: \_\_\_\_\_

Type:	Basin <input type="checkbox"/>	Trench <input type="checkbox"/>	
Functioning properly?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Inlet blocked?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Sediment accumulating?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Vegetation accumulating?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Erosion or slope instability?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Excessive tree growth?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Trash or debris?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Pollution (oils, gas, etc.)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Underdrain blocked?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	n/a <input type="checkbox"/>
Maintenance required?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Scheduled on: __/__/__	or n/a <input type="checkbox"/>		
Completed on: __/__/__	or n/a <input type="checkbox"/>		

Maintenance description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Location: \_\_\_\_\_

Type:	Basin <input type="checkbox"/>	Trench <input type="checkbox"/>	
Functioning properly?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Inlet blocked?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Sediment accumulating?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Vegetation accumulating?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Erosion or slope instability?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Excessive tree growth?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Trash or debris?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Pollution (oils, gas, etc.)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Underdrain blocked?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	n/a <input type="checkbox"/>
Maintenance required?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Scheduled on: __/__/__	or n/a <input type="checkbox"/>		
Completed on: __/__/__	or n/a <input type="checkbox"/>		

Maintenance description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Location: \_\_\_\_\_

Type:	Basin <input type="checkbox"/>	Trench <input type="checkbox"/>	
Functioning properly?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Inlet blocked?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Sediment accumulating?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Vegetation accumulating?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Erosion or slope instability?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Excessive tree growth?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Trash or debris?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Pollution (oils, gas, etc.)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Underdrain blocked?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	n/a <input type="checkbox"/>
Maintenance required?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Scheduled on: __/__/__	or n/a <input type="checkbox"/>		
Completed on: __/__/__	or n/a <input type="checkbox"/>		

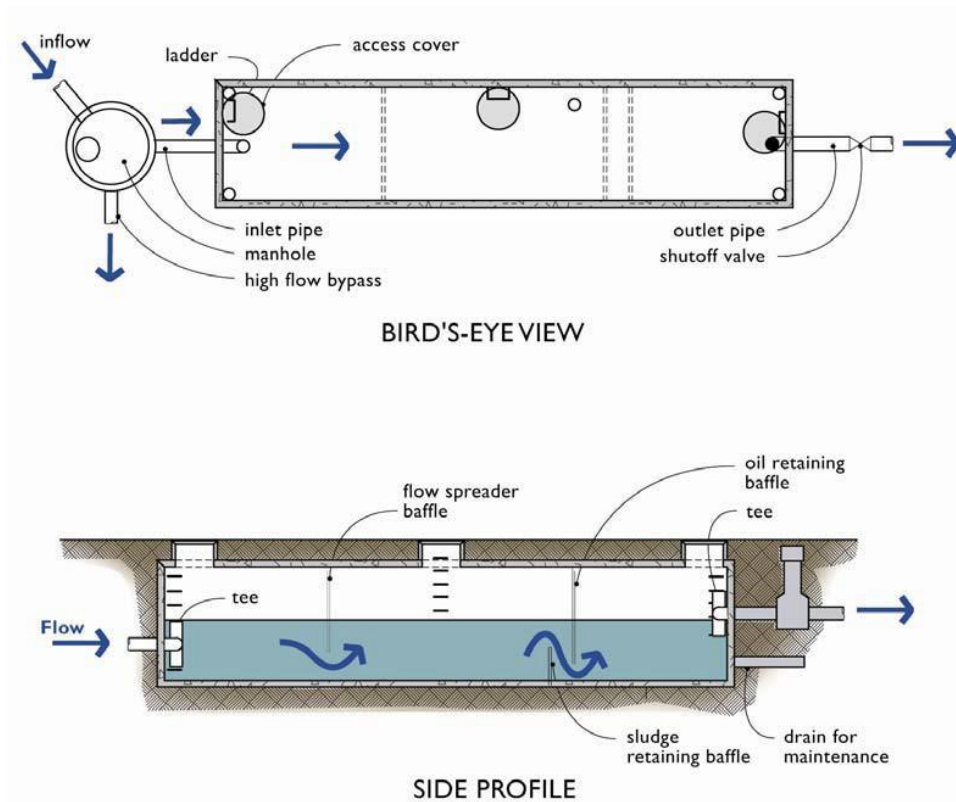
Maintenance description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## Oil/Water or Grit Separator

An oil/water separator is an underground vault that treats stormwater by mechanically separating oil from water. The oil rises to the surface and floats on the water and sediment settles to the bottom. Oil/water separators are typically utilized in locations where high oil concentrations in the stormwater runoff are anticipated (e.g. service and fuel stations). Oil/water separators are most commonly used as the first pre-treatment facility in a series of stormwater management facilities.

Grit separators are similarly designed. By slowing the water flow down as it passes through the device, solids (grit) settle out by gravity to the bottom of separator. Grit separators are used in locations where there are high sand or solids concentrations, such as vehicle wash areas or vector/street sweeping washout areas.



<b>Oil/Water or Grit Separator</b>			
<b>Drainage System Feature</b>	<b>Potential Defect</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Maintenance and Expected Results</b>
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality (i.e. obvious oil or other contaminants present)	Effluent discharge from vault should be clear without thick visible sheen.
	Floatable Material and Sediment Accumulation	Accumulated floatable material and bottom sediment exceeds 25% of the total capacity.	No sediment deposits on vault bottom that would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
		Maintenance person judges that structure is unsound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
Inlet and/or Outlet Tee	Tee is missing or turned sideways, such that the entering or exiting water is not dispersed.	Tee is securely in place and functioning properly.	



# OIL/WATER OR GRIT SEPARATOR INSPECTION FORM

Staff Person Conducting Inspection: \_\_\_\_\_ Date: \_\_/\_\_/\_\_

Location: \_\_\_\_\_

- Functioning properly? Yes  No
- Chamber contents >25%? Yes  No
- Visible trash or debris? Yes  No
- Damaged pipes? Yes  No
- Damaged access covers? Yes  No
- Internal structural damage? Yes  No
- Inlet or Outlet Tee? Yes  No
- Maintenance required? Yes  No
- Scheduled on: \_\_/\_\_/\_\_ or n/a
- Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Location: \_\_\_\_\_

- Functioning properly? Yes  No
- Chamber contents >25%? Yes  No
- Visible trash or debris? Yes  No
- Damaged pipes? Yes  No
- Damaged access covers? Yes  No
- Internal structural damage? Yes  No
- Inlet or Outlet Tee? Yes  No
- Maintenance required? Yes  No
- Scheduled on: \_\_/\_\_/\_\_ or n/a
- Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Location: \_\_\_\_\_

- Functioning properly? Yes  No
- Chamber contents >25%? Yes  No
- Visible trash or debris? Yes  No
- Damaged pipes? Yes  No
- Damaged access covers? Yes  No
- Internal structural damage? Yes  No
- Inlet or Outlet Tee? Yes  No
- Maintenance required? Yes  No
- Scheduled on: \_\_/\_\_/\_\_ or n/a
- Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Location: \_\_\_\_\_

- Functioning properly? Yes  No
- Chamber contents >25%? Yes  No
- Visible trash or debris? Yes  No
- Damaged pipes? Yes  No
- Damaged access covers? Yes  No
- Internal structural damage? Yes  No
- Inlet or Outlet Tee? Yes  No
- Maintenance required? Yes  No
- Scheduled on: \_\_/\_\_/\_\_ or n/a
- Completed on: \_\_/\_\_/\_\_ or n/a

Maintenance description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## **Operational BMPs**

Municipal operations and maintenance activities have the potential to negatively impact stormwater quality. Operational BMPs refer to the common practices and procedures listed in the table below, that can prevent the discharge of polluting materials to the MS4 or surface waters. The following operational BMPs have been developed and are being implemented to ensure compliance with operation and maintenance requirements and to effectively minimizing pollutant runoff to the maximum extent practicable from municipal operations.

### Municipal Operations & Maintenance

Operational BMPs	Potential Pollutants									
	Sediment	Nutrients	Trash	Metals	Bacteria	Oil & Grease	Organics	Pesticides	Oxygen Demanding Substances	Salt
Road, Parking Lot Bridge & Sidewalk Maintenance	x	x	x	x	x	x	x		x	x
ROW & Vegetated Property Maintenance	x	x	x		x			x		
Unpaved Road Maintenance	x									
Cold Weather operations	x									x
Fleet Maintenance	x			x		x	x			
Building & Grounds	x	x	x		x		x	x	x	
Solid Waste Handling and Disposal	x	x	x	x	x	x	x	x	x	
Materials Storage	x	x	x	x		x	x	x	x	x
Spill Response and Prevention	x	x	x	x	x	x	x	x	x	x

## Road, Sidewalk, Parking Lot and Bridge Maintenance

### General

Streets, roads, highways, bridges, sidewalks and parking lots are potential sources of pollutants to stormwater and waters of the state. Operation and maintenance (O&M) practices, if not conducted properly, can contribute to the problem. Stormwater pollution from roadway, sidewalk, parking lot and bridge maintenance should be addressed on a site-specific basis.

### Procedures

#### ***Street Sweeping and Cleaning***

Street sweeping frequency is based on factors including but not limited to traffic volume, land use, field observations of sediment and trash accumulation and citizen complaints.

- Street sweeping prioritization and intervals are identified in the SWMP.
- Perform street cleaning during dry weather when possible.
- Maintain cleaning equipment in good working condition and operate according to manufacturer specifications
- If available use vacuum or regenerative air sweepers.
- Keep record of the areas swept and/or the amount of waste collected.
- Material will be dewatered (if necessary) and stored in a manner that prevents it from discharging in to the MS4 or to waters of the state.
- Disposal of street sweeping debris will occur in accordance with Parts 115 & 121 of Act 451 of 1994 (Natural Resources and Environment Protection Act)

#### ***Street Repair and Maintenance***

##### *Pavement marking*

- Schedule pavement marking activities for dry weather.
- Properly use, storage, and disposal of paints.
- Properly maintain application equipment.
- Street sweep thermoplastic grindings.
- Use water based paints when possible.

##### *Concrete installation and repair*

- Schedule asphalt and concrete activities for dry weather.
- Take necessary measures to protect adjacent storm drain inlets and watercourses from demolished asphalt or concrete.
- When making saw cuts in pavement, minimize water use and avoid wet weather when possible. Prevent slurry from entering storm drain inlets.
- Avoid discharging ready-mix concrete truck wash water into drainage system.

### *Patching, resurfacing, and surface sealing*

- When possible schedule patching, resurfacing and surface sealing during dry weather.
- Avoid stockpiling materials adjacent to storm drain inlets or watercourses.
- During wet weather, protect patching material from runoff into the drainage system.
- Protect storm drain inlets from seal coat, slurry seal, etc.
- Minimize amount of water used for dust control.
- Sweep, instead of hose down streets to clean up tracked dirt.

### *Equipment cleaning maintenance and storage*

- Inspect equipment and repair fluid leaks.
- Perform major equipment repairs in the designated area
- If refueling or repairing vehicles and equipment must be done onsite, use a location away from storm drain inlets and watercourses.

## ***Bridge and Structure***

### *Paint and Paint Removal*

- Transport paint and materials to and from job sites in containers with secure lids
- Avoid transferring or loading paint near storm drain inlets or watercourses.
- Test and inspect spray equipment prior to starting to paint.
- When possible schedule graffiti removal activities during dry weather.
- Plug nearby storm drain inlets prior to starting painting where there is significant risk of a spill reaching storm drains.
- If sand blasting is used to remove paint, cover adjacent storm drain inlets prior to starting work.
- Perform work on a maintenance traveler or platform, or use suspended netting or tarps to capture paint, rust, paint removing agents, or other materials, to prevent discharge of materials to surface waters if the bridge crosses a watercourse. If sanding, use a sander with a vacuum filter bag.
- Properly dispose of paint and any toxic cleanup water.

### *Repair Work*

- Prevent concrete, steel, wood, metal parts, tools, or other work materials from entering storm drains or watercourses.
- Clean up the job site when the repair work is completed.

## ***Parking Lots***

### *Maintenance*

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

#### *Repair Work*

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

## Right-Of-Way (ROW) & Vegetated Property Maintenance

### General

ROW & Landscape maintenance activities include vegetation removal, herbicide and insecticide application, fertilizer application, watering, and other vegetation maintenance practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute sediment, nutrients, trash and pesticides to the MS4 or waters of the state. Use of the procedures outlined below can prevent or reduce the discharge of pollutants to stormwater during ROW and other landscape maintenance.

### Procedures

#### *Mowing, Trimming, and Weeding*

- Whenever possible use mechanical methods of vegetation removal (e.g. mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Mulching mowers may be recommended for flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect non-mulched grass clippings, pruning waste, tree trimmings, and weeds and dispose of at the designated yard waste disposal site.

#### *Planting*

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

#### *Waste Management*

- Do not dispose of collected vegetation into waterways or storm drainage systems. Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

### *Irrigation*

- Where practical, use automatic timers to minimize runoff.
- Where feasible install an override to shut off irrigation during rain events.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

### *Fertilizer and Pesticide Management*

- Pesticide application must be conducted by a State of Michigan certified pesticide applicator. (See other considerations listed below)
- Follow all federal, state, and local laws and regulations governing the application, use, storage, and disposal of fertilizers and pesticides including training and certification of applicators.
- Do not apply pesticides or fertilizer if rain is expected.
- Apply pesticides and fertilizer only when wind speeds are low.
- Do not mix or prepare pesticides or fertilizer for application near storm drains.
- Prepare the minimum amount of pesticide or fertilizer needed for the job and use the lowest effective application rate.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

### **Other Considerations**

- Pesticide use is regulated by the following: Michigan Act 24 – New Pesticide Requirements; Act 451, Part 83, Pesticide Control; Regulation 633, Restricted Use Pesticides; Regulation 636, Pesticide Applicators; and Regulation



637, Pesticide Use. Links can be found on the Michigan Department of Agriculture's Web site (see below). These acts and regulations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping.

- The Michigan Department of Agriculture coordinates and maintains the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- The Michigan Acts have imposed requirements on school districts regarding pesticide use in schools, public buildings and health care facilities. An IPM program must be in place. Also for schools and daycares, written notification must be sent to the parents or guardians of the children before pesticides are applied on school property. All applicators must attend a training program approved by the Michigan Department of Agriculture.

## Unpaved Road Maintenance

### General

Unpaved roads differ from paved in both design and maintenance. The surface of roads are shaped, compacted, and smoothed so that surface water will move quickly from the road surface into established ditches. For an unpaved road to shed water properly, it should have a tight, impervious surface. This requirement calls for a higher percentage of fine, which act as a binding agent for the surface. Unpaved roads have more fines than the base gravel under asphalt pavement. Unpaved surfaces with a small amount of fines do not have enough of this binder to hold the surface together when the weather is dry. As the surface falls apart, the loose material is thrown to the shoulders and ditches, and into the air as dust by vehicular traffic. Ruts, corrugations and potholes may then appear.

Unpaved road maintenance activities include grading, shaping and the addition of gravel. These maintenance practices have the potential to contribute sediment to the MS4 or waters of the state. Use of the procedures outlined below can prevent or reduce the discharge of pollutants to stormwater during unpaved road maintenance.

### Procedures

#### *Dust Control*

- Divert runoff through vegetated filter areas and or rock-lined turnouts
- Avoid sending stormwater runoff directly to surface waters
- Keep runoff velocities low and avoid concentrating runoff
- Minimize areas of disturbance and stabilize disturbed areas
- Road graders should travel at top speeds of 3-5 miles per hour to minimize displacement of dust and
- Use the correct type of gravel for the application. Gravel is a mixture of three sizes of material, stone sand and fines. Without the correct blend gravel will perform poorly.

#### *Grading and Shaping*

- Grade roads in the spring as soon as the frost leaves the ground, or as soon as possible after rain while the surface materials are still moist but not wet.
- Limit road surface to that which can be stabilized by the end of the workday.
- Do not perform maintenance if rain is in the forecast (after rain is best).
- Properly crown and compact of the road surface hastens the removal thereby reducing road surface erosion.
- Do not stockpile grading materials near surface waters.

## Cold Weather Operations

### General

Cold weather operations include plowing, sanding, deicing, and snow pile storage and disposal. These operations have the potential to discharge sediment and salt to the MS4 and waters of the state. The application and storage of deicing materials, most commonly sodium chloride, can lead to water quality problems for surrounding areas. Salts are applied to streets to reduce the amount of ice during winter storm events. Salts lower the melting point of ice, allowing roadways to stay free of ice buildup during cold winters making travel safer. Salt storage requirements of the State of Michigan Part 5 Rules (Rules 324.2001 through 324.2009) of Act 451 of 1994, as amended, must be followed. Implementing the following management practices can help minimize the discharge of pollutants.

### Procedures

- Sand, salt and other deicers applied for improved traction on roads and parking lots shall be prevented from enter municipal storm sewers and receive waters to the maximum extent practicable.
- Use the minimum amount of salt needed to get the job done.
- Consider pre-wetting of salt or use brine solution as a way to reduce and better control salt applications.
- Salt should be stored under cover to prevent loss due to runoff.
- Salt application rates and frequency should be based on traffic volume, road grade and curvature, intersections, and weather conditions.
- Good housekeeping procedures shall be practice at salt and sand storage facilities to prevent the discharge of salt and stand from these areas
- During loading or unloading, good housekeeping practices shall be observed to limit the amount of residual salt and sand left in an open environment. Care shall be taken to scrape, sweep, or remove salt and sand and place in the covered storage areas.
- Discharge wash water from trucks used for salting into sanitary sewers.
- Cleanup loading area after winter storm events that require salt application.
- Snow piles storage will occur in vegetated areas wherever feasible to allow snow melt to infiltrate and vegetation to filter suspended solids, salt and other pollutants.
- In areas where snow cannot be stored in a vegetated areas adjacent catch basins will be protected from the discharge of pollutants during melting events.
- Snow will not be disposed of via the MS4 or surface waters.

## Fleet Maintenance

### Inspection

A comprehensive inspection of fleet maintenance facilities with an identified high potential for pollutant discharge should occur once every six months and include inspection of fueling areas, storage tanks, catch basin inserts, containment areas, and drip pans.

### Vehicle and Equipment Fueling

Spills and leaks that occur during vehicle and equipment fueling can contribute hydrocarbons, oil and grease, as well as heavy metals to stormwater runoff. Implementing the following management practices can help prevent fuel spills and leaks. The potential for pollutant discharge can be reduced through source control, pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### Procedures

#### *General*

- "Spot clean" leaks and drips routinely. Leaks are not cleaned up until the absorbent is picked up and disposed of properly.
- Post signs to remind employees not to top off the fuel tank when filling.
- Report leaking vehicles to supervisor.
- Install inlet catch basin equipped with a small sedimentation basin or grit chamber to remove large particles from stormwater in highly impervious areas. Proper maintenance of these devices is necessary.
- Ensure the following safeguards are in place:
  - Overflow protection devices on tank systems to warn the operator to automatically shutdown transfer pumps when the tank reaches full capacity.
  - Protective guards around tanks and piping to prevent vehicle or forklift damage.
  - Clearly tagging or labeling all valves to reduce human error.
  - Automatic shut off for severed fuel hoses.

#### *Fuel Dispensing Areas*

- Maintain clean fuel-dispensing areas using dry cleanup methods such as sweeping for removal of litter and debris, or use of rags and absorbents for leaks and spills. Do not wash down areas with water.

- Comply with Part 211, Underground Storage Tank Regulations, of Act 451 of 1994, as amended, and the [Michigan Underground Storage Tank Rules \(MUSTR\)](#)
- Fit fuel dispensing nozzles with "hold-open latches" (automatic shutoffs) except where prohibited by local fire departments.
- Post signs at the fuel dispenser or fuel island warning vehicle owners/operators against "topping off" of vehicle fuel tanks.
- Design fueling area to prevent stormwater runoff and spills.
- Cover fueling area with an overhanging roof structure or canopy so that precipitation cannot come in contact with the fueling area and if possible use a perimeter drain or slope pavement inward with drainage to a blind sump (must be properly maintained and water properly disposed of); pave area with concrete rather than asphalt.
- Apply a suitable sealant that protects the asphalt from spilled fuels in areas where covering is infeasible and the fuel island is surrounded by pavement.
- Use secondary drip containment when transferring fuel from the tank truck to the fuel tank.

## Vehicle and Equipment Cleaning

Wash water from vehicle and equipment cleaning activities performed outdoors or in areas where wash water flows onto the ground can contribute toxic hydrocarbons and other organic compounds, oils and greases, nutrients, phosphates, heavy metals, and suspended solids to stormwater runoff. Use of the procedures outlined below can prevent or reduce the discharge of pollutants to stormwater during vehicle and equipment cleaning. Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives. In general, use properly maintained off-site commercial washing and steam cleaning businesses whenever possible. These businesses are better equipped to handle and properly dispose of the wash waters.

### Procedures

#### *General*

- Use off-site, professional vehicle wash services if no onsite area directs wash water to the sanitary sewer
- Use biodegradable, phosphate-free detergents for washing vehicles as appropriate.
- Mark the area clearly as a wash area.
- Provide a trash container in wash area.

#### *Vehicle and Equipment Cleaning*

- Consider washing vehicles and equipment inside the building if washing/cleaning must occur on-site. This will help to control the targeted constituents by directing them to the sanitary sewer.
- If washing must occur on-site and outdoor, use grassy or impervious areas
- Perform pressure cleaning and steam cleaning off-site to avoid generating runoff with high pollutant concentrations. If done on-site, no pressure cleaning and steam cleaning should be done in areas designated as wellhead protection areas for public water supply.

### *Disposal*

- Discharge equipment wash water to the sanitary sewer, a holding tank, or a process treatment system, regardless of the washing method used.
- Discharge vehicle wash water to (1) the sanitary sewer, a holding tank, or process treatment system or (2) an enclosed recycling system.
- Discharge wash water to sanitary sewer only after contacting the Clean Water Plant to find out if pretreatment is required.

## **Vehicle and Equipment Repair**

Vehicle or equipment maintenance and repair is potentially a significant source of stormwater pollution, due to the use of materials and wastes created that are harmful to humans and the environment. Engine repair and service (e.g. parts cleaning), replacement of fluids (e.g. oil change), and outdoor equipment storage and parking (dripping engines) can impact water quality if stormwater runoff from areas with these activities occurring on them becomes polluted by a variety of contaminants. Implementation of the following activities will prevent or reduce the discharge of pollutants to stormwater from vehicle and equipment maintenance and repair activities.

### **Procedures**

#### *General*

- Move maintenance and repair activities indoors whenever feasible.
- Otherwise, cover the work area so as to limit exposure to the rain.
- Wherever possible, store idle equipment containing fluids under cover.
- Use a vehicle maintenance area designed to prevent stormwater pollution – either indoors or minimize contact of stormwater with outside operations through berming and appropriate drainage routing.
- Avoid hosing down your work areas. If work areas are washed, collect and direct wash water to sanitary sewer.

- Mark storm drain inlets to indicate that they are not to receive liquid or solid wastes.
- Clean yard storm drain inlets(s) regularly.
- Do not pour materials down drains or hose down work areas; use dry sweeping.

### *Material and Waste Handling*

- Store materials and wastes under cover whenever possible.
- Designate a special area to drain and replace motor oil, coolant, and other fluids. This area should not have any connections to the storm drain or the sanitary sewer and should allow for easy clean up of drips and spills.
- Drain all fluids from wrecked vehicles immediately. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).
- Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- Dispose of all waste materials according to applicable laws and regulations.
- Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.
- Promptly transfer used fluids to the proper waste or recycling drums and store in an appropriately designed area that can contain spills. Don't leave drip pans or other open containers lying around.
- Do not dispose of oil filters in trash cans or dumpsters, which may leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Most municipalities prohibit or discourage disposal of these items in solid waste facilities. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.
- Store cracked and/or dead batteries in a non-leaking covered secondary container and dispose of properly at recycling or household hazardous waste facilities.

### *Maintenance and Repair Activities*

- Provide a designated area for vehicle maintenance.
- Keep equipment clean; don't allow excessive build-up of oil and grease.
- If temporary work is being conducted outside: Use a tarp, ground cloth, or drip pans beneath the vehicle or equipment to capture all spills and drips., The collected drips and spills must be disposed, reused, or recycled properly.
- If possible, perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills:
  - Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, or remove other parts. Use a drip pan under any vehicle that might leak while you work on it to keep splatters or drips off the shop floor.

- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave drip pans or other open containers lying around.
- Keep drip pans or containers under vehicles or equipment that might drip during repairs.
- Do not change motor oil or perform equipment maintenance in non-appropriate areas.
- If equipment (e.g., radiators, axles) is to be stored outdoors, oil and other fluids should be drained first. This is also applicable to vehicles being stored and not used on a regular basis.
- Monitor parked vehicles closely for leaks and place pans under any leaks to collect the fluids for proper disposal or recycling.

### *Parts Cleaning*

- Clean vehicle parts without using liquid cleaners wherever possible to reduce waste.
- Do all liquid cleaning at a centralized station so the solvents and residues stay in one area.
- Discharge wastewater generated from steam cleaning and pressure washing to an appropriate treatment control that is connected to a blind sump. Non-caustic detergents should be used instead of caustic cleaning agents, detergent-based or water-based cleaning systems in place of organic solvent degreasers, and non-chlorinated solvent in place of chlorinated organic solvents for parts cleaning.
- Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.



## Solid Waste Handling and Disposal

### General

Proper waste handling ensures that waste generated onsite or during maintenance activities does not come into contact with stormwater runoff or surface waters. Waste reduction is also a major component of waste management and should be encouraged through training and periodic procedure review. Management of waste once it is collected may involve reuse, recycling, or proper disposal.

### Procedures

#### *Solid Waste Collection*

For solid waste generated at owned or operated facilities, the following procedures should be followed:

- All trash dumpsters must have lids or be placed under a covered area.
- Regularly inspect solid waste containers for structural damage. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).
- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.
- Recycle whenever possible

#### *Dewatering, Storage and Disposal of Catch Basin and Street Sweeping Waste*

- If materials collected during catch basin cleaning and street sweeping will be dewatered prior to disposal, dewatering is to occur where no discharge to the MS4 or surface waters will occur.
- Materials stored onsite awaiting disposal should be covered or otherwise protected from precipitation and prevented from discharging liquids or solids into the MS4 or surface waters.
- Disposal locations are identified in their respective BMP tables

## Materials Storage

### General

Outdoor raw materials and material storage areas which are exposed to rain and/or runoff can pollute stormwater. Materials include any items used in municipal operations that could have the potential to pollute stormwater or surface waters if discharged including, but not limited to chemicals, oils solvents, pesticides or waste. Raw materials typically include sand, topsoil, asphalt, or other construction materials.

Improper storage of these materials can result in accidental spills discharge to the MS4 or surface waters. Use the procedures below to prevent and minimize the discharge of pollutants to the stormwater drainage system from material storage areas.

### Procedures

- Inventories should be kept of stored materials.
- Minimize inventory of materials.
- Try to keep chemicals in their original containers, and keep them well labeled.
- Avoid storing chemicals, drums, or bagged materials directly on the ground.
- Store materials indoors or under covered areas whenever possible.
- Keep outdoor storage areas in good condition.
- Prevent stormwater transport of eroded stockpile material.
- Keep outdoor storage areas and containers in good condition.
- Minimize the pooling of water on the site.
- Tanks should be surrounded by secondary containment if required
- Conduct periodic inspections of storage areas, material containers, and storage tanks.
- Comply with the Standard Operating Procedure identified in the stormwater management plan for any facility with a high potential for pollutant discharge.
- Have an employee trained in spill containment and cleanup present during loading/unloading of dangerous waste and hazardous materials.

## Spill Response and Prevention

### General

Spill response and prevention is an important part of operational BMPs. All staff and contractors should be trained to prevent and respond to spills as instructed in the Pollution Incident Prevention Plan (PIPP) if one is required. Depending on the nature of the material spilled, spills have the potential to discharge sediment, nutrients, trash, metals, bacteria, oil/grease, organics, pesticides, oxygen demanding substances, and salt in to the MS4 or waters of the state. In addition the following procedures are recommended for all sites with or without a PIPP:

### Procedures

- Do not store potentially polluting materials near storm drains or surface waters.
- When working on municipal operations near storm drains or surface waters protect these areas from the discharge of potentially polluting materials.
- Have adequate stockpiles of spill cleanup materials and/or a spill kit readily available and in a known location.
- Store portable absorbent booms or soak up in, or near un-bermed fueling areas.
- Cleanup leaks, drips and spills immediately. Use dry methods if possible, such as the application of adsorbent materials and sweeping.
- Never hose down a spill.
- Properly dispose of spill cleanup material including prompt removal of adsorbent materials.
- Report spills promptly.

## References:

Agencies Association (BASSMA) <http://www.basmaa.org/>

Alameda Countywide Clean Water Program on-line

Association (BASMAA) <http://www.basmaa.org/>

Best Management Practice Guide for Retail Gasoline Outlets, California Stormwater Quality Task Force. 1997.

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

DTSC Doc. No. 619a Switching to Water Based Cleaners

DTSC Doc. No. 621 <http://www.stormwatercenter.net/>

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

Francisco, Uribe & Associates, Oakland, California, 1990.

Greater Lansing Regional Committee **Good Housekeeping and Pollution Prevention Manual for Municipal Activities** <http://www.mywatersheds.org/housekeeping.html>

Harvard University. 2002. Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety.

[http://ladpw.org/wmd/npdes/model\\_links.cfm](http://ladpw.org/wmd/npdes/model_links.cfm)

<http://www.ci.berkeley.ca.us/pw/Storm/stormala.html>

<http://www.deq.state.mi.us/documents/deq-swq-nps-wrm.pdf>

<http://www.dnr.metrokc.gov/wlr/dss/spcm.htm>

<http://www.mto.gov.on.ca/english/engineering/roadsalt.htm>

[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

<http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf>

<http://www.saltinstitute.org/>

<http://www.saltinstitute.org/snowfighting/index.html>

<http://www.stormwatercenter.net/>

<http://www.usroads.com/journals/p/rmj/9712/rm971202.htm>

[http://www.warrenswcd.org/files/RRAMP\\_Manual.pdf](http://www.warrenswcd.org/files/RRAMP_Manual.pdf)

King County - <ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF>

King County Stormwater Pollution Control Manual - <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995.

King County Surface Water Management. July. On-line: <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Los Angeles County Stormwater Quality. Public Agency Activities Model Program. On-line: [http://ladpw.org/wmd/npdes/public\\_TC.cfm](http://ladpw.org/wmd/npdes/public_TC.cfm)

Metropolitan Area Planning Council Fact Sheet: Permeable Paving. <http://www.mapc.org/resources/low-impact-dev-toolkit/permeable-paving>

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July 1998 (Revised February 2002 by the California Coastal Commission).

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Municipal Activities Model Program Guidance. 2001. Project Clean Water. November.

Orange County Stormwater Program [http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) <http://www.basma.org>

RURAL ROADS ACTIVE MANAGEMENT PROGRAM (RRAMP) For the municipalities located in the Lake Champlain Watershed of New York San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1998. Water Utility Operation and Maintenance Discharge Pollution Prevention Plan. June

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Fresh Concrete and Mortar Application Best Management Practices for the Construction Industry. June.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Roadwork and Paving Best Management Practices for the Construction Industry. June.

This BMP was taken from the Greater Lansing Regional Committee **Good Housekeeping and Pollution Prevention Manual for Municipal Activities** <http://www.mywatersheds.org/housekeeping.html>

United States Environmental Protection Agency (USEPA). 1999. Stormwater Management Fact Sheet Non-stormwater Discharges to Storm Sewers. EPA 832-F-99-022. Office of Water, Washington, D.C. September.

United States Environmental Protection Agency (USEPA). 1999. Stormwater O&M Fact Sheet Catch Basin Cleaning. EPA 832-F-99-011. Office of Water, Washington, D.C. September.

United States Environmental Protection Agency (USEPA). 2001. Illicit Discharge Detection and Elimination. On-line: [http://cfpub.epa.gov/npdes/stormwater/menuofbmps/illi\\_1.cfm](http://cfpub.epa.gov/npdes/stormwater/menuofbmps/illi_1.cfm)

United States Environmental Protection Agency (USEPA). 2001. Pollution Prevention/Good Housekeeping for Municipal Operators Septic System Controls. On-line: [http://www.epa.gov/npdes/menuofbmps/poll\\_14.htm](http://www.epa.gov/npdes/menuofbmps/poll_14.htm)

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Illegal Dumping Control. On line: [http://www.epa.gov/npdes/menuofbmps/poll\\_7.htm](http://www.epa.gov/npdes/menuofbmps/poll_7.htm)

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Roadway and Bridge Maintenance. On-line [http://www.epa.gov/npdes/menuofbmps/poll\\_13.htm](http://www.epa.gov/npdes/menuofbmps/poll_13.htm)

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: [http://www.epa.gov/npdes/menuofbmps/poll\\_8.htm](http://www.epa.gov/npdes/menuofbmps/poll_8.htm)