STORMWATER BEST MANAGEMENT PRACTICE OPERATION AND MAINTENANCE PLANNING GUIDE

to assist in the development of maintenance plans

required by municipalities in West Michigan

Prepared by

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Macatawa Area Coordinating Council
A Cooperative Effort Among Units of Government

MACATAWA WATERSHED PROJECT

Cover Photos (MACC)

Left: permeable pavers in a parking lot in Traverse City, MI

Center: stormwater pond in a subdivision in Zeeland, MI

Right: rain garden in a parking lot in Holland, MI

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Background and Purpose

Ottawa County, Allegan County, the City of Holland, and the City of Zeeland have been implementing stormwater management plans in compliance with the State of Michigan's municipal separate storm sewer system (MS4) permit since 2003. They amended their permit applications in 2013 to, among other revisions, update performance standards for **water quality treatment** and **channel protection** associated with post-construction stormwater runoff control. The performance standards are required under the State of Michigan's MS4 permit to ensure that negative downstream impacts do not occur as a result of development. New and redevelopment projects in urbanized areas must follow these standards if subject to plan review (contact the local municipality for specific criteria). The local municipality may require that other types of development, including those in non-urbanized areas, follow the same standards. Ottawa and Allegan County work with their urbanized municipalities to implement and enforce the performance standards. In most cases this occurs through local adoption of Stormwater Ordinances that require that the standards be followed and a maintenance agreement be signed to ensure that stormwater **best management practices** (BMPs) are maintained in perpetuity.

Development, especially soil compaction and increased impervious surfaces, leads to increased volumes of water running off the surface than would have naturally occurred prior to development (Figure 1). In a natural system, more water infiltrates into the soil, recharging groundwater, and very little runs off the

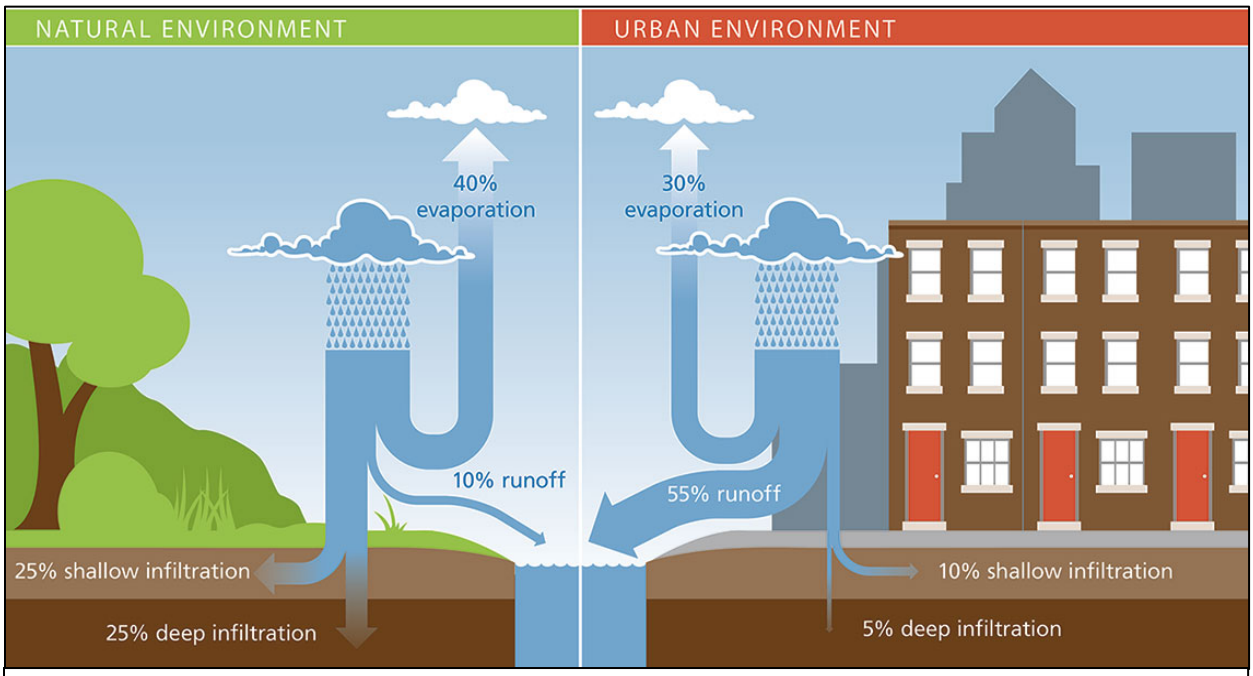

Figure 1. Comparison of natural and urban water cycles. Image: City of Philadelphia

surface. Many human activities on the land leave behind pollutants such as soil, fertilizers and other chemicals. Rain water washes this **nonpoint source pollution** off of the land into storm drains and eventually into streams and lakes where they can degrade water quality and impair wildlife habitat, recreation and other uses. Therefore along with increased runoff volumes, development can also result in increased amounts of pollution in surface water. The water quality protection performance standard is in place to minimize this impact. In addition, increased volumes of water will move faster through the

stream channel. The force of fast-moving, large volumes of water can cause excess streambank erosion that can alter the shape of the stream, disrupt connections to natural floodplains and cause downstream sedimentation that can destroy wildlife habitat. Other negative impacts could include loss of streamside property due to erosion and flooding of downstream neighborhoods or communities. The channel protection performance standard is in place to minimize these impacts downstream of a development.

Fortunately, developers can take various measures (BMPs) to retain or slow down water, protect streambanks and keep pollution out of our waterways. One way to do so is through the use of properly maintained stormwater BMPs. The revised standards will encourage the use of newer and innovative stormwater controls compared to more typical practices like detention and retention ponds. Proper operation and maintenance (O&M) of any stormwater control is essential to ensure proper function as well as meet water quality and channel protection performance standards. It is also more cost-effective to properly maintain stormwater controls as opposed to rebuilding ones that fail.

This guide is intended to assist in developing O&M plans for stormwater BMPs. Operation and maintenance plans are critical for ensuring that stormwater controls will continue to function as designed and meet water quality and channel protection performance standards well into the future. Proactively inspecting and maintaining BMPs will cost less than major repairs or full system replacements if they fail due to a lack of maintenance. Engineers, consultants or contractors should develop the O&M plan in tandem with the design of the stormwater control system.

This guide is a supplement to local site development rules for new construction and redevelopment projects that require stormwater controls. The local municipality in which a development or redevelopment is permitted may require an O&M plan in conjunction with a maintenance agreement. This guide does not include specific jurisdictional development standards, applicable ordinances, maintenance agreement language or design standards for stormwater BMPs. Contact the appropriate jurisdiction for more information related to these items. Section V includes additional references for BMP design and maintenance.

The sections of this guide are as follows:

Section I: Operation and Maintenance Plan Components

This section outlines the elements to include in a stormwater BMP O&M plan. Appendix A provides additional online resources that may help in plan development. Appendix B contains a template to help prepare a plan for site-specific stormwater BMPs. A Word version is also provided for easy editing.

Section II: Non-Structural Stormwater BMPs

This section provides information about non-structural methods to preserve and enhance site features that naturally manage stormwater. Evaluate and consider non-structural options prior to designing a structural stormwater system. These non-structural BMPs include minimizing soil compaction, protecting natural flow paths and sensitive areas, disconnecting from the storm sewer system, and using native plants. Inspect and maintain non-structural BMPs to ensure proper stormwater management.

Section III: Structural Stormwater BMPs

This section includes brief descriptions and maintenance overviews of structural stormwater BMPs. Use these overviews as standalone guides and insert them into a stormwater BMP O&M plan as applicable.

The structural BMPs include conveyance and storage structures as well as low impact development and small site BMPs.

Section IV: Stormwater BMP Inspection Checklists

This section contains inspections checklists for each of the BMPs described in Section III. These checklists provide questions to guide the inspector through a comprehensive review of all aspects and components of the BMP. The checklists include a rating system to document the current state of the BMP as well as space to record observations, corrective maintenance completed at the time of the inspection and recommendations for scheduling corrective maintenance.

Definitions

Best management practice (BMP) – effective and practical means of preventing or reducing nonpoint source pollution

Channel protection performance standard[1] (*as defined by the State of Michigan in the Permit Application for Discharge of Storm Water to Surface Waters of the State from a MS4*) – the post-construction runoff rate and volume of stormwater discharge may not exceed the **pre-development**[2] rate and volume for all storms up to the 2-year, 24-hour storm

Invasive plant – a species that is non-native to the local ecosystem whose introduction is likely to cause economic or environmental harm or harm to human health

Low impact development (LID) – systems and practices that use or mimic natural processes that result in infiltration, evapotranspiration or other uses of stormwater to protect water quality and habitat. Sometimes the term is used interchangeably with **green infrastructure** (GI), but LID is an approach to development and GI is perhaps best described as managing wet weather using these principles. GI also refers to the existing natural areas that already provide these benefits.

Municipal separate storm sewer system (MS4) – a conveyance or system of conveyances that is owned by a public entity and is designed to collect or convey stormwater. It can include storm drains, pipes, open ditches, the road, parking lots, and any associated structures such as catch basins, detention/retention ponds and other BMPs.

Nonpoint source pollution (NPS) – caused by rainwater or snowmelt moving over the ground, picking up natural and man-made pollution and delivering them to streams and lakes

Total suspended solids (TSS) – all particles in a water column that will not pass through a filter. Suspended solids can be found in sanitary and industrial waste water as well in stormwater runoff. In surface water, suspended solids absorb heat from the sun which decreases oxygen levels, and restrict the depth of sunlight which decreases aquatic plant growth. As particles settle they can smoother eggs of fish and other aquatic organisms and can suffocate newly hatched aquatic insects. Suspended solids can clog the gills of fish, reduce their growth rates and lower their resistance to disease.

Water quality treatment performance standard[1] (*as defined by the State of Michigan in the Permit Application for Discharge of Storm Water to Surface Waters of the State from a MS4*) – treatment to reduce total suspended solids (TSS) by 80% or to a level not to exceed 80 mg/L must be provided for the first 1" of runoff generated from the entire site or for 90% of all runoff producing storms for the project site.

[1] Check local development rules and/or ordinances to confirm conformance with this standard. Some may have additional requirements beyond this minimum established by the State of Michigan.

[2] The State of Michigan defines pre-development as the last land use prior to the planned new development or redevelopment. See footnote 1.

Section I: Operation and Maintenance Plan Components

It is recommended that all O&M plans for stormwater best management practices include the following sections/information:

A. Purpose (goal and objectives)
B. BMP description(s)
C. Responsible parties
D. Maintenance tasks and schedule (frequency and timing)
E. Solid waste handling procedures
F. Recordkeeping
G. Training
H. Evaluation

A. Purpose

Even though it may seem obvious, it is important to state the purpose of the plan, including goals and objectives, so that there is a benchmark against which to measure the plan's success. This includes covering the why, what, when, who, and how. A good way to start is by writing a problem or issue statement. For example, the problem statement for this guidance document could be:

> *Stormwater BMPs are essential components of any site development plan to prevent flooding and safely convey stormwater offsite. If properly designed, they can help improve water quality, provide wildlife habitat and add aesthetic value. In order to ensure that stormwater BMPs continue to provide these services long-term, it is critical to inspect and maintain them on a regular basis. Unfortunately, landowners do not always properly maintain stormwater BMPs and they can end up causing harm, such as flooding or degraded water quality. Failure of improperly maintained BMPs can be very costly to repair or replace. Proper maintenance is always important, but even more so now as new and innovative BMPs, such rain gardens and green roofs, are being more widely implemented. A thorough and robust O&M plan is critical to ensure long-term effectiveness of all stormwater BMPs and help reduce long-term O&M costs.*

Once you have defined the issue or problem that your plan will address, then determine the purpose or goal of the plan – the "why." The purpose or goal statement is a broad statement about a long-term desired outcome that will address your problem or issue statement. For example, the purpose (or goal) of this guidance document is to provide guidelines for developing a stormwater BMP O&M plan. A goal of an O&M plan could be to ensure long-term, cost-effective functionality of stormwater BMPs or to maintain compliance with a local maintenance agreement (or both).

Once the goal is clearly stated, then develop objectives. Objectives should include a measureable outcome that can be achieved in a given timeframe – the "what" and "when". For example, an objective of this guidance document is to provide easy-to-use inspection and maintenance checklists in early 2020. An objective of an O&M plan might be to train responsible parties how to properly inspect and maintain their stormwater system within 60 days of construction completion. Another could be to establish inspection and maintenance schedules that will begin 1 month after the BMP is constructed.

Develop one or more actions items for each objective. Action items specify "how" to achieve the objective and "who" will do it. For example, an action item for this guide is for MACC staff to publish the final guide

on our website. An action item in an O&M plan could be to have a designated person conduct inspections of stormwater BMPs on an annual basis and record the inspection in a database (creating the database could be another action item).

B. BMP Descriptions

Include a section that describes the specific BMPs installed on the site. This can include a general description or fact sheet about the BMPs (See Sections II and III). More importantly, provide information about the specific BMPs on site including the standards that engineers used to design them. This information is important to ensure that BMPs continue to function as designed and approved. Consider including copies of engineered drawings of each BMP as approved during the site plan review process. If the contractor altered or adjusted the installation of the BMPs in any way, replace these drawings with as-builts so the person inspecting the system has an accurate set of plans for reference.

In addition to providing detailed information about the BMPs, include detailed information about the site itself. Are there changes in topography, water table, soil type, *etc.* that could impact certain BMPs more than others? Should you inspect certain BMPs more frequently because of certain site factors?

Include a copy of the site plan that shows BMP locations, associated infrastructure and how/where they connect to a municipal storm sewer system or natural watercourse. Indicate any site specific features that may impact BMPs, such as steep slopes or high water tables. The site plan is an important tool for conducting inspections to ensure that responsible parties regularly inspect and maintain all components of the BMP or system of BMPs. The site plan is also an important tool for investigating problems or issues with the stormwater system, such as flooding or an accidental discharge of polluting materials.

C. Responsible Parties

Who is responsible for O&M may change over the lifespan of the BMP. Identify and designate responsible parties for all stages of construction: during construction of the BMP, during construction of the building or development project and after all construction activity is complete. Include specific contact information for responsible parties through these various stages. Include a procedure for notifying new responsible parties as they change through the stages or as new contractors or other participants become involved. Include specific names, addresses and contact information in the plan.

D. Maintenance Tasks and Schedule

The primary task, and arguably the most important, in any O&M plan is **inspections**. They are completed relatively quickly and identify concerns before they result in failure or cause other harm. Initially, conduct inspections at least monthly, after significant rain events and during significant seasonal events, such as fall leaf drop and spring snowmelt. Blockages, damage or other concerns are more likely to occur during weather-related or seasonal events. It is easier and more cost effective to address small concerns before they become a significant problem. After completing a full year of monthly inspections, evaluate the frequency of inspections and adjust as necessary based on the inspection results.

A regular inspection schedule may negate the need for a regular maintenance schedule, except in the case where **routine maintenance** like mowing or weeding is necessary. Schedule **corrective maintenance** as needed instead of performing maintenance with a regular frequency, saving time and money.

The specific tasks and schedule for inspection and routine maintenance will vary seasonally and based on the type of BMP. Section III provides general seasonal inspection guidelines and checklists for structural stormwater BMPs. Use the information in these guides to develop an inspection and routine maintenance schedule for all BMPs located on the site. Summarize the specific tasks and schedule in a table similar to Table 1.

Table 1. Sample Inspection and Routine Maintenance Schedule

Stormwater BMP	Activity	Spring			Summer			Fall			Winter		
		M	A	M	J	J	A	S	O	N	D	J	F
Rain Garden	Inspections	X	X	X	X	X	X	X	X	X	X	X	X
	Pull weeds		X	X									
	Mow or remove plant litter		X						X				
Detention basin – dry	Inspections	X	X	X	X	X	X	X	X	X	X	X	X
	Mow			X	X	X	X	X					

In addition to inspections and routine maintenance, describe procedures and tasks related to **corrective maintenance** to address problems discovered during inspections and **emergency maintenance** when an unexpected failure occurs.

Develop an **emergency action plan** and distribute it to users/residents of the site to communicate emergency maintenance procedures. Emergency action plans may not be necessary for all BMPs or all sites. Consider the following plan components and determine if necessary for the specific situation. Include the following information in your emergency action plan:

1. Who to contact in case of emergency. Be specific about when it is appropriate to call 911 first.
2. What constitutes an emergency (situation that threatens life, safety or health) – *e.g.* flooding, sewage discharge, system collapse or washout resulting in excess erosion, spill of a hazardous chemical or other significant pollutant
3. What does not constitute an emergency and who to contact for these issues
4. Any actions that may be acceptable for someone on site to perform
5. Expected response time (*e.g.* responsible party will perform site inspection within 24 hours of notification)
6. Response procedure (examples provided below)
    a. Inspect and determine source of problem
    b. Install immediate temporary measures to alleviate the problem
    c. Develop a plan for permanent measures or repairs including timeframe for completion and who is responsible for implementing and paying the costs
    d. All repairs and corrective maintenance will be completed within a given timeframe (typically days)
7. Contact information for other organizations that may need to be notified and a procedure to ensure they are notified
    a. Health Department or local BPW if sewage related
    b. Local municipality

c. Department of Environment, Great Lakes and Energy if a pollutant reached waters of the State (Part 5 reporting requirement, See Appendix C)
d. County Drain or Water Resources Commissioner's office if pollutant discharged to county drain
e. Part 91 agency if emergency is related to soil erosion discharge from a construction site

8. Recordkeeping procedures (See Sub-Section F)

E. Solid Waste Handling Procedures

Routine and corrective maintenance generates waste material, most commonly trash, sediment and vegetation. Handle and dispose of all waste material according to any applicable laws. Specify procedures in the O&M plan describing how to properly handle and dispose of both liquid and solid waste. Include references to applicable state or local laws.

Collect and dispose of trash in a proper trash receptacle. If possible, sort out items that can be recycled. If trash in a stormwater BMP is a persistent problem, consider adding signage, nearby trash receptacles or physical barriers.

Periodically, based on inspection findings, remove sediment and other solids from catch basins and other stormwater controls. Solid and liquid waste removed from storm sewer systems (includes all types of stormwater controls) is defined as liquid hazardous waste and must be processed according to Part 121, Liquid Industrial By-Products of NREPA (Appendix D). Review, follow and reference the "Catch Basin Cleaning Activities Guidance Document" published by the Michigan Department of Environment, Great Lakes and Energy (DEGLE) in your O&M plan (Appendix E).

F. Recordkeeping

Keep records for all inspections and types of maintenance performed on all components of the stormwater system at a given site. This information is critical to evaluate the effectiveness of the BMPs as well as the effectiveness of the inspection and maintenance procedures. At a minimum, all records should include the date, name and title of the person completing the inspection or maintenance and a description of the inspection or maintenance performed. It may also be helpful to include a copy of the site plan or simple drawing of the site to indicate where inspections or maintenance occurred. Take photos to document deficiencies found during inspections as well as the corrective maintenance performed. Section IV provides inspection checklists for specific structural BMPs. Use these or similar checklists to document simple corrective maintenance done at the time of the inspection. Additional documentation may be necessary for follow up or corrective maintenance that is completed at a later date. At a minimum, record what actions were taken and when. See sample maintenance recordkeeping form in Appendix F.

Also keep records for all routine maintenance that is completed. This can be a simple table or checklist to record dates when routine maintenance, such as mowing or weeding, occurs. This is also a good way to set and track a schedule of routine maintenance activities.

Finally, keep detailed records for any and all emergency maintenance performed. This is especially important for purposes of insurance claims, liability and other legal considerations, such as permit violations.

G. Training

Provide thorough training to any and all persons that are responsible for conducting or supervising inspections and maintenance. Training should include not only how to conduct inspections and maintenance, but also understanding the importance of stormwater management and how stormwater BMPs function.

Any person performing stormwater BMP inspection and maintenance should receive at least 8 hours of training annually. Include the following topics in a training plan:

- Health and safety
- Applicable regulations and liability
- Proper equipment use and maintenance techniques
- Consistent and accurate recordkeeping
- Waste handling procedures
- Controlling stormwater pollution through stormwater system O&M

In some cases, landowners hire private contractors to perform inspections or conduct maintenance as opposed to an employee or resident of the site. Include a statement in the plan that any contractors hired must demonstrate that their employees have received proper training in the above applicable topics.

While there is not currently a formal training program available in the State of Michigan, there are a number of resources that can be used to develop a simple training program (See Appendix A).

H. Evaluation

Conduct an annual review of your O&M plan to determine the efficiency and effectiveness of the program. If you determine that any procedures are not efficient or effective, then modify them as necessary and re-evaluate the next year. An evaluation should look at all aspects of the program including inspection and maintenance procedures, waste handling procedures, recordkeeping, employee training, and effectiveness of the BMPs. Also, be sure to update contact information for responsible parties if there have been changes. Use a checklist, or other form, to document the evaluation (see example in Appendix G).

I. Summary

Operation and maintenance plans are critical to ensure long-term function of stormwater BMPs. Regular inspections and maintenance help identify issues that can be easily and cost-effectively addressed before they become large, expensive problems. An O&M plan should be specific to the site conditions and BMPs present. Include all details about the site and BMPs that could impact inspection and maintenance activities. Identify all parties with responsibilities for inspection and maintenance through the life of the site. Perform inspections on a regular schedule and maintenance as needed. Be sure to verify proper disposal methods for maintenance wastes. Keep detailed records of all inspections and maintenance activities. Ensure that anyone performing inspections or maintenance has received an appropriate amount of training. Evaluate your plan regularly and make adjustments as needed. Finally, be sure to write the plan for the intended audience. Avoid using too many technical words or descriptions if the plan is for homeowners, volunteers or property managers.

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Section II: Non-Structural Stormwater BMPs

The use of non-structural stormwater BMPs focuses on preserving existing open space, protecting natural features and using those features to help manage stormwater runoff and protect water quality. Non-structural BMPs addressed here include minimizing soil compaction, protecting natural flow areas, identifying and protecting sensitive areas, using native plants, and stormwater disconnection. The *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers* (SEMCOG 2008) discusses these and other non-structural BMPs at length.

A. Minimize Soil Compaction

Soil compaction is a process that causes an increase in the bulk density of soil as air is displaced from the spaces between soil particles. This commonly occurs through the use of heavy equipment or repeated traffic, mechanized or animal. Soil compaction is a concern for stormwater management due to the loss of pore space in the soil. The pore space allows water to move into and through the soil profile (infiltration). When that space is removed, infiltration is reduced. As a result, soil can behave like an impervious surface and experience ponding or runoff.

Soil compaction and total disturbed area should be limited to only the extent necessary for construction activities. Designate minimal disturbance areas on the site plan where construction activities are limited to clearing of brush and minor grading. Clearly flag or fence off these areas on site. Do not allow clear-cutting, excavation, filling, stockpiling of materials, or construction traffic in these areas. Restore soil pore space and permanent vegetation after construction if there is any disturbance in these designated areas.

Undisturbed areas should require minimal maintenance if soil compaction has been minimized. Any landscape vegetation retained or replanted should be healthier and require less maintenance. Take care to not cause additional soil compaction after construction due to excessive repeated use, such as frequent lawn mowing. Avoid this by minimizing lawn or other high maintenance plantings and instead plant low-mow or no-mow grass varieties (various fescues) or consider using native plants (See Sub-Section D). Also avoid concentrated foot traffic in vegetated areas by installing or clearly marking pedestrian pathways.

Some local development standards may allow for credits in site design calculations when the developer agrees to minimize soil compaction and limit site disturbance. Check the local development standards for specifics and additional criteria for minimizing soil compaction.

B. Protect Natural Flow Paths

The natural flows paths are paths of least resistance along which stormwater will naturally flow during a rain or snowmelt event. They could include swales, depressions and ephemeral streams. Protect and utilize these areas to help reduce peak stormwater runoff, improve water quality and reduce stormwater runoff volume. Using natural flow paths and stormwater features onsite can help reduce the need (and cost) for engineered stormwater controls.

Identify natural flow paths and, as much as possible, design the site around these areas. Designate natural flow paths on the site plans and ensure that they are adequate to handle post-construction runoff volumes. Protect natural flow paths from disturbance during construction. Consider adding features to enhance their function such as vegetated buffers and check dams for water quality improvement or berms to increase storage capacity.

Natural flow paths require regular inspections and as long and they are protected, very little maintenance. Inspections should look for erosion, bank/channel stability, sediment or debris accumulation, and condition of vegetation including the presence of invasive species. Schedule corrective maintenance to address these problems as needed.

Some local development standards may allow for credits in site design calculations when the developer agrees to protect natural flow paths. Check the local development standards for specifics and additional criteria for protecting natural flow paths.

C. Protect Sensitive Areas

Environmentally sensitive areas are features that may require special consideration or pose a challenge for stormwater management. Protect these areas and avoid them during construction. In some cases, these areas should be protected from the negative impacts of increased stormwater volumes and associated water pollutants. In other cases, they can serve to mitigate the effects of increased stormwater volumes and abate water pollution. Sensitive areas include:

1. Waterbodies such as lakes and ponds
2. Stream and rivers
3. Floodplains and flood-prone areas
4. Riparian areas
5. Wetlands
6. Woodlands
7. Sand dunes
8. Natural drainageways
9. Soils and topography (erodible soils, steep slopes)
10. Susceptible groundwater supplies
11. Threatened and endangered species habitat

These features are site specific and can only be determined through site survey and delineation, and review of aerial photographs and maps. Identify these areas if present on site and indicate them on the site plan. Local site development rules may require that you include the size of these areas and that the developer demonstrate a good faith effort to protect these areas during development. Check local development rules for specific sensitive area requirements including conservation easements. In addition to local development rules, there may be State or Federal laws regarding development in these areas, such as:

1. **Inland lakes and streams** [Part 301, Inland Lakes and Streams, of the Natural Resources and Environmental Protection Act (NREPA) 1994 PA 451, as amended] administered by the Michigan DEGLE
2. **Floodplains** (Part 31, Water Resources Protection, of the NREPA) administered by the Michigan DEGLE
3. **Wetlands** (Part 303, Wetlands Protection, of the NREPA) administered by the Michigan DEGLE
4. **Critical sand dunes** (Part 353, Sand Dunes Protection and Management, of the NREPA) administered by the Michigan DEGLE
5. **High risk erosion areas** (Part 323, Shorelands Protection and Management, of the NREPA) administered by the Michigan DEGLE

6. **Threatened and endangered species** (Part 365, Endangered Species Protection, of the NREPA) administered by the MDNR

Check with your local Michigan DEGLE or MDNR office on specific permitting requirements if these or other sensitive area features are a part of the site or if you need assistance identifying these features on your site.

In general, make all reasonable attempts to avoid disturbing sensitive areas during construction, including excavation, filling, equipment staging, material stockpiling, and placement of access roads. Consider enhancing these areas with native plant buffers to further protect them from post-construction runoff impacts. If protected during construction, then maintenance of these areas should be very minimal. Regularly inspect these areas to ensure that no adverse impacts occur after construction is complete. Look for signs of erosion, instability, debris or sediment accumulation, and vegetative condition including the presence of invasive species. Schedule corrective maintenance to address these problems as needed.

D. Native Plants

Native plants are species that occurred naturally in an area prior to human settlement. These plants are adapted to the local soil, temperature, precipitation, and predation (herbivory, insects and disease). Since they are so readily adapted, native plants typically require very little maintenance once established. Native plants offer numerous benefits including stormwater management (infiltration and evapotranspiration), filtering sediment and nutrients from runoff and wildlife habitat. Native plants range from grasses and forbs to trees and shrubs and can be an alternative to traditional ornamental non-native landscape plantings and turf grass.

Establish native plants from seed, plugs or potted plants in the spring (mid-May to mid-June) or fall (mid Sept to mid Oct). Maintenance needs during the first few years of establishment include watering (1" per week is adequate for most species) and weeding. Close spacing (1' for grasses and forbs) and placement of mulch in planting beds can help with weed suppression and moisture retention. Mowing and spot spraying with herbicide during the first two years is typically the most effective weed control. Be sure to read and follow all label directions when using herbicides. Once native plants are well established, then maintenance is similar to most other perennial landscape plantings. Mow grasses and forbs and remove plant litter once a year. Consider doing this in early spring, leaving plant litter and seed heads standing all winter to provide habitat for overwintering songbirds. Inspect trees and shrubs for disease and insect problems and treated as needed. Also inspect trees and shrubs for dead or broken branches and prune as necessary. Pruning should occur outside of the growing season to allow scars to heal before damaging insects are active. See Appendix A for additional resources about native plants. Appendix H contains lists of Michigan native plants.

Some local development standards may allow for credits in site design calculations when the developer agrees to use native plants. Check the local development standards for specifics and additional criteria for using native plants.

E. Stormwater Disconnection

Stormwater disconnection is a way to minimize the amount of stormwater that leaves the site via traditional storm sewer systems. This includes directing runoff from roofs, roads and driveways into vegetated stormwater BMPs that allow for infiltration. This type of design maximizes the flow of water

over the land and minimizes the use of curb and gutter and piped drainage systems. This will help reduce the volume and rate of water leaving the site and help improve water quality. Consider the following site factors when planning for stormwater disconnection: the capability of the soil for infiltration, depth to water table and slope. Stormwater disconnection in and of itself does not require maintenance, but you must maintain the vegetated infiltration areas to ensure their effectiveness and efficiency (See Section III).

Some local development standards may allow for credits in site design calculations when the developer agrees to disconnect stormwater. Check the local development standards for specifics and additional criteria for stormwater disconnection.

F. References

Southeast Michigan Council of Governments (SEMCOG). 2008. Low Impact Development Manual for Michigan. Available online at http://semcog.org/Reports/LID/index.html

Section III. Structural Stormwater BMPs

This section includes brief descriptions and maintenance overviews of structural stormwater BMPs. Include these standalone descriptions in your stormwater BMP O&M plan as applicable. The structural BMPs included are:

Conveyance and Storage

- Storm sewer
- Culvert or bridge
- Open channel
- Detention basin – dry
- Detention basin – wet
- Detention basin – extended/wetland
- Retention basins

Low Impact Development (LID) and Small Site

- Infiltration practices
- Bioretention/rain garden
- Constructed filter
- Planter box
- Permeable pavement
- Capture reuse
- Vegetated roof
- Sediment forebay
- Water quality swale
- Vegetated swale
- Vegetated filter strip
- Level spreader

There are additional BMPs that are acceptable as stormwater BMPs that are not in this guide. In particular, this guide does not address water quality devices. There is a great deal of variability in these devices, so if used on a project, read and follow the manufacturer's recommendations for O&M. Be sure to include this information in your O&M plan.

Invasive Species Overview

Many of the stormwater BMPs listed and described in this section have a vegetative component. Anytime vegetation is included, inspection and maintenance procedures must account for the presence of non-native, invasive plant species. It is important to recognize and appropriately remove or control invasive species because they can have adverse impacts and may cause the stormwater BMPs to function improperly. Many invasive plants have dense root systems or growth patterns that can block inlets, outlets and flow of water through a BMP. Other plants can cause other damage, such as Japanese knotweed (*Fallopia japonica*), whose roots are strong enough to penetrate concrete and asphalt (Figure 2).

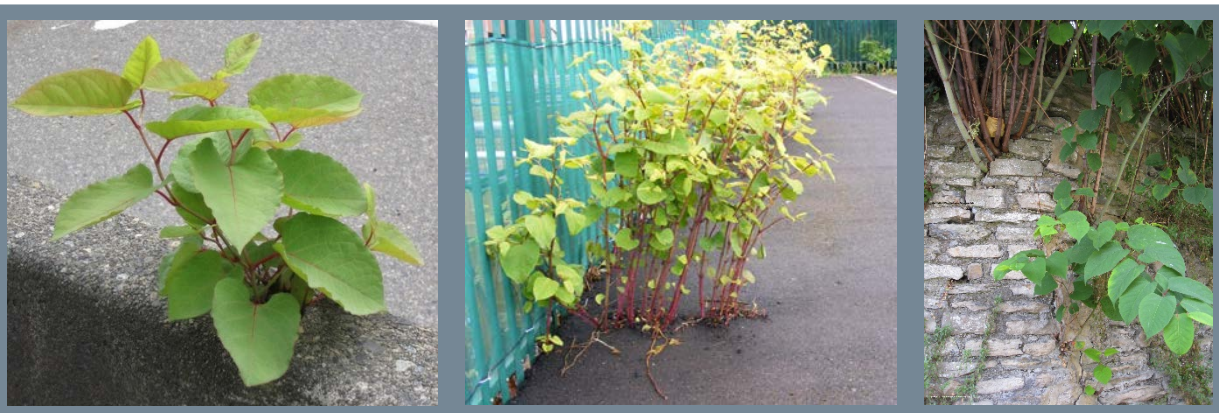


Figure 2. Japanese knotweed is a non-native, invasive species whose roots are strong enough to penetrate, concrete, asphalt and brick structures. Photos: remonline.com, odonovanagri.com, knotweed-removal.co.uk

Many invasive species require specialized removal or treatment techniques to ensure that the plant does not regrow or continue to spread. In general, never mow perennial invasive plant species. Many perennial plants spread by rhizomes and the act of mowing will cause the species to spread further, including Japanese knotweed. You can mow annual invasive plants as long mowing occurs before the plant goes to seed. Consult with a natural resource management or landscape professional for other treatment options.

A few common species that may invade wet edges of stormwater BMPs include:

- Japanese knotweed, Figure 2
- Phragmites (*Phragmites australis*), Figure 3
- Narrow-leaved cattail (*Typha angustifolia*), Figure 3
- Purple loosetrife (*Lythrum salicaria*), Figure 3

Figure 3. Common invasive plants. From left to right: phragmites, narrow-leaved cattail, purple loosestrife. Photos: Wikimedia Commons

It is also important to inspect permanent water features for aquatic invasive species, especially in urban areas where people may be tempted to dump unwanted aquarium or water garden plants. Aquatic plants can also impair the function of stormwater features by impeding the flow of water or reducing the capacity of the structure. Several aquatic plant species are present in Michigan and many others are on a watch list as the threat is high for their introduction. Aquatic plants that are present in some Michigan waterways, including stormwater ponds, include (see pictures in Figure 4):

A. Carolina Fanwort (*Cabomba caroliniana*)
B. Curly-leaf pondweed (*Potamogeton crispus*)
C. Eurasian watermilfoil (*Myriophyllum spicatum*)
D. European frogbit (*Hydrocharis morsus-ranae*)
E. European water clover (*Marsilea quadrifolia*)
F. Flowering rush (*Butomus umbellatus*)
G. Parrot feather (*Myriophyllum aquaticum*)
H. Starry stonewort (*Nitellopsis obtusa*)
I. Water Lettuce (*Pistia stratiotes*)

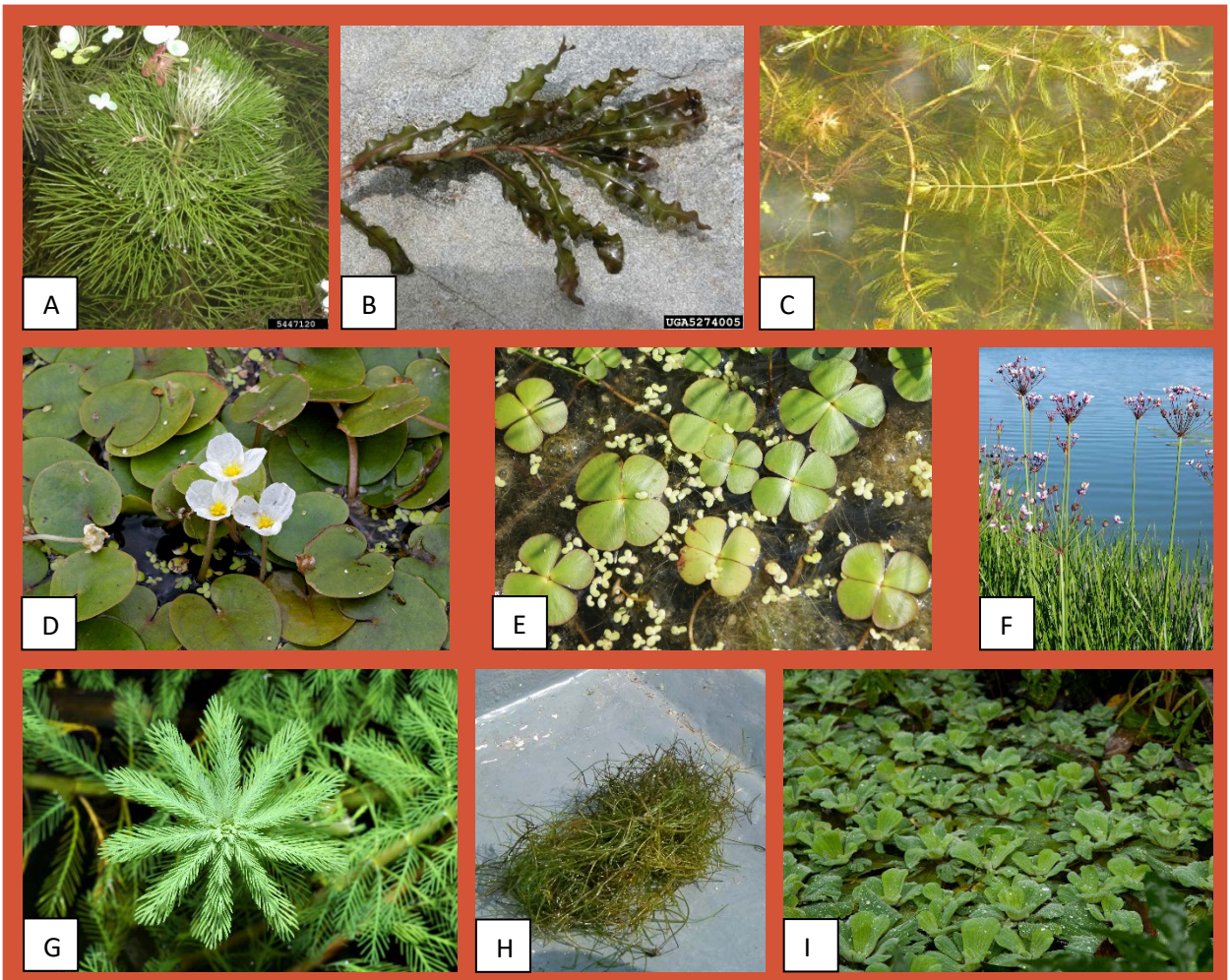


Figure 4. Aquatic invasive plants detected in Michigan. Photos: Wikimedia Commons

Develop a general plan for managing invasive species associated with stormwater BMPs. The first step in management is prevention followed by early detection and rapid response. The earlier you find a new infestation of invasive plants, the earlier you can control them before they become a problem. It is also generally easier and cheaper to control invasive plants before they become widespread. The control technique selected will depend on a number of factors including the type of plant and effective treatments, size of infestation, time of year, location in proximity to surface water, presence of sensitive plants or animals, and proximity to people.

There are numerous resources, including West Michigan based organizations, that provide information about identifying and controlling invasive plant species. A good place to start is with the Midwest Invasive Species Information Network (MISIN - http://www.misin.msu.edu/). The website (and mobile application) provide excellent information on identification of invasive species and allows you to report sightings. There are training modules to learn how to identify species and a whole host of other information. Appendix A includes a list of additional invasive plant species resources.

STORM SEWER

Storm Sewer Overview

A storm sewer is a system designed to convey stormwater. It includes inlets, catch basins, conveyance pipes, and outlets. A storm sewer system can also include additional above ground conveyances including curb and gutter. Storm sewer systems can be separate or combined with sanitary wastewater. Most urbanized communities in West Michigan have separate systems where stormwater is carried in separate pipes from sanitary waste water and discharged directly into surface water bodes.

Storm drain system outlet

Storm sewer conveyance pipes

Storm drain inlet

All photos: Wikimedia Commons

Routine Maintenance

Spring/Summer: Inspect catch basins once a year in residential areas, twice a year in industrial and commercial areas. Schedule catch basin cleaning as needed when basins are 40% full. See Appendix E for more information about catch basin cleaning. In communities that offer spring cleanup of yard debris, do not pile debris on or near catch basins.

Autumn: Remove leaves and other debris from inlets. Sweep curb and gutter to remove leaves. In communities that offer fall leaf pickup, do not pile leaves on or near catch basins.

Winter: Keep catch basins clear of ice and excess snow accumulation to ensure that snowmelt can easily enter the system.

Typical Corrective Maintenance

- Clear debris from inlets
- Replace/repair damaged inlets, catch basins or manholes
- Eliminate illicit discharges or illegal dumping

CULVERTS OR BRIDGES

Culvert and Bridge Overview

A culvert or bridge is the structure at the intersection of a road and stream or drain that allows for continued water flow. They can be part of a stormwater conveyance system and may serve as an entry point for stormwater off of a road or driveway surface. Culverts come in a variety of sizes, shapes, and materials including metal, concrete, plastic, or wood. In some cases, a single crossing may be comprised of multiple culverts in order to convey large storm flows safely (this is no longer common practice). If not properly designed, installed and maintained, culverts and bridges can be sources of erosion and restrict fish passage (some types of culverts).

Concrete bridge

Corrugated metal culverts

Concrete box culvert

All photos: MACC

Routine Maintenance

The most important activity with culverts and bridges is regular inspection. Depending on the type of structure, the inspection frequency will vary. In general, inspect smaller culverts more frequently as obstructions are likely to occur more often than with larger structures. Inspect for debris and obstructions at least seasonally and after significant rain events. If a trash rack is installed at the inlet, then inspect more frequently. Check for invasive plant species on embankments and in channel and remove or treat as appropriate. *Do NOT mow perennial invasive plant species as it may cause them to spread.*

Typical Corrective Maintenance

- Clear debris from inlets or trash racks (trash, tree branches)
- Remove sand or sediment deposits from inside structure
- Stabilize erosion on embankment or around structure
- Stabilize erosion occurring as a result of in-stream scour
- Removal of nuisance vegetation/invasive species from embankment or in stream/drain channel
- Correction of undermining
- Repair or replace structural damage
- Joint repairs
- Repair or replace energy dissipaters (if present)

OPEN CHANNEL

Open Channel Overview

Open channels provide a simple and effective way to drain and convey stormwater and snowmelt runoff. Open channels should be used in combination with other BMPs for filtration and pollutant removal, though some filtration may occur in open channels dependent on the design. There are several types of open channel design including grassed channels, dry swales and wet swales. Natural channel designs, including 2-stage ditches, are preferred in order to mimic natural stream conditions, including meandering and floodplain capacity. Natural design concepts allow natural processes of erosion and sediment transport to occur and can reduce issues common to traditional ditch design, such as bank erosion, down cutting and flooding. See resources in Appendix A for further information on natural channel design.

Natural channel design, Kids Creek, Traverse City, MI

Two-stage ditch, Allegan County, MI

All photos: MACC

Routine Maintenance

Inspection and maintenance can vary greatly depending on the type of channel and the additional features associated with the channel, such as check dams or underdrains. In general, inspect open channels seasonally and after significant rain events to check for blockages and damage. Inspect and maintain vegetation as designed and installed. Check for invasive plant species on banks and in the channel and remove or treat as appropriate. Regular mowing to a height of 4-9" should occur in grassed channels when dry. *Do NOT mow perennial invasive plant species as it may cause them to spread.*

Typical Corrective Maintenance

- Remove in-channel blockages such as trash, tree limbs and other debris
- Remove blockages and repair damage to inlet or outlet structures
- Repair clogging or damage to underdrains, if present (dry swales)
- Remove accumulated sand or sediment
- Stabilize erosion on banks or around structures such as check dams and culverts
- Removal of nuisance vegetation/invasive species from embankment or in stream/drain channel
- Revegetate thin or bare patches

DETENTION BASIN

Detention Basin Overview

Detention basins provide temporary storage of stormwater to reduce peak flow and prevent downstream flooding. Major types of detention basins include dry basins, underground vaults, extended detention basins, wet ponds, and constructed wetlands. Each have benefits and limitations for their use and maintenance needs can vary from low to high. Many of these systems also include storm sewer and pretreatment BMPs[3]. See other applicable BMP overviews for additional maintenance needs.

Dry detention pond, Wisconsin
Flickr

Wet detention pond, Illinois
Wikimedia Commons

Constructed wetland, Virginia
Wikimedia Commons

Routine Maintenance

Spring/Summer: Inspect all system components and remove excess debris and sediment. Maintain a no-mow and chemical free buffer (15-25') around wet ponds. Mow in dry detention ponds when dry and remove all clippings and other debris from the basin. Check for invasive plant species on banks and in the basins and remove or treat as appropriate. *Do NOT mow perennial invasive plant species as it may cause them to spread.*

Autumn: Inspect and remove excess debris and sediment.

Winter: Continue inspection and removal of debris especially if sand, ash or cinders are used for winter traction. Inspect inlet and outlet pipes for freezing (follow recommended design criteria to minimize problems).

Typical Corrective Maintenance

- Sediment removal from forebay before 50% full
- Inspect and clean catch basins, inlets and pretreatment BMP
- Sediment removal from pond followed by stabilization and revegetation
- Replace vegetation if less than 85% vegetative cover

[3] Pretreatment may be required for projects subject to county or local Site Development Rules

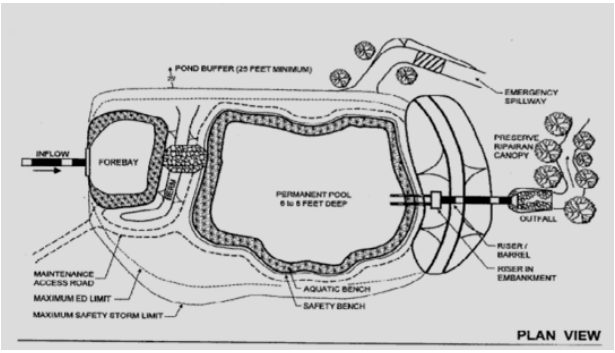
RETENTION BASIN

Retention Basin Overview

Retention basins help reduce flooding and downstream erosion as well as improve water quality through sedimentation and soil filtration. Retention basins can be dry basins or wet ponds. Dry basins accept and infiltrate stormwater runoff. Wet ponds also accept and infiltrate stormwater runoff but typically have a permanent pool set below the groundwater level. Retention basins include pretreatment for water quality[4] and an emergency outlet and/or overflow spillway structure to handle excess volume. Both dry basins and wet ponds often include planted landscapes of grasses and/or flowering plants. The plants provide structural stability and water quality benefits by removing nutrients through root uptake. If basins receive stormwater from parking lots or road surfaces, an oil/grit separator may be necessary to capture these pollutants before they enter the basin.

Retention pond, Canada Wikimedia Commons

Retention pond, Canada Wikimedia Commons



Retention pond conceptual design stormwatercenter.net

Routine Maintenance

Inlet & Overflow: Conduct quarterly inspections of pretreatment, inlet and emergency outlet structures to check for blockages and damage.

Erosion: Inspect the entire perimeter of the basin as well as the basin itself and other structural components for evidence of erosion. Excess sediment should not enter the basin. Check for general sediment buildup in the structure.

Vegetation: Keep plants to a height that allows for the inspection of various issues, such as animal burrowing, sink holes, wet areas, etc. Check for the presence of invasive plant species on banks and in the basins and remove or treat as appropriate. *Do NOT mow perennial invasive plant species as it may cause them to spread.*

Oil/grit separator: Inspect regularly and pump out as necessary. Inspections may need to be completed more frequently in commercial or industrial areas where there is a greater potential for pollutants.

Typical Corrective Maintenance

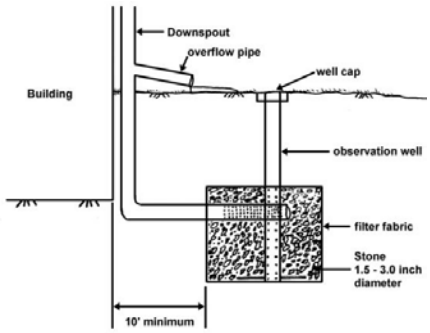
- Clear blocked inlet/outlet
- Stabilize erosion
- Remove sediment
- Revegetate thin or bare patches
- Aerate soil to alleviate compaction (in turf/mowed areas)
- Pump out oil/grit separator

[4] Pretreatment may be required for projects subject to county or local Site Development Rules

INFILTRATION PRACTICES

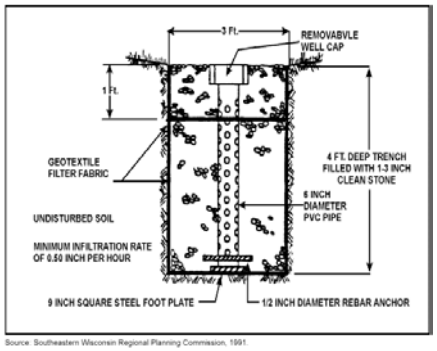
Infiltration Practices Overview

Infiltration practices are located in permeable soils and capture, store and infiltrate stormwater runoff. Some common practices include dry wells, infiltration basins, berms, trenches, subsurface infiltration beds, bioretention, and level spreaders. These practices typically share some key design considerations such as depth to water table, soil, proximity to buildings, possible pretreatment to limit clogging, and emergency overflow structures. While designs differ, the functions are the same.[5]



Dry well
Michigan DEQ

Infiltration trench, Pennsylvania
Flickr



Infiltration trench design
EPA 832-F-99-019

Design Variations

Dry Well: Excavated depression filled with coarse aggregate that temporarily stores stromwater until it infiltrates. Stormwater can enter in an underground pipe and from overland flow. Pretreatment is typically included and offsets/setbacks from buildings are required. Use dry wells for drainage areas less than one acre.

Infiltration Basin: A shallow, level and uncompacted surface that infiltrates stormwater over a period of several days. Use infiltration basins in drainage areas of five to fifty acres.

Infiltration Berm: This practice uses the land's topography to control water flow and infiltration. They can create flow pathways, retain flow or control volumes.

Infiltration Trench: A linear surface or sub-surface facility composed of stone that allows water to spread, slow down and infiltrate. Use infiltration trenches on sites with a drainage area less than five acres in size.

Subsurface Infiltration Bed: Generally a shallow bed of rock aggregate below parking areas or lawns for drainage areas no larger than ten acres.

Bioretention: See the Rain Garden BMP Overview.

Level Spreaders: See the Level Spreader BMP Overview.

Routine Maintenance

- Remove accumulated trash, debris or sediment.
- Check for invasive plant species and remove or treat as appropriate. *Do NOT mow perennial invasive plant species as it may cause them to spread.*
- Maintain grass if present (2-4") or other vegetation by mowing and re-mulching. Do not use pesticides or fertilizers.

[5] Pretreatment may be required for projects subject to county or local Site Development Rules

BIORETENTION/RAIN GARDEN

Rain Garden Overview

Rain gardens collect and hold rainwater from downspouts, driveways and sidewalks for a *short time*, allowing water to slowly seep into the ground. When planted with the right species, rain gardens also attract birds, butterflies and other wildlife. Rain gardens are not completely maintenance-free. If rain gardens include mulch, use only shredded bark mulch as wood chips will float away. It is not necessary to replace mulch annually unless desired for aesthetics. Water newly planted rain gardens on a regular schedule. *Established* rain gardens may never need to be watered nor receive fertilizer. It is important, however, to regularly inspect and maintain rain gardens.[6]

Rain garden, Holland MI
MACC

Rain garden, Indiana
Wikimedia Commons

Down spout inlet to a rain garden
Wikimedia Commons

Routine Maintenance

First Season Care: The most important tasks during the first year of the rain garden are adequate watering and weed control. Young rain gardens should receive about an inch of water per week during the growing season until it is well established (2-3 years).

Spring: Inspect for weeds and invasive plant species. Remove by hand as most herbicides will damage the native plants. Cut and remove the previous season plant litter when spring growth is about 4-6" tall. Use a weed whacker or mow to a height of 6" inches then rake away dead material. *Do NOT mow perennial invasive species as this may cause them to spread.* Spring is also a good time to check inlets and outlets, remove debris and check for damage.

Summer: Continue weeding as needed.

Autumn: You can remove plant litter in the fall, but consider leaving some material and seed heads for over-wintering birds. Like in spring, fall is a good time to check inlets and outlets, remove debris and check for damage.

Typical Corrective Maintenance

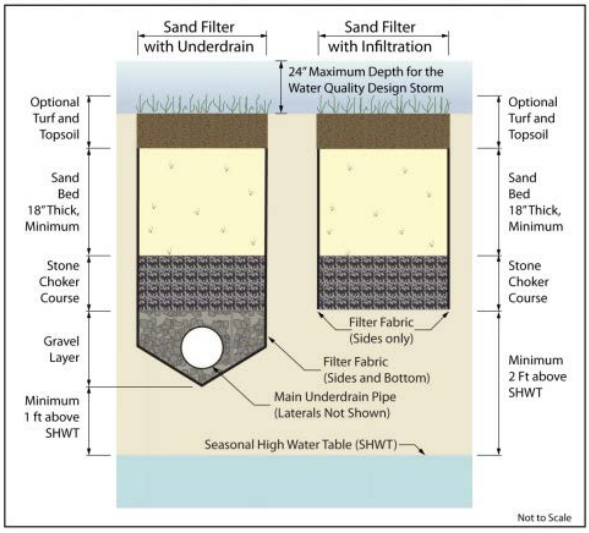
- Replace dead plants, trim overgrown plants
- Repair erosion
- Repair inlet/outlet damage
- Remove accumulated sediment and other debris

[6] Pretreatment may be required for projects subject to county or local Site Development Rules

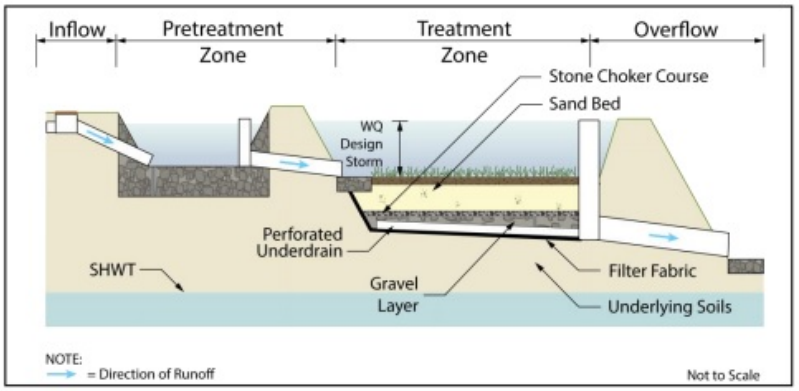
CONSTRUCTED FILTER

Constructed Filter Overview

Constructed Filters are structures or excavated areas containing a layer of sand, compost, organic material, peat, or other filter media that reduce pollutant levels in stormwater runoff by filtering sediments, metals, hydrocarbons, and other pollutants. Infiltration filters and underdrain filters are the two main types of systems. Both styles include a pre-treatment zone[7] and a treatment zone. Stormwater first enters the pretreatment zone that helps remove debris, trash and coarse sediment. Water then moves into the treatment zone and outlets to a pipe or through the subsoil via infiltration. Constructed sand filters are best suited for areas with high impervious surfaces with minimal sediment loads and organic materials and are less likely to clog the sand bed.



Cross section of the two types of sand filters
Both images: New Jersey Stormwater BMP manual



Design of sand filter with underdrain

Routine Maintenance

Spring: Clean out/remove debris that has built up in the pretreatment zone.

Summer: Vegetated pretreatment areas should be mowed/trimmed on a regular schedule throughout the growing season.

Autumn: Clean out/remove debris that has built up in the pretreatment zone.

Winter: Minimal maintenance due to the inability to access the facility during periods of snow cover or frozen ground.

Typical Corrective Maintenance

- Replace of filter media
- Till and aerate filter area
- Repair leaks in sedimentation chamber or damage to other structural components
- Clean out sediment from filter bed chamber, sedimentation chamber and underdrains

[7] Pretreatment may be required for projects subject to county or local Site Development Rules

PLANTER BOXES

Planter Box Overview

Planter boxes receive runoff from impervious surfaces that irrigates the vegetation in the planter box, preventing stormwater from directly entering the storm sewer. They play an important role in urban areas by minimizing runoff, reducing water pollution and creating a greener built environment. There are three main types of planter boxes: contained, infiltration and flow-through.

Roadway planter box concept
Both images: EPA

Planter box, Colorado

Routine Maintenance

Spring: Maintenance activities include weeding, trimming and mulching. Trim plants to 6" with a string trimmer or pruner, and remove dead vegetation to encourage new growth. Check for invasive plant species and remove or treat as appropriate. *Do NOT mow, prune or trim perennial invasive species as this may cause them to spread.* If invasive plants have outcompeted natives, replace the original plants to maintain functionality. Replace old mulch each spring to improve appearance and drainage. Mulch should be free of soil, weed seeds and herbicide. Do not use pine bark and "chipped" mulch.

Summer: Continue to remove weeds and treat invasive plant species as needed. Boxes may need additional watering during extremely dry periods.

Autumn: Remove excess leaves and other debris. Replace or remove any diseased, undesirable or dead plants.

Winter: Minimal maintenance since snow will likely be covering the box. Pay attention to early spring days where snow may melt but the ground/soil in box is still frozen.

Typical Corrective Maintenance

- Replace dead plants
- Repair or cleanout of inlet/outlet mechanisms
- Repair or replacement of concrete structures surrounding box
- Repair or replacement of filter media if infiltration is reduced

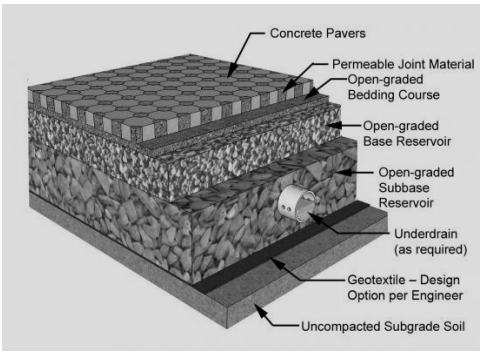
PERMEABLE PAVEMENT

Pervious Pavement Overview

There are many different types of permeable pavement including pervious concrete, porous asphalt, permeable paver blocks, and reinforced turf/gravel. Regardless of the type, all permeable structures allow the movement of stormwater through the surface to encourage infiltration and reduce surface runoff. As water flows through the pavement, the structure tends to trap pollutants and suspended solids, aiding in water quality benefits but increasing maintenance needs.

Traditional asphalt (L), permeable asphalt (R)
EPA

Permeable Pavers
EPA



Permeable paver cross section
Flickr

Routine Maintenance

Spring/Summer: Keep pavement free of leaves and lawn waste. Regularly sweep permeable surfaces to remove fine sediments and optimize permeability. At a minimum, vacuum pavement during spring following the last snow to remove accumulated debris. Clean inlets draining to the subsurface bed. Inspect adjacent plantings and address any soil washout onto pavement.

Autumn: Vacuum pavement, clean inlets and inspect adjacent plantings for soil washout.

Winter: Porous pavements are commonly not treated or plowed until 2 or more inches of snow accumulates. Install skids or rollers on snow plows to raise blade and prevent damage. Salt application is acceptable for most types of permeable pavement, although alternative deicers are preferred. Do not use most de-icing products on pervious *concrete*. Do not apply abrasives such as sand or cinders to any type of permeable pavement. Permeable pavement, if properly designed and sited, should not experience issues related to frost or freeze-thaw cycles that traditional impervious materials may experience.

Typical Corrective Maintenance

- Fix erosion and remove trash in adjacent planted areas
- Repair potholes or other depressions
- Remove moss or plant growth using pressure washing, weed burners or street sweeping equipment
- Add aggregate material to fill the open areas of pavers
- Turf pavers may require reseeding if bare areas appear

CAPTURE REUSE

Capture Reuse Overview

Also referred to as rainwater harvesting, this practice intercepts and stores runoff from rooftops and allow for its reuse at a later time, typically for irrigation or to supplement greywater needs. This practice reduces the need for water while also reducing stormwater discharge from the site. The two main storage types are rain barrels and cisterns. Both are desirable since maintenance activities and associated costs tend to be minimal.

Underground cistern installation
EPA

Duel rain barrel system in a residential setting
Flickr

Routine Maintenance

Cisterns

- Check the inlet, outlet and overflow annually for blockages and accumulated sediment
- Drain and clean sediment from tank bottom
- Drain and clean tank walls with chlorine solution prescribed frequency
- Chlorinate tank at prescribed frequency
- Drain container prior to winter to avoid damage related to water freezing

Rain Barrels

- Inspect rain barrels at least four times per year, and after major storm events
- Remove debris from screen as needed
- Replace screens, spigots, downspouts, and leaders as needed
- To avoid damage, drain container prior to winter, so that water is not able to freeze in devices (store inside or upside down

Typical Corrective Maintenance

- Structural repairs or replacement of fittings and/or hoses
- Replace clogged filters
- Cleanout gutters and other collection system components to reduce organic debris

VEGETATED ROOF

Vegetated Roof Overview

Vegetated roof or "green roof" types include intensive, semi-intensive or extensive, depending on the depth of planting medium and the amount of maintenance needed. Multiple layers make up a vegetated roof including growing medium, water retention, drainage, and roof protection.

Green roof at Haworth Corporate Headquarters, Holland MI
MACC

Green roof at EPA New England Regional Office, Boston MA
EPA

Routine Maintenance

Spring: If plant litter from the previous season is thick or tall enough that it will negatively affect spring growth, remove using a scythe, trimmer or weed-whip prior to spring growth. Check inlets and outlets, remove debris and check for damage.

Summer: Weeding is important especially during the establishment phase. Hand weeding is best; do not use herbicides or other chemicals that could damage the roofing membrane or warranty. Look for and remove tree seedlings to avoid structural damage from roots.

Autumn: Depending on goals, remove thatch or leave standing dead vegetation and seed heads to provide winter bird habitat. Check inlets and outlets, remove debris and check for damage. Inspect for roof leaks (may require a contractor). Check the caulking and look over all access areas and make sure they are all properly sealed.

Winter: Moisture can accumulate on the roof when snow and ice melts, placing a high level of stress on the waterproofing material. Spread accumulating snow throughout the roof to avoid exceeding load limits. Do not allow drifts to form. The best method to remove snow is to shovel it onto a tarp and drag it over the edge of the roof. Leave a 4 inch layer of snow on the roof to help to insulate plants and protect them from harsh winter conditions.

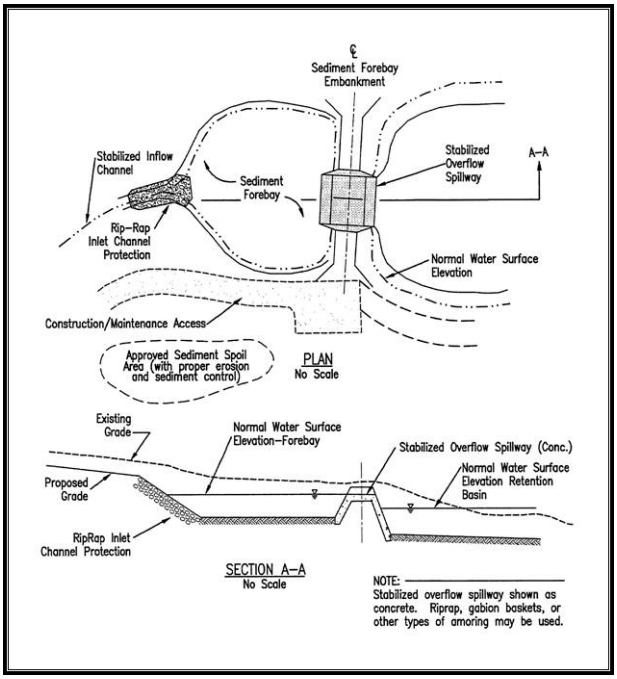
Typical Corrective Maintenance

- Replace dead plants, replace eroded growing media
- Repair structural damage and leaks

SEDIMENT FOREBAY

Sediment Forebay Overview

A sediment forebay is a settling basin or plunge pool constructed at the inlet of a stormwater BMP. The purpose of the sediment forebay is to allow sediment to settle out of the incoming stormwater before it reaches the larger stormwater BMP. This helps facilitate maintenance of the larger BMP by trapping sediment in a smaller, easier to clean basin. Stormwater BMPs that commonly incorporate sediment forebays are retention, detention or extended detention basins; infiltration practices; bioretention; and water quality swales.



Example sediment forebay design
Both images: Virginia Water Resources Research Center

Sediment forebay at inlet of retention pond

Routine Maintenance

Inspect sediment forebays at least annually to check for damage, debris and sediment accumulation. Periodically mow embankments to maintain vegetation and control growth of woody species. Check for invasive plant species around and in the forebay and remove or treat as appropriate. *Do NOT mow perennial invasive plant species as it may cause them to spread.* Check for and remove debris from inlet and outlet structures. Monitor for sediment accumulation and remove as needed. To more easily monitor sediment accumulation, install a staff gauge or other measuring device and indicate the depth at which cleanout is necessary.

Typical Corrective Maintenance

- Remove sediment and other debris
- Repair damage to spillway/outlet
- Control of woody and/or invasive species

VEGETATED SWALE

Vegetated Swale Overview

A bioswale or a vegetated swale is a shallow stormwater channel that includes vegetation that helps slow, filter and infiltrate stormwater runoff. There are different types and designs of vegetated swales but all help reduce pollutants entering the aquatic system. Bioswales are able to remove various types of pollutants, including silt, inorganic contaminants, organic chemicals, and pathogens. In some cases, swales can act as a conveyance for stormwater in place of traditional curbs and gutters; however, the primary objective is still water filtration.

Grass Swale
Wikimedia Commons

Vegetated Swale
EPA

Routine Maintenance

First season: Irrigate during plant establishment and during dry periods. Plant vegetation as soon as possible after construction to prevent erosion. If runoff velocities are high, consider sodding the swale or diverting runoff until vegetation is fully established. If adjacent to areas that will receive salt in the winter, select salt tolerant species.

Spring/Summer: Inspect swale for sediment/debris accumulation or damaged plants that may have occurred from snow plowing activities. Remove weeds and debris throughout spring and summer. Check for invasive plant species around and in the swale and remove or treat as appropriate. *Do NOT mow perennial invasive plant species as it may cause them to spread.*

Autumn: Remove leaves, mow and trim vegetation to ensure safety, aesthetics, and proper swale operation. Mow only when swale is dry.

Winter: Do not place plowed snow from roads and parking lots directly into vegetated swales. Place snow adjacent so that snowmelt is filtered through the swale. If planted adjacent to roads or parking lots, reduce salt use, use alternative deicing products or plant salt tolerant species. If snowmelt filters through the swale, inspect in the spring for sediment accumulation and remove as necessary.

See Bioretention/Rain Garden Maintenance Overview for more about native plant maintenance.

Typical Corrective Maintenance

- Reseed bare patches or replace dead plants
- Repair/stabilize erosion
- Clear debris from inlets/outlets
- Remove accumulated sediment from swale or pre-treatment device
- Replace filter media in infiltration trench. This can be minimized or prolonged through the use of pre-treatment.

VEGETATED FILTER STRIP

Filter Strip Overview

A filter strip is a type of vegetated buffer strip that is typically narrow and long. It slows down runoff, allowing sediments, organic matter and other pollutants to settle out. Filter strips require sheet flow across the strip. Installing a level spreader will help to ensure uniform flow. Benefits include low cost instillation and added aesthetic and habitat. Install vegetated filter strip with other BMP's to achieve more comprehensive stormwater management.

Vegetated filter strip adjacent to roadway
Virginia Water Resources Research Center

Filter strip at an airport, WA
Flickr

Seasonal Routine Maintenance

Spring/Summer: Remove weeds and debris. Check for invasive plant species and remove or treat as appropriate. If invasive plants have outcompeted natives, replace the original plants to maintain functionality. Mow grassed filter strips to maintain a height of 4-6". *Do NOT mow perennial invasive plant species as it may cause them to spread.*

Autumn: Possible removal of dead vegetation or mowing if visibility/safety becomes an issue with tall plants. See note above about mowing invasive plant species.

Winter: Typically, no winter maintenance is needed.

Typical Corrective Maintenance

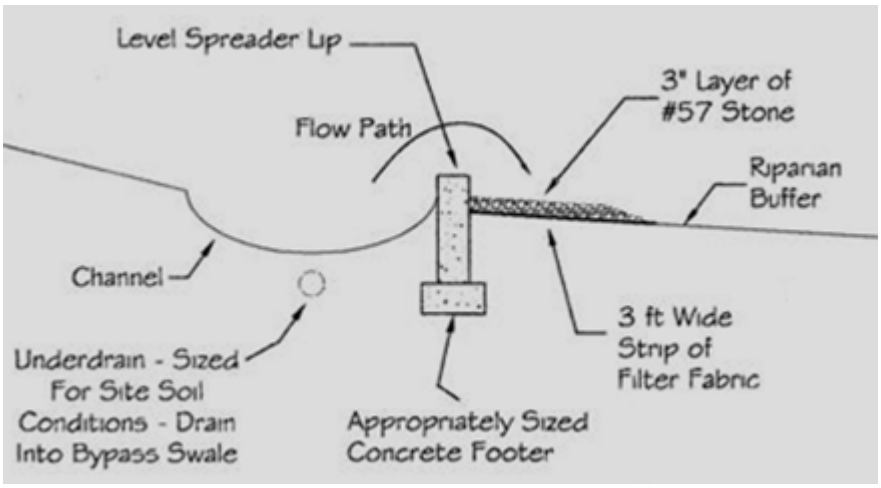
- Weed/invasive species removal
- Replanting or reseeding bare patches; maintain vegetation as specified in the original design
- Repair rill and gully erosion due to sheet flow into the filter strip
- Remove sediment and other debris when buildup exceeds 2" in depth
- Soil aeration or liming to improve infiltration if poor drainage is observed

LEVEL SPREADER

Level Spreader Overview

A level spreader is an erosion control device consisting of a forebay, channel and riparian buffer constructed at zero percent grade across a slope to intercept concentrated flow and convert it to sheet flow. The flow outlets to a stable, vegetated area to allow for infiltration and water quality improvement effectively prohibiting erosion. Use level spreaders in conjunction with other BMPs either to provide pre-treatment at the inlet or to disperse flows at the outlet. There are several different types of level spreaders including concrete sills, earthen berms and level perforated pipes.

Level spreader
Wikimedia Commons



Level spreader conceptual design
Virginia Water Resources Research Center

Routine Maintenance

Spring/Summer: Inspect after major storm events. Periodically mow vegetation to control weeds and encroachment of woody vegetation. Avoid mowing when wet to avoid rutting. Remove clippings and dispose outside of the level spreader. Check for invasive plant species and remove or treat as appropriate. *Do NOT mow perennial invasive plant species as it may cause them to spread.*

Autumn: Remove weeds or woody vegetation, remove leaf buildup.

Winter: Do not store snow removed from streets, parking lots and driveways in a level spreader.

Typical Corrective Maintenance

- Remove accumulated sediment and trash or leaf buildup
- Repair any erosion and revegetate
- Fertilize as necessary to keep the vegetation healthy and dense
- Repair diverter box, clean clogged inlet or outlet pipes
- Repair any scour or undercutting
- Remove and replace stone washout
- Address settlement of the level spreader
- Repair erosion from concentrated flow downhill of the level spreader

Section IV. Stormwater BMP Inspection Checklists

This section includes inspection checklists for all structural stormwater BMPs included in Section III. There is also an inspection checklist to use for non-structural practices if present on the site. Use these checklists to document inspection findings, any corrective actions taken at the time of the inspection and corrective maintenance that needs to be scheduled. Do not use these checklists to document and keep track of routine maintenance (Table 1) or scheduled corrective maintenance (Appendix F).

Conducting the Inspection

In order to ensure that inspections are properly completed and documented, you must first review existing information about the site and gather appropriate paperwork and tools. Use the following checklists to help you prepare for inspections.

Pre-inspection, review the following information:

- Parcel information
- City/County permit (right of way and/or building permit)
- Relevant sections of the stormwater site plan
- As-builts or record drawings
- Plant species list if vegetated practices present
- Legal agreements
- Location information
- Site-specific O&M manual/plan
- Maintenance logs and previous inspections
- Enforcement documents

Bring these items with you:

- As-builts or record drawings to make sure you can properly locate all stormwater BMPs
- Site-specific O&M plan so you can determine if the plan is being followed
- Inspection form
- Camera
- Appropriate personal protective equipment as dictated by site conditions (at a minimum gloves, close-toed shoes, high visibility vest)
- Hand tools for corrective maintenance (shovel, hand trowel, garbage bags, etc.)

Properly document photos:

- Document the date and time
- Document the exact location (enable location services if using an enabled device)
- Describe what you photographed and why
- Additional considerations
    - Keep the viewer's perspective in mind
    - Include a prop, if necessary, for size reference
    - Use a landmark to show the location
    - Use a consistent naming convention (e.g. date-name of facility-descriptive title)

Document your findings:

- Fill out the inspection forms completely, more information is better than less.
- If there are any simple maintenance needs that you can perform quickly with minimal tools, do it right away and document on the form.
- Reference the pictures that you took on the inspection form.
- Clearly describe the corrective maintenance that needs to occur and how soon it should be done. Follow up to make sure that the corrective maintenance occurs.
- Provide copies of the completed inspection form to all applicable parties as identified in the O&M plan.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

NON-STRUCTURAL BMPs

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. SOIL COMPACTION			
Areas of ponding water or slow infiltration	0 1 2 3 N/A		
Areas of minimal vegetative growth	0 1 2 3 N/A		
B. NATURAL FLOW PATHS AND STORMWATER DISCONNECTION			
Evidence of erosion	0 1 2 3 N/A		
Bank instability	0 1 2 3 N/A		
Sediment or debris accumulation	0 1 2 3 N/A		
Vegetation is sparse or in poor condition	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
C. SENSITIVE AREAS			
DESCRIBE SENSITIVE AREA:			
Evidence of erosion	0 1 2 3 N/A		
Sediment or debris accumulation	0 1 2 3 N/A		
Vegetation is sparse or in poor condition	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that are needed and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

STORM SEWER

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
Drain inlet/outlet pipe condition (crushed, broken, etc.)	0 1 2 3 N/A		
B. VEGETATION			
Accumulation of grass clippings around inlet	0 1 2 3 N/A		
Vegetation growing across and blocking more than 10% of the inlet	0 1 2 3 N/A		
Vegetation growing in inlet pipe joints that is more than six inches tall	0 1 2 3 N/A		
C. TREATMENT AREA			
Evidence of standing water (ponding, noticeable odors, water stains, algae)	0 1 2 3 N/A		
Evidence of oil or chemical accumulation	0 1 2 3 N/A		
Sediment in the basin exceeds 33% of the sump depth	0 1 2 3 N/A		
Fractures or cracks in catch basin	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

CULVERT OR BRIDGE

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERALL STUCTURE			
Trash or debris blocking inlet or trash rack	0 1 2 3 N/A		
Excess sediment accumulation in structure	0 1 2 3 N/A		
Structural condition (*e.g.* joint separation, cracks, rusting, *etc.)*	0 1 2 3 N/A		
Evidence of scour or undermining	0 1 2 3 N/A		
Outlet energy dissipater damaged or non-functional (if present)	0 1 2 3 N/A		
B. VEGETATION			
Excess vegetation in stream at inlet or outlet that is blocking flow	0 1 2 3 N/A		
Overgrown or nuisance (invasive) vegetation on embankment or adjacent banks	0 1 2 3 N/A		
C. OTHER			
Source of pollution (illicit discharge) present	0 1 2 3 N/A		
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

D. CORRECTIVE ACTIONS (Taken / Needed)

Describe source of problem and list any corrective actions that need to be taken and when

E. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

OPEN CHANNEL

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Trash or debris blocking inlet/outlet or channel	0 1 2 3 N/A		
Excess sediment accumulation	0 1 2 3 N/A		
Erosion occurring on banks or near structural features	0 1 2 3 N/A		
Damage to inlet/outlet, check dams, etc.	0 1 2 3 N/A		
B. VEGETATION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species) on side slopes or adjacent buffer	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Excess trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of standing water (ponding, noticeable odors, water stains, algae)	0 1 2 3 N/A		
Damaged or clogged underdrain, if present	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

DETENTION BASIN

Type (select one): dry pond wet pond constructed wetland underground

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
Structural condition (crushed, broken, etc.)	0 1 2 3 N/A		
B. VEGETATION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (*i.e.* invasive non-native species)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
B. TREATMENT AREA			
Erosion or evidence of channelized flow within the basin	0 1 2 3 N/A		
Algae or aquatic invasive species (wet pond or constructed wetland)	0 1 2 3 N/A		
Sediment or debris accumulation	0 1 2 3 N/A		
Wildlife tunneling or burrowing	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

G. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

G. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

RETENTION BASIN

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Oil/grit separator needs pumping, if present	0 1 2 3 N/A		
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
B. VEGETATION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Algae or aquatic invasive species present	0 1 2 3 N/A		
Trash/debris/sediment accumulation	0 1 2 3 N/A		
Erosion or evidence of channelized flow	0 1 2 3 N/A		
Wildlife tunneling or burrowing	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

INFILTRATION PRACTICES

Type (select one): Dry well Infiltration basin Infiltration berm Infiltration trench Subsurface infiltration bed

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
B. VEGETATATION – (If present in design)			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Standing water present 72 hrs after last rainfall	0 1 2 3 N/A		
Trash, debris or sediment accumulation	0 1 2 3 N/A		
Wildlife tunneling or burrowing	0 1 2 3 N/A		
Erosion or evidence of channelized flow	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

BIORETENTION / RAIN GARDEN

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
B. VEGETATION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Trash/debris/sediment accumulation	0 1 2 3 N/A		
Signs of erosion or movement of mulch (or gravel)	0 1 2 3 N/A		
Signs of mulch layer thinning (or gravel)	0 1 2 3 N/A		
Clogging of rock rip rap, if present			
Underdrain system broken/clogged (if present)	0 1 2 3 N/A		
Evidence of oil/chemical accumulation	0 1 2 3 N/A		
Evidence of soil compaction (poor drainage)	0 1 2 3 N/A		
Evidence of standing water (ponding, noticeable odors, water stains, algae)	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

CONSTRUCTED FILTER

Select Type: Infiltration Underdrain

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Trash, debris or sediment accumulation	0 1 2 3 N/A		
Erosion around structures	0 1 2 3 N/A		
Clogging of structures	0 1 2 3 N/A		
B. VEGETATION – (If present in design)			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (*i.e.* invasive non-native plants)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Trash/debris/sediment accumulation	0 1 2 3 N/A		
Erosion or scoured areas due to flow channelization or high flows	0 1 2 3 N/A		
Evidence of standing water. Should drain within 10 hours. (ponding, algae, odor)	0 1 2 3 N/A		
Evidence of decreased sand bed permeability/drain time is significantly different from the design drain time	0 1 2 3 N/A		
Film or discoloration of any surface filter material. This indicates organics or debris have clogged the filter surface.	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

PLANTER BOXES

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
Drain inlet/outlet pipe condition	0 1 2 3 N/A		
B. VEGETATION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Evidence of standing water more than 72 hours after rain (ponding, noticeable odors, water, algae, stains)	0 1 2 3 N/A		
Erosion or scoured areas due to flow channelization or high flows	0 1 2 3 N/A		
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

PERMEABLE PAVEMENT

Select Type: Porous Asphalt Pervious Concrete Permeable Paver System Plastic Grid System

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Bare/exposed soil in adjacent area (erosion of materials onto surface)	0 1 2 3 N/A		
Excessive landscape waste/lawn clippings in adjacent area or on surface	0 1 2 3 N/A		
Water is not draining within 24-48 hours (check observation well if present)	0 1 2 3 N/A		
B. PAVEMENT CONDITION			
Signs of clogging or standing water present	0 1 2 3 N/A		
Evidence of deterioration/raveling	0 1 2 3 N/A		
Spalling or cracking of pavement observed	0 1 2 3 N/A		
Collapsing areas of paver system	0 1 2 3 N/A		
Loss of aggregate between pavers	0 1 2 3 N/A		
Should an infiltration test be performed?	yes no		
C. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

D. CORRECTIVE ACTIONS (Taken/Needed)

Describe source of problem and list any corrective actions that are needed and when

E. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

CAPTURE REUSE

Select Type: Rain Barrel Cistern-Above Ground Cistern-Below Ground

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Debris blocking structure inlet, backflow assemblies and overflow outlet	0 1 2 3 N/A		
B. STRUCTURE			
Structural damage, cracks, etc.	0 1 2 3 N/A		
Pipe joints disconnected or damaged	0 1 2 3 N/A		
Leaks	0 1 2 3 N/A		
Tears in screen, if present	0 1 2 3 N/A		
Condition of filters, if present	0 1 2 3 N/A		
Excess sediment or debris in cistern	0 1 2 3 N/A		
Excess organic material in source area (rooftop, gutters, etc.)	0 1 2 3 N/A		
C. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

D. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

E. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

VEGETATED ROOF

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
Structural condition (crushed, broken, etc.)	0 1 2 3 N/A		
B. VEGETATION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native plants)	0 1 2 3 N/A		
Inadequate plant covering of exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Loss of growing media (wind erosion)	0 1 2 3 N/A		
Root barrier is perforated	0 1 2 3 N/A		
Waterproof membrane is leaking or cracked	0 1 2 3 N/A		
Other structural damage	0 1 2 3 N/A		
Evidence of standing water (*i.e.* ponding, noticeable odors, water stains)	0 1 2 3 N/A		
D. OTHER			
Irrigation system functioning properly (if present)	0 1 2 3 N/A		
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS (Taken/Needed)

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

SEDIMENT FOREBAY

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET, OUTLET & OVERFLOW			
Oil/grit separator needs pumping, if present	0 1 2 3 N/A		
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
B. VEGETATAION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Algae or aquatic invasive species	0 1 2 3 N/A		
Erosion or evidence of channelized flow	0 1 2 3 N/A		
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Wildlife tunneling or burrowing	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

VEGETATED SWALE

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLETS, OUTLET & OVERFLOW			
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Evidence of clogging or blockage	0 1 2 3 N/A		
B. VEGETATION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. TREATMENT AREA			
Condition of check dams (if present)	0 1 2 3 N/A		
Evidence of material build up at check dams (if present)	0 1 2 3 N/A		
Condition of underdrain system	0 1 2 3 N/A		
Evidence of standing water (ponding, odors, water stains, algae)	0 1 2 3 N/A		
D. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

E. CORRECTIVE ACTIONS (Taken/Needed)

Describe source of problem and list any corrective actions that need to be taken and when

F. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

VEGETATED FILTER STRIP

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. TREATMENT AREA			
Evidence of trash/debris or sediment accumulation	0 1 2 3 N/A		
Sediment accumulation, depth exceeds two inches	0 1 2 3 N/A		
Erosion or scoured areas due to flow channelization or higher flows	0 1 2 3 N/A		
Evidence of standing water (ponding, noticeable odors, water stains, algae)	0 1 2 3 N/A		
B. VEGETATION			
Vegetation is overgrown	0 1 2 3 N/A		
Nuisance weeds or other vegetation is taking over (i.e. invasive non-native species)	0 1 2 3 N/A		
Inadequate plant covering or exposed soil	0 1 2 3 N/A		
Plant material is dead, dying or appears unhealthy	0 1 2 3 N/A		
C. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

G. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

G. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

STORMWATER BMP MAINTENANCE INSPECTION CHECKLIST

LEVEL SPREADER

Location:_____ Owner Name: _____

Inspector:_____ Date of Inspection: _____ Time of Inspection: _____

Date of Last Inspection: _____ Current Weather Conditions: _____ Date of Last Rain: _____

Age of practice: _____ General Site Conditions: _____

INSPECTION RATING SYSTEM

0 = Good condition. Well maintained, no action required. Satisfactory Performance.
1 = Moderate condition. Should monitor. Satisfactory Performance.
2 = Degraded condition. Routine maintenance and repair needed. Unsatisfactory Performance.
3 = Serious condition. Immediate need for repair or replacement. Unsatisfactory Performance.

NOTE TO INSPECTOR: All personnel entering any confined spaces must take appropriate safety measures and follow applicable OSHA regulations.

INSPECTION ITEMS	RATING	WHAT DID YOU SEE?	WHAT DID YOU DO?
A. INLET			
Excessive trash/debris/sediment accumulation	0 1 2 3 N/A		
Evidence of erosion/instability	0 1 2 3 N/A		
Rock riprap or gravel out of place	0 1 2 3 N/A		
B. TREATMENT AREA			
Weed or woody plant encroachment	0 1 2 3 N/A		
Sediment or debris accumulation	0 1 2 3 N/A		
Scour or undercutting	0 1 2 3 N/A		
Settlement of structure	0 1 2 3 N/A		
Stone from below the lip is washing downhill	0 1 2 3 N/A		
Damaged turf reinforcement or riprap rolling downhill	0 1 2 3 N/A		
Erosion in the buffer or swale	0 1 2 3 N/A		
Gullies or sediment flow from concentrated flows downhill	0 1 2 3 N/A		
Evidence of standing water (ponding, noticeable odors, water stains, algae)	0 1 2 3 N/A		
C. OTHER			
Complaints from local residents	0 1 2 3 N/A		
Public hazards observed (describe)	0 1 2 3 N/A		
Other:	0 1 2 3 N/A		

D. CORRECTIVE ACTIONS

Describe source of problem and list any corrective actions that need to be taken and when

E. PHOTOGRAPHS

Attach photographs with descriptions showing current condition of system and any deficiencies noted in this inspection.

APPENDIX A

ADDITIONAL RESOURCES

Invasive Plants

Michigan Invasive Species: http://www.michigan.gov/invasives

Midwest Invasive Plane Information Network. You can sign up to be a member which will allow you to take training modules to learn how to identify invasive species and then report sightings of them. http://www.misin.msu.edu/

Laws and Permitting

Critical sand dunes and high risk erosion areas: http://www.michigan.gov/deq/0,4561,7-135-3311_4114---,00.html

Floodplains: http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3725---,00.html

Inland Lakes and Streams: http://www.michigan.gov/deq/0,4561,7-135-3313_3681_28734-161112--,00.html

Threatened and Endangered Species: http://www.michigan.gov/dnr/0,4570,7-153-10370_12141_12168-30522--,00.html

Wetlands Protection: http://www.michigan.gov/deq/0,4561,7-135-3313_3687-10813--,00.html

Native Plants

Alternatives to grass. While the species included on this website are not necessarily native, they provide a low maintenance alternative to the traditional turf grass lawn as well as additional benefits such as water quality improvement and habitat. https://www.planetnatural.com/organic-lawn-care-101/alternatives/

Arbor Day Foundation Tree Care Tips. https://www.arborday.org/trees/tips/

Grow Native, native plant maintenance. http://grownative.org/native-plant-info/landscape-guide/maitenance/

Lawn alternatives. While not every species listed on this website is native, the species they discuss require much less maintenance than a traditional turf grass lawn and provide added benefits such as water quality improvement and habitat. http://eartheasy.com/grow_lawn_alternatives.htm

Michigan Native Plant Producers Association. This website includes links to members who sell native plant seeds, plugs and potted plants. Many of their websites include information about selecting the appropriate native plants. Some offer planning and installation services. http://www.mnppa.org/

Michigan State University Extension, choosing native trees and shrubs. http://msue.anr.msu.edu/news/choosing_native_trees_and_shrubs_for_your_michigan_landscape

MSU Extension, alternatives to ash trees. http://msue.anr.msu.edu/uploads/files/e2925.pdf

Michigan State University Regional Native Plant Lists. http://www.canr.msu.edu/nativeplants/plant_facts/local_info/

Prairie Moon Nursery Plant Finder. The pdf catalog includes detailed information about physical characteristics and site preferences for a large variety of native plants, though not all are native to Michigan. https://www.prairiemoon.com/choosing.php?fclassid=1

Stormwater BMPs

Constructed Filter. http://www.njstormwater.org/bmp_manual/NJ_SWBMP_9.9.pdf

Filter Strips. http://www.lakesuperiorstreams.org/stormwater/toolkit/filterstrips.html

International Stormwater BMP Database. This site includes ways to retrieve and share data about BMP performance and guidance on evaluating and monitoring BMPs. http://www.bmpdatabase.org/

Level spreaders. Massachusetts Clean Water Toolkit.
http://prj.geosyntec.com/npsmanual/levelspreader.aspx

Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers. Includes design specifications as well as maintenance activities.
http://semcog.org/Plans-for-the-Region/Environment/Green-Infrastructure

Planter boxes: http://www.stlmsd.com/sites/default/files/engineering/498693.PDF

Rain Garden Network: http://www.raingardennetwork.com/maintaining-a-rain-garden/

Rain Garden Manual, Wisconsin: http://dnr.wi.gov/topic/shorelandzoning/documents/rgmanual.pdf

Rain Garden Manual, Ohio: http://www.cuyahogaswcd.org/files/resources/raingardenmanual-2016.pdf

State of Michigan BMP Design, Pollutants Controlled Calculation Assistance, and other Technical Manuals. Includes design specifications as well as maintenance activities. http://www.michigan.gov/deq/0,4561,7-135-3313_71618_3682_3714-118554--,00.html

Stormwater planter: http://nacto.org/docs/usdg/stormwater_planter_crwa.pdf

USEPA National Menu of Best Management Practices for Stormwater.
https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#post

Stormwater BMP Maintenance

Green roof operation and maintenance.
http://stormwater.pca.state.mn.us/index.php/Operation_and_maintenance_of_green_roofs

Green roof winter maintenance.
http://www.greenrooftechnology.com/green-roof-blog/necessary-winter-maintenance-for-green-roofs

Michigan catch basin design and maintenance. https://www.michigan.gov/documents/deq/deq-wb-nps-cab_250605_7.pdf

Pervious pavement:
http://www.perviouspavement.org/downloads/pervious_maintenance_operations_guide.pdf

EPA: www.epa.gov/soakuptherain/permeable-pavement

Pervious Pavement: www.perviouspavement.org

Winter Maintenance:
http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/winter_maintenance_fact_sheet.pdf

USEPA Stormwater Maintenance. https://www.epa.gov/npdes/stormwater-maintenance

Training

Chesapeake Stormwater Network, Stormwater BMP Maintenance. Several pdfs of training modules and videos. These resources contain information specific to municipal requirements in the Chesapeake Bay region and should only be used for general education about stormwater BMPs and maintenance activities.
http://chesapeakestormwater.net/training-library/stormwater-bmp-maintenance/

New Jersey Stormwater Management Maintenance Training. While this presentation has information specific to New Jersey Administrative Code that would not necessarily apply in Michigan, it includes good general BMP information and maintenance guidelines.
http://www.nj.gov/dep/stormwater/presentations/handout-part-1-n-2-2014-12-03-bmp-overview-n-maintenance.pdf

Stormwater One Online Training and Credentials. This site provides several free online training modules (many other courses for a fee) about low impact development and green infrastructure.
https://stormwaterone.com/free-training

US Environmental Protection Agency (EPA) Learn about Green Infrastructure Website. This site includes basic information about green infrastructure and a webcast series.
https://www.epa.gov/green-infrastructure/learn-about-green-infrastructure

US EPA Operation and Maintenance Considerations for Green Infrastructure. The site provides a good overview about designing practices with maintenance in mind, plus several other resources to assist with maintenance planning.
https://www.epa.gov/G3/operation-and-maintenance-considerations-green-infrastructure

USEPA Technical Memorandum, Operation and Maintenance of Green Infrastructure Receiving Runoff from Roads and Parking Lots.
https://www.epa.gov/sites/production/files/2016-11/documents/final_gi_maintenance_508.pdf

APPENDIX B

OPERATION AND MAINTENANCE PLAN TEMPLATE

Stormwater Best Management Practice

Operation and Maintenance Plan Template

Notes to users:

Items shown in brackets [EXAMPLE] are placeholders where you fill in information specific to your site. Delete the actual brackets before publication.

Sentences or words that appear in *italics* are suggestions or instructions for the plan writer. Delete these prior to publishing a site specific plan.

Leave sentences or words that appear in plain font, or modify them as necessary.

APPENDIX B

[PLAN TITLE]

e.g. Stormwater Best Management Practice Operation and Maintenance Plan

Prepared for

[SITE NAME]

Prepared by

[NAME OF PREPARER]

[DATE]

APPENDIX B

TABLE OF CONTENTS *[delete if not needed]*

APPENDIX B

Purpose

Stormwater best management practices (BMPs) are essential components of any site development plan to prevent flooding and safely convey stormwater offsite. They must also serve to protect water quality and not cause erosion or other negative impacts downstream. In order to ensure that stormwater BMPs continue to provide all of these services long-term, inspect and maintain them on a regular basis.

The goal of this plan is to outline a long-term strategy to ensure regular inspection and proper long-term maintenance of stormwater BMPs at [SITE NAME]. The objectives of this plan are to:

1. Conduct biweekly inspections of all stormwater BMPs on site
2. Conduct routine maintenance
   Include more information about the frequency of routine maintenance as this varies depending on the type of maintenance performed.
3. Conduct corrective maintenance as needed within 30 days of discovery
4. Document all inspections and maintenance when they occur
5. Conduct employee training at least annually
6. Evaluate the effectiveness of this plan annually
7. [ADDITIONAL OBJECTIVE] *include as many objectives as needed to fully address the needs of the BMPs and the site*

Stormwater BMPs

This section is very site specific. At a minimum, provide a list of all stormwater BMPs including components of larger systems of BMPs. Insert the BMP descriptions from Section III. If proprietary devices are on site, include specific information as provided by the manufacturer as it relates to descriptions and components of the system. If there are numerous BMPs, consider summarizing them in a table. Insert a copy of the site plan or include in an Appendix.

EXAMPLE

Table 1. Stormwater BMPs

BMP	***Quantity***	***Location***
Catch basins	*10*	*8 around parking lot, 2 in driveway*
Bioswale	*1*	*NW corner of building*
Permeable pavers	*1,000 ft^2*	*Sidewalk and entry to building*
Planter box	*3*	*SE, SW and NE corners of the building*

This table could be followed by the fact sheets from Section III (or manufacturer's information), any additional information specific to the site including design specifications, and finally the site plan. Clearly label all BMPs on the site plan.

APPENDIX B

Responsible Parties

List all persons that will be responsible for inspections and maintenance during and after construction. Include full contact information. Include a process for updating this list and ensuring that new responsible parties receive a copy of the plan. Provide this list of contacts to the township or city to keep on file with the maintenance agreement in case of emergency.

EXAMPLE

Construction Supervisor
Joe Smith
333 Industrial Dr
Somewhere MI 99999
555-555-5555

Property Manager
Bob Smith
444 Marigold Ln
Someplace MI 99999
555-555-5555

Maintenance Supervisor
Mary Smith
555 Easy St
Nowhere MI 99999
555-555-5555

Provide all responsible parties a copy of this plan. Keep a master copy of the plan on file in the office of the Property Manager. The Property Manager is responsible for updating this list and providing copies of the plan to new responsible parties. The Property Manager will notified all responsible parties of any changes to this list within 10 business days of the changes.

APPENDIX B

Maintenance Tasks and Schedules

This section is specific to the site and the BMPs. Develop this section of your plan using information from Section III and IV of the guide. Summarize information in tables as opposed to narratives to clearly and concisely convey the information. Include a section about emergency maintenance procedures or reference the location of other existing emergency procedures.

EXAMPLE

Inspections and routine maintenance will be conducted according to Table 2.

		Spring			***Summer***			***Fall***			***Winter***		
BMP	***Activity***	***M***	***A***	***M***	***J***	***J***	***A***	***S***	***O***	***N***	***D***	***J***	***F***
Catch basins	*Inspection**	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
Bioswale	*Inspection**	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
	Pull weeds		*X*	*X*									
	Remove thatch	*X*											
Permeable pavers	*Inspection**	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
	Sweeping to remove grass clippings and leaves			*X*	*X*	*X*	*X*	*X*	*X*	*X*			
Planter box	*Inspection**												
	Pull weeds		*X*	*X*									
	Remove thatch	*X*											

**complete every other week using the attached inspection checklists [or in an appendix]*

Complete minor corrective maintenance, such as debris removal, at the time of inspection and document it on the inspection form. When corrective maintenance is necessary, document it on the inspection form and schedule it within 30 days. When completed, document the corrective maintenance on the attached maintenance recordkeeping form [or in an appendix]. Keep all completed inspection and maintenance forms on file in the office of the Property Manager.

Solid Waste Handling Procedures

Properly handle and dispose of all solid waste removed from stormwater BMPs during the routine, corrective and emergency maintenance according to applicable laws and regulations. Dispose of trash in a proper trash receptacle and separate and sort recyclable items. To prevent the spread of weed seeds, bag and dispose of all weeds in the trash. Compost or properly dispose of thatch and other native plant materials with other yard waste. *Include the following statement if the site is a non-household entity:* Sediment and other materials removed from catch basins and any other stormwater BMP is classified as liquid hazardous waste. Handle and process this waste according to Part 121, Liquid Industrial By-Products of the Natural Resources and Environmental Protection Act. *If the plan is for a household entity, then Part 121 does not apply, but properly dispose of sediment and other materials removed from catch basins and other BMPs and do not allow material to discharge into waters of the state. When in doubt, hire a certified pumper/hauler to clean catch basins and remove sediment from other BMPs. Hand remove small amounts of sediment in vegetated BMPs and redistributed in the landscape. However, if sediment is getting into a vegetated BMP, then the BMP is likely not functioning properly and needs corrective maintenance.*

APPENDIX B

Recordkeeping

Immediately record all inspections and maintenance performed on the appropriate recordkeeping forms found in [SECTION, PAGE OR APPENDIX]. The person conducting the inspection or maintenance is responsible for filling out the form, scheduling or notifying the appropriate person that corrective maintenance needs to be scheduled and forwarding the completed form to the Property Manager.

Add any specific information regarding preferred methods of recordkeeping. Will hard copy forms be filled out by hand or will an electronic version be available? Do original hard copies need to be kept on file or are digital scans acceptable? How will the records be backed up, if at all?

Training

Provide training for all persons responsible for conducting stormwater BMP inspections or maintenance. All persons will complete a minimum of 8 hours of in-class or online study initially and another 4 hours annually after the first year. Training will include:

- Health and safety issues
- Applicable regulations and liability
- Proper equipment use and maintenance techniques
- Consistent and accurate recordkeeping
- Waste handling procedures
- Controlling stormwater pollution through stormwater system operation and maintenance

Provide specific information about what training materials to use, who will conduct the training, whether it will be classroom or online, etc.

Contractors hired for certain maintenance activities will demonstrate that their employees are properly trained in applicable inspection and maintenance procedures.

Evaluation

The responsible parties will evaluate the effectiveness and efficiency of this plan an annual basis according to the checklist found [INSERT LOCATION HERE OR IN AN APPENDIX]. *Use the example provided in Appendix F or modify it to fit the needs of your plan.*

APPENDIX C

RELEASE NOTIFICATION REQUIREMENTS IN MICHIGAN

Release Notification Requirements in Michigan

While diligent efforts have been made to assure that the information provided in the following table is accurate and complete as of August 18, 2015, there is no guarantee that it covers all of the regulatory requirements for release notification and reporting in Michigan.

Chemical releases in Michigan are potentially reportable under one *or more* of twenty-seven different **state and federal regulations**. Determining which regulations apply to a specific release can be an overwhelming task. The "Release Notification Requirements in Michigan" table was compiled by the Michigan SARA Title III Program staff in the Department of Environmental Quality (DEQ) to help owners and operators of facilities in Michigan, including vehicles and farms, determine their potential notification and reporting requirements in the event of a chemical release.

Check your permits, licenses, registrations, pollution prevention plans, and local ordinances for *additional* release reporting requirements. In particular, all NPDES permits and most air permits have release reporting requirements in them that are not included on this table.

This table should be used as a tool to identify potential reporting requirements *before* a release occurs, and to identify follow-up reporting requirements based on the release. The table outlines **what** releases must be reported, **when** they must be reported, and **to whom** they must be reported.

What Is a Chemical Release?

The term "release" means spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing. "Chemical" includes substances considered to be toxic or hazardous as well as substances as seemingly harmless as salad oil.

Chemical Lists

The EPA published a consolidated list of chemicals subject to SARA Title III, CERCLA, section 112(r) of the Clean Air Act called the "List of Lists." See the following EPA website for the List of Lists: http://www2.epa.gov/epcra/epcracerclacaa-ss112r-consolidated-list-lists-march-2015-version

The "List of Lists" includes:

- **CERCLA Hazardous substances**, including **RCRA waste streams** and **unlisted hazardous wastes**, with reportable quantities (RQ) for releases (originally published in 40 CFR 302, Table 302.4).
- **SARA Title III Extremely Hazardous Substances** (EHS) with RQs for releases (originally published in 40 CFR 355).
- **SARA Title III Section 313 Toxic chemicals** (originally published in 40 CFR 372 Subpart D).

The Part 5 Rules, Spillage of Oil and Polluting Materials, were promulgated pursuant to Part 31 of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). These rules include a list of "**polluting materials**" with threshold reporting quantities for releases.

NREPA Part 201 has been updated and now refers to the **2015 version of the CERCLA list** of hazardous substances.

NOx Exemption in CERCLA and SARA Title III

On **October 4, 2006**, EPA finalized an exemption for certain releases of emissions of NO and NO_2 (collectively NOx) to air from CERCLA and SARA Title III reporting requirements (71 FR 58525). The exemption was effective November 3, 2006, and applies to releases to the air of less than 1,000 pounds of NOx in 24 hours that are the result of combustion. The exemption also applies to emissions from combustion-related activities such as detonation or processes that include both combustion and non-combustion operations, such as nitric acid production.

Petroleum Exclusion in CERCLA

Petroleum, including crude oil or any fraction thereof is excluded from the definitions of "hazardous substance," and "pollutant or contaminant" under CERCLA. Petroleum releases, accordingly, must generally be addressed under the authority of other law such as the underground storage tank (UST) provisions of RCRA, or the Clean Water Act (CWA). This exception, which has become known as the "***petroleum exclusion***," plays a significant role in CERCLA because many sites contain petroleum contamination. Petroleum frequently contains specific listed hazardous substances, the most common of which are benzene, toluene and xylenes. In general, such substances are not treated as CERCLA hazardous substances as long as they are found in refined petroleum fractions and are not present at levels that exceed those normally found in such fractions. Substances present in petroleum as a result of contamination during use or from mixing or combining are not within the petroleum exclusion and in such cases, the substances are considered CERCLA hazardous substances.

NREPA Part 201, Environmental Remediation, section 20114(1)(b) states that the requirements to report a release under this regulation apply to “reportable quantities of hazardous substances established pursuant to 40 CFR 302.4 and 302.6” This regulation references the listed hazardous substances published in the Code of Federal Regulations. It does not adopt the petroleum exclusion that applies to federal regulation of releases of CERCLA hazardous substances. As a result, petroleum constituents, including component substances such as benzene, toluene, and xylenes, plus any additives (e.g., MTBE, lead) are all reportable under Part 201 based on the reportable quantities in the 2015 version of the CERCLA list of hazardous substances published in 40 CFR 302.4 and 302.6.

Initial Notification: There is NO PENALTY for over-reporting!

When there is a release, determining if, when, and to whom it should be reported can be a daunting task even if you are familiar with the table. It is therefore recommended that **if there is a release, immediately call** the following three numbers even if the content or quantity of the released material has not yet been determined:

Post These Numbers by Every Phone

911 to notify Local authorities
800-292-4706 (PEAS) to notify State authorities
800-424-8802 (NRC) to notify Federal authorities

You can then respond to the release, reassess the situation, and make additional notifications as required (e.g. as specified in the table or in your permits). Your follow-up report will provide details that explain why a release was *or was not* reportable.

SARA Title III section 304 requires that the LEPC be notified immediately of a release. Many LEPCs accept the call to 911 as notification. Others require direct notification. Contact your LEPC in advance to find out their requirements.

Written Follow-up Report

Written follow-up report forms that are specified in the table are required by regulation. The DEQ has developed a generic written report form called "Spill or Release Report" (EQP 3465) that can be used to report releases of:

- Hazardous and extremely hazardous substances under SARA Title III,
- Hazardous waste under NREPA Part 111,
- Liquid industrial waste under NREPA Part 121,
- Hazardous substances under NREPA Part 201, and
- Polluting materials under NREPA Part 31, Part 5 Rules.

Hot Tip!

Use the generic Spill or Release Report form to record *initial* notifications.

Links to the release reporting forms and chemical lists referenced in the table are available on the DEQ SARA Title III Release Reporting website. Visit this site for updated DEQ and LEPC contact information.

NOTE: Executive Order 2012-14 transferred the DEQ storage tank program to the Bureau of Fire Services in LARA effective December 2, 2012. Phone numbers and email addresses associated with the storage tank program and staff have not changed.

For information regarding a specific regulation, contact the agency specified in the "notes" column of the table. If this is a DEQ division, contact the *district* division office.

General questions or comments regarding this table should be directed to the DEQ Environmental Assistance Center at 800-662-9278 or deq-assist@michigan.gov.

DEQ program information is available at www.michigan.gov/deq or you may contact the DEQ Environmental Assistance Center.

DEQ Release Reporting website:
www.michigan.gov/chemrelease

Acronyms are defined at the end of the table.

Release Notification Requirements in Michigan*

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
SARA Title III Section 304 40 CFR 355.40 (**EHS & Hazardous Substances**)	Release of a CERCLA **hazardous** substance (40 CFR 302, Table 302.4) or **Extremely Hazardous** Substance (EHS) (40 CFR 355, Appendix A) from a facility (all buildings, equipment, etc. located on a single site or adjacent sites owned or operated by the same person) at which a hazardous chemical (as defined under 29 CFR 1910.1200(c)) is used, produced or stored (including motor vehicles, rolling stock, and aircraft) in a quantity equal to or greater than its corresponding reportable quantity in any 24-hr period that migrates beyond the facility boundaries. Includes continuous release reportable under CERCLA Section 103. Excludes release that is federally permitted or that results in exposure to persons solely within the boundaries of the facility. See 67 FR 18899 (4/17/02) for guidance on the CERCLA federally permitted release definition for certain air emissions. Does not apply to the application, handling, and storage by an agricultural producer of a pesticide product registered under FIFRA. Excludes release < 1000 lbs of NOx released to the air from combustion or combustion-related activities.	Immediate (within 15 minutes after discovery): to LEPC(s) of any area(s) potentially affected, and SERC (DEQ PEAS line accepts notification on behalf of SERC) by owner or operator. Continuous releases must be identified as such and are reported initially and when there is a significant change in the release. See 73 FR 76948 (12/18/08): Only CAFOs are required to report continuous releases to the air from animal waste. Transportation related releases can be reported to 911.	As soon as practicable (within 30 days) after release: to LEPC(s) and SERC. Not required for releases that occur during transportation or from storage incident to transportation. For continuous releases: Initial written within 30 days after initial telephone notification: to LEPC(s) and SERC. Michigan SARA Title III Program accepts reports on behalf of the SERC.	PEAS: 800-292-4706 Contact your LEPC for a phone number to report releases. Call 911 if your LEPC is not active. For further information & LEPC contact information, contact Michigan SARA Title III Program 517-284-7272
CERCLA Section 103 40 CFR 302 (**Hazardous Substances**)	Release into the environment of a CERCLA **hazardous** substance (40 CFR 302, Table 302.4) or hazardous constituent in a mixture or solution (including hazardous waste streams) from a vessel or facility (any building, structure, etc. including motor vehicles, rolling stock, aircraft, pipe, pipeline, well, pond, lagoon, impoundment, ditch, landfill, or site where a hazardous substance has come to be located) in a quantity equal to or greater than its corresponding reportable quantity in any 24-hour period. Excludes petroleum, including oil, or any fraction thereof. See 40 CFR 302.6 for notification requirements for radionuclide releases. Includes continuous release: occurs without interruption or abatement or that is routine, anticipated, and intermittent and incidental to normal operations or treatment processes. See 67 FR 18899 (4/17/02) for guidance on the CERCLA federally permitted release definition for certain air emissions. See 71 FR 58525 (10/4/06) re Exemption for NOx releases to the air of < 1000 lbs from combustion or combustion-related activities. Does not apply to the application, handling, and storage by an agricultural producer of a pesticide product registered under FIFRA.	Immediate (within 15 minutes after discovery): to NRC by person in charge of vessel or offshore or onshore facility. Continuous releases must be identified as such and are reported initially and when there is a significant change in the release. See 73 FR 76948 (12/18/08) re Exemption from reporting continuous releases to the air from animal waste.	For continuous releases only: Initial written within 30 days after initial telephone notification & Follow-up within 30 days of first anniversary of initial written notification: to EPA Region 5.	NRC 800-424-8802 or online at www.nrc.uscg.mil For further information contact Michigan SARA Title III Program 517-284-7272 or EPA's Superfund, TRI, EPCRA, RMP, and Oil Information Center 800-424-9346

NOTE: If the release is a **THREAT TO HUMAN HEALTH or SAFETY**, call 911 or your local fire department.

***This table covers only those reporting requirements found in rules and regulations that apply in Michigan. **Releases might be reportable under multiple regulations**.

Additional reporting requirements might be found **in permits**, licenses, registrations, **contingency and pollution prevention plans**, and local ordinances.

Release Notification Requirements in Michigan*

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
NREPA 1994 PA 451 Part 201, **Environmental Remediation**	(i) Unpermitted release into the environment over a 24-hour period of a **hazardous** substance (*July 1, 2012, edition* of the CERCLA list, 40 CFR 302, Table 302.4) in a quantity equal to or greater than its corresponding reportable quantity. Does not include release solely from UST systems regulated under Part 213, and release solely from disposal area licensed under Part 115 and discovered through disposal area's hydrogeological monitoring plan. Release of substance regulated by MI Dept of Agriculture & Rural Development (MDARD) (fertilizer, soil conditioner, or pesticide) excluding normal agricultural practices: *also* report to MDARD.	Within 24 hours after discovery: to DEQ-RRD district office (PEAS after hours) by owner or operator or person holding easement interest. Report agricultural release to MDARD.	Upon request: Provide a response activity plan to DEQ-RRD district supervisor.	PEAS: 800-292-4706 MDARD Agriculture Pollution Emergency Hotline: 800-405-0101 For further information contact DEQ-RRD
NREPA 1994 PA 451 Part 201, **Environmental Remediation** (Continued)	(ii) The owner or operator has reason to believe that one or more **hazardous** substances are migrating or have migrated from his or her property and are present beyond the property boundary at a concentration in excess of cleanup criteria for unrestricted residential use. (iii) The release is a result of an activity that is subject to permitting under NREPA Part 615 and the owner or operator is not the owner of the surface property and the release results in **hazardous** substance concentrations in excess of cleanup criteria for unrestricted residential use. Hazardous substance means a hazardous substance defined in CERCLA (40 CFR 302), hazardous waste as defined in NREPA part 111, petroleum as defined in NREPA part 213, or any substance demonstrated to pose an unacceptable risk to public health, safety, welfare, or the environment. Cleanup criteria for unrestricted residential use means criteria that satisfy the requirements in section 20120a(1)(a) or (16); or as defined under NREPA part 213.	Within 30 days after discovery: to DEQ-RRD district office and owners of property to which hazardous substances migrated or owner of surface property by owner or operator of property where release occurred. Specific form required for: "Notice of Migration of Contamination" (Form EQP4482).	Upon request: Provide a response activity plan to DEQ-RRD district supervisor.	For further information contact DEQ-RRD

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Release Notification Requirements in Michigan*

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
NREPA 1994 PA 451 Part 83, Pesticide Control Regulation 640, Commercial Pesticide Bulk Storage (**Agricultural**)	Release to the environment of a commercial **pesticide** >5 gallons or 100 pounds. Reportable agrichemical spills as defined in the provisions of SARA Title III section 304 and CERCLA section 103 shall be immediately reported to PEAS and the NRC. The term "release" excludes normal agricultural practices.	Immediate: to PEAS* Also notify NRC for spills reportable under SARA Title III & CERCLA. *MDARD prefers direct notification to their hotline. PEAS forwards all agriculture calls to MDARD.	Within 90 days: to MDARD Pesticide and Plant Pest Management Div. a revised site plan.	MDARD Agriculture Pollution Emergency Hotline: 800-405-0101 PEAS: 800-292-4706 NRC 800-424-8802 or online at www.nrc.uscg.mil For further information contact MDARD 517-284-5644
NREPA 1994 PA 451 Part 85, Fertilizers Regulation 641 Commercial Fertilizer Bulk Storage Regulation 642, On Farm Fertilizer Bulk Storage (**Agricultural**)	Release to the environment of a commercial **fertilizer** >55 gallons liquid or 650 pounds dry, or tank overfills; or an on farm fertilizer > 55 gallons liquid. For storage tank with bladder system instead of diking: also report all overfills and internal spills. The term "release" excludes normal agricultural practices. The term "liquid fertilizer" excludes anhydrous ammonia.	Immediate: to MDARD by commercial bulk storage facility personnel (For farms, the regulation does not specify who makes the report.)	Not required.	MDARD Agriculture Pollution Emergency Hotline: 800-405-0101 For further information contact MDARD 517-284-5644
Fire Prevention Code 1941 PA 207 Section 29.5g	A fire, explosion, spill, leak, accident, or related occurrence that involves the transportation, storage, handling, sale, use, or processing of hazardous material by a firm, person, or vehicle. **Hazardous** material = explosives, pyrotechnics, flammable gas, flammable compressed gas, flammable liquid, nonflammable compressed gas, combustible liquid, oxidizing material, poisonous gas or liquid, LPG, or irritating, etiologic, radioactive, or corrosive material. Act 207 amended 6/19/2006. The State Fire Marshall is in LARA, Bureau of Fire Services.	Immediately following incident, report known details regarding incident: to LARA Bureau of Fire Services *and* organized local fire department by owner of firm or vehicle or the person *and* the chief of first police or organized fire dept upon scene of incident.	Not required.	Contact LARA Bureau of Fire Services by calling the MSP HazMat hotline: 800-525-5555 For further information: contact local fire department

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Release Notification Requirements in Michigan*

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
49 CFR 171 (**Transportation of Hazardous Materials**)	Initial verbal notice: Incident during transportation (including loading, unloading, temporary storage) involving (1) **hazardous** material and resulting in death, injury requiring hospitalization, public evacuation ≥ 1 hour, major transportation artery or facility closure ≥ 1 hour, or flight pattern alteration; (2) fire, breakage, spillage, or suspected radioactive contamination occurs involving a **radioactive** material; (3) fire, breakage, spillage or suspected contamination involving an **infectious** substance other than a regulated medical waste; (4) **marine pollutant** release exceeding 450 L (119 gal) liquid or 400 kg (882 lbs) solid; (5) other per judgment of person in possession of the hazardous material (e.g., continuing danger to life exists at scene of incident); (6) during transportation by aircraft, a fire, violent rupture, explosion or dangerous evolution of heat occurs as a direct result of a battery or battery-powered device. Hazardous material = CERCLA hazardous substance (40 CFR 302, Table 302.4), hazardous waste (40 CFR 262), marine pollutant (49 CFR 172.101 Appendix B), elevated temperature material, listed on Hazardous Materials Table (49 CFR 172.101), or meets criteria for hazard class/division in 49 CFR 173. Written follow-up report: Required for all of above, plus any unintentional release of hazardous material from a package (including tank); or any quantity of hazardous waste discharged during transportation; or structural damage to lading retention system, even if no release, on specification cargo tank with ≥ 1000 gal capacity containing hazardous material; or undeclared hazardous material discovered.	As soon as practical but no later than 12 hours after occurrence of the incident: to NRC by each person in physical possession of the hazardous material. (A reportable incident *must* be reported by telephone, not online.) For infectious substances, notice may be given to the Director, Centers for Disease Control and Prevention, U.S. Public Health Service instead of NRC.	Within 30 days after discovery: to US DOT on DOT Form F 5800.1 (01-2004) "Hazardous Materials Incident Report." Report online at https://hazmatonline.phmsa.dot.gov/incident/ Report must be updated w/i 1 year of incident if: Death results from injury; hazardous material or package info on prior report misidentified; damage, loss or cost not known on prior report becomes known or changes by $25,000 or 10%. See regulation for exceptions to written report.	NRC 800-424-8802 or online at www.nrc.uscg.mil U.S. Public Health Service 800-232-0124 For further information contact US DOT Hazardous Materials Information Center at 800-467-4922 or online at www.phmsa.dot.gov/hazmat
NREPA 1994 PA 451 Part 31, Water Resources Protection (Release to **surface of ground**, **surface water , groundwater** or **public sewer system**)	Unpermitted release directly or indirectly to public sewer system, surface of ground, surface water or groundwater from an oil storage facility or on-land facility of a "**polluting material**" (**oil**, **salt**, or any material specified in table 1 in R 324.2009) in excess of its threshold reporting quantity during any 24-hour period. See Part 5 rules, effective 8/31/01, for details and exemptions. HB 5586 effective 6/15/04 amended the reporting requirements. *Rule revisions pending as of November 2014.*	As soon as practicable after detection: to PEAS *and* 911 by owner, operator or manager. State agencies call 911 if release reported to them by another state or Canada.	Within 10 days after release: to DEQ-WRD district supervisor *and* to the local health department where the release occurred, outlining cause, discovery, response & prevention of recurrence.	PEAS: 800-292-4706 For further information contact DEQ-WRD

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Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
CWA Section 311 33 CFR 153 (**Navigable waters** – Coast Guard/DOT) Control of Pollution by **Oil** and **Hazardous** Substances, Discharge Removal	Discharge of a harmful quantity of **oil** or a **hazardous** substance from a vessel or onshore or offshore facility into or upon navigable **waters** of the United States or adjoining **shorelines**. Harmful quantity = oil discharge that violates applicable water quality standards, or causes a film or sheen upon or discoloration of the surface of the water or adjoining shorelines, or causes a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines; or a CERCLA hazardous substance (40 CFR 302, Table 302.4) in a quantity equal to or greater than its corresponding reportable quantity. Oil = oil of any kind or in any form including petroleum, crude oil, petroleum refined products, sludge, oil refuse, oil mixed with wastes, etc., as well as vegetable and animal oils.	Immediate: to NRC by person in charge of vessel or facility. If direct reporting to NRC not practicable, may report to district Coast Guard or EPA predesignated OSC.	Not required.	NRC 800-424-8802 or online at www.nrc.uscg.mil District 9 Coast Guard 216-902-6117 EPA Region 5 for predesignated OSC 312-353-2318 For further information contact EPA Region 5 at 312-353-8200 or District 9 Coast Guard at 216-902-6045
CWA Section 311 40 CFR 110 (**Discharge of Oil**)	Discharges of **oil** that violate applicable **water** quality standards, or cause a film or sheen upon or discoloration of the surface of the water or adjoining **shorelines**, or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. Oil = oil of any kind or in any form including petroleum, crude oil, petroleum refined products, sludge, oil refuse, oil mixed with wastes, etc., as well as vegetable and animal oils.	Immediate: to NRC by person in charge of vessel or facility.	Not required.	NRC 800-424-8802 or online at www.nrc.uscg.mil For further information contact DEQ-WRD
NREPA 1994 PA 451 Part 31, Water Resources Protection (**Sewer Systems**)	Discharge of untreated sewage or partially treated sewage from a **sewer system** onto land or into the waters of the state. "Sewer system" means a sewer system designed and used to convey sanitary sewage or storm water, or both.	Immediate (within 24 hours): to DEQ-ODWMA district office (PEAS after hours); Local health depts.; Daily newspaper circulated in source & affected counties; & Affected municipalities.	At end of discharge: to same parties notified initially on Form EQP 5857 (Rev. 12/2011) "Report of Discharges of Untreated or Partially Treated Sewage." Includes results of E. coli testing.	PEAS: 800-292-4706 For further information contact DEQ-ODWMA
NREPA 1994 PA 451 Part 41, **Sewerage Systems**	Discharges of pollutants from **sewerage systems** (which can include combined sewers) in excess of those authorized by a discharge permit issued by the DEQ to surface water or groundwater as a result of a facility breakdown or emergency. Sewerage systems handle sanitary sewage or other industrial liquid wastes.	Promptly: to DEQ-ODWMA district office (PEAS after hours) by owner.	Within 72 hours: to DEQ-ODWMA district supervisor, outlining cause, discovery, corrective actions taken to minimize impact, restore operations, and eliminate future unpermitted discharges.	PEAS: 800-292-4706 For further information contact DEQ-ODWMA

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Additional reporting requirements might be found **in permits**, licenses, registrations, **contingency and pollution prevention plans**, and local ordinances.

Release Notification Requirements in Michigan*

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
NREPA 1994 PA 451 Part 211, **Underground Storage Tanks** Part 213, Leaking Underground Storage Tanks	Releases of a **regulated substance** of any amount from underground storage tank (UST) systems (includes the emergency shutoff valve on down) subject to registration; overfill from UST fillpipe or vent onto ground; release from aboveground pipe attached to UST system. Regulated substance = petroleum or CERCLA hazardous substance (40 CFR 302, Table 302.4) or substance listed in CAA title 1 part A sect 112. Petroleum includes, but is not limited to, crude oil, motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, and petroleum solvents.	(Part 211) Within 24 hours after discovery: to LARA Bureau of Fire Services, Storage Tank Division by email, or fax on Form EQP 3826 (Rev. 4/12) If free product, Form EQP 3800 (Rev 02/2003) required by UST owner or operator, or employee of owner or operator. Includes releases discovered years after UST system removed	(Part 213) At 180 days Initial Assessment Report on Form EQP3841 (Rev. 02/2003) if not closed; at 365 days Final Assessment Report on Form EQP3842 (Rev. 11/2006) if still not closed; at closure Closure Report on Form EQP3843 (Rev. 02/2003) to DEQ-RRD district project manager.	Email: deq-std-tanks@michigan.gov Fax:517-335-2245 For further information contact DEQ-RRD or phone 800-MICHUST
NREPA 1994 PA 451 Part 111, **Hazardous Waste** Management (Generators; Treatment, Storage & Disposal Facilities (TSDF); Transporters)	Any amount of characteristic **hazardous waste** or listed hazardous waste (as defined in R 299.9203 "Hazardous Waste Rule 203") reaches the surface water or groundwater, or A fire, explosion, or other release of hazardous waste or hazardous waste constituent occurs that could threaten human health or the environment. or A release of >1lb (or ≤1lb if not immediately cleaned up) hazardous waste to the environment from a tank system or associated secondary containment system. Additional hazardous waste reporting requirements under NREPA Part 201 and CERCLA. NREPA Part 111 requires transporters to comply with 49 CFR 171 and 33 CFR 153.	Immediate: to PEAS (or for Tank systems/secondary containment, within 24 hours of discovery: to DEQ-OWMRP) and to NRC if threat to human health or environment outside facility by generator, or owner or operator of TSDF, or transporter.	For large quantity generators and TSDF: Within 15 days after incident IF the contingency plan had to be implemented: to DEQ-OWMRP. For tank/secondary containment systems: Within 30 days of discovery: to DEQ-OWMRP. For transporters: to US DOT if required per 49 CFR 171.	PEAS: 800-292-4706 NRC 800-424-8802 or online at www.nrc.uscg.mil For further information contact DEQ-OWMRP
NREPA 1994 PA 451 Part 121, **Liquid Industrial Waste**	The **liquid industrial waste** spill could threaten public health, safety, welfare, or the environment, or has reached surface water or groundwater. Liquid industrial waste includes nonhazardous brine, by-product, industrial wastewater, leachate, off-spec commercial chemical product, sludge, sanitary or storm sewer clean-out residue, grease trap clean-out residue, spill residue, used oil, or other liquid waste not regulated by other laws.	Immediate: to PEAS and local authorities by generator, transporter, or owner or operator of facility. Refer to MCL 324.12111(1) for required report elements	Prepare within 30 days after incident. Submit upon request: to DEQ-OWMRP district supervisor. Refer to MCL 324.12111(1) for required report elements	PEAS: 800-292-4706 For further information contact DEQ-OWMRP
NREPA 1994 PA 451 Part 55, **Air Pollution** Control	Abnormal condition, start-up, shutdown, or malfunction that results in emissions exceeding permissible (in rule, permit or order) levels of **hazardous air pollutants** (HAPs) (CAA Sect. 112(b)) or **toxic air contaminants** (as specified in permit) for > 1 hour, or any air contaminant for > 2 hours. Written follow-up report only required for emission exceedences lasting > 2 hours.	As soon as possible, but not later than 2 business days after discovery: to DEQ-AQD district office (PEAS after hours) by owner or operator.	Within 10 days after start-up, shutdown, or abnormal condition, malfunction corrected. Or within 30 days of abnormal condition, malfunction discovery- whichever first: to DEQ-AQD district supervisor.	PEAS: 800-292-4706 For further information contact DEQ-AQD

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Release Notification Requirements in Michigan*

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
NREPA 1994 PA 451 Part 55, **Air Pollution** Control (Permit to Install Exemptions)	Emergency venting of **natural gas** from transmission and distributions systems or **field gas** from gathering lines in amounts > 1,000,000 standard cubic feet per event. Emergency = unforeseen event that disrupts normal operating conditions and poses a threat to human life, health, property or the environment if not controlled immediately. See R 336.1285(mm), effective 6/20/2008, for details.	Within 24 hours of the event: to PEAS by owner or operator.	Not required.	PEAS: 800-292-4706 For further information contact DEQ-AQD
Public Health Code 1978 PA 368 Part 133, **Dry Cleaning**	Condition or incident presents a threat or hazard to **public health** or safety.	Immediate: to DEQ-AQD district office (PEAS after hours) by owner or operator.	Within 30 days after incident: To DEQ-AQD district supervisor.	PEAS: 800-292-4706 For further information contact DEQ-AQD
NREPA 1994 PA 451 Part 615, Supervisor of Wells (**oil and gas production fields**)	A loss, spill or release of (1) any amount of **brine**, **crude oil**, or **oil or gas field waste** *unless* it is less than 42 gallons and occurs while an authorized representative is on site and is completely contained and cleaned up within 1 hour, or (2) any unpermitted amount of **natural gas**, or (3) **chemicals** used in association with oil and gas activities.	Within 8 hours after discovery of: 42 gallons or more of brine, crude oil, or oil or gas field waste, or any amount of chemical or natural gas, or; less than 42 gallons if the spill contacts surface water, groundwater, or other environmentally sensitive resources, or is not completely contained and cleaned up within 48 hours: to DEQ-OOGM district office (PEAS after hours) by permittee.	Within 10 days after discovery of loss or spill: to DEQ-OOGM district supervisor on Form EQP-7233 (Rev 1/2012) "Report of Loss or Spill." by permittee Written report only for less than 42 gallons of brine, crude oil, or oil and gas field waste if spill does not contact surface water, groundwater, or other environmentally sensitive resources, and is completely contained and cleaned up within 48 hours.	PEAS: 800-292-4706 For further information contact DEQ-OOGM
49 CFR 191 Transportation of Natural and Other **Gas by Pipeline**	An incident, meaning: (1) Event that involves a release of **gas** from a pipeline, or of liquefied natural gas, liquefied petroleum gas, refrigerant gas, or gas from an LNG facility that results in: Death or hospitalization; or Property damage ≥ $50,000; or estimated gas loss of ≥ three million cubic feet. (2) Event that results in emergency shutdown of LNG facility. (3) Significant event per operator. Written Incident reports not required for LNG facilities. Applies to pipeline systems and the transportation of gas through those systems in or affecting interstate or foreign commerce. (See 49 CFR 191.3 for details.)	Earliest practicable moment following discovery: to NRC by operator. Notification must electronic unless there is a safety-related condition to report.	As soon as practicable, and within 30 days after discovery: to US DOT. on DOT Form PHMSA F 7100.1 "Incident Report – Gas Distribution System." or PHMAS F 7100.2 "Incident Report – Gas Transmission and Gathering Systems" or PHMSA F 7100.3 "Incident Report – Liquefied Natural Gas (LNG) Facilities" Supplemental report filed as necessary as soon as practicable.	NRC 800-424-8802 or online at www.nrc.uscg.mil For further information contact US DOT Pipeline Safety Information Center at 202-366-4595 or online at http://ops.dot.gov

NOTE: If the release is a **THREAT TO HUMAN HEALTH or SAFETY**, call 911 or your local fire department.

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Additional reporting requirements might be found **in permits**, licenses, registrations, **contingency and pollution prevention plans**, and local ordinances.

Release Notification Requirements in Michigan*

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
49 CFR 195 Transportation of **Hazardous Liquids by Pipeline**	Release of hazardous liquid (**petroleum**, **petroleum products**, or **anhydrous ammonia**) or **carbon dioxide** from a pipeline system that results in any of the following: (a) Explosion or fire; (b) Release of ≥ 5 gallons (except if < 5 barrels released due to maintenance and release not otherwise reportable, confined to property, does not pollute water, and cleaned up promptly); (c) Death of any person; (d) Injury requiring hospitalization; or (e) Property damage > $50,000. (See 49 CFR 195.50, revised 1/8/02, for details) Applies to pipeline facilities and the transportation of hazardous liquids associated with those facilities in or affecting interstate or foreign commerce. (See 49 CFR 195.1 for details.)	Earliest practicable moment following discovery: to NRC by operator if Release caused: Death or hospitalization; Fire or explosion; Property damage; Water pollution; or was Significant per the operator.	As soon as practicable, and within 30 days after discovery: to US DOT on DOT Form PHMSA F 7000-1 "Accident Report – Hazardous Liquid Pipeline Systems" Supplemental report must be filed within 30 days after operator receives changes or additions to original report.	NRC 800-424-8802 or online at www.nrc.uscg.mil For further information contact US DOT Pipeline Safety Information Center at 202-366-4595 or online at http://ops.dot.gov
1978 PA 368 Part 135, **Radiation** Control	For any emergency. Or for incident involving naturally occurring or accelerator produced **radioactive material**- Immediate notice if: Incident may have caused or threatens to cause: dose to body 25 rems, to skin 150 rems, to extremities 375 rems (per rule 247); 24 hour concentration exceeds 5000 times limits specified in table II of rules 261 to 269; contamination causes operation shut down for 1 week, or property damage >$100,000. Notice within 24 hours if: Incident may have caused or threatens to cause: dose to body 5 rems, to skin 30 rems, to extremities 75 rems (per rule 247); 24 hour concentration exceeds 500 times limits specified in table II of rules 261 to 269; contamination causes operation shut down for 1 day, or property damage >$1000.	Immediate or within 24 hours (see reporting criteria): to DEQ-OWMRP Radiological Protection Section (PEAS after hours) or MSP Operations Division for all **Power Plant** related incidents (day or night). by licensee or registrant.	Within 30 days after release: to DEQ-OWMRP Radiological Protection Section by licensee or registrant. Written report also required if level of radiation or concentration of radioactive material in unrestricted area >10 times any applicable limit. See Rule 250 (R 325.5250) for required report content.	DEQ-OWMRP Radiological Protection Section 517-284-5185 MSP Operations Div 517-241-8000 PEAS: 800-292-4706 For further information contact DEQ-OWMRP Radiological Protection Section
10 CFR 20 (Standards for Protection Against **Radiation**)	For incident involving source, by-product, or special nuclear **radioactive material**- Immediate notice if: Event that may have caused or threatens to cause: effective dose equivalent to individual 25 rems, lens dose equivalent 75 rems, shallow-dose equivalent to skin or extremities 250 rads; individual could receive 5 times annual limit on intake in 24 hours. OR Any lost, stolen, or missing licensed material in an aggregate quantity equal to or greater than 1000 times the quantity specified in appendix C to part 20 under such circumstances that it appears to the licensee that an exposure could result to persons in unrestricted areas. Notice within 24 hours if: Event that may have caused or threatens to cause: an individual in 24 hours to receive effective dose equivalent >5 rems, lens dose equivalent >15 rems, shallow-dose equivalent to skin or extremities >50 rems; individual could receive >1 times annual limit on intake in 24 hours.	Immediate or within 24 hours (see reporting criteria): to USNRC by USNRC Licensee responsible for the incident.	Within 30 days of incident: to USNRC by licensee. Report content specified in 10 CFR 20.2003 Written report also required for occurrences as specified in 10 CFR 20 Section 20.2203 and after the occurrence of any lost, stolen, or missing licensed material becomes known to the licensee, and if at the time the report is filed all licensed material in a quantity greater than 10 times the quantity specified in appendix C to part 20 is still missing.	US Nuclear Regulatory Commission (USNRC) 301-816-5100 For further information contact DEQ-OWMRP Radiological Protection Section 517-284-5185

NOTE: If the release is a **THREAT TO HUMAN HEALTH or SAFETY**, call 911 or your local fire department.

***This table covers only those reporting requirements found in rules and regulations that apply in Michigan. **Releases might be reportable under multiple regulations**.

Additional reporting requirements might be found **in permits**, licenses, registrations, **contingency and pollution prevention plans**, and local ordinances.

Release Notification Requirements in Michigan*

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
MIOSHA 1974 PA 154 Section 61, Records & Reports; Notice of **Fatalities or Hospitalization**	A release that results in a **fatality** within 30 days of the incident or in-patient **hospitalization** within 24 hours of the incident. Note: the OSHA amendment to require employers to report all work-related hospitalization s within 24 hours becomes effective Jan 1, 2015. Michigan intends to adopt the new rules by reference within 6 months of the Sept 18, 2014 FR publication.	Within 8 hours: for a fatality or Within 24 hours: for hospitalization to MIOSHA Hotline by Employer.	Not required.	MIOSHA Fatality or Catastrophe Hotline 800-858-0397 For further information contact LARA-MIOSHA 517-322-1831
TSCA 40 CFR 761.125 (**PCBs**)	Spills of **PCB**s at concentrations of 50 ppm or more and subject to decontamination requirements under TSCA that: contaminate surface water, sewers, drinking water supplies, grazing lands or vegetable gardens, or exceed 10 pounds. (TSCA specifies that these requirements are in addition to any under CWA or CERCLA. e.g. CERCLA requires spills of 1 pound or more to be reported to NRC.)	As soon as possible after discovery, and within 24 hours: to EPA Region 5.	Not required to be submitted. Records of cleanup and certification of decontamination shall be documented.	EPA Region 5 Corrective Action Section 312-886-7890 For further information contact EPA Region 5 Corrective Action Section
SARA Title III Section 313 40 CFR 372 (**Toxic chemical** release reporting)	Covered facilities as defined in 40 CFR 372 subpart B are subject to **toxic** chemical release reporting for toxic chemicals and chemical categories listed in 40 CFR 372 subpart D.	Not applicable.	Annually by July 1: to EPA & SERC on EPA's Form R "Toxic Chemical Release Inventory Reporting Form" (EPA Form 9350-1, Rev.10/2011) Report aggregate releases (permitted & unpermitted)	Michigan SARA Title III Program accepts reports on behalf of SERC For further information contact Michigan SARA Title III Program 517-284-7272

Table prepared by the Michigan SARA Title III Program in the DEQ

Acronyms used in table:

AQD = Air Quality Division
AST = Above Ground Storage Tank
CAA = Clean Air Act
CAFO = Concentrated Animal Feeding Operation
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR = Code of Federal Regulations
CWA = Clean Water Act
DEQ = Michigan Department of Environmental Quality
DOT = Department of Transportation
EHS = Extremely Hazardous Substance
EPA = U. S. Environmental Protection Agency
EPCRA = Emergency Planning & Community Right-to-Know Act
FIFRA = Federal Insecticide, Fungicide, & Rodenticide Act
FL/CL = Flammable and combustible liquids
FR = Federal Register
HAP = Hazardous Air Pollutant
HazMat = Hazardous Materials
HB = House Bill
LARA = Michigan Department of Licensing & Regulatory Affairs
LEPC = Local Emergency Planning Committee
LNG = Liquefied Natural Gas
LPG = Liquefied Petroleum Gas
MCL = Michigan Compiled Laws
MDARD = Michigan Department of Agriculture & Rural Development
MIOSHA = Michigan Occupational Safety and Health Administration
MSP = Michigan Department of State Police
NRC = National Response Center (U.S. Coast Guard)
NREPA = Natural Resources & Environmental Protection Act
ODWMA = Office of Drinking Water & Municipal Assistance
OOGM = Office of Oil, Gas, and Minerals
OPS = Office of Pipeline Safety (US DOT)
OSC = On Scene Coordinator
OWMRP = Office of Waste Management & Radiological Protection
PA = Public Act (Michigan)
PCB = Polychlorinated biphenyl
PEAS = Pollution Emergency Alerting System
PHMSA = Pipeline & Hazardous Materials Safety Administration
RMP = Risk Management Program
RRD = Remediation and Redevelopment Division
SARA = Superfund Amendments and Reauthorization Act of 1986
SERC = State Emergency Response Commission
TRI = Toxic Chemical Release Inventory
TSCA = Toxic Substance Control Act
TSDF = Treatment, Storage & Disposal Facility
US DOT = U.S. Department of Transportation
USNRC = U. S. Nuclear Regulatory Commission
UST = Underground Storage Tank
WRD = Water Resources Division

NOTE: If the release is a **THREAT TO HUMAN HEALTH or SAFETY**, call 911 or your local fire department.

***This table covers only those reporting requirements found in rules and regulations that apply in Michigan. **Releases might be reportable under multiple regulations**.

Additional reporting requirements might be found **in permits**, licenses, registrations, **contingency and pollution prevention plans**, and local ordinances.

APPENDIX D

NON-HAZARDOUS LIQUID INDUSTRIL BY-PRODUCTS GENERATOR REQUIRMENTS

Michigan Department of Environmental Quality
Office of Waste Management and Radiological Protection

NON-HAZARDOUS LIQUID INDUSTRIAL BY-PRODUCTS GENERATOR REQUIREMENTS

Guidance

Many different types of entities, including government agencies, produce unwanted, discarded liquids and sludges that are regulated as liquid industrial by-products under Michigan's waste regulations. Liquid industrial by-products are not just generated by industrial activities. Common examples of liquid industrial by-products include used petroleum, animal or vegetable oils being recycled; storm sewer, catch basin, and sanitary sewer clean-out residues being disposed; grease trap waste; industrial wastewaters; uncontaminated precipitation removed from secondary containment structures; wash waters; antifreeze that is not a hazardous waste; and some off-specification commercial chemical products. This guidance summarizes the liquid industrial by-product generator requirements found in Part 121, Liquid Industrial By-Products, of Act 451 (Part 121). Household waste is not subject to the liquid industrial by-products regulation unless it is mixed with non-household discarded liquids. If unwanted household liquids are collected and managed separately from liquid industrial by-products, they may be managed to meet the waste diversion requirements found in Part 115, Solid Waste Management of Act 451 of 1994, as amended (Act 451). When mixed with discarded liquids from non-households, they too are subject to the liquid industrial by-product regulations.

Liquid industrial by-product includes any unwanted liquids or sludges that meet all of the following conditions:

- The discarded material is a liquid. The paint filter test or Test Method 9095 is the test method required to demonstrate a representative sample of waste is/is not liquid. This test method is described in the "Test Methods for Evaluating Solid Wastes, Physical-Chemical Methods" SW-846 available on-line at www.epa.gov/sw-846/main.htm. When performing Test Method 9095, a predetermined amount of the sample is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-minute test period, the sample contains free liquids and is subject to regulation as a liquid industrial by-product. Any unwanted non-hazardous material containing free liquids is a liquid for the purpose of compliance with Part 121.
- The discarded material is not subject to hazardous waste regulation. See the waste characterization guidance and recorded webinar for information on how to determine if your waste is subject to hazardous waste regulations. Conditionally exempt small quantity generator hazardous waste liquids must be managed, at a minimum, to meet the liquid industrial by-product regulations.
- **The discarded material is generated by a non-household entity.** Hospitals, service industries like dry cleaners and auto repair facilities, manufacturing industries like machine shops, and municipalities are all subject to the Part 121 liquid industrial by-product regulations.
- **The discarded material is not specifically or conditionally excluded from the definition of liquid industrial by-product.** See the definition of liquid industrial by-product found in Section 324.12101(n) of Part and the materials specifically excluded from regulation as a liquid industrial by-products under Section 324.12012a of Part 121.

Liquid Industrial By-Products management is overseen by several entities:

- The Office of Waste Management and Radiological Protection (OWMRP) oversees the management of liquid industrial by-products at generator locations, destination receiving facilities called liquid industrial by-product "designated facilities," and some authorized land application sites depending on the characteristics of the liquid industrial by-product, it may also be regulated under Part 115, Solid Waste Management, of Act 451, which is also overseen by OWMRP. Used oil is also subject to management requirements found in Part 111, Hazardous Waste Management, of Act 451, the Part 111 rules, and Part 167, Used Oil, of Act 451. The OWMRP also oversees the permitting and registering of liquid industrial by-products transporters pursuant to the Hazardous Materials Transportation Act, Act 138 of 1998, as amended.

The Michigan Department of Agriculture and Rural Development oversees the land application of liquid industrial by-products that can be land applied in accordance with the Right to Farm Act.

- The Water Resources Division (WRD) oversees the permitting and discharge of liquid industrial by-products into surface water and groundwater.
- Municipalities owning and operating local waste water treatment plants (WWTPs) oversee the permitting and discharge of liquid industrial by-products to their sewer system. Prior to discharge to any sewer system, permission to discharge must be obtained from the local authorities.
- Other local agencies, which vary between communities, oversee local ordinances. Therefore, the local authorities that oversee liquid industrial by-product locally may be the county, city zoning or building office, the public health department's environmental health section, or fire department.
- The Michigan State Police, Commercial Vehicle Enforcement Division and US Department of Transportation (US DOT) oversees transportation requirements if the waste is a US DOT hazardous material.
- Insurance companies may have requirements for storage and shipping of liquid industrial by-products.

If the facility generates liquid by-product, the company needs to:

1. **Characterize the waste to determine the appropriate management standards.**

   ✓ See the waste characterization guidance and recorded webinar for information on how to determine if a discarded material subject to hazardous waste, liquid industrial by-product, or solid waste regulations. If the material is determined to be a liquid industrial byproduct, handle it to meet the requirements summarized in this guidance.

   ✓ Keep records of waste evaluations, test results, or other information used to determine the type of waste/by-product at least three years after it is shipped for treatment, storage, or disposal.

2. **Meet storage requirements.**

   ✓ Protect containers from weather, fire, physical damage and vandals. Remember to leave enough room when filling containers so the container doesn't fail because the contents expanded in the heat or froze in the cold.

Example of using racks to protect drums from physical damage from traffic.

   ✓ Mark or label containers so workers know what is in the container. Make sure the labels stay readable. If it is used oil, the used oil regulations require the label to state "Used Oil." You may use purchased labels, handwrite or stencil the waste information on the container, or you can buy containers with information already printed on the container. Labels should include language that is commonly used in commerce and emergency response to describe the liquid industrial by-product. This may include a product name and details regarding the process generating the waste. Labels should include a description consistent with the waste type used on the shipping documents and the characterization record documenting the liquid industrial by-product determination. The content description required for labeling liquid industrial by-product and the waste type used for shipping and reporting liquid industrial by-product is separate, unique, and different from the U.S. DOT shipping description, class, and identification number specified in 49 CFR 172.101 that must be included on a bill of lading for shipping a liquid industrial byproduct that is a hazardous material as defined under U.S. DOT standards. A generator can include the words "by-product" or "waste" on a label, as long as the label accurately describes the liquid industrial by-product.

- ✓ Manage liquid industrial by-product to prevent releases into air, soil, drains, surface water or groundwater.
  - Containers must be maintained in good condition.
  - Any leaking containers must be replaced.
  - Containers must be kept closed except when adding or removing waste, or managed in accordance with other state laws. For liquid industrial by-product, closed means that container covers are securely affixed with a bolted ring clamp or closed snap ring, bung plugs are installed in openings, and threaded covers are screwed shut. Non-pressurized mobile oil drain pans must be, at a minimum, emptied when not in use. If a funnel is routinely used, to avoid having to remove the funnel and reclose the container regularly, a threaded funnel with a one-way valve, ball valve, or funnel with a latchable, gasketed cover can be used.

Non-pressurized mobile oil drain pan

  - Containers must be compatible with the type of waste being stored in them. The Safety Data Sheet (SDS) for the virgin ingredients may provide some recommendations or see Web sites like www.flw.com/datatools/compatibility/.
  - Incompatible wastes must not be placed in the same container.
- ✓ Liquid industrial by-product that has a flashpoint above 140 degrees Fahrenheit and below 200 degrees Fahrenheit that is stored in aboveground containers and tanks would also be regulated as a flammable and combustible liquid by the Michigan Department of Licensing and Regulatory Affairs (LARA), Bureau of Fire Services, Storage Tank Division. You may also be regulated by the MIOSHA General Industry Safety Standards - Part 75, Flammable and Combustible Liquids available at www.michigan.gov/miosha, and the local municipality's fire prevention code.
- ✓ Liquid industrial by-product in an underground storage tank that is a regulated substance under Part 211 (Underground Storage Tanks) of Act 451 would have additional requirements under the tank regulations. For forms and additional information, please go to www.deq.state.mi.us/sid-web/.
- ✓ If the waste in aboveground containers contains 1 percent or more of the polluting materials identified in the WRD's Part 5, Spillage of Oil and Polluting Materials rules, and the facility meets the threshold management quantity (TMQ), then the facility must also meet those rule requirements. For the listed chemicals the TMQ is 440 pounds when stored outdoors, or 2200 pounds when stored indoors. See information at www.michigan.gov/deqwater "Emergency Response for Releases to Water."
- ✓ There are no state time limit requirements on storing liquid industrial by-product at the generating facility, but local ordinances may have limits.
- ✓ See the Holding Tank guidance if using one for accumulation and storage.
- ✓ A generator of liquid industrial by-product is no longer required to obtain a Site Identification Number if the only activity occurring at the site is the generation of liquid industrial by-product and/or conditionally exempt small quantity generator hazardous waste. If the site accepts liquid industrial by-product from another site (e.g. acts as a liquid industrial by-product "designated facility") and/or self-transports their own liquid industrial by-product, a site notification must be filed for the activities occurring at that site and a Site Identification Number will be assigned. See the Site Identification Form EQP 5150 and instructions on-line at www.michgian.gov/deqwaste under "Announcements" to notify of waste activities. A Site Identification Number is also often called an EPA ID number. It is issued to the owner or operator at a specific address and tracks the waste activities occurring over time at the site. The Site Identification Number is used on the Uniform Hazardous Waste Manifests and/or shipping documents to help verify proper recycling and disposal of liquid industrial by-product. To determine if a Site Identification Number has been assigned to a site and to determine what activities are occurring at a site, search the Waste Data System (WDS) at www.deq.state.mi.us/wdspi using the street number and zip code for the site in question.

3. Meet shipping document requirements.

A liquid industrial by-product generator must create and maintain a shipping document for all liquid industrial by-product shipments. A shipping document can be a log, invoice, bill of lading, Uniform Hazardous Waste Manifest or other record; and it can be in written or electronic form. All shipping documents must include the following information:

- ✓ Name and address of the generator
- ✓ The name of the transporter
- ✓ The type and volume of liquid industrial by-product in the shipment
- ✓ The date the by-product was shipped off site from the generator
- ✓ The name, address and Site Identification Number of the generator.

Liquid industrial waste codes are not required but may be used, so long as all of the required information is included on the shipping document. If using a Uniform Hazardous Waste Manifest for shipping only liquid industrial by-product from a site without a Site Identification Number, the DEQ encourages use of the following for the Generator Site Identification Number field:

- "MICESQG" for shipping CESQG hazardous waste liquids
- "MILIB" for shipping liquid industrial by-product(s)
- "MICESQGLIB" for shipping both CESQG liquid hazardous waste and liquid industrial by-product(s).

The generator must sign the shipping document, certifying that the liquid industrial by-product in the shipment is fully and accurately described on the shipping document, is in proper condition for transport, and that the information on the shipping document is factual. The transporter must sign the shipping document certifying that the liquid industrial by-product on the shipping document was received for shipment. A copy of the shipping document must be maintained by the generator, and a copy provided to the transporter to accompany the shipment. The transporter must deliver the liquid industrial by-product only to the designated facility listed on the document. The designated facility receiving the shipment must provide confirmation of receipt to the generator or the generator's authorized representative. The confirmation may be a documented phone call, email, or other receipt, written or electronic.

A consolidated shipping document may be used to document transport of a uniform type of by-product collected from multiple pick-ups in one shipment. For a consolidated shipping document, the transporter is listed as the generator on the shipping record and the confirmation of receipt from the designated facility is provided to the transporter. However the generator of the waste remains responsible for proper handling of the shipment. When a consolidated shipping document is used, the generator must obtain a receipt from the transporter listing the transporter company's name, the driver's signature, the date of pickup, the type and quantity of by-product accepted for shipment, the consolidated shipping document number, and the designated facility.

Shipping records, including consolidated shipping records, and confirmation of designate facility receipt of shipments must be kept by the generator of records for at least three years after the liquid industrial by-product was shipped for treatment, storage, or disposal.

A liquid industrial by-product generator must either hire a permitted and registered liquid industrial by-product transporter to take the waste to an appropriate disposal or recycling facility or they may self-transport liquid industrial by-product if it was generated from equipment or property in which they have an ownership interest. When self-transporting, although a permit and registration is not required under Act 138, spill insurance must still be maintained.

4. Meet on-site treatment requirements.

- ✓ If the company is operating an on-site reclamation, treatment, or disposal facility, keep records of all liquid industrial by-product produced and reclaimed, treated or disposed at the facility.

- ✓ If liquid industrial by-product is treated, stored or disposed of in a surface impoundment, obtain the applicable Part 31 (Water Resources Protection) of Act 451 discharge permit and manage leachate appropriately. Discuss specific requirements with the DEQ District Office.

5. **Immediately report a release that could threaten public health or the environment or one that reached surface water or groundwater.** Report releases to the Pollution Emergency Alerting System at (800) 292-4706 that could threaten the public health, safety, and welfare, or environment, or that has reached surface water or groundwater and prepare a written report. If waste is subject to other regulations that require release reporting, also meet those requirements. Information at www.michigan.gov/deqrelease.

6. **Cleanup all spills.** If you have questions about cleanup requirements, contact the DEQ District Office. Cleanups may be overseen by the Remediation and Redevelopment Division or OWMRP, depending on the circumstances.

7. **Plan to prevent emergencies.** Depending on the type of liquid by-product, emergency planning may be required if threshold management quantities are reached under other regulations. Common examples include:

   a. Oil storage under the federal Spill Prevention Control and Countermeasure (SPCC) regulations. A SPCC plan is required when oil storage capacity on-site meets 1320 gallons. Oils include used and virgin oils, gasoline, diesel fuel, etc. SPCC regulations also require secondary containment, inspections and release reporting.

   b. Ethylene glycol antifreeze is regulated under the state's Part 5 rules "Spillage of Oil and Polluting Materials" when a facility has 440 pounds of regulated materials stored outdoors or 2200 pounds stored at discrete indoor areas. To determine if you have other polluting materials, see the list of regulated chemicals in these rules. They apply when the liquid by-product concentration is 1 percent or more and more of the listed chemical. More information is available at www.michigan.gov/deqwater "Emergency Response for Releases to Water."

Talk to your environmental consultant, call the DEQ District Office, or call the Environmental Assistance Center at 800-662-9278 with questions about the regulations.

APPENDIX E

CATCH BASIN CLEANING ACTIVITIES GUIDANCE

Catch Basin Cleaning

Catch Basin Cleaning Activities Guidance Document

Catch Basin Cleaning Activities

Catch basins are included in storm sewer system designs in order to remove solids such as gravel, sand, oils, and organic material carried by storm water. Catch basins also contain elevated concentrations of metals (attached to the solids) from street runoff or drainage from industrial, commercial and residential properties. In order to maintain the storm sewer systems effectiveness, catch basins must be periodically cleaned out. The Department of Environmental Quality (DEQ) Water Bureau (WB) and Waste and Hazardous Materials Division (WHMD) oversee environmental regulations pertaining to this activity. The Michigan Occupational Safety and Health Administration (MIOSHA) within the Department of Labor and Economic Growth oversee confined space entry and other worker health and safety standards.

In the past, the waste generated from the catch basin cleaning activities was typically discharged back into the storm sewer system. This type of discharge is unauthorized per Part 31, Water Resources Protection (Part 31) of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA) and is therefore illegal. The combined solid and liquid waste stream (solid/liquid waste) from cleaning storm sewers systems is legally defined as “liquid industrial waste” pursuant to Part 121, Liquid Industrial Wastes (Part 121) of NREPA.

The following are options recommended to properly deal with the waste stream generated from catch basin cleaning activities:

1. Have the waste transported to drying beds to separate the solid/liquid waste. This is usually performed at a publicly owned treatment plant or at a privately owned permitted facility where the liquid portion of the waste stream is separated from the solids and treated.

2. Request permission from the local wastewater treatment plant operator to discharge the combined solid/liquid waste into the sanitary system. Most treatment plants will require pre-treatment prior to the discharge. All applicable local ordinance provisions must be followed.

3. When conducting catch basin maintenance activities where the above options are not available, the following method can be used as long as there are no discharges to surface waters during dry weather conditions.

- Conduct visual inspection to ensure the water in the sump has not been contaminated. If necessary, collect a grab sample of the water and look for signs of contamination such as visible sheen, discoloration, obvious odor, etc. See the EPA Visual Inspection guidance for more tips. If there is any doubt of the quality of the water, it should be collected into the Vactor truck and treated as waste under Part 121 or Part 115 Solid Waste Management (Part 115) of NREPA.

- Using a sump pump, or any other pumping mechanism, remove the majority of water in the sump of the basin without disturbing the solid material below. Do not use pumps connected to the Vactor truck's holding tank.

- The clear water may then be directly discharged to one of the following:
  - Sanitary system (with prior approval from local sewer authority)
  - Curb and gutter
  - Back into the storm sewer system as long as it is contained within the system during dry weather condition to ensure no discharge into surface water
  - Applied to the ground adjacent to the catch basin (evenly distributed at a maximum rate of 250 gallons/acre/year)

- The remaining liquid/solid in the sump should be collected with a Vactor truck and disposed of off-site in accordance with Parts 115 or 121.

The entity whose catch basin is being cleaned is responsible for meeting the generator requirements under Part 121. See the Liquid Industrial Waste Generator guidance for more information.

The entity transporting the solid/liquid waste must meet the applicable transporter requirements. A local, state, or federal government may use its own vehicle to service catch basins or other parts of the sewer system without being a permitted and registered transporter under the provisions of the Hazardous Materials Transportation Act, 1998 PA 138, as amended (HMTA).

If the local government contracts with a private company to transport the liquids generated from cleaning the catch basins or other parts of the sewer system, that entity must be registered and permitted as a uniform liquid industrial waste transporter under the provisions of HMTA.

The transporter must notify the WHMD about their activity and obtain a site identification number. Follow the instructions and links to the form EQP5150 and online paying option posted at www.deq.state.mi.us/wdspi. There is a fee.

A uniform hazardous waste manifest must accompany the load, or a consolidated manifest may be used per Operational Memo 121-3, when the liquid waste is transported over public roadways by the local government or by a contract transporter. Keep the records at least three years from shipment. The waste transporting portion of the vehicle and/or containers used to

transport the waste must be kept closed except when adding or removing the waste, and the exteriors must be kept free of the liquid waste and residue.

The facility accepting the solid/liquid waste must meet operating requirements:

- They must notify the WHMD that they are operating a liquid industrial waste designated facility, obtain a site identification number, and meet operating requirements under Part 121. This includes practices to prevent unauthorized discharge of the waste, sign manifests, and keep required records. If waste containers are used, they must be kept closed and protected from the weather, fire, physical damage and vandals.

- The discharge of the liquids into the treatment plant that is permitted by the WB must meet the wastewater treatment plant requirements. Any other discharge of the liquids would require a separate DEQ discharge permit.

- The resulting solid waste must be managed under Part 115 requirements. Dispose of the solid waste in a licensed landfill. Contact the landfill authority for their specific disposal requirements, including any tests they require to document the solids are not hazardous or liquid waste. Do not use the solids as fill on local government or private property, or for any other use, unless it meets the conditions of being an inert material according to the solid waste rules R299.4114 through R299.4118. See the Waste Characterization Guidance for information how to determine if the waste is hazardous or not.

Street sweeping activities are also subject to the above solid waste requirements. Street sweeping involves the use of specialized equipment to remove litter, loose gravel, soil, pet waste, vehicle debris and pollutants, dust, de-icing chemicals, and industrial debris from road surfaces. See the BMPs for Street Sweeping and Parking Lot and Street Cleaning.

Follow-up Answers Can be Found as Follows:	
Topic	**Contact:**
Using the solids as fill or other use under Part 115	Duane Roskoskey at 517-335-4712
Part 121 transportation requirements and HMTA	WHMD District Office
Managing waste under Part 31, or general questions regarding this guidance	Mark Fife at 517-241-8993
Confined space entry requirements	MIOSHA Consultation, Education and Training Division at 517-322-1809

APPENDIX F

EXAMPLE CORRECTIVE MAINTENANCE RECORD

Stormwater Best Management Practice Maintenance Record

Date: _____

Person completing form (printed name): _____

Location (attach site map if necessary): _____

Type of stormwater BMP: _____

Describe maintenance performed. Attach before and after photos.

Was corrective maintenance able to fix the problem? ☐ YES ☐ NO

If no was checked, what additional maintenance is necessary and how soon should it be done?

If yes was checked, is follow up necessary prior to next regular inspection? ☐ YES ☐ NO

If yes, explain below:

Date of follow up: _____

Comments:

APPENDIX G

EXAMPLE PLAN EVALUATION

Stormwater Operation and Maintenance Plan Annual Evaluation

Facility Name: _____ Date of Evaluation: _____

Completed by: _____

INSPECTION PROCEDURES

Were all inspections completed on time?	YES	NO	
Were all components of the storm water system accessible for each inspection?	YES	NO	
Were all inspections documented?	YES	NO	

If no was marked for any of the above, explain here:

Recommended changes to plan:

MAINTENANCE PROCEDURES

Was all routine maintenance completed as scheduled?	YES	NO	
Was corrective maintenance addressed within the timeframe specified in the plan?	YES	NO	
Were emergency maintenance procedures effective?	YES	NO	N/A
Was all maintenance that was completed adequately documented?	YES	NO	

If no was marked for any of the above, explain here:

Recommended changes to plan:

Stormwater Operation and Maintenance Plan Annual Evaluation

WASTE HANDLING PROCEDURES

Were all maintenance wastes disposed of according to applicable rules?	YES	NO
Were adequate records kept about when, where and how much waste material was disposed?	YES	NO

If no was marked for any of the above, explain here:

Is trash/debris a consistent problem?	YES	NO	If yes, explain:

Recommended changes to plan:

TRAINING

Was training of responsible persons completed this year?	YES	NO
Was the level of training adequate for the work that was expected to be performed?	YES	NO
Were all training activities documented?	YES	NO

If no was marked for any of the above, explain here:

Recommended changes to plan:

Anything else?

APPENDIX H

MICHIGAN NATIVE PLANT LISTS

Michigan Native Shrubs and Trees*

October 2007

Scientific Name	Common Name	20 yr max height (feet)	Mature height (feet)	Soil*	Drought Tolerance	Moisture Use	pH	Shade Tolerance
SHRUBS								
Chamaedaphne calyculata	leatherleaf	4	4	SLC	Low	High	5-6	Intermediate
Cornus amomum	silky dogwood	7	7	SLC	Low	High	5-7	Intermediate
Ilex verticillata	common winterberry	6	9	LC	Low	High	4.5-7.5	Intermediate
Rubus flagellaris	northern dewberry	3	3	SLC	Low	High	5-7	Intermediate
Salix candida	sageleaf willow	6	6	SLC	Low	High	5.7-7.6	Intermediate
Salix humilis	prairie willow	10	10	SL	Low	High	5.9-7	Intermediate
Salix sericea	silky willow	12	12	SLC	Low	High	5.2-7	Intermediate
Salix exigua	narrowleaf willow	10	10	SL	Medium	High	6-8.5	Intermediate
Symphoricarpos orbiculatus	coralberry	2	2	LC	Medium	High	5.5-7.5	Intermediate
Viburnum opulus var. americanum	American cranberrybush	4	4.5	SLC	Medium	High	4.5-6.9	Intermediate
Rosa carolina	Carolina rose	5	5	SL	High	Low	4-7	Intermediate
Shepherdia canadensis	russet buffaloberry	6	6	SL	High	Medium	5.3-8	Intermediate
Alnus rugosa	speckled alder	16	16	SLC	Low	Medium	5-7	Intermediate
Hamamelis virginiana	American witchhazel	15	20	LC	Low	Medium	4.5-6.2	Intermediate
Lindera benzoin	northern spicebush	12	12	LC	Low	Medium	4.5-6	Intermediate
Spiraea alba	white meadowsweet	3	3	SLC	Low	Medium	4.3-6.8	Intermediate
Corylus americana	American hazelnut	10	10	LC	Medium	Medium	5-7	Intermediate
Rubus occidentalis	black raspberry	5	6	LC	Medium	Medium	5.2-7.5	Intermediate
Cornus sericea ssp. sericea	redosier dogwood	12	12	SLC	Low	High	4.8-7.5	Intolerant
Salix bebbiana	Bebb willow	12	12	SLC	Low	High	5.5-7.5	Intolerant
Rubus hispidus	bristly dewberry	2	2	SLC	Medium	High	4.5-7	Intolerant
Juniperus communis	common juniper	5	10	SLC	High	Low	5.5-8	Intolerant
Physocarpus opulifolius	common ninebark	10	10	SLC	High	Low	4.5-6.5	Intolerant
Prunus pumila	sandcherry	6	6	SL	Medium	Low	5.9-7	Intolerant
Rhus copallinum	flameleaf sumac	8	8	SLC	Medium	Low	5.3-7.5	Intolerant
Spiraea tomentosa	steeplebush	4	4	SLC	Medium	Low	4.5-7	Intolerant
Betula pumila	bog birch	20	20	LC	Low	Medium	5.1-8.5	Intolerant
Sambucus nigra ssp. canadensis	common elderberry	7	7	L	Medium	Medium	5-7	Intolerant
Vaccinium angustifolium	lowbush blueberry	1	2	SLC	Medium	Medium	4.7-7.5	Intolerant
Cephalanthus occidentalis	common buttonbush	20	20	SLC	Medium	High	5.3-8.5	Tolerant
Ceanothus americanus	New Jersey tea	3	3	SL	High	Low	4.3-6.5	Tolerant
Cercis canadensis	eastern redbud	16	16	SL	High	Low	4.5-7.5	Tolerant
Cornus rugosa	roundleaf dogwood	9	10	SL	High	Low	6.4-7.8	Tolerant
Ribes americanum	American black currant	8	5	SLC	High	Low	4-9	Tolerant
Rubus idaeus ssp. strigosus	grayleaf red raspberry	7	7	SLC	High	Low	4-9	Tolerant
Viburnum rafinesquianum	downy arrowwood	6	6	SL	Medium	Low	4.5-7.1	Tolerant
Rubus allegheniensis	Allegheny blackberry	6	6	LC	High	Medium	4.6-7.5	Tolerant
Viburnum acerifolium	mapleleaf viburnum	6	6	SL	High	Medium	4.8-7.5	Tolerant
Rosa palustris	swamp rose	8	8.2	LC	Low	Medium	4-7	Tolerant
Vaccinium corymbosum	highbush blueberry	12	12	SLC	Low	Medium	4.7-7.5	Tolerant
Amelanchier sanguinea	roundleaf serviceberry	10	10	SL	Medium	Medium	4.5-7.2	Tolerant
Cornus racemosa	gray dogwood	6	15	LC	Medium	Medium	5-7	Tolerant
Taxus canadensis	Canada yew	5	5	C	Medium	Medium	5.3-7.5	Tolerant
Viburnum prunifolium	blackhaw	16	16	LC	Medium	Medium	4.8-7.5	Tolerant

*This is by no means an exhaustive list of all species native to Michigan.

Michigan Native Shrubs and Trees*

October 2007

Scientific Name	Common Name	20 yr max height (feet)	Mature height (feet)	Soil*	Drought Tolerance	Moisture Use	pH	Shade Tolerance
			TREES					
Platanus occidentalis	American sycamore	65	100	SL	Low	High	4.9-6.5	Intermediate
Ptelea trifoliata	common hoptree	20	25	SL	Low	High	4.8-7	Intermediate
Quercus bicolor	swamp white oak	30	100	SLC	Low	High	4.3-6.5	Intermediate
Celtis occidentalis	common hackberry	25	50	SLC	High	Low	6-7.8	Intermediate
Cornus drummondii	roughleaf dogwood	48	48	LC	Low	Low	5.9-7.5	Intermediate
Juniperus virginiana	eastern redcedar	25	50	SLC	High	Low	4.7-8	Intermediate
Rhus hirta	staghorn sumac	30	30	SL	High	Low	4.5-7.2	Intermediate
Acer saccharinum	silver maple	45	80	SLC	Low	Medium	5.2-4	Intermediate
Betula alleghaniensis	yellow birch	25	100	SLC	Medium	Medium	4.6-6.9	Intermediate
Carya ovata	shagbark hickory	15	90	SL	Medium	Medium	4-6.7	Intermediate
Picea glauca	white spruce	30	100	SLC	High	Medium	4-8.2	Intermediate
Pinus strobus	eastern white pine	40	150	L	Medium	Medium	4-6.5	Intermediate
Quercus alba	white oak	25	100	SL	Medium	Medium	4.5-6.8	Intermediate
Quercus macrocarpa	bur oak	25	100	SLC	High	Medium	4.5-7.5	Intermediate
Quercus rubra	northern red oak	36	100	LC	Medium	Medium	4.3-6.5	Intermediate
Quercus velutina	black oak	25	90	SLC	Low	Medium	4.5-6	Intermediate
Thuja occidentalis	arborvitae	25	50	SLC	Low	Medium	5.2-7	Intermediate
Betula papyrifera	paper birch	40	70	SLC	Low	High	4.5-7	Intolerant
Juglans nigra	black walnut	35	100	L	Low	High	5.5-8	Intolerant
Populus balsamifera	balsam poplar	35	80	SLC	Low	High	4.5-7	Intolerant
Populus deltoides	eastern cottonwood	80	130	SLC	Low	High	5.2-7.3	Intolerant
Populus grandidentata	bigtooth aspen	40	65	SL	Low	High	4.8-7.2	Intolerant
Populus tremuloides	quaking aspen	40	65	SLC	Low	High	6-9	Intolerant
Quercus palustris	pin oak	40	100	LC	Low	High	4.5-6.5	Intolerant
Salix amygdaloides	peachleaf willow	45	60	SL	Low	High	6-8	Intolerant
Salix nigra	black willow	50	100	SLC	Low	High	4.8-8	Intolerant
Gleditsia triacanthos	honeylocust	35	75	SLC	High	Low	6-8.5	Intolerant
Pinus banksiana	jack pine	30	80	SLC	Low	Low	6-8.2	Intolerant
Pinus resinosa	red pine	30	80	SL	Low	Low	4.5-6	Intolerant
Prunus nigra	Canadian plum	25	38	SL	Low	Low	4-9	Intolerant
Sassafras albidum	sassafras	24	75	SL	High	Low	4.5-7.2	Intolerant
Acer nigrum	black maple	28	100	SLC	Medium	Medium	4.5-6.0	Intolerant
Carya alba	mockernut hickory	18	100	SL	Medium	Medium	6.5-7.4	Intolerant
Carya cordiformis	bitternut hickory	30	100	SLC	High	Medium	6.5-7.4	Intolerant
Carya glabra	pignut hickory	30	90	L	High	Medium	6.5-7.4	Intolerant
Castanea dentata	American chestnut	35	115	L	Medium	Medium	5.5-6.5	Intolerant
Gymnocladus dioicus	Kentucky coffeetree		80	SLC	Medium	Medium	6.0-8.0	Intolerant
Juglans cinerea	butternut	20	80	SL	Low	Medium	6-7	Intolerant
Larix laricina	tamarack	20	80	SL	Low	Medium	5.5-6.5	Intolerant
Liriodendron tulipifera	tuliptree	50	120	SL	Medium	Medium	4.5-6.5	Intolerant
Prunus pensylvanica	pin cherry	25	30	SLC	Low	Medium	4.3-6.6	Intolerant
Prunus serotina	black cherry	40	80	SL	Medium	Medium	5-7.5	Intolerant
Prunus virginiana	chokecherry	15	25	SLC	Medium	Medium	5.2-8.4	Intolerant
Quercus coccinea	scarlet oak	30	90	SL	Medium	Medium	4.5-6.9	Intolerant
Quercus muehlenbergii	chinkapin oak	30	80	L	High	Medium	6.5-8	Intolerant
Quercus shumardii	Shumard's oak	35	110	SL	High	Medium	5.8-7.6	Intolerant

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Michigan Native Shrubs and Trees*

October 2007

Scientific Name	Common Name	20 yr max height (feet)	Mature height (feet)	Soil*	Drought Tolerance	Moisture Use	pH	Shade Tolerance
Acer rubrum	red maple	35	90	SLC	Low	High	5.4-7.4	Tolerant
Carya laciniosa	shellbark hickory	35	100	L	Low	High	6.4-7.4	Tolerant
Picea mariana	black spruce	20	65	SLC	Low	High	4.7-6.5	Tolerant
Salix discolor	pussy willow	20	40	SLC	Low	High	4-7	Tolerant
Salix eriocephala	Missouri River willow	40	52	LC	Low	High	4-7	Tolerant
Cornus florida	flowering dogwood	30	40	L	Medium	Low	5-7	Tolerant
Euonymus atropurpurea	eastern wahoo	25	36	SLC	High	Low	4-8	Tolerant
Ostrya virginiana	hophornbeam	20	45	SLC	Medium	Low	4.2-7.6	Tolerant
Sorbus decora	northern mountain ash	40	60	C	Low	Low	4-7	Tolerant
Abies balsamea	balsam fir	18	60	SLC	Low	Medium	4-6	Tolerant
Acer saccharum	sugar maple	20	100	SL	Medium	Medium	3.7-7.3	Tolerant
Aesculus glabra	Ohio buckeye	25	70	LC	Medium	Medium	5-7.1	Tolerant
Amelanchier arborea	common serviceberry	25	50	SL	Low	Medium	5.5-7.5	Tolerant
Amelanchier laevis	Allegheny serviceberry	30	40	SL	Medium	Medium	4.8-7	Tolerant
Asimina triloba	pawpaw	30	35	SL	Low	Medium	5.2-7.2	Tolerant
Carpinus caroliniana	American hornbeam	18	40	SL	Low	Medium	4-7.4	Tolerant
Cornus alternifolia	alternateleaf dogwood	25	25	L	Low	Medium	5.8-7.5	Tolerant
Fagus grandifolia	American beech	30	95	SL	High	Medium	4.1-6.5	Tolerant
Morus rubra	red mulberry	45	70	SLC	Medium	Medium	5-7	Tolerant
Nyssa sylvatica	blackgum	30	95	SL	Low	Medium	4.5-6	Tolerant
Tilia americana	American basswood	60	130	SL	Medium	Medium	4.5-7.5	Tolerant
Tsuga canadensis	eastern hemlock	22	105	SL	Low	Medium	4.2-5.7	Tolerant
Viburnum lentago	nannyberry	28	28	LC	Low	Medium	5-7	Tolerant

*Soil: S = sand, L = loam, C = clay

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Michigan Native Plants

BOTANICAL NAME	COMMON NAME	HEIGHT	BLOOM COLOR	BLOOM TIME	SOIL MOISTURE	SUNLIGHT*
Geum triflorum	Prairie Smoke	1’	Pink	Apr-Jun	Dry	F
Carex bicknellii	Copper-Shouldered Oval Sedge	1’-2’	Brown	May-Jun	Dry	F
Carex brevior	Plains Oval Sedge	1’-2’	Brown	May-Jun	Dry	F
Potentilla arguta	Prairie Cinquefoil	1’-3’	Yellow	Jun-Sep	Dry	F
Asclepias hirtella	Tall Green Milkweed	2’-3’	White	Jun-Aug	Dry	F
Asclepias sullivantii	Prairie Milkweed	2’-3’	Pink	Jun-Aug	Dry	F
Aster oblongifolius	Aromatic Aster	2’-3’	Lavender/Yellow	Aug-Oct	Dry	F
Parthenium integrifolium	Wild Quinine	2’-3’	White	Jun-Sep	Dry	F
Physostegia virginiana v. arenaria	Prairie Obedient Plant	2’-4’	Pink	Jul-Sep	Dry	F
Silene regia	Royal Catchfly	2’-4’	Red	Jul-Aug	Dry	F
Verbena stricta	Hoary Vervain	2’-4’	Purple	Jun-Sep	Dry	F
Echinacea pallida	Purple Coneflower	2’-5’	Lavender	May-Aug	Dry	F
Helianthus mollis	Downy Sunflower	2’-5’	Yellow	Jul-Sep	Dry	F
Silphium integrifolium	Rosin Weed	2’-6’	Yellow	Jul-Sep	Dry	F
Baptisia bracteata	Cream Wild Indigo	3’-4’	Cream	May-Jun	Dry	F
Aster laevis	Smooth Blue Aster	3’-5’	Blue	Aug-Oct	Dry	F
Desmanthus illinoensis	Illinois Sensitive Plant	3’-5’	White	Jul-Aug	Dry	F
Helianthus pauciflorus	Prairie Sunflower	3’-5’	Yellow	Jul-Oct	Dry	F
Ratibida pinnata	Yellow Coneflower	3’-6’	Yellow	Jul-Oct	Dry	F
Silphium laciniatum	Compass Plant	3’-8’	Yellow	Jun-Sep	Dry	F
Andropogon gerardii	Big Bluestem	4’-8’	Purple	Jul-Sep	Dry	F
Opuntia humifusa	Eastern Prickly Pear	0.5'	Yellow	Jun-Jul	Dry	FP
Asclepias verticillata	Whorled Milkweed	1’-2’	White	Jun-Sep	Dry	FP
Aster sericeus	Silky Aster	1’-2’	Purple	Aug-Oct	Dry	FP
Campanula rotundifolia	Harebell	1’-2’	Blue	Jun-Oct	Dry	FP
Coreopsis lanceolata	Sand Coreopsis	1’-2’	Yellow	May-Aug	Dry	FP
Coreopsis palmata	Prairie Coreopsis	1’-2’	Yellow	Jun-Aug	Dry	FP
Koeleria pyramidata	June Grass	1’-2’	White	May-Jul	Dry	FP
Liatris cylindracea	Cylindrical Blazing Star	1’-2’	Violet	Jul-Oct	Dry	FP
Lupinus perennis	Wild Lupine	1’-2’	Purple	Apr-Jul	Dry	FP
Monarda punctata	Horse Mint	1’-2’	Pink	Jul-Sep	Dry	FP
Penstemon hirsutus	Hairy Beard Tongue	1’-2’	Lavender	May-Jul	Dry	FP
Ranunculus fascicularis	Early Buttercup	1’-2’	Yellow	Apr-May	Dry	FP
Silene stellata	Starry Campion	1’-2’	White	Jul-Oct	Dry	FP
Viola pedata	Bird’s Foot Violet	1’-2’	Lavender	Apr-Aug	Dry	FP
Asclepias tuberosa	Butterfly Milkweed	1’-3’	Orange	Jun-Sep	Dry	FP

This is not intended to be an all inclusive list of species native to Michigan. Check with suppliers on availability of these and other species.

BOTANICAL NAME	COMMON NAME	HEIGHT	BLOOM COLOR	BLOOM TIME	SOIL MOISTURE	SUNLIGHT*
Aster ericoides	Heath Aster	1’-3’	White	Aug-Oct	Dry	FP
Ceanothus americanus	New Jersey Tea	1’-3’	White	Jun-Oct	Dry	FP
Chamaecrista fasciculata	Partridge Pea	1’-3’	Yellow	Jun-Oct	Dry	FP
Dalea candida	White Prairie Clover	1’-3’	White	Jun-Oct	Dry	FP
Dalea purpurea	Purple Prairie Clover	1’-3’	Purple	Jun-Sep	Dry	FP
Pycnanthemum tenuifolium	Mountain Mint	1’-3’	White	Jun-Aug	Dry	FP
Rosa carolina	Pasture Rose	1’-3’	Pink	Jun-Sep	Dry	FP
Solidago nemoralis	Old-Field Goldenrod	1’-3’	Yellow	Aug-Nov	Dry	FP
Solidago speciosa	Showy Goldenrod	1’-3’	Yellow	Jul-Oct	Dry	FP
Tephrosia virginiana	Goat’s Rue	1’-3’	Pink/Cream	Jun-Jul	Dry	FP
Apocynum androsaemifolium	Spreading Dogbane	1’-4’	Pink	May-Sep	Dry	FP
Aster oolentangiensis	Sky-Blue Aster	1’-4’	Blue	Jul-Nov	Dry	FP
Astragalus canadensis	Canadian Milk Vetch	1’-4’	Cream	Jun-Oct	Dry	FP
Baptisia australis	Blue Wild Indigo	1’-4’	Blue	May-Jun	Dry	FP
Kuhnia eupatorioides v. corymbulosa	False Boneset	1’-4’	White	Aug-Oct	Dry	FP
Amorpha canescens	Lead Plant	2’-3’	Purple	Jun-Aug	Dry	FP
Anemone cylindrica	Thimbleweed	2’-3’	White	Jun-Aug	Dry	FP
Baptisia tinctoria	Yellow Wild Indigo	2’-3’	Yellow	Jun-Aug	Dry	FP
Liatris aspera	Rough Blazing Star	2’-3’	Violet	Jul-Nov	Dry	FP
Asclepias syriaca	Common Milkweed	2’-4’	Pink	Jun-Aug	Dry	FP
Bouteloua curtipendula	Side-Oats Grama	2’-4’	Purple	Jul-Oct	Dry	FP
Desmodium sessilifolium	Sessile-Leaved Tick Trefoil	2’-4’	Purple	Jul-Sep	Dry	FP
Euphorbia corollata	Flowering Spurge	2’-4’	White	May-Oct	Dry	FP
Helianthus occidentalis	Western Sunflower	2’-4’	Yellow	Aug-Sep	Dry	FP
Lespedeza capitata	Round-Headed Bush Clover	2’-4’	Green	Jul-Sep	Dry	FP
Schizachyrium scoparium	Little Bluestem	2’-4’	Brown	Aug-Sep	Dry	FP
Solidago juncea	Early Goldenrod	2’-4’	Yellow	Jul-Sep	Dry	FP
Stipa spartea	Porcupine Grass	2’-4’	Green	Jun	Dry	FP
Monarda fistulosa	Wild Bergamot	2’-5’	Lavender	Jul-Sep	Dry	FP
Baptisia lactea	White Wild Indigo	3’-4’	White	May-Aug	Dry	FP
Desmodium canescens	Hoary Tick Trefoil	3’-5’	Purple	Aug	Dry	FP
Echinacea purpurea	Broad-Leaved Purple Coneflower	3’-5’	Purple	Jun-Aug	Dry	FP
Hypericum prolificum	Shrubby St. John’s Wort	3’-5’	Yellow	Jul	Dry	FP
Liatris scariosa v. nieuwlandii	Savanna Blazing Star	3’-5’	Violet	Aug-Oct	Dry	FP
Calamovilfa longifolia	Sand Reed	3’-6’	Brown	Jul-Sep	Dry	FP
Desmodium illinoense	Illinois Tick Trefoil	3’-6’	Purple	Jul-Aug	Dry	FP

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BOTANICAL NAME	COMMON NAME	HEIGHT	BLOOM COLOR	BLOOM TIME	SOIL MOISTURE	SUNLIGHT*
Agastache nepetoides	Yellow Giant Hyssop	3’-7’	Yellow	Jul-Oct	Dry	FP
Heliopsis helianthoides	False Sunflower	4’-6’	Yellow	Jun-Oct	Dry	FP
Carex pensylvanica	Common Oak Sedge	0.5-1’	Brown	Apr-May	Dry	FPS
Zizia aptera	Heart-Leaved Meadow Parsnip	1’-2’	Yellow	Apr-May	Dry	FPS
Anemone virginiana	Tall Anemone	1’-3’	White	Jun-Aug	Dry	FPS
Carex muhlenbergii	Sand Bracted Sedge	1’-3’	Brown	May-Jun	Dry	FPS
Cacalia atriplicifolia	Pale Indian Plantain	3’-8’	White	Jun-Oct	Dry	FPS
Senecio obovatus	Roundleaf Ragwort	0.5'-1.5'	Yellow	May-Jun	Dry	PS
Cyperus esculentus	Field Nut Sedge	1’-2’	Green	Jul-Aug	Medium	F
Juncus tenuis v. dudleyi	Dudley’s Rush	1’-2’	Brown	May-Jul	Medium	F
Hierochloe odorata	Sweet Grass	1’-3’	Green	Apr-Jun	Medium	F
Sabatia angularis	Rose Gentian	1’-3’	Pink	Jul-Nov	Medium	F
Sporobolus heterolepis	Prairie Dropseed	2’-3’	Green	Aug-Sep	Medium	F
Andropogon virginicus	Broom Sedge	2’-4’	Brown	Aug-Sep	Medium	F
Liatris pycnostachya	Prairie Blazing Star	2’-4’	Pink	Jul-Sep	Medium	F
Cacalia plantaginea	Prairie Indian Plantain	3’-5’	White	Jun-Aug	Medium	F
Eryngium yuccifolium	Rattlesnake Master	3’-5’	White	Jul-Sep	Medium	F
Vernonia missurica	Missouri Ironweed	3’-5’	Purple	Jul-Sep	Medium	F
Verbena hastata	Blue Vervain	3’-6’	Violet	Jun-Sep	Medium	F
Spartina pectinata	Prairie Cord Grass	3’-7’	Green	Jul-Aug	Medium	F
Silphium terebinthinaceum	Prairie Dock	3’-8’	Yellow	Jun-Sep	Medium	F
Sorghastrum nutans	Indian Grass	4’-9’	Green	Aug-Sep	Medium	F
Sisyrinchium angustifolium	Stout Blue-Eyed Grass	1’	Blue	May-Aug	Medium	FP
Sisyrinchium atlanticum	Eastern Blue-Eyed Grass	1’	Blue	May-Jul	Medium	FP
Allium cernuum	Nodding Onion	1’-2’	Lavender	Jun-Oct	Medium	FP
Phlox pilosa	Sand Prairie Phlox	1’-2’	Pink	May-Aug	Medium	FP
Dodecatheon meadia	Shooting Star	1’-3’	White/Pink	Apr-Jun	Medium	FP
Equisetum hyemale	Tall Scouring Rush	1’-3’	Brown	Apr-Aug	Medium	FP
Gentiana flavida	Cream Gentian	1’-3’	Cream	Sep-Oct	Medium	FP
Heuchera richardsonii	Prairie Alum Root	1’-3’	Green	May-Sep	Medium	FP
Lobelia spicata	Pale Spiked Lobelia	1’-3’	Lavender	May-Aug	Medium	FP
Polygonum pensylvanicum	Pinkweed	1’-3’	Pink	Jun-Oct	Medium	FP
Pycnanthemum virginianum	Common Mountain Mint	1’-3’	White	Jun-Oct	Medium	FP
Rudbeckia hirta	Black-Eyed Susan	1’-3’	Yellow	May-Oct	Medium	FP
Teucrium canadense	Germander	1’-3’	Purple	Jul-Sep	Medium	FP
Euthamia graminifolia	Common Grass-Leaved Goldenrod	1’-4’	Yellow	Jul-Sep	Medium	FP

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BOTANICAL NAME	COMMON NAME	HEIGHT	BLOOM COLOR	BLOOM TIME	SOIL MOISTURE	SUNLIGHT*
Solidago canadensis	Canadian Goldenrod	1’-5’	Yellow	Jul-Sep	Medium	FP
Solidago rigida	Stiff Goldenrod	1’-5’	Yellow	Jul-Oct	Medium	FP
Asclepias purpurascens	Purple Milkweed	2’-3’	Purple	Jun-Jul	Medium	FP
Hypericum kalmianum	Kalm’s St. John’s Wort	2’-3’	Yellow	Jun-Aug	Medium	FP
Rudbeckia fulgida	Showy Black-Eyed Susan	2’-3’	Yellow	Aug-Sep	Medium	FP
Aster praealtus	Willow Aster	2’-4’	Blue/White	Sep-Oct	Medium	FP
Penstemon digitalis	Foxglove Beard Tongue	2’-4’	White/Pink	May-Jul	Medium	FP
Penstemon laevigatus	Smooth Beard Tongue	2’-4’	White	May-Jun	Medium	FP
Rumex altissimus	Pale Dock	2’-4’	Green	May-Jul	Medium	FP
Tradescantia ohiensis	Common Spiderwort	2’-4’	Blue	May-Oct	Medium	FP
Desmodium canadense	Showy Tick Trefoil	2’-5’	Purple	Jun-Sep	Medium	FP
Eupatorium serotinum	Late Boneset	2’-5’	White	Jul-Oct	Medium	FP
Rudbeckia triloba	Brown-Eyed Susan	2’-5’	Yellow	Aug-Oct	Medium	FP
Spiraea tomentosa	Steeplebush	2’-5’	Pink	Jul-Sep	Medium	FP
Oenothera biennis	Common Evening Primrose	2’-6’	Yellow	Jun-Nov	Medium	FP
Solidago canadensis v. scabra	Tall Goldenrod	2’-7’	Yellow	Aug-Oct	Medium	FP
Panicum virgatum	Switch Grass	3’-5’	Green/Purple	Jun-Oct	Medium	FP
Rudbeckia subtomentosa	Sweet Black-Eyed Susan	3’-5’	Yellow	Aug-Sep	Medium	FP
Senna hebecarpa	Wild Senna	3’-5’	Yellow	Jul-Aug	Medium	FP
Aster novae-angliae	New England Aster	3’-6’	Violet	Jul-Oct	Medium	FP
Elymus canadensis	Canada Wild Rye	3’-6’	Green	Jun-Sep	Medium	FP
Hypericum pyramidatum	Great St. John’s Wort	3’-6’	Yellow	Jul-Aug	Medium	FP
Spiraea alba	Meadowsweet	3’-6’	White	Jun-Sep	Medium	FP
Thalictrum dasycarpum	Purple Meadow Rue	3’-6’	Cream	May-Jul	Medium	FP
Veronicastrum virginicum	Culver’s Root	3’-6’	White	Jun-Aug	Medium	FP
Helianthus grosseserratus	Saw-Tooth Sunflower	4’-12’	Yellow	Jul-Oct	Medium	FP
Coreopsis tripteris	Tall Coreopsis	4’-8’	Yellow	Aug-Sep	Medium	FP
Vernonia gigantea	Smooth Tall Ironweed	4’-9’	Purple	Jul-Oct	Medium	FP
Helianthus tuberosus	Jerusalem Artichoke	5’-10’	Yellow	Aug-Oct	Medium	FP
Helianthus giganteus	Tall Sunflower	5’-12’	Yellow	Jul-Sep	Medium	FP
Juncus tenuis	Path Rush	0.5'-2’	Brown	Jun	Medium	FPS
Geranium maculatum	Wild Geranium	1’-2’	Lavender	Apr-Jul	Medium	FPS
Aster lateriflorus	Side-Flowering Aster	1’-3’	White	Jul-Oct	Medium	FPS
Eupatorium coelestinum	Blue Mistflower	1’-3’	Blue	Aug-Sep	Medium	FPS
Zizia aurea	Golden Alexanders	1’-3’	Yellow	Apr-Jun	Medium	FPS
Glyceria striata	Fowl Manna Grass	1’-5’	Green	May-Jun	Medium	FPS

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BOTANICAL NAME	COMMON NAME	HEIGHT	BLOOM COLOR	BLOOM TIME	SOIL MOISTURE	SUNLIGHT*
Aquilegia canadensis	Wild Columbine	1'-3'	Red/Yellow	Apr-Jul	Medium	FPS
Agastache foeniculum	Lavender Hyssop	2’-4’	Purple	Jun-Sep	Medium	FPS
Elymus virginicus	Virginia Wild Rye	2’-4’	Green	Jun	Medium	FPS
Solidago rugosa	Rough Goldenrod	2’-5’	Yellow	Aug-Oct	Medium	FPS
Aster lanceolatus	Panicled Aster	3’-5’	White	Jul-Nov	Medium	FPS
Liatris spicata	Marsh Blazing Star	3’-5’	Pink	Jul-Sep	Medium	FPS
Heracleum lanatum	Cow Parsnip	4’-10’	White	May-Jul	Medium	FPS
Anemonella thalictroides	Rue Anemone	0.5'-1'	White	Apr-May	Medium	PS
Solidago caesia	Blue-stemmed Goldenrod	1.5'-3'	Yellow	Aug-Oct	Medium	PS
Aster cordifolius	Heart-Leaved Aster	1'-4'	Blue/White	Aug-Oct	Medium	PS
Aster sagittifolius	Arrow-Leaved Aster	2'-4'	Lavender/White	Aug-Oct	Medium	PS
Aster shortii	Short's Aster	2'-4'	Blue	Aug-Oct	Medium	PS
Aureolaria flava	Smooth False Foxglove	2'-6'	Yellow	Jul-Sept	Medium	PS
Elymus hystrix	Bottlebrush Grass	3'-5'	Green	Jun-Jul	Medium	PS
Elymus villosus	Silky Wild Rye	3'-6'	Green	Jul	Medium	PS
Scrophularia marilandica	Late Figwort	3'-6'	Brown	Jul-Oct	Medium	PS
Eleocharis acicularis	Needle Spike Rush	0.5'	Green	May-Oct	Wet	F
Brasenia schreberi	Water Shield	0.5'-1’	Purple	Jun-Jul	Wet	F
Eleocharis palustris	Great Spike Rush	1’-2’	Green	Jul	Wet	F
Juncus canadensis	Canadian Rush	1’-2’	Brown	Jul-Sep	Wet	F
Juncus torreyi	Torrey’s Rush	1’-2’	Brown	Jun-Sep	Wet	F
Rhynchospora macrostachya	Horned Beak Rush	1’-2’	Brown	May-Jun	Wet	F
Triglochin maritimum	Common Bog Arrow Grass	1’-2’	White	May-Sep	Wet	F
Carex vulpinoidea v. ambigua	Large Yellow Fox Sedge	1’-3’	Brown	May-Jun	Wet	F
Mentha arvensis v. villosa	Wild Mint	1’-3’	White	Jul-Sep	Wet	F
Bidens cernua	Nodding Bur Marigold	1’-4’	Yellow	Jun-Oct	Wet	F
Carex scoparia	Lance-Fruited Oval Sedge	2’-3’	Green	May-Jun	Wet	F
Carex vesicaria	Tufted Lake Sedge	2’-3’	Green	Jun-Jul	Wet	F
Ludwigia alternifolia	Seedbox	2’-3’	Yellow	Jun-Aug	Wet	F
Lythrum alatum	Winged Loosestrife	2’-3’	Purple	Jun-Sep	Wet	F
Alisma subcordatum	Common Water Plantain	2’-4’	White	Jul-Sep	Wet	F
Carex utriculata	Common Yellow Lake Sedge	2’-4’	Green	May-Jun	Wet	F
Nelumbo lutea	Lotus	2’-4’	Cream	Jul-Aug	Wet	F
Pycnanthemum muticum	Broad-Leaved Mountain Mint	2’-4’	White	Aug-Sep	Wet	F
Scirpus pendulus	Red Bulrush	2’-4’	Brown	May-Jun	Wet	F
Bidens coronata	Tall Swamp Marigold	2’-5’	Yellow	Jun-Oct	Wet	F

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BOTANICAL NAME	COMMON NAME	HEIGHT	BLOOM COLOR	BLOOM TIME	SOIL MOISTURE	SUNLIGHT*
Physostegia virginiana	Obedient Plant	2’-5’	Pink	Aug-Oct	Wet	F
Scirpus pungens	Chairmaker’s Rush	2’-5’	Brown	May-Sep	Wet	F
Solidago riddellii	Riddell’s Goldenrod	2’-5’	Yellow	Sep-Nov	Wet	F
Sparganium eurycarpum	Common Bur Reed	2’-6’	Green	May-Aug	Wet	F
Scirpus atrovirens	Dark Green Rush	3’-5’	Brown	Jun-Aug	Wet	F
Scirpus cyperinus	Wool Grass	3’-5’	Tan	Jun-Sep	Wet	F
Aster puniceus	Bristly Aster	3’-6’	Lavender/White	Aug-Oct	Wet	F
Filipendula rubra	Queen of the Prairie	3’-6’	Pink	Jul	Wet	F
Scirpus fluviatilis	River Bulrush	3’-7’	Brown	May-Jul	Wet	F
Scirpus acutus	Hard-Stemmed Bulrush	4’-6’	Brown	Apr-Aug	Wet	F
Scirpus validus	Great Bulrush	4’-8’	Brown	May-Aug	Wet	F
Nymphaea odorata	White Water Lily Bud	0.5'	White	May-Sep	Wet	FP
Viola lanceolata	Lance-Leaved Violet	0.5'	White	Apr-Jun	Wet	FP
Agalinis tenuifolia	Slender False Foxglove	1’-2’	Lavender	Aug-Oct	Wet	FP
Anemone canadensis	Meadow Anemone	1’-2’	White	May-Sep	Wet	FP
Carex squarrosa	Narrow-Leaved Cattail Sedge	1’-2’	Green	May-Jun	Wet	FP
Carex typhina	Common Cattail Sedge	1’-2’	Green	Jun	Wet	FP
Carex viridula	Green Yellow Sedge	1’-2’	Green	May-Sep	Wet	FP
Eleocharis ovata	Blunt Spike Rush	1’-2’	Green	May-Sep	Wet	FP
Justicia americana	Water Willow	1’-2’	Lavender	Jun-Aug	Wet	FP
Lycopus americanus	Common Water Horehound	1’-2’	White	Jul-Sep	Wet	FP
Nuphar advena	Yellow Pond Lily	1’-2’	Yellow	May-Sep	Wet	FP
Polygonum amphibium v. stipulaceum	Water Knotweed	1’-2’	Rose	Jun-Oct	Wet	FP
Triadenum virginicum	Marsh St. John’s Wort	1’-2’	Pink	Jul-Sep	Wet	FP
Carex haydenii	Long-Scaled Tussock Sedge	1’-3’	Brown	May	Wet	FP
Carex interior	Prairie Star Sedge	1’-3’	Green	May	Wet	FP
Carex straminea	Awned Oval Sedge	1’-3’	Green	May-Jun	Wet	FP
Deschampsia cepitosa	Tufted Hair Grass	1’-3’	Green	May-Jun	Wet	FP
Dulichium arundinaceum	Three-Way Sedge	1’-3’	Green	Jul-Aug	Wet	FP
Gentiana andrewsii	Bottle Gentian	1’-3’	Blue	Aug-Oct	Wet	FP
Panicum rigidulum	Munro Grass	1’-3’	Green	Jul-Aug	Wet	FP
Pedicularis lanceolata	Fen Betony	1’-3’	Yellow	Aug-Oct	Wet	FP
Penthorum sedoides	Ditch Stonecrop	1’-3’	Green	Jun-Oct	Wet	FP
Pontederia cordata	Pickerel Weed	1’-3’	Violet	Jun-Sep	Wet	FP
Acorus calamus	Sweet Flag	1’-4’	Green	May-Jun	Wet	FP
Aster umbellatus	Flat-Top Aster	1’-4’	White	Jul-Oct	Wet	FP

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BOTANICAL NAME	COMMON NAME	HEIGHT	BLOOM COLOR	BLOOM TIME	SOIL MOISTURE	SUNLIGHT*
Carex prairea	Fen Panicled Sedge	1’-4’	Brown	May	Wet	FP
Juncus effusus	Common Rush	1’-4’	Brown	Jul	Wet	FP
Sagittaria latifolia	Common Arrowhead	1’-4’	White	Jun-Sep	Wet	FP
Carex emoryi	Riverbank Sedge	2’-3	Brown	May	Wet	FP
Carex aquatilis	Long-Bracted Tussock Sedge	2’-3’	Brown	Apr-Jun	Wet	FP
Carex atherodes	Hairy-Leaved Lake Sedge	2’-3’	Green/Brown	May-Jun	Wet	FP
Carex bebbii	Bebb’s Oval Sedge	2’-3’	Brown	Jun	Wet	FP
Carex comosa	Bristly Sedge	2’-3’	Green	May-Jun	Wet	FP
Carex cristatella	Crested Oval Sedge	2’-3’	Brown	May-Jun	Wet	FP
Carex stricta	Common Tussock Sedge	2’-3’	Brown	Apr-Jun	Wet	FP
Carex tribuloides	Awl-Fruited Oval Sedge	2’-3’	Green	May-Jul	Wet	FP
Carex vulpinoidea	Brown Fox Sedge	2’-3’	Brown	May-Jun	Wet	FP
Glyceria canadensis	Rattlesnake Grass	2’-3’	Green	Jun	Wet	FP
Solidago ohioensis	Ohio Goldenrod	2’-3’	Yellow	Jul-Oct	Wet	FP
Bromus ciliatus	Fringed Brome	2’-4’	Brown	Jun-Jul	Wet	FP
Calamagrostis canadensis	Bluejoint Grass	2’-4’	Brown	Jun	Wet	FP
Decodon verticillatus	Swamp Loosestrife	2’-4’	Magenta	Jul-Sep	Wet	FP
Mimulus ringens	Monkey Flower	2’-4’	Lavender	Jun-Sep	Wet	FP
Lobelia cardinalis	Cardinal Flower	2’-5’	Red	Jul-Oct	Wet	FP
Oxypolis rigidior	Cowbane	2’-5’	White	Jul-Sep	Wet	FP
Peltandra virginica	Arrow Arum	2’-5’	Green	Jun-Jul	Wet	FP
Rumex orbiculatus	Great Water Dock	2’-5’	Green	May-Sep	Wet	FP
Sparganium americanum	American Bur Reed	2’-5’	Green	Jun-Aug	Wet	FP
Silphium perfoliatum	Cup Plant	3’-10’	Yellow	Jul-Oct	Wet	FP
Asclepias incarnata	Swamp Milkweed	3’-5’	Pink	Jun-Sep	Wet	FP
Boltonia asteroides	False Aster	3’-5’	White	Aug-Oct	Wet	FP
Eupatorium perfoliatum	Common Boneset	3’-5’	White	Jul-Oct	Wet	FP
Glyceria grandis	Reed Manna Grass	3’-5’	Green	Jun	Wet	FP
Helenium autumnale	Sneezeweed	3’-5’	Yellow	Jul-Nov	Wet	FP
Typha latifolia	Broad-Leaved Cattail	3’-6’	Brown	Jun-Jul	Wet	FP
Hibiscus laevis	Smooth Rose Mallow	3’-7’	White/Pink	Jul-Sep	Wet	FP
Hibiscus moscheutos	Swamp Rose Mallow	3’-7’	White/Pink	Jul-Sep	Wet	FP
Typha angustifolia	Narrow-Leaved Cattail	3’-7’	Brown	Jun-Jul	Wet	FP
Vernonia fasciculata	Common Ironweed	3’-7’	Purple	Jul-Oct	Wet	FP
Zizania aquatica	Wild Rice	3’-7’	Green	Jul-Sep	Wet	FP
Angelica atropurpurea	Great Angelica	4’-12’	White	May-Jun	Wet	FP

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BOTANICAL NAME	COMMON NAME	HEIGHT	BLOOM COLOR	BLOOM TIME	SOIL MOISTURE	SUNLIGHT*
Eupatorium maculatum	Spotted Joe-Pye Weed	4’-7’	Pink	Jun-Oct	Wet	FP
Eupatorium fistulosum	Hollow Joe-Pye Weed	5’-9’	Pink	Jul-Aug	Wet	FP
Lathyrus palustris	Marsh Vetchling	1’	Pink/Purple	May-Sep	Wet	FPS
Caltha palustris	Marsh Marigold	1’-2’	Yellow	Mar-Jun	Wet	FPS
Carex frankii	Bristly Cattail Sedge	1’-2’	Green	Jun-Jul	Wet	FPS
Carex granularis	Pale Sedge	1’-2’	Green	May-Jun	Wet	FPS
Carex projecta	Loose-Headed Oval Sedge	1’-3’	Green	Jun-Jul	Wet	FPS
Carex stipata	Common Fox Sedge	1’-3’	Brown	Apr-May	Wet	FPS
Epilobium coloratum	Cinnamon Willow Herb	1’-3’	Pink	Jun-Sep	Wet	FPS
Senecio aureus	Golden Ragwort	1’-3’	Yellow	Apr-Jun	Wet	FPS
Bidens frondosa	Common Beggars-Tick	1’-4’	Orange	Jul-Sep	Wet	FPS
Lobelia siphilitica	Great Blue Lobelia	1’-4’	Blue	Jul-Oct	Wet	FPS
Carex crus-corvi	Crowfoot Fox Sedge	2’-3’	Brown	Jun	Wet	FPS
Carex hystericina	Porcupine Sedge	2’-3’	Green	May-Jun	Wet	FPS
Carex lupulina	Common Hop Sedge	2’-3’	Green/Brown	May-Jun	Wet	FPS
Carex lurida	Bottlebrush Sedge	2’-3’	Green	May-Jun	Wet	FPS
Iris virginica	Blue Flag	2’-3’	Purple	May-Jul	Wet	FPS
Carex lacustris	Common Lake Sedge	2’-4’	Browm	May-Jun	Wet	FPS
Chelone glabra	Turtlehead	2’-4’	Cream	Aug-Sep	Wet	FPS
Leersia oryzoides	Rice Cut Grass	2’-4’	Green	Jul-Sep	Wet	FPS
Carex crinita	Fringed Sedge	2’-5’	Green	May	Wet	FPS
Rumex verticillatus	Swamp Dock	2’-5’	Green	Jun-Sep	Wet	FPS
Sium suave	Tall Water Parsnip	2’-6’	White	Jul-Sep	Wet	FPS
Rosa palustris	Swamp Rose	2’-7’	Pink	Jun-Aug	Wet	FPS
Rudbeckia laciniata	Wild Golden Glow	3’-10’	Yellow	Jul-Nov	Wet	FPS
Solidago patula	Swamp Goldenrod	3’-6’	Yellow	Aug-Oct	Wet	FPS
Verbesina alternifolia	Wingstem	3’-7’	Yellow	Jul-Oct	Wet	FPS

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* Sunlight: F = full sun, P = part shade, S = shade