International Stormwater Best Management Practices (BMP) Database

User's Guide for BMP Data Entry Spreadsheets

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Environment and Water Resources Institute of the
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Disclaimer

The BMP Database ("Database") was developed as an account of work sponsored by the Water Environment Research Foundation (WERF), the American Society of Civil Engineers (ASCE)/Environmental and Water Resources Institute (EWRI), the American Public Works Association (APWA), the Federal Highway Administration (FHWA), and U.S. Environmental Protection Agency (USEPA) (collectively, the "Sponsors"). The Database is intended to provide a consistent and scientifically defensible set of data on Best Management Practice ("BMP") designs and related performance. Although the individuals who completed the work on behalf of the Sponsors ("Project Team") made an extensive effort to assess the quality of the data entered for consistency and accuracy, the Database information and/or any analysis results are provided on an "AS-IS" basis and use of the Database, the data information, or any apparatus, method, or process disclosed in the Database is at the user's sole risk. The Sponsors and the Project Team disclaim all warranties and/or conditions of any kind, express or implied, including, but not limited to any warranties or conditions of title, non-infringement of a third party's intellectual property, merchantability, satisfactory quality, or fitness for a particular purpose. The Project Team does not warrant that the functions contained in the Database will meet the user's requirements or that the operation of the Database will be uninterrupted or error free, or that any defects in the Database will be corrected.

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The Project Team's tasks have not included, and will not include in the future, recommendations of one BMP type over another. However, the Project Team's tasks have included reporting on the performance characteristics of BMPs based upon the entered data and information in the Database, including peer reviewed performance assessment techniques. Use of this information by the public or private sector is beyond the Project Team's influence or control. The intended purpose of the Database is to provide a data exchange tool that permits characterization of BMPs solely upon their measured performance using consistent protocols for measurements and reporting information.

The Project Team does not endorse any BMP over another and any assessments of performance by others should not be interpreted or reported as the recommendations of the Project Team or the Sponsors.

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Urban Water Resources Research Council (UWRRC) of EWRI-ASCE—many participants who have provided input, review and shared data over the course of the project.

Use of Materials:

Ken Mackenzie, P.E., Urban Drainage and Flood Control District, Denver, CO granted permission to use graphics from the Urban Storm Drainage Criteria Manual, Volume 3.

This BMP Database was originally developed as a result of the vision and support of the Urban Water Resources Research Council (UWRRC) of EWRI-ASCE in cooperation with the USEPA Office of Water, Washington, D.C., with Eric Strassler serving as USEPA Project Officer and Carol Bowers serving as ASCE Project Manager.

Introduction

This User's Guide is provided to assist researchers submitting best management practice (BMP) performance monitoring data to the International Stormwater BMP Database (BMP Database). This guide provides a general overview of the BMP Database project and the structure of the database, followed by more detailed descriptions of the information requested in the BMP Data Entry Spreadsheets (Version 3.2, August 2010) [1]. These spreadsheets must be used for submissions of the data to the Stormwater BMP Database. Excel

> **Software Requirements**
>
> Microsoft Excel 97-2003 or 2007 is required for use of the Data Entry Spreadsheet Package
>
> Microsoft Access 2007 is required to use the BMP Database, but is not required for use of the Data Entry Spreadsheets.

The BMP Data Entry Spreadsheet package contains 34 spreadsheets for data entry; however, most users typically require less than half of these to enter their data. For example, 17 of the spreadsheets request BMP-specific design information for various BMP types; therefore, if only one BMP type is present, then only one of these design spreadsheets would need to be completed (plus site related information and monitoring data). Data elements are categorized by relative importance for evaluating BMP performance; some data elements are "required" for evaluation of BMP performance, others are "important" but may not currently be commonly reported information, and others are supplemental and identified as "nice to have." Precipitation, flow and water quality data spreadsheets are formatted in a manner that is intended to encourage users to "cut and paste" from existing electronic documents, rather than manually entering data. For example, users are encouraged to paste water quality data from their laboratory's electronic data deliverable (EDD) formats into the water quality spreadsheet to decrease data entry time and errors.

For more information on the project, including the BMP Data Entry Spreadsheets, the master BMP Database, BMP Monitoring Manual, and BMP data analysis summaries, go to www.bmpdatabase.org.

Project Background

In the 1990's, as required by the Clean Water Act, the U.S. Environmental Protection Agency (USEPA) mandated that most municipalities in the United States with populations larger than 10,000 obtain a stormwater runoff discharge permit. One of the requirements of this permit program is the use of non-structural and structural BMPs appropriate to reduce pollutants to the Maximum Extent Practicable (MEP). In response to this program, communities need to know which types of BMPs are appropriate for them (e.g., which BMPs function best in cold climates

[1] The BMP Data Entry Spreadsheets replace the original CD-release of the BMP Database in 1999, as well as earlier versions of the spreadsheet package. The CD version of the BMP Database contained a Data Entry Module and a Data Retrieval Module using a run-time Microsoft Access platform. Since that time, dramatic changes in software and the Internet have occurred that have necessitated changes to the format of the originally released product. The revised Data Entry Spreadsheets are similar to the structure and data elements contained in the original database, but allow more flexibility for database users in a familiar Excel format. Additionally, significant expansions and updates to the Data Entry Spreadsheets were completed in 2009 to incorporate Low Impact Development techniques. The search engine component of the database is now available on-line at www.bmpdatabase.org.

or in areas of heavy rainfall) and how to monitor the performance of the BMPs they select to ensure they function properly. However, a centralized, easy-to-use, scientifically sound tool for assessing the appropriateness of BMPs under a variety of site conditions was lacking. In addition, BMP studies in the literature had not historically followed standardized or transferable data collection, reporting and performance evaluation protocols, making a scientific and consistent evaluation of these data difficult to impossible.

In response to this problem, the International Stormwater BMP Database project (first known as the National BMP Database) began in 1996 through the efforts of a team of experts from the Urban Water Resources Research Council (UWRRC) of the American Society of Civil Engineers (ASCE) under a grant from the USEPA. The original principal investigators for the project were:

Ben Urbonas, P.E., Urban Drainage and Flood Control District
Eric Strecker, P.E., Geosyntec Consultants
Jonathan Jones, P.E., Wright Water Engineers, Inc.

The project's original long-term goal, which remains the central focus of the project, is to gather transferable technical design and performance information to improve BMP selection and design so that local stormwater problems can be cost-effectively addressed. Original project tasks included:

1. Develop a set of recommended monitoring and reporting protocols for BMP monitoring studies.
2. Design and create a national stormwater BMP database.
3. Collect existing BMP design and performance data, evaluate it to ascertain if it could meet the protocols and, if so, enter the data into the BMP Database.
4. Develop a recommended data evaluation approach.
5. Evaluate the data entered into the database and report initial findings.

A companion project to develop detailed stormwater BMP monitoring guidance emerged when it became apparent that much of the available BMP data was of limited value due not only to inconsistent BMP monitoring and reporting protocols, but also due to actual monitoring procedures.

The analysis of the BMP studies contained in the BMP Database has been updated periodically, as more studies have been submitted to the database. Several "flat file" spreadsheets containing a summary of monitoring data and a summary of analyses results are available on the project web site www.bmpdatabase.org, along with PDF files for each individual BMP and cumulative analysis reports for the overall data set.

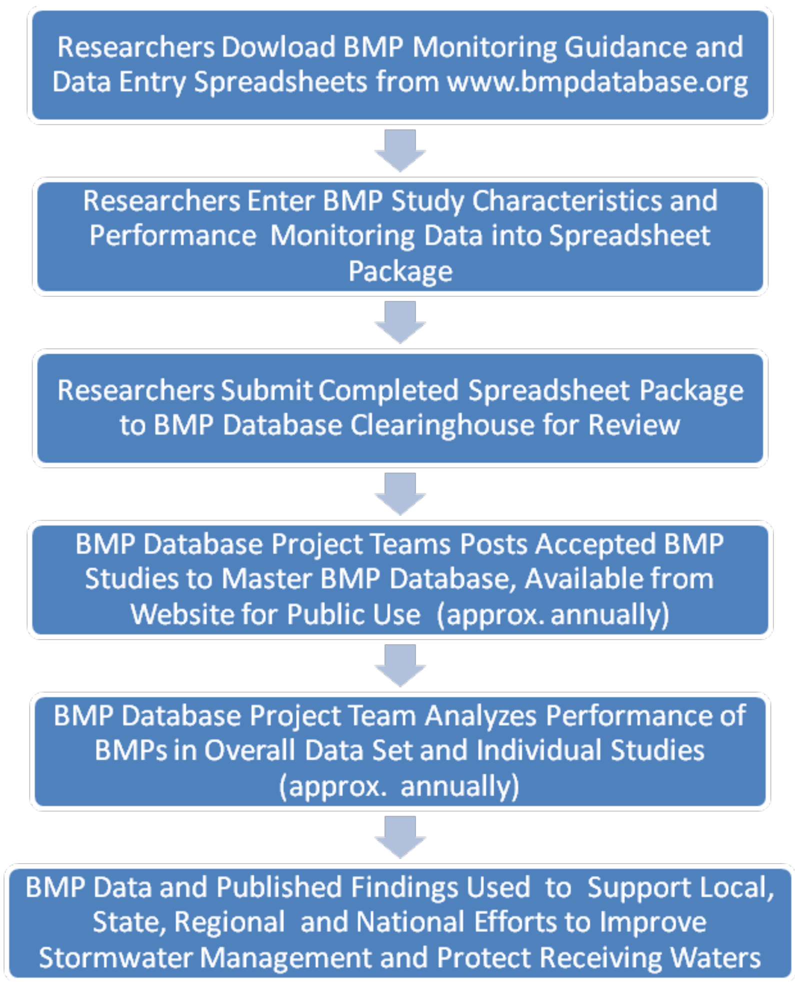
In 2004, the project transitioned from a USEPA grant-funded project to a more broadly supported coalition of partners including the Water Environment Research Foundation (WERF), ASCE Environmental and Water Resources Institute (EWRI), USEPA, Federal Highway Administration (FHWA) and the American Public Works Association (APWA). Wright Water Engineers, Inc. and Geosyntec Consultants manage the BMP Database clearinghouse, answer questions related to the project, conduct and update performance evaluations of the overall data set, and disseminate project findings. The overall project is managed by WERF's Jeff Moeller with the support of an expert advisory committee.

BMP Database

The cornerstones of the project are the BMP monitoring and reporting protocols and the BMP Database itself, which were developed based on the input and intensive review of many experts for the purpose of developing standardized reporting parameters necessary for more accurate BMP performance analysis. The BMP Database encompasses a broad range of parameters including test site and watershed characteristics, BMP design and layout characteristics, monitoring instrumentation, and monitoring data for precipitation, flow and water quality.

As of 2010, the BMP Database contains over 400 BMP studies and can be searched on-line or downloaded from the project website. The website also contains statistical analysis of the BMP performance monitoring data. The Project Team reviews data submissions prior to accepting the studies for inclusion in the Database. The overall project operates within the framework summarized in Figure 1.

Figure 1. BMP Database Project Framework



BMP Monitoring Guidance

During the initial stages of the BMP Database project, it became clear that better guidance was needed regarding stormwater BMP monitoring, particularly if monitoring results were to be valuable to the broader technical, management, and regulatory community. As a result, a companion project to the BMP Database was completed to provide such monitoring guidance, resulting in the BMP monitoring manual, *Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the Requirements of the National Stormwater BMP Database* (Geosyntec et al. 2002). The initial release of the monitoring manual was developed to promote collection of more useful and representative data associated with BMP studies, as well as more consistent reporting of monitoring results appropriate for inclusion in the BMP Database. Since that time, both the BMP Database project and stormwater management practices have continued to evolve, prompting a second release of the manual *Urban Stormwater BMP Performance Monitoring* (Geosyntec and WWE 2009). This manual can be downloaded at no cost from the BMP Database website: (http://www.bmpdatabase.org/MonitoringEval.htm) and is a good overall companion resource to this User's Guide.

The purposes of the updated Monitoring Manual are primarily twofold:

1. Improve the state of the practice by providing and enhancing a recommended set of protocols and standards for collecting, storing, analyzing, and reporting stormwater BMP monitoring data that will lead to better understanding of the function, efficiency, and design of urban stormwater BMPs.

2. Provide monitoring guidance for "Low Impact Development" (LID) strategies at the overall site level (e.g., monitoring overall sites with multiple distributed stormwater controls).

The Monitoring Manual provides guidance for all stages of BMP monitoring programs ranging from the early stages of study design to the end stages of data interpretation and reporting. Guidance is provided for monitoring a broad range of individual BMPs as well as overall site monitoring with multiple distributed BMPs, such as is the case with LID sites. The Monitoring Manual focuses primarily on the collection, reporting, and analysis of water quantity and quality measurements at the heart of quantitative BMP efficiency projects. Detailed information is provided on multiple topics pertinent to BMP monitoring, which is not repeated in this User's Guide. Data providers are encouraged to download the BMP Monitoring Manual as a supplement to this User's Guide. Key areas of focus in the Monitoring Manual include:

1. Designing the Monitoring and Reporting Program

2. Methods and Equipment for Stormwater BMP Monitoring

3. Implementing the Monitoring Program

4. Data Management, Evaluation and Reporting of Results

5. BMP Performance Analysis

6. Low Impact Development(LID)/Distributed Controls Monitoring

7. Data Interpretation and Performance Evaluation of LID Studies

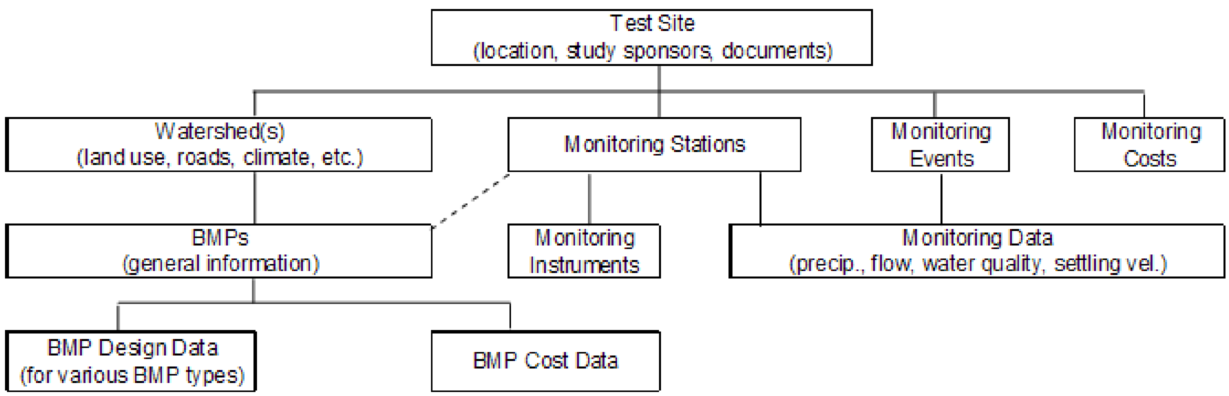
8. LID Case Studies

9. Supplemental Resources on Key Topics (Appendices), providing a summary of the BMP Data Entry Spreadsheets, a comparison of various data analysis approaches, guidance on determining required number of samples for meaningful data interpretation, guidance on error analysis, and supplemental information on statistical issues.

BMP Database Structure and Relationships to Spreadsheets

The BMP Database is stored in Microsoft Access 2007 and includes multiple tables that can be linked together by key fields such as Test Site I.D., Watershed I.D., Event I.D., BMP I.D., and Monitoring Station I.D. A *simplified* overview of the general relationships between various types of requested data is provided in Figure 2. A detailed Element-Relationship (E-R) Diagram can be downloaded separately from this User's Guide for more information and is provided in the "reports" module of the BMP Database.

Figure 2. Conceptual Overview of BMP Database



The Data Entry Spreadsheets are provided in Microsoft Excel 97-2003 and include 34 worksheets used to upload data to the master BMP Database. Table 1 provides corresponding table and worksheet names.

A separate "User Tips" guide can be downloaded from the project website for those using the back-end BMP Database in Microsoft Access 2007 to retrieve data.

Special Note to Providers of Multiple BMP Studies or Managers of Local BMP Databases

Please contact the BMP Database Clearinghouse (clary@wrightwater.com) prior to entering studies to the Database to determine the most efficient approach for submitting data to the BMP Database. For example, rather than entering data into the spreadsheet package, it may be more efficient to "map" an existing local or regional database to a blank version of the BMP Database in Access, which is available upon request. In some cases, providers of large data sets may choose to use the spreadsheet package for all site, watershed and BMP design information, but choose to provide monitoring data in the form of an existing local database. Examples of providers of large data sets include state departments of transportation, regional flood control districts, state departments of environmental protection, large-scale university research programs, and others.

Table 1. Relationship Between Excel Worksheets and Master Database

Excel Worksheet Name	**Access Database Table Name**
PART 1. GENERAL TEST SITE	
1. Test Site (*General Information*)	TESTSITE
2. Study Info (*Study Documentation*)	LAYOUTS PHOTOS
3. Agencies (*Monitoring and/or Sponsoring Study*)	AGENCIES
4. Location Info (*Site Location*)	TESTSITE
PART 2. ESTABLISH MONITORED EVENTS	
5. Monitoring Events	EVENT
6. Monitoring Costs (*for Overall Site*)	MONITORINGCOSTS
PART 3. WATERSHED (TRIBUTARY AREA)	
7. Watershed (*General Information*)	WATERSHED NS01
8. Roads and Parking Lots (*in Watershed*)	WATERSHED NS01
9. Land Use	LANDUSE
PART 4. GENERAL BMP (required for all sites)	
10 BMP (General)	BMP INFO S02
11. BMP Costs	BMP COSTS
PART 5. MONITORING STATIONS	
12. Monitoring Station Relation (*to BMPs*)	MONITORING STATION
13. Instrumentation (*at Monitoring Stations*)	INSTRUMENTS
PART 6. MONITORING RESULTS	
14. Precipitation	PRECIPITATION
15. Flow	FLOW
16. Water Quality	WATER QUALITY
17. Settling Velocity	TSSVELOC
PART 7. INDIVIDUAL BMP DESIGN SPREADSHEETS	
18. Detention Basin	DETENTION BASIN S02d
19. Retention Pond	RETENPOND S02r
20. Grass Filters (*Buffer Strips and Swales*)	GRASSFILTER S02g
21. Media Filters	MEDIAFILT S02f
22. Permeable Pavement	POROUSPAV S02p
23. Infiltration Basin	INFBASINS S02i
24. Perc Trench (*Percolation Trench and Dry Wells*)	INFTRENCH S02t
25. Wetland Channel	WETLAND CHANNEL S02c
26. Wetland Basin	WETLANDBASIN S02w
27. Manufactured Device (*Multiple Types*)	MANUFACTURED DEVICE S02
28. Bioretention	BIORETENTION S02b
29. Green Roof	GREENROOF S02g
30. Rain Harvest (*Rainwater Harvesting*)	RAINWATERHARVEST S02r
31. LID (*Low Impact Development*)	LIDSITE S02L
32. Non-structural (*BMPs*)	NONSTRUCT INFO N02
33. Other BMP	OTHERBMP S02o
34. Composite BMP	COMPOSITE BMP S02c

Brief Overview of Requested Data

In keeping with Figure 2 and Table 1, which provide an overview of the overall BMP Database structure, a brief description of each general data category in the BMP Database follows.

Test Site

The purpose of the Test Site data set is to identify the study, its location, involved parties and cost of monitoring for the study. Additionally, the "Study Info" spreadsheet enables the user to attach supporting information such as links to published studies, quality assurance plans, photos, BMP and site layouts and other information. Climate information is also entered at the Test Site level based on an EPA-sponsored report by Driscoll et al. (1990): *Analysis of Storm Event Characteristics for Selected Rainfall Gages Throughout the United States*. The user simply selects the closest climate station from a pick-list provided in the data entry spreadsheet.

Monitored Events

The purpose of the Monitoring Event table is to develop a user-defined list of events monitored at the test site so that precipitation, flow and water quality data can easily be paired together. Monitored events are based on the start date of the storm, and users can provide comments to identify unusual or important aspects of the storm event or other factors related monitoring during the event.

Watershed (Tributary to BMP)

The purpose of the Watershed table is to identify the conditions in the area tributary to the BMP. For example, watershed parameters include data elements related to tributary area, land use, soil type, imperviousness, storm drainage system efficiency, and other information. Since initial release of the Database, FHWA and various state departments of transportation have taken interest in the BMP Database. As a result, additional information is now being requested for sites located along highways.

More than one watershed may be present at a BMP test site for studies that use a reference (i.e., Control) watershed to compare BMP performance. This approach is often the case for LID and non-structural BMP studies. Additionally, studies may include data for an overall LID test site, as well as individual BMPs with the site. In such cases, multiple test watershed entries may also be needed.

General BMP

Basic descriptive information is requested for all BMP types, including parameters such as type of BMP, installation date, basic design parameters related to inflow and outflow configurations, maintenance and rehabilitation descriptions, and cost data. Multiple BMPs may be entered as part of a single test site submission, provided that they have the same tributary area or are part of an overall LID site. Additionally, for sites using a reference watershed site, a "Control BMP" type must be entered as the BMP type in this table to indicate that BMPs are not in place in the watershed. Data providers can also enter a "Composite BMP" type to enable performance analysis of a BMP system; however, design information must still be entered for the individual

BMPs at the test site. An overview of the type of information requested for structural, nonstructural and LID sites follows.

Structural BMPs

Design data requested vary according to the following common groups of BMPs: Detention Basins, Manufactured Devices, Retention Ponds, Infiltration Basins, Percolation Trenches/Dry Wells, Permeable Pavement, Wetland Basins, Wetland Channels/Swales, Grass Filters (buffers and swales), Media Filters, Bioretention, Rainwater Harvesting, and Green Roofs. An "Other" BMP category is also provided to enable flexibility for entry of BMPs that may not fit a pre-defined category. Most of the parameters requested in the structural BMP tables are identified as "required" in order to compare the effectiveness of various BMP designs. All BMP-specific design spreadsheets are located at the end of the spreadsheets in the Excel workbook, with each BMP type having a separate worksheet.

Non-structural BMPs

Non-structural BMP data requested are generally narrative/descriptive information on the type and extent of BMP practice being implemented, as well as cost data. Non-structural BMPs have been divided into the general categories of education, maintenance, recycling and source controls. Evaluating non-structural BMP characteristics is new ground for many, and defining measurable (i.e., quantifiable) parameters for non-structural BMPs is an evolving science. When more than one non-structural BMP is employed, it can be extremely difficult, if not impossible, to isolate the effectiveness of one BMP from the effects of other non-structural BMP(s) being tested at the same site. Also, a significant amount of data is needed to discern differences in water quality results between comparable watersheds with and without non-structural BMPs. For this reason, nonstructural BMP testing programs will typically need to take place over more than one year. It is likely that confounding variables will be difficult to identify and to isolate in non-structural BMP tests.

Low Impact Development (LID) Sites

LID sites attempt to mimic pre-development site hydrologic conditions by controlling runoff close to its source. As a result, BMPs are typically dispersed throughout a development site. For studies of LID implemented at the site scale, a series of narrative descriptions on key aspects of the site are requested. Designs of individual BMP components (e.g., rain gardens, permeable pavement, grass swales) can also be entered as part of an LID site submission. The *Urban Stormwater BMP Performance Monitoring Manual* (Geosyntec and WWE 2009) provides more detailed information on monitoring LID sites.

Composite BMPs

Effective implementation of BMPs often includes a "treatment train" of practices. The Composite BMP spreadsheet enables the data provider to identify the overall system in place at a site. Users must also enter design information for the individual BMPs in place at the test site, but the Composite BMP allows evaluation of performance of the overall test site.

Monitoring Stations

Monitoring stations must be identified for the test site as a whole, and then the relationship of each monitoring station to each BMP at the test site must be identified (e.g., inflow, outflow, rain gauge). **Proper entry of data into the monitoring station table is critical to proper analysis and retrieval of data for the test site.** For test sites that contain more than one BMP, two BMPs may share the same monitoring station (e.g., outflow from one BMP represents inflow to a downstream BMP). In such cases, the relationship of the monitoring station must be identified relative to each BMP.[2]

Information on instruments installed at monitoring stations is also requested. Multiple instruments may be present at a single monitoring station. This information provides much insight into the flow gauging and sampling techniques used and the reliability of the data collected at the site. As a result, instrumentation reporting should be encouraged for all new evaluation efforts.

Monitoring Results

Monitoring results may include precipitation, storm runoff or base flow, water quality data, and/or settling velocity distributions associated with a monitoring event. Monitoring results must be reported in association with previously defined monitoring events and monitoring stations. For sites also monitoring groundwater levels, the Water Quality spreadsheet can be used to enter depth to groundwater. Each data set is briefly described below.

Precipitation

Precipitation data such as date and time that the event began and ended, total depth and peak one-hour precipitation rate are important parameters for evaluating BMP performance. For example, a BMP may perform well for a low-intensity, short duration storm, but perform poorly for storms of longer duration. This type of information can help to explain variations in BMP performance. Particularly for LID sites and practices, precipitation data are fundamental to evaluation of BMP performance.

Flow (Runoff and Base Flow)

Documentation of flow conditions is fundamental to evaluation of BMP and site-level LID performance. Requested data include influent and

Data Entry Tips

Double-check units of measure. (e.g., are units of volume used for volume fields? milligrams vs. micrograms properly entered?)

Only use standard water quality parameter names from the provided pick-lists and be sure to specify the sample fraction (e.g., dissolved, total) where necessary.

Provide detection limits and laboratory qualifiers. Non-detected values should not be reported as "0" values; instead, provide the detection limit and a U qualifier.

Use comment fields to explain unusual data results that have been verified, but may appear to be errors or outliers to subsequent data users.

Event, Precipitation, Flow and Water Quality tables all have "flagging" fields that enable the user to specify whether the results are appropriate for analysis. Use these fields and explain anomalies in the comment fields.

Be sure to select the WQX parameter that corresponds to the form in which the analysis result was reported from the laboratory. For example, is orthophosphate reported "as P" or "as PO4"? Are results total or dissolved?

[2] Prior to 2007, a monitoring station "matrix" approach was used so that shared monitoring stations were only entered into the database once; however, this approach made data analysis more complicated for database users conducting data analysis. The revised monitoring station table has been restructured to facilitate analysis.

effluent runoff volumes, bypassed volumes (if any) and peak flow rates. Base flow data are also requested, if present. For BMPs where volume reduction is a design objective, flow volumes are fundamental to evaluation of the BMP's or LID site's performance. Additionally, flow volumes are necessary to evaluate load reductions provided by the BMP, as well as to evaluate how the BMP performs under a range of flow conditions. For example, a BMP may perform well under small, frequently occurring storm events for which the facility is designed, but perform poorly under larger, infrequent storm events.

Water Quality

Water quality data are at the core of BMP performance evaluations with regard to characterizing effluent quality achievable by various BMPs, quality of runoff relative to receiving water criteria and objectives, and evaluation of pollutant load reductions. The water quality data entry format in the 2010 release of the spreadsheets has been updated to be compatible with many Electronic Data Deliverable (EDD) formats now offered by laboratories and is generally based on EPA's Water Quality Exchange (WQX) format, using "Modern" STORET terminology.[3] The spreadsheet data entry approach enables pasting of EDDs into the BMP Database, thereby reducing the likelihood of data entry errors.

Particle size distribution data, which are important to evaluating the performance of many BMP types, can be entered into the water quality data table using WQX codes provided in a pick-list.

Description of Data Priority Codes

In order to enable meaningful analysis of BMP data, a fairly large amount of information is requested in the spreadsheet package. These data requests are prioritized as "required," "important, but not required" or "nice to have." The priority level for each data element is color coded in the spreadsheet cells according to these three priority levels:

- **Required**: "Required" data are necessary for proper evaluation and comparison of BMP performance. If these data are not provided, then the BMP study may either be rejected from inclusion in the BMP Database or excluded from certain types of analysis. Required fields are color-coded in blue in the spreadsheets.
- **Important**: "Important" data are also necessary for proper evaluation and comparison of BMP data. If these data are currently unavailable, they should be collected in future monitoring efforts. Many of the watershed data elements fall into this category. Important fields are color-coded in purple in the spreadsheets. (Note: in previous releases of the Database, this priority code was previously called "essential, but not required.")

> **Tip: Use of Comments Fields**
>
> Most spreadsheets in the BMP Data Entry package have Comments fields, where the user can provide a descriptive narrative. Users are encouraged to use the comments fields, even though these fields are "nice to have" (optional). Providing simple comments can help to ensure that future users of the data correctly understand the BMP site design, watershed conditions and monitoring data.

[3] Pre-2007 releases of the Database were based on STORET "Legacy" terminology and formats, which many users found confusing. The historic data contained in the Database have been transitioned to EPA's WQX format.

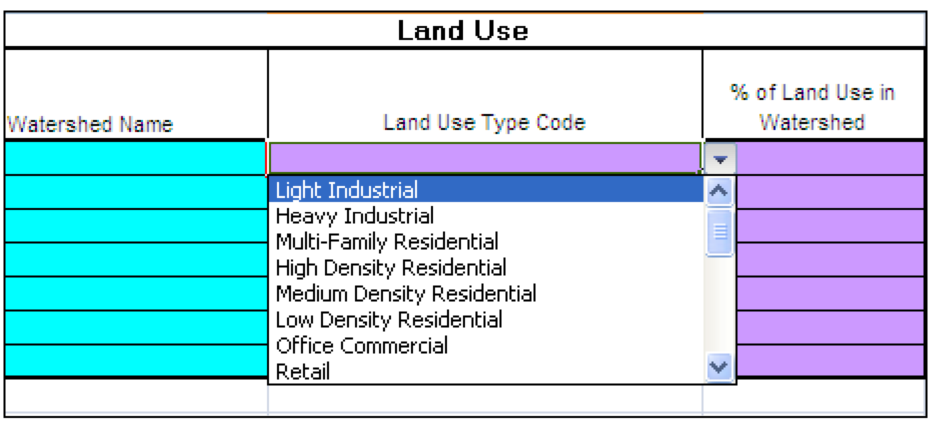
- **Nice to have**: "Nice to have" fields provide data that are useful in BMP evaluation but not essential for BMP evaluation. For example, "comments" and cost data are considered nice to have. Nice-to-have fields are color-coded in yellow in the spreadsheets.

- **Variable**: "Variable" fields identify data sets that are required for some BMP types, but not others. Data elements identified as variable are contained primarily in the Watershed spreadsheet. Typically, variable fields are required for LID/infiltration-oriented practices and identified as important or nice-to-have for other BMP types.

Pick-lists

Some fields in the Excel workbook require that entries conform to pre-established "pick-lists". The pick-lists are provided in dropdown boxes on the individual spreadsheets (Figure 3), as well as below the data entry spreadsheet (in some cases) for most spreadsheets. Exceptions include the "Units" pick-list provided on a separate worksheet at the beginning of the spreadsheet package. (In the master BMP Database itself, pick-lists are provided in tables identified by at "tbl" prefix.) When a pick-list is provided, the data provider is not required to manually use the dropdown box, provided that the information entered is a value listed in the pick-list. If the entry is not consistent with the options in the pick-list, then the user will receive an error message. As an example, for the monitoring data spreadsheets, the user must select previously defined monitoring event numbers and monitoring station names from dropdown pick-lists; however, the user can also paste or type in these values, provided that they exist in the pick-list.

Figure 3. Example Pick-list in a Dropdown Box in the Land Use Data Entry Spreadsheet

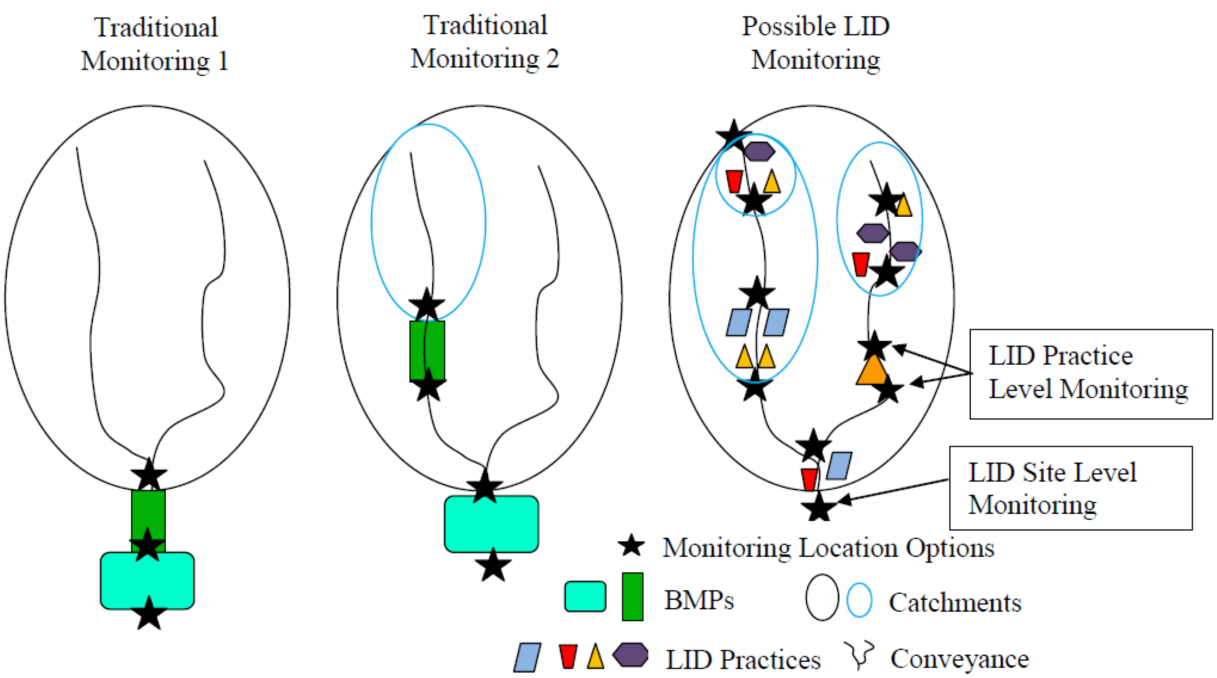


Although a variety of units may be entered into the data entry spreadsheets, the master Database will provide only SI units. Data providers are requested to provide unit conversions prior to submittal of data to the BMP Database. Preferred units are provided in call-out boxes adjacent to the relevant data entry spreadsheet. A variety of on-line unit conversion tools are publically available (e.g., http://www.onlineconversion.com/) to aid data providers in this process.

Part 1. General Test Site Information

Three general information worksheets and one worksheet identifying document attachments must be completed for each test site. These spreadsheets request information on test site location, sponsoring and monitoring agencies/entities, location information, and documents associated with the study or test site. Only one test site is allowed per workbook, although the single test site may include multiple BMPs if the tributary watersheds to the BMPs are approximately the same, as shown in "Traditional Monitoring 1" in Figure 4. In Figure 4 for "Traditional Monitoring 2", where the watershed areas between the two BMPs differ significantly (e.g., 50 versus 100 acres), separate test sites would be created, even though the BMPs are in series. In the "Possible LID Monitoring" sketch in Figure 4, the study would be entered as one test site. For large data providers, please contact the BMP Database Clearinghouse in advance to determine the most efficient manner to enter multiple BMP sites.

Figure 4. Test Site Definition Example



1. General Test Site

The purpose of the BMP General Test Site information data is to identify the general study location and related information. The location information is important for a variety of reasons. For example, it enables recognition of the types of conditions under which the BMP test is conducted (e.g., Seattle = lots of low intensity rain much of the year, Phoenix = few high intensity storms). This information also enables interface with other EPA databases. Data requested as part of General Test Site information are described below. All test site information is <u>required</u>, unless otherwise noted.

Test Site Name is the name that the site is known by locally (e.g., Shop Creek, First Bank). A test site is a unique geographic location where a BMP testing effort has been conducted. The site may contain more than one BMP, but ONLY if the watersheds tributary to these BMPs are virtually identical. In cases where several BMPs are located in the same general vicinity, new test sites should be identified whenever the tributary watersheds for the BMPs differ by more than five percent in area, even if the BMPs are in series.

City closest to the test site. The site does not have to be within the city limits.

County in which test site is located. This information is nice to have.

State where test was performed (2 characters).

Zip Code of the test site.

Country where the test site is located (2 characters).

Site Elevation is the elevation above mean sea level provided to the nearest 100 feet from a U.S. Geological Survey (USGS) quadrangle map or to the nearest 30 meters for studies outside of the United States. Units of measurement must be selected from the provided pick-list.

Number of Watersheds associated with the test site. For non-structural and LID sites, it is common to have more than one watershed, with one serving as a reference (or control) location, and the other serving as the test site watershed.

Number of BMPs located at the test site. This helps alert subsequent users to treatment trains that may be present at the site.

Type of BMP being tested must be identified as either Structural (=1), Non-Structural (=2), Both (=3) or Site-level LID (=4).

Comments are encouraged to provide a general overview of the study and to identify any concerns or limitations associated with usage of data from the study. Comments are considered nice to have.

2. Test Site/Study Documentation

As the Database has evolved, many users have requested additional supplemental information about the underlying BMP studies. This spreadsheet provides a checklist of potential attachments to the study submittal, as well as other document information, including the following:

Year Submitted to Database helps track growth of the BMP Database over time and is useful to database users wanting to identify recently accepted data sets. This is required information.

Data Provider helps track the individual submitting the study for future contact purposes. The data provider may or may not correspond to the entity conducting or sponsoring the study. This is required information.

Report Title (or Data Source), Report Authors, and **Year of Publication** enable BMP Database users to go to the original underlying research for more detailed information about the BMP study. Whenever peer-reviewed journal papers are available regarding the study, identify these. In some cases, the data source may be "unpublished data" from a department of transportation or department of environmental protection database. If so, describe the underlying data source and date that information was retrieved. This is nice to have information.

Attachments provide the BMP Database users with more information about the BMP study. In the spreadsheet, enter Yes (Y) or No (N) to identify whether various attachments have been provided with the study submittal.

- **Study Reports** enable future BMP Database users/researchers to access more detailed information on the study. These should be provided in PDF format. This information is nice to have.

- **Photos** enable future BMP Database users/researchers to develop a visual image of the BMP. Please provide photos in "jpg" format. This information is nice to have.

- **BMP Layout** enables future BMP Database users to develop a clear understanding of the BMP. Drawings of the BMP and/or site layout in plan, profile and layout view are requested. These drawings must be "saved down" to a "jpg" format. This is required information.

- **QAPP/SAP(s)** are Quality Assurance Project Plans and Sampling and Analysis Plans that are often developed as part of monitoring efforts. Attaching a PDF of these plans enables future BMP Database users to assess the quality of the data and study design. Although this information is not currently provided on-line to BMP Database users, it is archived by the Project Team and is available upon request for Database users. This information is nice to have.

Abstract enables the data provider to paste a previously developed abstract into the spreadsheet or to create a study abstract for use by future BMP Database users. This information is nice to have.

3. Monitoring and Sponsoring Agencies

The purpose of this spreadsheet is to provide contact information for the entity(ies) sponsoring the BMP test and the entity(ies) actually conducting the test. For example, EPA may be sponsoring the test by providing funding, while a private firm may be actually conducting the test. All address lines may not be necessary for an entity. For example, there may be no department name and only one address line may be necessary. Multiple entries are allowed for each test site. Specific data requested include:

Agency Name identifies the entities sponsoring and/or monitoring the study. This is required information.

Agency Responsibility should be selected from the provided pick-list to identify whether the agency monitored, sponsored and both monitored/sponsored the study. Multiple entities may be involved with a BMP study. This is required information.

Agency Type should be selected from the provided pick-list. Agency types may include a city, county, state, industry, federal, special district, council of governments, authority, consultant, or other. This information is nice to have.

Address information includes agency department (if any), street or post office address, city, state, zip code, country, phone, fax and e-mail. This is required information. Fax and e-mail should be provided when available.

4. Location

Regional Climate Station in the United States that is most relevant to the test site can be selected from the Regional Climate Station pick-list based on a Climate Station State Code and a Climate Station ID. This is required information for studies in the U.S. If an appropriate climate station is not available, then select "ZZ Not Listed" from the Dropdown list. Storm event statistics have already been calculated for these stations including the average and coefficient of variation for these parameters: number of storms, precipitation (in/yr), storm duration (hours), storm intensity (in/hr), and storm volume (in/hr). These data were taken from *Analysis of Storm Event Characteristics for Selected Rainfall Gauges Throughout the United States* by Eugene D. Driscoll, Gary E. Palhegyi, Eric W. Strecker and Philip E. Shelley, prepared for the U.S. Environmental Protection Agency, December 1989. For sites outside of the United States, this information can be developed based on the definition of an individual storm being separated by six hours or more of inter-event time. Storms that have less than 0.1 inches of total rainfall should be filtered out before calculating these statistics. For non-United States test sites, this information can be entered into the Comments field on the General Test Site information spreadsheet or table.

Latitude is the North-South coordinate that locates the project to the nearest second on the globe relative to the equator. The latitude should be reported in a decimal degree format, typically generated by a Global Positing System (GPS) device. This is important information.

Longitude is the East-West coordinate that locates the project to the nearest second on the globe relative to the selected principal meridian. The longitude should be reported in a decimal degree format, typically generated by a Global Positing System (GPS) device. This is important information.

(Horizontal) Reference Datum associated with the latitude and longitude should also be selected from the provided pick-list (e.g., NAD83, WGS84). This is important information.

Hydrologic Unit Code is the USGS 8-digit hydrologic unit code (HUC) which represents a geographic area containing part or all of a surface drainage basin or distinct hydrologic feature. The first two digits of the code represent the water resources region; the first four digits represent the subregion; the first six digits represent the accounting unit; and all eight digits represent the cataloguing unit. The HUC can be looked up on the EPA "Surf Your Watershed" web site at http://www.epa.gov/surf/. If the user's search response is "no results", then higher level tributary names should be tried, or other descriptors such as county name or zip code entered until a HUC is provided. This is important information for sites in the United States.

EPA Reach Code is the EPA-designated RF1 or RF3 river reach with which the station is associated. Sites will either have an RF1 code or an RF3 code, but not both. There are about 67,000 RF1 codes and over 2 million RF1 codes within the United States. The first eight digits of the Reach Codes are the hydrologic unit code (HUC) described above; therefore, the user only needs to provide the last three or four digits in the Reach Code which follow the 8-digit HUC. The RF1 and RF3 codes can be obtained from the BASINS watershed analysis software, which EPA has distributed to state water quality agencies, as well as many regional or local agencies. The BASINS software modules may be obtained from EPA at no charge; however, the user must have ArcView, a commercial GIS software product. More information on obtaining BASINS is available on the EPA web site at http://www.epa.gov/OST/BASINS/. This is important information for sites in the United States.

Other Location Information is nice to have for test sites in the U.S., particularly when GPS coordinates are not available for a test site.

Township is a public land surveying unit consisting of 36 sections or 36 square miles in the United States. Townships are located by their distance and direction (north or south) from a selected baseline. For example: Township 2 North (T2N). This information can be identified on a USGS quadrangle map.

Range identifies the site distance and direction (east or west) from the selected principal meridian. For example, Range 60 West (R60W). This information can be found on a USGS quadrangle map.

Principal Meridians are the infinite sets of imaginary circles around the globe passing through the north and south poles from which degrees of longitude are measured. The principal meridian is the local or international meridian from which the degrees of longitude locating the BMP test site are measured.

Section is a land area containing one square mile or 640 acres that can be identified on a USGS quadrangle map. There are 36 sections in a township numbered from 1 to 36.

Quarter, Quarter-Quarter and Quarter-Quarter-Quarter Sections should be provided to locate the BMP test site on a USGS quadrangle map. A quarter section of land is 160 acres. A quarter-quarter section is 40 acres and a quarter-quarter-quarter section is 10 acres. Enter from smallest quarter to largest quarter for the quarter-quarter and quarter-quarter-quarter fields. Enter the data in the form of NE, NW, SW, or SE. For example, the BMP test site is located in the northeast (NE) quarter of the southwest (SW) quarter of the northeast (NE) quarter of section 36.

USGS Quadrangle Map Name is the USGS map on which the site can be located.

Time Zone in which the BMP test site is located off-set in hours from Greenwich Mean Time should be selected from the provided pick-list. For example in the United States, Eastern Time is -5, Central Time is -6, Mountain Time is -7 and Pacific Time is -8.

Part 2. Establish Monitored Events

5. Monitoring Events

In order to properly link monitoring events for the overall test site, a monitoring events table must be established for the test site as a whole. More detailed information for monitoring events is included in the precipitation, flow and water quality spreadsheets.

Event Number is pre-entered, numbered from 1 to 300. Additional event numbers may be added, if necessary. This is <u>required</u> information prerequisite for all subsequent monitoring data entry.

Event Start Date is the calendar date (month, day and 4-digit year) that the storm started (e.g., 01/01/1998) or the base flow event was sampled. The event start date may not correspond exactly to the event sample date for longer storms or BMPs with extended release periods. This is <u>required</u> information.

Event Start Time is the time that the storm (or monitoring event for base flow) started (e.g., 21:00). This is <u>important</u> information to differentiate between storms on the same date.

Event Type identifies whether the monitored event is associated with storm runoff, base flow/dry weather, or other event. This is <u>required</u> information that must be selected from a pick-list.

Antecedent Dry Period (hrs) is an indicator of antecedent watershed conditions and potential for dry weather pollutant build up. This is <u>important</u> information for LID facilities and infiltration-oriented BMPs and <u>nice to have</u> for other BMP types.

Describe Antecedent Watershed Conditions is a narrative description of conditions immediately prior to the start of monitoring, including relevant field notes. This is <u>important</u> information for LID facilities and infiltration-oriented BMPs.

Quality Assurance/Quality Control (QA/QC) Description can be used to identify whether QA/QC procedures for the field and laboratory were followed for the sampling event and to identify any QA/QC issues or sampling event limitations. QA/QC descriptions relate not only to water quality aspects of the project, but also checking and calibrating precipitation and flow monitoring equipment. (Note: If a Quality Assurance Project Plan (QAPP) and or Sampling and Analysis Plan (SAP) is available in PDF format, these files may be attached separately after identifying them in the "Study Info" spreadsheet associated with the Test Site information.) This is <u>important</u> information.

Comments allow the user to enter observations regarding the event conditions. For example, if the event generated flow conditions greater than the BMP design storm, this could be noted in the event field. This information is <u>nice to have</u>.

6. Site Monitoring Costs

Enter approximate annual monitoring costs for the overall test site for each year. Data are requested for both fixed and temporary monitoring stations. All monitoring cost data should be reported in U.S. currency and are considered <u>nice to have</u> information.

Fixed Monitoring Station Costs are those costs associated with fixed monitoring instrumentation installed for long-term use. For example, a shed may be constructed to house the instrumentation. Year of cost basis, equipment, maintenance, sampling and laboratory costs are requested for fixed monitoring stations.

Temporary Monitoring Station Costs are those costs associated with temporary monitoring instruments not intended for long-term use. Year of cost basis, equipment, sampling and laboratory costs are requested for temporary monitoring stations.

Data requested for monitoring costs include:

- **Monitoring Year** is the year during which monitoring was conducted. If monitoring has been conducted over a five-year period, then enter costs for each of the five years. This may be done by simply dividing the total monitoring costs by the number of years.
- **Year of Cost Basis** is the year that the monitoring activities were conducted or equipment purchased. For example, if the instrument was purchased in 1995 for $500, then 1995 is the year of cost basis.
- **Equipment Costs** are the costs of sampling and flow gauging equipment (rental or purchase) and installation.
- **Maintenance Costs** (permanent stations only) are the annual maintenance costs for equipment.
- **Sampling Costs** are the annual costs of sampling.
- **Laboratory Costs** are the annual costs of sample analysis by a laboratory.
- **Comments** may be needed to clarify unusual monitoring costs or other details as deemed appropriate by the user.

Part 3. Watershed (Tributary Area) Information

Several spreadsheets must be completed providing watershed information to characterize conditions at the time that test data were collected. The term "watershed" in this context refers only to the area tributary to the BMP or LID site, not the watershed as a whole. For studies that are conducted over time, if watershed conditions have changed significantly over time (e.g., land use changed from agricultural to commercial) at the test site, set-up a separate test site to enter data collected since the time that the watershed changed.

Standard BMP Database Watershed Units

Length = meters

Area = hectares

7. General Watershed

Watershed characteristics play a significant role in the types and quantities of pollutants contributed to stormwater runoff as well as hydrologic response of a test site to runoff events. The information requested below is useful for comparing effectiveness of BMPs under various watershed conditions. Requested information ranges from basic watershed geometry and surface characteristics to parameters useful as indicators of time of concentration, hydraulic connectivity, and the potential for conveyance losses. The priority level (e.g., required, nice-to-have) of the data varies based on the type of BMP study being conducted and is described further below. Unless otherwise noted, the priority levels are:

- For non-structural BMPs and LID sites (or sites minimizing directly connected impervious area), this is required information.
- For infiltration/percolation type structural BMPs, this is important information.
- For non-infiltrating structural BMPs, this information is nice to have if available.

Minimum Recommended Watershed Characteristics for All Studies

Since release of the BMP Database, some researchers have sometimes reported being overwhelmed with the amount of information requested in the watershed spreadsheet. Regardless of the data priorities identified below, the following parameters are considered reasonably attainable for most BMP studies and should be provided for basic description of the watershed.

- Watershed Type (test or reference)
- Watershed Description (narrative)
- Total Watershed Area
- % Impervious Area
- Hydrologic Soil Group
- Soil Type
- Type of Vegetation
- Land Use Types and Percentages

More complete data on watershed parameters requested is highly encouraged for sites focusing on evaluation of volume reduction.

Watershed Name is the name that the watershed is referred to locally. This is required information.

Watershed Type Code can either be a Test Watershed (=1) or a Reference Watershed (=2) and is required information that must be selected from the pick-list. This field is required because LID studies, non-structural BMP studies, and some types of structural BMPs (e.g., permeable pavement) often utilize reference watersheds to compare outflow characteristics between test and reference sites. These types of studies can be set-up with two basic approaches:

1) **BMP Performance Comparisons Over Time**. This involves a before-and-after type of approach where measurements are taken in the same watershed prior to non-structural BMP implementation and then taken again after BMP implementation. In this case, the first set of measurements serve as the reference, and the second set serve as the BMP test.

2) **BMP Performance Comparisons in Space.** This involves setting up a non-structural BMP test using two or more geographically separate watersheds that have similar watershed characteristics. The watershed without BMPs in place serves as the reference and the watershed with BMPs in place serves as the test.

Some structural BMP tests may also incorporate a reference watershed. For example, permeable pavement effectiveness may be evaluated by comparing water quality data from a watershed with permeable pavement in place to a watershed without permeable pavement in place. Typically, structural BMPs are simply evaluated by collecting inflow and outflow data for the subject BMP and comparing the water quality; therefore, only a test watershed is required for these studies.

Watershed Description enables the data provider to narratively describe the watershed and identify any unique or important conditions that may be present. This provides the context and initial screening of comparability to other studies by subsequent users of the study. This information is nice to have if available.

Total Watershed Area is the topographically defined area draining to the BMP for structural BMP studies or the drainage area studied for non-structural and LID sites. This is required information.

Total Length of Watershed is the length of the watershed along the main drainage path to the furthest point on the watershed divide. For LID studies, this parameter is helpful in estimating watershed lag.

Average Overland Flow Length describes the area-weighted average drainage path length to an inlet or hardened conveyance. This information provides more refined characterization of the basic parameter of watershed length for LID studies.

Maximum Overland Flow Length describes the maximum drainage path length to an inlet or hardened conveyance. This information provides more refined characterization of the basic parameter of watershed length for LID studies.

Narrative Description of Flow Paths (for LID sites) enables description of watershed geometry-based LID practices that modify the flow patterns of the site in order to increase time of concentration and promote losses. The potential metrics that may be used in the narrative description of the flow patterns include, but are not limited to, the following:

- Time of concentration (T_c) to a hardened conveyance; accompanied by method used to compute T_c and inputs.
- Hydraulic width, based on Stormwater Management Model (SWMM) documentation.
- Average lot depth.
- Average slope of pervious area.

Total Length of Grass-Lined Channel is the total length of grass-lined and natural channels in the watershed. This is the portion of the storm drainage network in the watershed that is not conveyed in concrete channels, storm sewers or pipes.

Total Watershed Area Disturbed is the total watershed area that is disturbed or under construction. This parameter may be useful in indicating the types and levels of pollutant loads in stormwater. If a quantitative estimate is not reasonably attained, describe general extent of disturbed area in the Comments field.

Percent (%) Irrigated Lawn and/or Agriculture in Watershed is particularly important in arid areas where vegetation may be difficult to establish without irrigation. This describes the extent of site potentially producing dry weather flows or having soil moisture content above seasonal normal for unirrigated land.

Percent (%) Total Impervious Area in Watershed represents the percentage of the watershed that is impervious. Common impervious surfaces include, but are not limited to, rooftops, walkways, patios, driveways, parking lots, storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and macadam or other surfaces that similarly impede the natural infiltration of urban runoff. The percent of the total watershed that is impervious can be determined as the total impervious area divided by the total area of the watershed. This is required information.

Percent (%) of Total Impervious Area (above) that is Hydraulically Connected is calculated by dividing the hydraulically connected impervious area by the total impervious area. An example of hydraulically connected impervious area includes building rooftops that drain onto paved areas. This parameter provides a general description of the connectivity of a watershed. (It is the amount of area likely to discharge in a small storm event; however, larger areas may behave as Directly Connected Impervious Area in larger events.)

Percent (%) of Watershed Served by Storm Sewers is the percentage of the total watershed area directly served by storm sewers. The percentage of watershed area served by storm sewers is typically higher in urbanized areas than in rural areas.

Percent (%) of Impervious Area with Canopy (estimated) provides information about the estimated hydrologic response of a land area, providing a measure of the extent of LID implementation. Vegetative canopy over impervious area would be expected to decrease the effective imperviousness of a site.

Storm Sewer Design Return Period (yrs) is the most common design storm return period for the storm sewers in the watershed provided in years. The design storm is the storm for which a storm drainage system, flood protection project, spillway or other engineering structure is designed. For example, the storm sewers may be designed to handle flows generated by the 10-year storm.

Average Watershed Slope is the average unitless slope of the watershed. Calculate slope by dividing the vertical distance (or fall) by the linear length of the flow path (or run). Slope for each linear reach can be determined as the elevation difference for the reach divided by the length of the reach. An average slope for the watershed can then be calculated as a weighted sum of the slopes of individual reaches using the length of the individual reaches relative to the total length of the channel as the weighting factor.

Average Runoff Coefficient is based on runoff and rainfall data collected in the watershed using the area-weighted average runoff coefficient. This is the data provider's estimate of the runoff potential of the watershed considering imperviousness and connectivity. Estimating this parameter without long term monitoring data requires professional judgment. It is typically the intent of LID site studies to quantify the average runoff coefficient. If data permit, calculate the average of individual storm runoff coefficients using each storm's runoff volume divided by its rainfall volume.

Hydrologic Soil Group is the dominant Natural Resource Conservation Service (NRCS) hydrologic soil group--A, B, C, or D. The appropriate soil group can be selected from a dropdown box. Hydrologic soil groups are used to estimate runoff from precipitation. Soils are placed in one of four groups on the basis of the infiltration of water after the soils have been wetted and have received precipitation from long-duration storms. The four groups include:

1. Group A soils have a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

2. Group B soils have a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

3. Group C soils have a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture to fine texture. These soils have a slow rate of water transmission.

4. Group D soils have a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a clay pan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

For LID sites, the hydrologic soil group is an indicator of the magnitude of runoff expected from pervious areas. Infiltration characteristics of the soil group may be different in developed conditions than what are reported in the soil survey due to soil compaction or mass grading/relocation as a result of development. This is important information.

Soil Type is the general NRCS soil type: (c)lay (s)ilt, or s(a)nd. Clay particles are smaller than 0.002 millimeters (mm) in diameter. Silt particles are between 0.002 and 0.05 mm in diameter. Sand particles range from 0.05 mm to 2.0 mm. The relevant soil type can be selected from a dropdown box.

Distribution of Hydrologic Soil Groups on LID Site allows for a more robust description of larger LID sites, or sites with a range of compaction-related impacts. Provide data in terms of % HSG A, % HSG B, etc.

Narrative Description of Soil Conditions enables the user to describe important aspects of the site soils. Representative comments may include:

- Prevalent soil type (Unified Soil Classification) in developed areas at time of monitoring (not in the pre-development).

- Measured saturated hydraulic conductivity in critical locations such as in the vicinity of infiltration-based practices.

- Average and minimum depth to seasonally high groundwater in developed areas.

- Degree of compaction and envelope of disturbance.

Type of Vegetation predominant in pervious areas (grass turf, dryland grasses, etc.) influences the rate and efficiency of stormwater infiltration and filtration.

8. Roads and Parking Lots in Watershed

Key factors affecting hydrologic response of a watershed include the characteristics of 1) roads, streets and alleys in the watershed and 2) parking lots in the watershed. Spreadsheet 8 requests a variety of information describing these surfaces, with these relative priority levels:

- For non-structural BMPs, LID sites, and structural BMPs that are based on minimizing directly connected impervious area, this is <u>required</u> information.
- For infiltration/percolation type structural BMPs, this is <u>important</u> information.
- For non-infiltrating structural BMPs, this information is <u>nice to have</u> if available.

Do not include parking lots in the streets, roads and alleys data elements, because parking lot information is requested separately.

<u>Streets, Roads and Alleys</u>

Total Paved Roadway Area includes the total area of paved roads, streets and alleys in the watershed as a component of the total impervious area of the watershed. Associated paved shoulders should be included in this area.

Total Length Curb/Gutter on Paved Roads includes the total length of curb and gutter along paved roads, streets, and alleys. Curbs and gutters are constructed stormwater conveyance systems that remove stormwater from paved roads, streets and alleys; however, they also concentrate stormwater runoff with minimal opportunity for infiltration, filtering or settling of pollutants.

Total Unpaved Roadway Area is the total area of unpaved roads, streets, and alleys in the watershed. Unpaved shoulders should be included in this area.

Total Length Curb/Gutter on Unpaved Roads is the total length of curb and gutter along unpaved roads, streets, and alleys.

% Paved Roads Draining to Grass Swales/Ditches can be calculated by dividing the length of paved roads, etc., draining to grass swales and ditches by the total length of paved roads, streets and alleyways in the watershed. Well-vegetated and maintained grass swales and ditches typically provide more infiltration and filtering of pollutants from stormwater than curb and gutter systems.

% Unpaved Roads Draining to Grass Swales/Ditches is the percentage of unpaved roads, street and alley areas draining to grass swales/ditches that can be calculated by dividing the length of unpaved roads, etc., draining to grass swales and ditches by the length of unpaved roads, streets and alleyways in the watershed.

Type of Pavement on Roads, streets and alleys can be (C)oncrete, (A)sphalt, or a Mix of (B)oth. These values can be selected from a dropdown box.

Parking Lots in Watershed

The following fields request information on parking lots in the watershed. Do not include the previously entered road, street and alley information.

Total Paved Parking Lot Area includes the total area of all paved parking lots within the watershed. Paved parking lots can be a significant component of total impervious area within a watershed.

Total Length Curb/Gutter on Paved Lots is the total length of curb and gutter along paved parking lots.

Total Unpaved Parking Lot Area is the total area of all unpaved parking lots within the watershed.

Total Length Curb/Gutter on Unpaved Lots is the total length of curb and gutter along unpaved parking lots.

% Paved Lot Area Draining to Grass Swales/Ditches is the percentage of parking lot areas draining to grass swales or ditches. This can be calculated by dividing the total parking lot area draining to swales by the total parking lot area.

% Unpaved Lot Area Draining to Grass Swales/Ditches is the percentage of unpaved parking lot areas draining to grass swales or ditches. This can be calculated by dividing the total unpaved parking lot area draining to swales by the total unpaved parking lot area.

Type of Pavement in Parking Lots can be (C)oncrete,(A)sphalt, or a Mix of (B)oth. Select the type of pavement present in parking lots in the watershed from the pick-list. In additional fields, provide the percentages of **porous concrete**, **porous asphalt** and **porous modular** pavement present relative to the total paved parking lot area.

Highway Data

Highway-related data includes usage-related information of interest to many departments of transportation. This information is nice to have in terms of BMP performance.

Highway Condition Characterization should be described narratively, addressing the presence of features such as cruising, acceleration, deceleration, intersections, parking/high turnover (e.g., toll plazas, rest stops, etc), parking/low turnover (e.g., park and rides).

Average Annual Daily Traffic (AADT) (cars/day) traffic volumes should be provided for highways.

Number of Lanes associated with the highway being monitored.

Type of Deicer Used should be selected from a dropdown box that includes the following options: 1) Sand; 2) Sand/Salt; 3) Magnesium Chloride; 4) Other Chemical; 5) None; 6) All of the above.

9. Land Use

Land Use information (Type and Relative Percentage) should be provided for each land use present in the watershed by selecting land use from the dropdown pick-list. The percent of each land use in the watershed can be categorized according to % Light Industrial, % Heavy Industrial, % Multi-family Residential, % Office Commercial, % Retail, % Restaurants, % Automotive Services, % Rangeland, % Orchard, % Vegetable Farming, % Highway, etc. This parameter may be useful in indicating the type and level of pollutant loads in stormwater. This is required information.

Estimate of Average Percent Imperviousness Per Land Use (for LID sites) This allows a direct estimate of total watershed imperviousness and could support estimates of impervious area draining to LID practices if LID implementation is described by land use (e.g., bioretention in 40 percent of residential land use, etc.). This information is nice to have for LID studies.

Part 4. General BMP Information

10. General BMP

A structural BMP includes constructed facilities or measures to help protect receiving water quality and control stormwater quantity. If multiple BMPs are present at a test site, they must have the same unique tributary watershed, otherwise they should be set-up as separate test sites as illustrated in Figure 4 for General Test Site information.

Watershed Name must be provided, as previously defined by the user, in order to place BMP data in the proper watershed context and associate the BMP with the test or reference watershed. This is required information.

BMP Name must be provided in terms of the common name or code used to identify this BMP locally (e.g., Shop Creek wetland or Southglenn Mall detention pond). This is required information.

Type of BMP Being Tested must be selected from the codes in the BMP type pick-list. If no BMPs are in place because data are being entered for a reference watershed, select "Control BMP." If multiple BMPs are in place in a watershed and the site is being monitored as an overall site, then enter each BMP in place in the watershed, as well as "Composite BMP" to enable analysis of the overall site, as well as the individual BMPs. If a site-scale LID site is being monitored, select LID Site, as well as any individual LID practices monitored at the site. This is required information.

Basis of Design provides information on the type of storm event that the BMP is designed to treat such as the 1-year, 24-hour storm, the 80th percentile storm/water quality capture volume, 2-year storm, etc. This is required information.

Purpose of BMP (treatment objectives) provides information on the treatment objective of the BMP. For example, a BMP may be designed to provide pretreatment for a downstream BMP, be designed to provide volume reduction, or be designed as a multi-purpose facility that integrates water quality and flood control. This is required information.

Source of Design Guidance for BMP identifies the design guidance followed for the BMP design. For example, a user might enter Western Washington Manual, Maryland Stormwater Manual, Urban Drainage and Flood Control District, Denver, CO, 2010 Volume 3 Urban Storm Drainage Criteria Manual, not applicable, or unknown. Where available, provide the year of the manual publication, since they are typically revised over time. This is required information.

Date Facility Placed in Service must be provided in terms of month, day and 4-digit year (e.g., 04/05/1998). If the exact day is unknown, use the first day of the month. This is required information for all BMPs. For non-structural BMPs, use this field to enter the date that the non-structural measure began being implemented.

Number of Separate Inflow Points to the Facility is required information for structural BMPs. For example, a wet pond may receive flow from two storm sewers and one natural drainage, for a total of three separate inflow points. This field is not applicable to non-structural BMPs.

BMP Designed to Bypass or Overflow identifies how the BMP functions when full. Select "Bypass" (B) or "Overflow" (O) from the pick-list. This is required information for structural BMPs, but is not required for non-structural BMPs.

Descriptions of Types and Designs of Outlets may include information such as perforated riser, pipe or plate with a horizontal orifice overflow, three vertical orifices that control water quality capture volume, 2-year and 10-year volumes, etc. This is required information for structural BMPs, but is not required for non-structural BMPs.

Upstream Treatment Provided must be answered by a yes or no from the dropdown box. This field is important in primarily two situations. The first often occurs in highway settings where roadside drainage may travel over a grass road shoulder or grass ditch prior to reaching the primary facility being monitored such as a detention pond. The second situation occurs where a treatment train of BMPs is being monitored and the BMP received outflow from an upstream BMP. This is required information.

Describe Upstream Treatment, if any, enables the data provider to narratively describe the upstream treatment that may be present at a site. This is important information and should be provided where upstream treatment is present.

Names of Upstream BMPs enables the user to provide a comma-separated list of BMP names entered into the BMP Database. This is designed to allow a future data user to recreate the BMP treatment train present at the site. This is important information and should be provided where upstream treatment is present.

General Configuration of BMP in Tributary Watershed identifies whether the BMP is on-line, off-line, on-site, regional, etc. This is important information.

Was qualified engineering oversight provided at construction? Provide a yes, no or unknown response to this question. This provides information related to quality control for the BMP installation. Certain types of BMPs can be very sensitive to seemingly minor deviations from the BMP design and engineering oversight can help to reduce the likelihood that the BMP was not installed as designed. This is important information.

Was structure installed as designed? Provide a yes, no or unknown response to this question. Installation problems can be a common problem with BMPs that were designed appropriately, but not installed as designed. This is important information.

General Description of Site Activities/Conditions Influencing Pollutant Loading to BMP includes information that could affect the types of pollutant loads to the BMP. For example, if extensive construction and land disturbance are present in the tributary watershed, this could affect sediment loading to BMPs and result in clogging that might not be present under fully developed watershed conditions. This is important information.

Maintenance and Conditions of BMP provides qualitative information on whether the BMP appears to be functioning as designed (e.g., Is the BMP in disrepair? Has the outlet been modified from the design? Is clogging present? Is there excessive sediment accumulation due to road sanding? etc.) This is important information.

Maintenance Type and Frequency provides a brief narrative description of maintenance activities. This is important information. For example, provide the number of times per year that the following maintenance practices or other site-specific practices were conducted:

- Tree/Shrub/Invasive Vegetation Control
- Mowing
- Algae Reduction
- Sediment Removal/Dredging
- Litter/Debris Control
- Erosion Control/Bank Stability
- Inlet Cleaning
- Outlet Cleaning
- Media Replacement/Regeneration
- Pump Cleaning/Repair
- Valve Cleaning/Repair
- Pipe Cleaning/Repair
- General Maintenance
- Odor Control
- Mosquito Control
- Vector Control
- Other Practice

Last Rehabilitation Date and **Type of Rehabilitation a**re used to identify when the facility was last rehabilitated and the scope of the rehabilitation effort. Enter month, day and 4-digit year (e.g., 04/05/1998) of rehabilitation. If the exact day is unknown, use the first day of the month. Rehabilitation activities are more extensive than routine maintenance practices (e.g., dredging a pond, replacing infiltration media). While the goal of maintenance practices are to ensure proper functioning and efficiency of a BMP, rehabilitation is required when a BMP no longer functions properly, in some cases due to lack of routine maintenance. Examples include replacing an outlet structure that has been washed out in a large storm; making repairs needed to put a BMP back on-line that has been out of use for an extended time period due to neglect, lack of funding, etc.; or modifying an existing water quantity control BMP to provide water quality functions. This is important information for structural BMPs, but is not required for non-structural BMPs.

Qualitative Evaluation of BMP Condition enables the user to provide a general characterization of the condition of the BMP at the time that monitoring was conducted. This is important information.

For BMPs without permanent pool, does surface ponding exist beyond the design drain time? Provide a yes/no answer. This is important information to characterize whether infiltration oriented BMPs are functioning as designed.

If clogging present, estimate percent of total surface area of structure affected to provide a semi-quantitative characterization of the degree to which BMP function may be impaired for infiltration-oriented BMPs. This information is nice to have.

Describe BMP/Comments enables the user to describe aspects of the BMP that are important to interpreting BMP performance or provide other comments on the BMP. This information is nice to have.

11. BMP Costs

BMP cost data should be provided whenever possible so that researchers, local governments and others can begin to conduct cost/benefit analysis for various BMP types and designs. The type of cost data varies slightly depending on the BMP type; nonetheless, a common set of BMP cost parameters has been consolidated for all BMP types to enable facilitation of comparisons across BMP types. If a particular parameter is not applicable, then it may be left blank. All cost data are considered nice to have. If provided, then BMP Name and Year of Cost Estimate are required.

BMP Name must be entered to associate the cost data with the appropriate BMP.

Year of Cost Estimate. Four-digit year (e.g., 1998) for which the above estimates were made.

Total Facility Costs (Base Cost of Original Design, Construction and Installation of BMP, Including Capital and Associated Costs). This is the overall initial cost of the facility. If an overall cost estimate is provided, then a description of items included in the total cost must also be provided.

Description of Items Included in Total Cost. If an overall initial cost of the facility is provided, then the individual cost components must be narratively described so that future comparisons of overall costs are accurately conducted.

Routine Maintenance Costs. Estimated average annual cost ($/year) of routine maintenance such as mowing, sediment removal, vacuuming, etc., at a frequency that ensures the continued function of the structure.

Periodic Rehabilitation Costs. Estimated average cost ($/event) of infrequent, rehabilitative maintenance. Examples include cost to revegetate or reseed the structure at a frequency that ensures the continued function of the structure. For media filters, this includes the cost of replacing the filter material at a frequency that ensures the continued function of the BMP. For permeable pavement, this should include estimated average annual cost to revegetate void spaces in modular block pavement.

Supplemental Facility Cost information. Several subcategories of cost data are requested, if available, as described below.

Excavation/ Clearing Costs. The estimated cost of all excavation-related activities, including stripping, drilling and blasting, trenching and shoring.

Structural Materials Costs. The estimated cost of materials used in constructing the BMP, excluding vegetative cover and structural control devices. Specific cost components that should be included for various BMP types include:

<u>Media Filters</u>: For media filters, provide the estimated materials and construction cost of establishing the filter system itself, including filter material, the underdrain system, the site survey and construction activities.

<u>Permeable Pavement</u>: this should include these estimated costs:

- establishing the structural and piping features of the BMP, including modular blocks, retaining concrete, sub-base material, and inlay material. Include costs of materials and construction;
- establishing the granular fill for the BMP, including sand or gravel inlay materials, filter fabric, and perforated underdrain (if any); or
- if poured-in-place permeable concrete or asphalt paving was used, this is the estimated cost of establishing the paving.

<u>Infiltration Trenches</u>: this should include these estimated costs:

- materials used in the percolation trench, such as granular fill and geotextiles;
- well drilling, if this is a dry well; or
- trench construction, if it is a percolation trench.

Facility Installation/Construction Costs. The estimated cost of installing or constructing the structure.

Structural Control Devices Costs. The estimated cost of establishing all structural control devices, such as inlet and outlet structures, trash racks and energy dissipaters. For grass filters and permeable pavement, this will also include control devices such as slotted curbing or other flow spreading devices, and outflow collection and conveyance systems. Reported costs should include both materials and construction.

Vegetation and Landscaping Costs. The estimated cost of establishing vegetation for the BMP, including acquiring landscape materials, establishing vegetation, and establishing the irrigation infrastructure, if any.

Engineering and Overhead Costs. The estimated engineering and associated overhead costs, including site, structural, and landscape design and engineering expenses.

Land Costs or Values. The estimated value of the land dedicated to this BMP or the cost of acquiring this land.

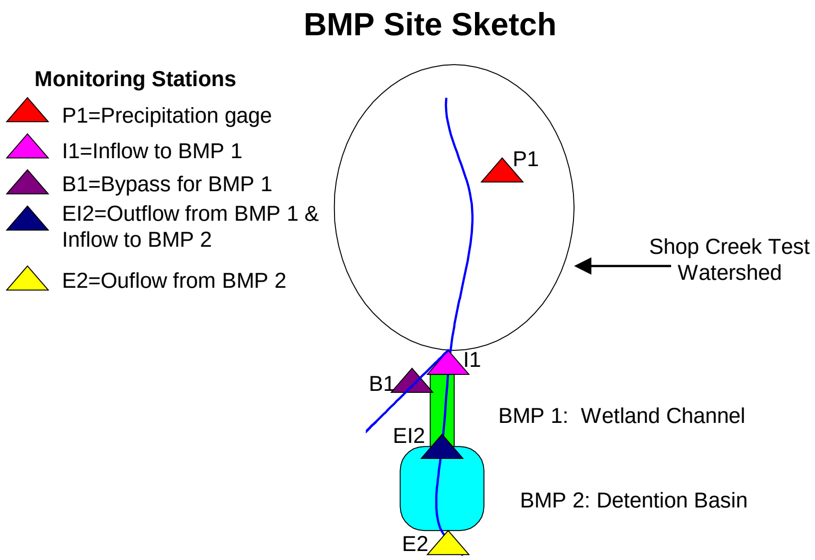
Comments Regarding Differential Cost of the BMP. This field enables the user to provide comments regarding the estimated portion of the BMP costs that would only be incurred due to the installation of the BMP itself. For example, a portion of landscaping, paving, curb and gutter and other similar components of site development would often be incurred even without installation of the BMP. (Differential Cost = All Costs Associated with BMP Installation/Construction – Portion of Costs Incurred Regardless of BMP Installation).

Part 5. Monitoring Stations

12. Monitoring Stations

The Monitoring Station spreadsheet must be completed to identify the monitoring stations in place at each test site and the relationship of each monitoring stations to each BMP. This spreadsheet is the basis for all subsequent data entry and is crucial to allow proper data retrieval. If a monitoring station is shared by two BMPs, the relationship of the monitoring station must be identified for each BMP. For example in Figure 5 below, the station monitoring outflow from BMP 1 also monitors the inflow to BMP 2, as indicated by "EI2". The precipitation gauge provides information for both BMPs and must be associated with each BMP. It is recommended that the user sketch the layout of the test site identifying the relative locations of the BMPs and associated monitoring stations as shown in Figure 5.

Figure 5. Example BMP Monitoring Station Site Sketch



Example Monitoring Station Relation entries for Figure 5:

BMP Name	Station Name (User Defined)	Monitoring Station Type (from pick-list)	Comments
Wetland Channel	P1	Rain Gauge	Shared monitoring station.
Wetland Channel	I1	Inflow	
Wetland Channel	B1	Bypass	
Wetland Channel	EI2	Outflow	Shared monitoring station.
Detention Basin	EI2	Inflow	Shared monitoring station.
Detention Basin	E2	Outflow	
Detention Basin	P1	Rain Gauge	Shared monitoring station.

All fields described below are required information, unless otherwise noted. **Absence of this information will cause the test record to be rejected and prevent proper linkage of data to the BMP.**

BMP Name must be provided in terms of the common name or code used to identify this BMP at your test site in Spreadsheet 10 BMP (General).

Station Name is the user-assigned name for the subject monitoring station. Stations shared by two BMPs should be entered twice (once for each BMP) in this spreadsheet. For example, if a station monitors outflow from one BMP and inflow to another BMP, then the monitoring station should be identified twice.

Monitoring Station Type identifies the function of each monitoring station in relation to each BMP. Select one of the following entries from the dropdown pick-list: Inflow, Outflow, Reference Outflow (for outflows from reference sites), Bypass, Overflow, Subsurface, Rain Gauge, Inter (for Intermediate), Receiving Water, Sediment/Solids, or Other. An intermediate location would be a sample taken from the middle of a pond. Subsurface stations could be lysimeters or piezometers.

Comments should be used to provide any unique conditions or limitations associated with the monitoring station. This information is nice to have.

13. Site Monitoring Instrumentation

The BMP Database requests information on the instruments present at the user-defined monitoring stations. More than one instrument may be present in a monitoring station. For example, a monitoring station may contain a flow gauge, a water quality sampler and a rain gauge.

Station Name is the previously entered monitoring station where the instrument is located. A monitoring station that contains the instrument must be selected or defined before entering data on specific instruments. This is required information.

Date Instrument Was Installed requests the date (month, day and 4-digit year) the instrument was installed (e.g., 6/1/1998). This is important information.

Instrument Type Code is used to describe the type of instrument installed at the monitoring station. Select the instrument type from the pick-list, including: Automatic Water Quality Sampler, Bubble Gauge, Digital Recorder, Graphic Recorder, Land Line Telemetered, Radio Telemetered, Satellite Relayed, ADHAS, Crest Stage Indicator, Tide Gauge, Deflection Meter, Stilling Well, CR Type Recorder, Weighing Rain Gauge, Tipping Bucket Rain Gauge, Acoustic Velocity Meter, or Electromagnetic Flow Meter, Pressure Transducer, Unknown or Other. If "Other" is selected, describe in the Comments field at the end of the spreadsheet. This is important information.

Data Type Code provides information on the type of monitoring that is conducted. Select the type of data collected by the instrument based on USGS codes. Data types may include: Tide, Water Flow/Stage Continuous, Water Flow/Stage Intermittent, Water Quality Continuous, Water Quality Grab, Precipitation Continuous, Precipitation Intermittent, Evaporation Continuous, Evaporation Intermittent, Wind Velocity Continuous, Wind Velocity Intermittent, Tide Stage Continuous, Tide Stage Intermittent, Water Quality Probe Continuous, Water Quality Probe Intermittent, Unknown, or Other. If "Other" is selected, describe in the Comments field. This is important information.

Type of Control Structure provides information on features associated with the measurement device that controls or regulates the flow at the measurement location. This feature may be a natural constriction of the channel, an artificial structure, or a uniform cross-section over a long reach of the channel. Examples of artificial structures include weirs and flumes. This is important information.

Comments may be necessary to explain special features associated with the instrument or other information deemed important to the user. This information is nice to have.

Part 6. Monitoring Results

Monitoring results can include data collected for precipitation, flow (storm runoff or base flow), water quality and particle settling velocity distributions. All monitoring data must be entered in association with the previously identified Monitoring Station, BMP Name and Monitoring Event in the following spreadsheets:

1) Precipitation Spreadsheet. Enter precipitation data for all precipitation monitoring stations included in the study.

2) Flow Spreadsheet. Enter runoff into or from BMPs, bypassed storm runoff, or base flows

3) Water Quality Spreadsheet. Enter water quality data for an event. Water quality parameters must be entered based on the constituent name selected from the EPA "WQX" constituent pick-list. Spreadsheet 16a provides commonly reported water quality constituents and Spreadsheet 35 provides a full pick-list. Properly formatted data may be pasted into the spreadsheet from Electronic Data Deliverables from the analysis laboratory. Depth to water and particle size distribution data may also be entered into the water quality spreadsheet.

4) Settling Velocity Distribution. If particle settling velocity distributions were developed for a sampling event, the results can be entered into the settling velocity distribution spreadsheet.

14. Precipitation Data

Standard BMP Database Precipitation Units

Depth = centimeters

Rate = centimeters/second

Precipitation data should be provided when available. Precipitation may be entered for several gauging stations in the watershed, provided that the locations have been previously identified in the Monitoring Station spreadsheet. Enter data for each precipitation event monitored in the watershed. Individual precipitation events are separated by a period of at least six hours of no precipitation. Example: If rainfall ceases at 6:00 p.m. and begins again at 12:00 p.m., then two separate storm events have occurred. If rainfall had begun again at 10:00 p.m., then only one storm event would have occurred. In the latter case, the total rainfall would be summed.

Previously Identified Event Number is the monitoring event associated with the collected precipitation data, as selected from the pick-list of previously identified monitoring stations.. This is <u>required</u> information necessary to ensure accurate pairing of data associated with an event.

Monitoring Station Name is the location where the precipitation data were collected, as selected from the pick-list of previously identified monitoring stations. This is <u>required</u> information. Absence of this information will cause the test record to be rejected.

Start Date is the calendar date (month, day and 4-digit year) that storm started (e.g., 01/01/1998). This is <u>important</u> information.

Start Time is the time that the storm started, e.g., 21:00. If only storm duration is provided, enter 00:00 for start time and enter the storm duration for end time. This is <u>important</u> information.

End Date is the calendar date (month, day and 4-digit year) that storm ended (e.g., 01/01/1998). This is important information.

End Time is the time that the storm ended, e.g., 13:21. This is important information.

Total Depth is the total amount of precipitation that occurred during the storm. For example, a total of 2 cm of rain fell during a 1-hour storm. This is required information.

Peak One Hour Precipitation Rate is the most intense one-hour of rainfall for the storm. For storms with less than one-hour duration, divide the storm rainfall depth by one hour. This parameter is intended to form a basis for linking rainfall intensity with the performance of similar BMPs nationwide. For structural BMPs, this is important information. For non-structural BMPs, this is required information.

Comments are encouraged to provide any additional relevant information or usage limitations. Comments are considered nice to have.

15. Flow

Standard BMP Database Flow Units

Volume = liters (L)

Rate = liters/second (L/sec)

Enter the following data collected for each flow monitoring event:

Previously Identified Event Number is the monitoring event associated with the collected flow data, as selected from the pick-list of previously identified monitoring stations.. This is required information necessary to ensure accurate pairing of data associated with an event.

Monitoring Station Name is the location where the flow data were collected, as selected from the pick-list of previously identified monitoring stations. This is required information. Absence of this information will cause the test record to be rejected.

Flow Start Date is the date (month, day and 4-digit year) that the measurement began being taken (e.g., 01/01/1998). This is required information.

Flow Start Time is the time at beginning of measurement event, e.g., 23:30. If only flow duration is provided, enter 00:00 for start time and enter the flow duration for end time. This is important information.

Flow End Date is the date (month, day and 4-digit year) that the measurement event ended (e.g., 01/01/1998). The end of runoff event can be defined as that point in time when the recession limb of the hydrograph is <2% of the peak or is within 10% of the pre-storm base flow, whichever is greater. This is important information.

Flow End Time is the time at the end of the measurement event, e.g., 01:30. The end of runoff event can be defined as that point in time when the recession limb of the hydrograph is <2% of the peak or is within 10% of the pre-storm base flow, whichever is greater. If only flow duration is provided, enter 00:00 for start time and enter the flow duration for end time. This is important information.

Total Flow Volume is the total flow volume measured at the inflow(s) or outflow(s) from the BMP, excluding bypassed flow volumes, which are entered in a separate field. This is required information. If the BMP is designed to infiltrate storm runoff and no underdrain discharge is present, enter "0" for the flow volume for the outflow monitoring station. Missing flow records can be identified by "-99999"; **do not use a "0" for missing flow events**.

Peak Storm Flow Rate into or from BMP is the greatest rate of storm flow into or from the BMP, for example, 5 L/sec. This is important information.

Total Bypass Volume, if any, quantifies flows bypassed around the BMP. If bypassed flows occurred this is required information. If bypass flows occurred, but were not quantified, note that bypass flows occurred in the Comments field.

Peak Bypass Flow Rate, if any, is the peak rate of flow measured for flows bypassing the BMP. This is important information.

Dry Weather Base Flow Rate is the flow rate during dry-weather conditions. Base flow is collected during non-wet weather conditions. If base flow related data (i.e., water quality data) are being entered into the BMP Database, then this is required information.

Percent Hydrograph Captured reflects the portion of the hydrograph measured (or "captured") in the sampling event. Typically, 100 percent of the hydrograph is targeted for capture in a monitoring event; however, in some cases, such as "first flush" monitoring, only a portion of the rising limb of the hydrograph may be targeted. In other cases, prolonged storm events such as those that occur in the Pacific Northwest, may make capture of the entire hydrograph logistically challenging. In such cases, the portion of the hydrograph reported should be provided rather than omitting the data altogether. This is important information. Enter data as a percent value rather than a decimal value (e.g., enter 99% rather than 0.99).

Estimate De Minimus Flow Contributions (not measured) is provided to acknowledge that even in well-designed BMP monitoring programs, there are often flows into a BMP that may not be fully captured in the inflow monitoring. Using 10 percent as a general rule of thumb to describe de minimus flows, identify flows that may not be fully reflected in monitored flows. Examples include high groundwater and limited sheet flow from adjacent road or facility slopes. If such water sources are present, describe the source of such flows. Understanding of this issue is often particularly important to Departments of Transportation which are also characterizing pavement runoff as part of their monitoring efforts. Additionally, inadequate characterization of de minimus flows can lead to erroneous conclusions if volume reduction is a performance objective for the BMP. This is important information.

Appropriate for Volume Comparison? (P or No) is the data provider's recommendation regarding whether the volume data are appropriate to be used for analysis of the hydrologic performance of the BMP. Provide "P" for "Pass" for acceptable data or No for flow data that are not considered appropriate for this purpose. A few examples of flow data that might have a "No" designation include:

- Sites where the flow data are adequate for proportioning water quality samples, but where unmeasured inflows or outflows to the site are present, making analysis of flow data misleading.
- Individual storm events where a monitoring equipment malfunction occurred.

- BMPs where volumetric changes between inflow and outflow are expected to be negligible; therefore, only one flow location was monitored and assigned to both the inflow and outflow locations.

If a "No" is provided, provide additional information in the Comments field. This is important information. The default assumption for the BMP Database is "P", unless a No value is provided by the data provider.

Comments are encouraged to provide any additional relevant information or usage limitations. Comments are considered nice to have.

16. Water Quality Data for Sampling Event

A separate spreadsheet titled "Water Quality Data" is provided that requests sampling event results, including water quality parameter as selected from a pick-list of water quality parameters, sample fraction, value, units, qualifier and analysis method. Data requested in this spreadsheet are described in more detail below. All water quality parameter are required, unless otherwise noted.

Standard BMP Database Water Quality Units

Nutrients and Solids = milligrams/L (mg/L)

Metals = micrograms/liter (µg/L)

Most Organics = µg/L

Most General Water Quality = mg/L

Field Parameters = parameter-dependent

Event Number (Previously Defined) is the monitoring event associated with the collected water quality data, as selected from the pick-list of previously identified monitoring stations. This is required information necessary to ensure accurate pairing of data associated with an event.

Monitoring Station Name (Previously Defined) is the location where the water quality data were collected, as selected from the pick-list of previously identified monitoring stations. This is required information. Absence of this information will cause the test record to be rejected.

Water Quality Sampling Start Date is the date that the water quality sample began being collected.

Water Quality Sampling Start Time is the time that the water quality sample began being collected. This is important information.

Sample Medium can be selected from a dropdown pick-list and includes: Groundwater, Surface Runoff/Flow, Soil, Dry Atmospheric Fallout, Wet Atmospheric Fallout, Pond/Lake Water, Accumulated Bottom Sediment, Biological, or Other.

Sample Type can be selected from a dropdown pick-list and includes the type of samples provided including: Flow Weighted Composite EMCs (Event Mean Concentrations), Time Weighted Composite EMCs, Unweighted (mixed) Composite EMCs, or Grab Sample.

What is STORET and how does it relate to WQX?
(Source: USEPA, http://www.epa.gov/storet/faq.html#101)

STORET refers to "STORage and RETrieval", an electronic data system for water quality monitoring data developed by EPA. STORET has taken various forms since the 1960's. Since about 2000, STORET has referred to a local data management system ("Modernized STORET") as well as data repository ("STORET Data Warehouse") developed for purposes of assisting data owners manage data locally and share data nationally. Up until September 2009, the distributed STORET database has been used to compile data at the national level in the STORET Data Warehouse. As of September 2009, the Water Quality Exchange, or WQX framework, provides the main mechanism for submitting data to the STORET Data Warehouse.

The "Water Quality Exchange", or WQX, is the primary framework for submitting data to the STORET Data Warehouse. WQX uses the technology, standards, and protocols of the National Environmental Information Exchange Network, or Exchange Network, to provide a means for data partners to share water quality monitoring data to the STORET Data Warehouse. WQX is not a distributed database, but rather a standard set of data elements that all data partners map to in order to share data.

Provide the Number of Samples, If Composite. A composite sample consists of multiple samples of water during a runoff-event that can be collected using a variety of methods such as flow-weighted, time-weighted, grab samples or other approaches. The purpose of a composite sample is to provide an overall picture of the characteristics of the water throughout the runoff event. This is important information.

WQX Characteristic is the name of the constituent analyzed based on the USEPA's "modern STORET" nomenclature being used in USEPA's Water Quality Exchange (WQX) database. The relevant constituent should be selected from the WQX pick-list. WQX codes must be used to enter water quality data in this BMP Database to ensure consistency with other USEPA databases and to provide for standardization of constituent names for later data retrieval. Commonly reported constituent names are provide on Spreadsheet 16a (and at the end of this User's Guide), with a complete list of over 3,000 constituent names on Spreadsheet 35.

Sample Fraction is the fraction of the water quality constituent that was analyzed (e.g., dissolved, total, total recoverable, etc.). This is required information for certain constituents that are reported in multiple forms (e.g., metals). See Spreadsheet 16a to determine whether sample fraction must be reported under WQX reporting requirements

Result Value is the field or analytical result for the water quality sample. If the value is below detection limits, provide the reported detection limit as the value with a "U" qualifier in the qualifier field. If the laboratory reports a "J" qualified value estimated below the detection limit, use the value provided by the laboratory. Do not use minus signs to indicate values below the detection limit. **Do not represent values below detection limits with a "0" or one-half of detection limit**. (Note: The BMP Database Clearinghouse will generate a separate "analysis value" for values below the detection limit, typically using a simple substitution method.)

Unit of the measured constituent must be provided (e.g., mg/L, #/100 mL).

Qualifier, if any, for the data should be selected from the Water Quality Qualifier Codes pick-list codes, which include the following qualifiers:

- J = Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.

- R = Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.

- U = Not Detected: The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.

- UJ = Not Detected/Estimated: The analyte was not detected at a level greater than or equal to the adjusted CRQL or the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

Detection Limit must be provided with sample results so that comparisons between sites can accurately conducted. This information is typically provided in most electronic data deliverables and hard-copy laboratory reports. *(Note: some historical data sets in the BMP Database do not have detection limits provided; however, detection limit is required for all new data submissions.)*

Detection Limit Type should be provided along with the detection limit. Detection limits are often provided as either Instrument Detection Limits (IDL) or Method Detection Limits (MDL). In some cases such as for bacteria result, an Upper Quantitation Limit (UQL) may be provided. A pick-list from USEPA's WQX Database is provided to complete this field. This information is important and is typically provided in hard-copy laboratory reports.

Analysis Method should be provided for the constituent. For example: EPA 8270 or Standard Method 513. This information is typically reported in Electronic Data Deliverables and can be easily pasted into this spreadsheet. If water quality data are being entered into the BMP Database, then this is important information.

Appropriate for Use in Performance Analysis? Provide a Yes or Exc (for exclude). This field enables the data provider to identify data that may have quality limitations or that should not be included in analysis of EMC data. For example, a data provider may include first-flush data, in addition to EMCs. An "Exc" flag should be placed on the first flush samples so that they are excluded from EMC-based performance analysis. If an "Exc" flag is provided, it should be described in the Result Comments field. This information is important.

Result Comments allows the user to clarify special circumstances associated with the analysis result. This information is nice to have, unless anomalies in monitoring are presents; in such cases, it is required information.

17. Particle Settling Velocity Distribution

Settling velocities of sediments in stormwater runoff can be either measured directly or calculated theoretically from specific gravity and particle size distribution data. Settling velocities give the most useful information related to BMP performance; however, historically, this information has not been frequently reported in typical stormwater BMP monitoring studies. Although the BMP Database continues to request settling velocity distribution data; an alternative to settling velocity distribution tests is particle size distribution data, which can be entered into the Water Quality spreadsheet using standard WQX codes.

Although particle settling velocity distribution is considered nice to have, it is highly recommended that either settling velocity distribution or particle size distribution be provided for studies focusing on removal of suspended sediment.

Event Number (Previously Defined) is the monitoring event associated with the collected water quality data, as selected from the pick-list of previously identified monitoring stations. This is required information necessary to ensure accurate pairing of data associated with an event.

Monitoring Station Name (Previously Defined) is the location where the water quality data were collected, as selected from the pick-list of previously identified monitoring stations. This is required information. Absence of this information will cause the test record to be rejected.

Settling Velocity Distributions are the rates at which suspended sediment settles over time. This can be determined through settling column tests. Based on the results of the test, enter the settling velocities at which various percentiles of the sediment settle. For example, 10 percent of the sediment may settle at a rate of 2 m/hr or faster, 20 percent may settle at a rate of 1.5 m/hr or faster, 30 percent may settle at a rate of 2 m/hr or faster, etc. The Comments field is provided to enable the user to provide additional information about the test. Units of measurement must be provided for each test conducted.

Comments are encouraged to provide a general overview of the study and to identify any concerns or limitations associated with usage of data from the study.

Part 7. Individual BMP Design Spreadsheets

BMP design information should be entered in the appropriate BMP spreadsheet selected from Spreadsheets 17 through 34.

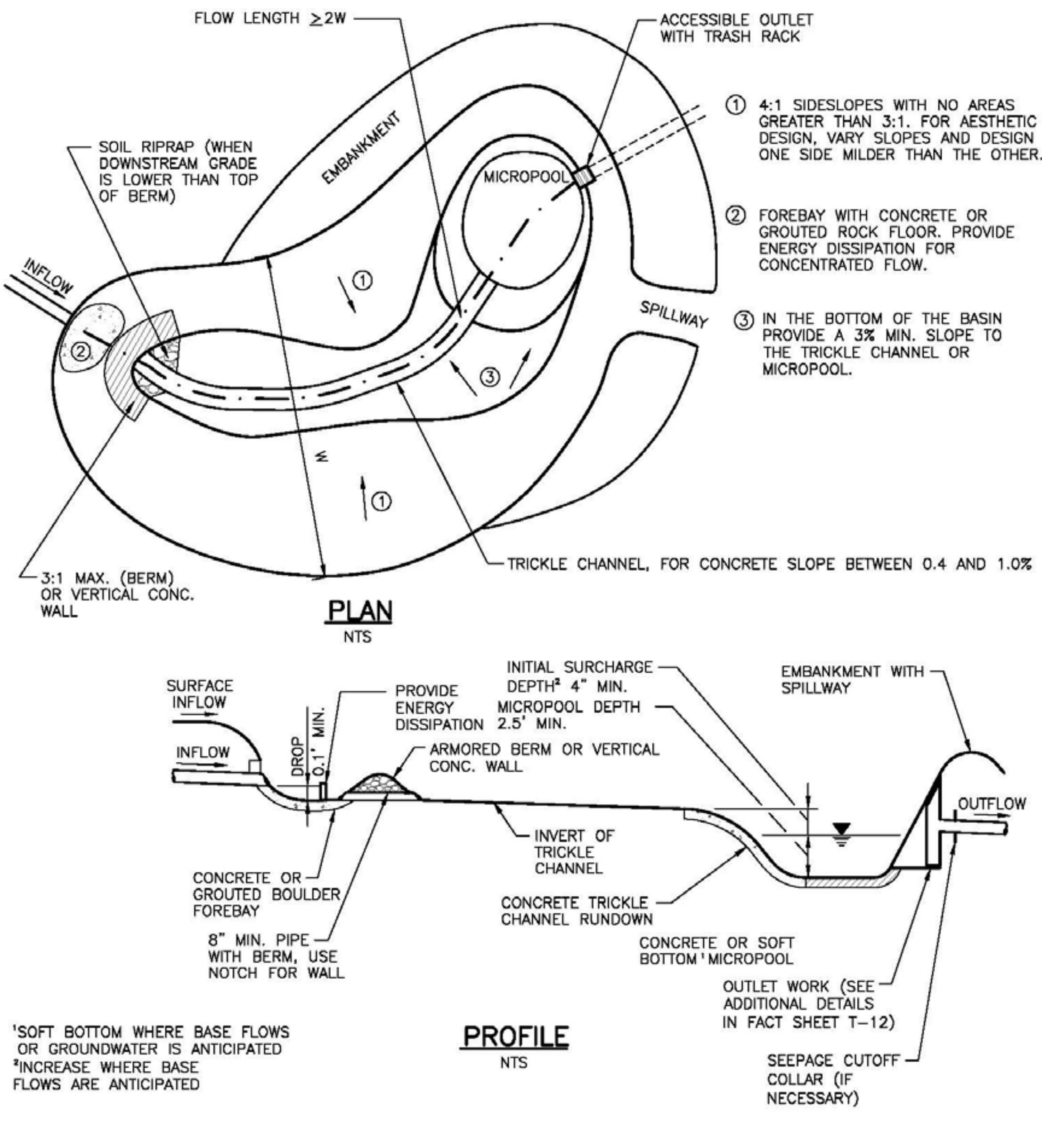
The BMP Name identified in Spreadsheet 10 BMP (General) must be entered first in each spreadsheet by selecting the BMP Name from the dropdown pick-list.

18. Detention (Dry) Basin Design Data

Extended detention (ED) dry basins are designed to completely empty at some time after stormwater runoff ends. These are adaptations of the detention basins used for flood control. The primary difference is in outlet design; the extended detention basin uses a much smaller outlet that extends the detention time for more frequent events so that pollutant removal is facilitated. The term "dry" implies that there is no significant permanent water pool between storm runoff events.

Figure 6. Example Extended Detention Basin Design

(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are <u>required</u> information necessary for the BMP test evaluation, unless otherwise noted or unless the feature does not exist in the BMP design.

Water Quality Detention Volume. The volume of storm runoff that is captured and slowly drained over a period of time (e.g., 12 to 48 hours) to promote settling and other pollutant removal mechanisms.

Water Quality Detention Surface Area When Full. The area of the water surface in the detention basin at full water quality detention volume.

Water Quality Detention Basin Length. Length of the water quality detention basin, measured as the distance between inflow and outflow. If there is more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.

Detention Basin Bottom Area. Area of the bottom of the entire detention basin, not including the side slopes but including the bottom stage area.

Brim-full Volume Emptying Time. Emptying time (in hours) of the water quality detention volume.

Half Brim-full Volume Emptying Time. Emptying time (in hours) of the lower half of the water quality detention volume.

Bottom Stage Volume, If Any. The volume of the lower "bottom stage" portion (if applicable) of the detention basin, which is designed to fill with runoff from smaller, more frequent storm events.

Bottom Stage Surface Area, If Any. The surface area of the lower "bottom stage" portion (if applicable) of the detention basin, which is designed to fill with runoff from smaller, more frequent storm events.

Is There a Micro Pool? Enter Y=Yes or N=No. Identify whether there is a small (i.e., micro) permanent pool within the bottom stage of the basin near the outlet.

Forebay Volume. Volume of the forebay portion of the detention basin when filled to the point of overflow into the rest of the basin. The forebay (if it exists) captures the initial inflow entering the detention basin to remove the bulk of sediments, routing its overflow to the bottom stage.

Forebay Surface Area. Surface area of water in the forebay at the level of overflow to the bottom stage.

Describe Vegetation Cover Within Basin. Describe the types of vegetation on the basin sides and floor.

Flood Control Volume, If Any. It is often feasible and desirable to establish the water quality detention basin within a larger flood control facility. If this is the case for this basin, record the volume of the flood control detention volume in excess of the water quality detention basin volume (if any).

List Design Flood Return Periods. If the water quality detention basin is embedded within a larger flood control facility, list the flood return period (in years) for which the flood control volume is designed (e.g., 25-year).

Depth to Seasonal High Water Table, If Known. Report the minimum depth to the water table during the monitoring season. This information is nice to have.

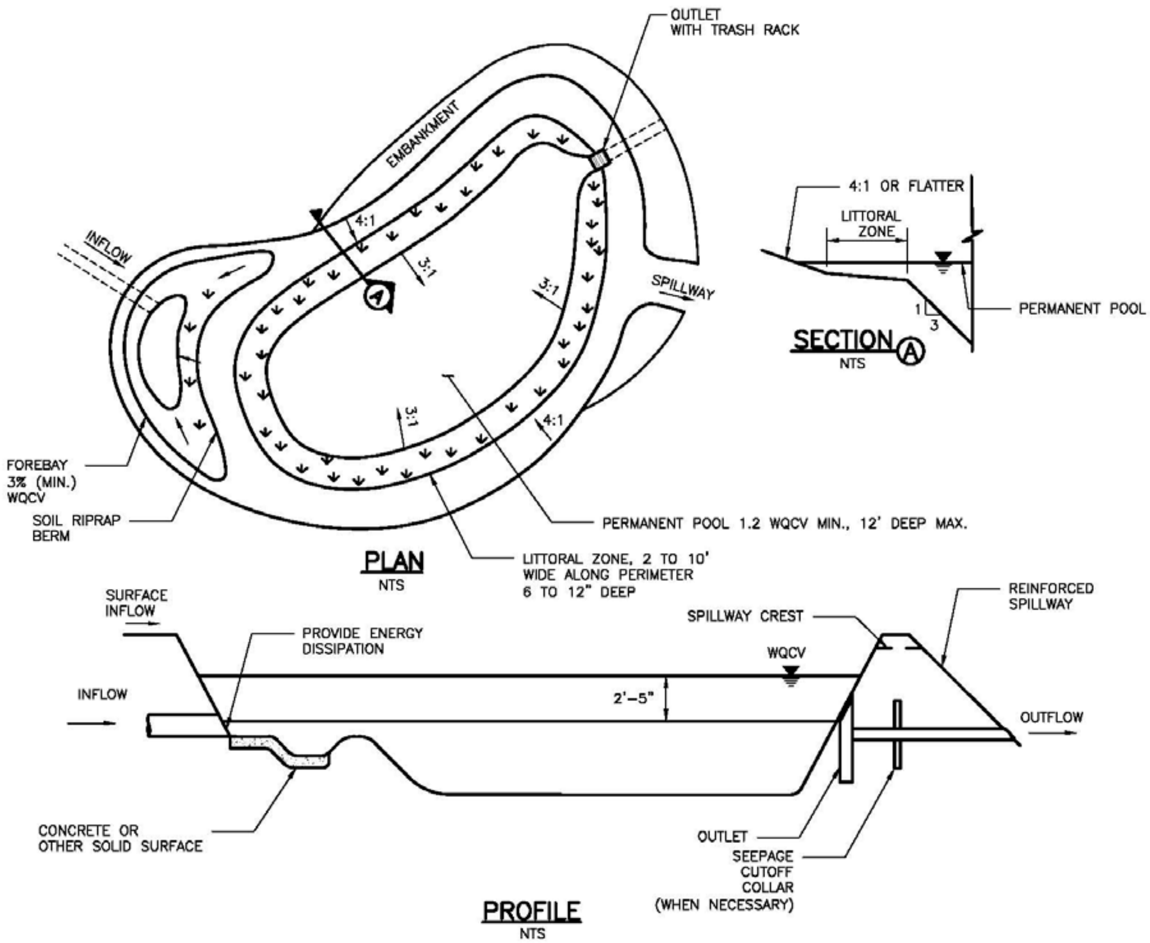
Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

19. Retention (Wet) Pond Design Data

Retention ponds are also commonly known as "wet ponds" because they have a permanent pool of water, unlike detention basins, which dry out between storms. The permanent pool of water is replaced in part or in total by stormwater during a storm event. The design is such that any available surcharge capture volume is released over time. The hydraulic residence time for the permanent pool over time can provide biochemical treatment. A dry weather base flow, pond liner and/or high groundwater table are required to maintain the permanent pool.

Figure 7. Example Retention Pond Design

(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Volume of permanent pool. Volume of the permanent pool of water.

Permanent Pool Surface Area. Area of the water surface for the permanent pool.

Permanent Pool Length. Length of the permanent pool of water, measured as the distance between inflow and outflow. If more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.

Littoral Zone Surface Area. Surface area of the littoral zone. The littoral zone refers to the area above the level of the permanent pool that is periodically and temporarily covered by captured storm runoff. This is important information.

Littoral Zone Plant Species List. List plant species (by Latin name, if known), percent of cover and densities in the littoral zone.

Water Quality Surcharge Detention Volume When Full. Retention ponds may be designed to handle a specified volume of runoff above the permanent pool, releasing this surcharge volume to the pool over a specified period of time through an outlet structure. Specify the surcharge detention volume.

Water Quality Surcharge Surface Area When Full. The surface area of any supplementary water quality detention volume above the permanent pool, if applicable.

Water Quality Surcharge Basin Length. Length of the water quality detention volume, measured as the distance between inflow and outflow. If more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.

Brim-full Emptying Time For Surcharge. The period of time (in hours) required for the retention pond water quality surcharge detention volume to be released to the permanent pool.

Half Brim-full Emptying Time For Surcharge. Period of time (in hours) required for the lower half of the retention pond water quality surcharge detention volume to be released to the permanent pool.

Forebay Volume. Volume of the forebay portion of the retention basin when it is filled to the point of overflow into the lower part of the basin. The forebay captures the initial inflow entering the basin to remove the bulk of sediments, with overflow routed to the lower pond.

Forebay Surface Area. Surface area of water in the forebay when it is filled to the point of overflow into the lower part of the basin.

Describe Vegetation Cover Within Basin Above Permanent Pool. Describe the types of vegetation (provide Latin names, if known) on the basin sides and floor.

Flood Control Volume, If Any. It is often feasible and desirable to incorporate the water quality retention basin within a larger flood control facility. If this is the case for this basin, record the volume of the flood control detention volume in excess of the retention basin volume.

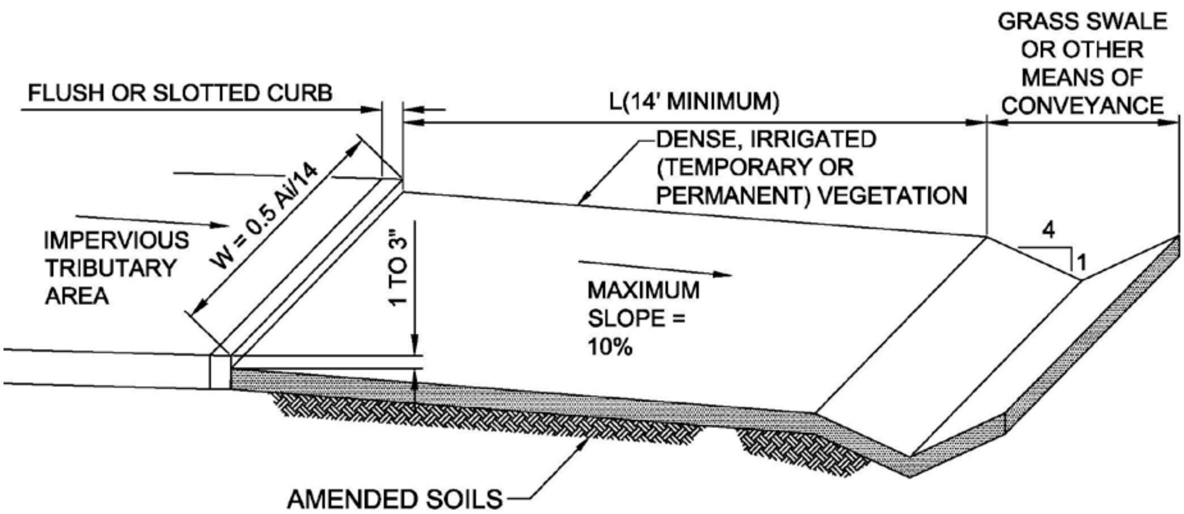
List Design Flood Return Periods (in years). If the water quality retention basin is embedded within a larger flood control facility, list the flood return periods (in years) for which the above flood control volume is designed (e.g., 25 for a 25-year flood).

Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

20. Grass Filter Strip and Swale Design Data

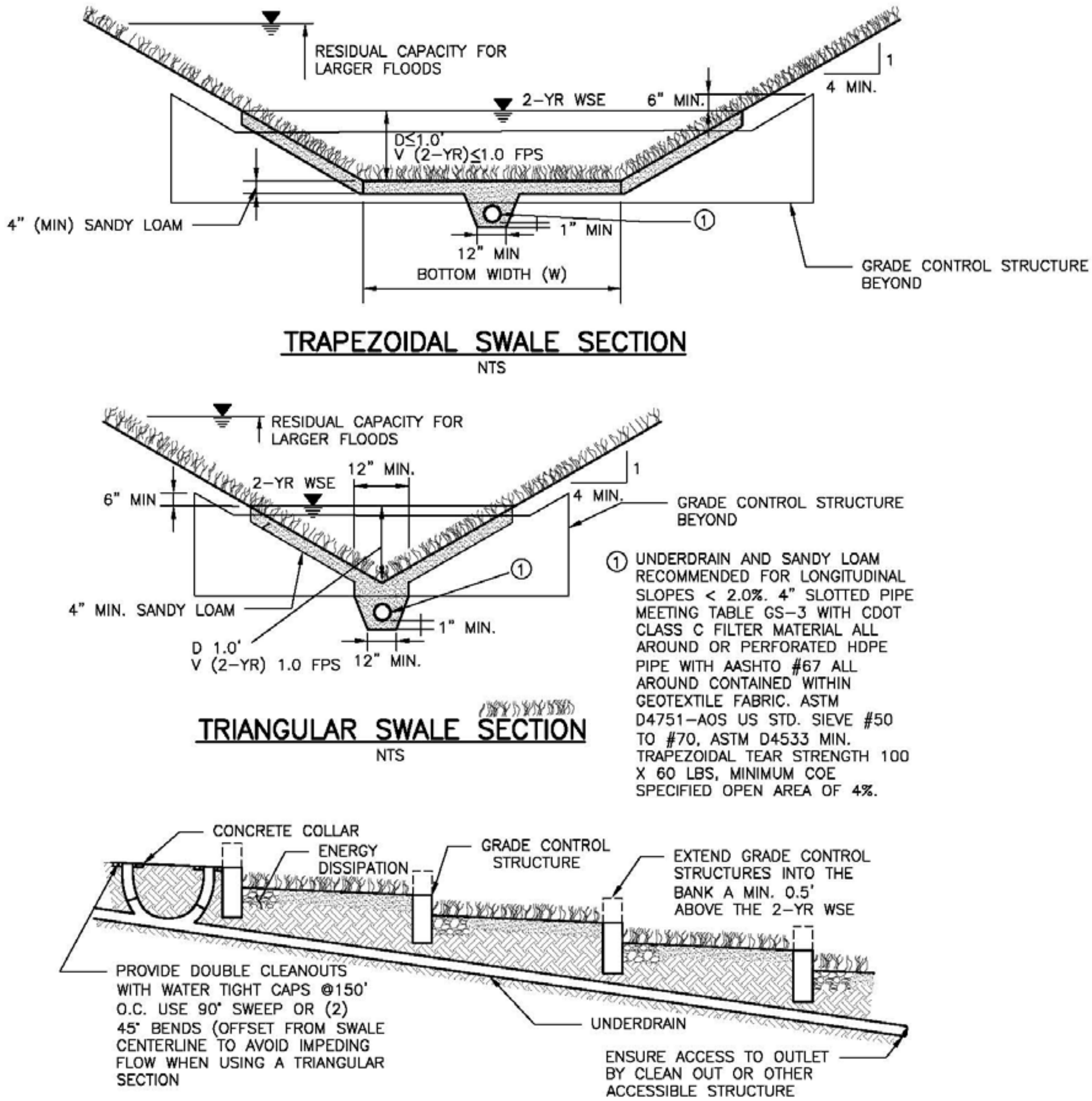
Grass filter strips, sometimes called biofilters or buffer strips, are vegetated areas designed to accept sheet flow provided by flow spreaders which accept flow from an upstream development. Vegetation may take the form of grasses, meadows, forests, etc. The primary mechanisms for pollutant removal are filtration, infiltration, and settling.

Figure 8. Example Grass Buffer Design
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



A **swale**, sometimes called a **biofilter**, is a shallow grass-lined channel with zero, or little, bottom width designed for shallow flow near the source of storm runoff. Examples of grass-lined swales are provided in Figure 9.

Figure 9. Example Grass Swale Design
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Grass Strip/Swale Length. Length of the grass strip in the direction of the flow path.

Grass Strip/Swale Width. Width of the grass strip perpendicular to the flow path.

Grass Strip/Swale Longitudinal Slope. The slope of the strip along the flow path expressed as unit length per unit length (e.g., feet/feet).

Flow Depth during 2-Year Storm. The design depth of flow over the strip during the 2-year storm peak flow.

2-Year Peak Flow Velocity. The design flow velocity over the strip during the 2-year peak flow.

Describe Grass Species and Densities. List the grass species and their densities.

Is Strip Irrigated? Enter Y=Yes if the strip is artificially watered during any part of the year, N=No if it is not.

Estimated Manning's *n* During 2-Year Flow. The Manning's roughness factor *n* expresses the degree of resistance to flow over the surface due to filter strip vegetation; here *n* should be estimated for the 2-year peak runoff event. The Manning's *n* is larger for rougher surfaces (e.g., high, dense vegetation) that increase flow friction. This information is nice to have.

Depth to Groundwater or Impermeable Layer. Depth to the seasonal high groundwater table and/or the impermeable layer, whichever is shallower. This information is nice to have.

Measured Saturated Infiltration Rate, if Known. Rate of infiltration into the filter strip under saturated soil conditions, based on soil surveys or infiltrometer measurements. This information is nice to have.

NRCS Hydrologic Soil Group. The Natural Resource Conservation Service Hydrologic Soil Group (e.g., A, B, C, or D) comprising the infiltrating surface. This classification reflects the infiltration rate of the soil, with Group A soils having the highest rates of infiltration and Group D soils having the lowest. This is important information.

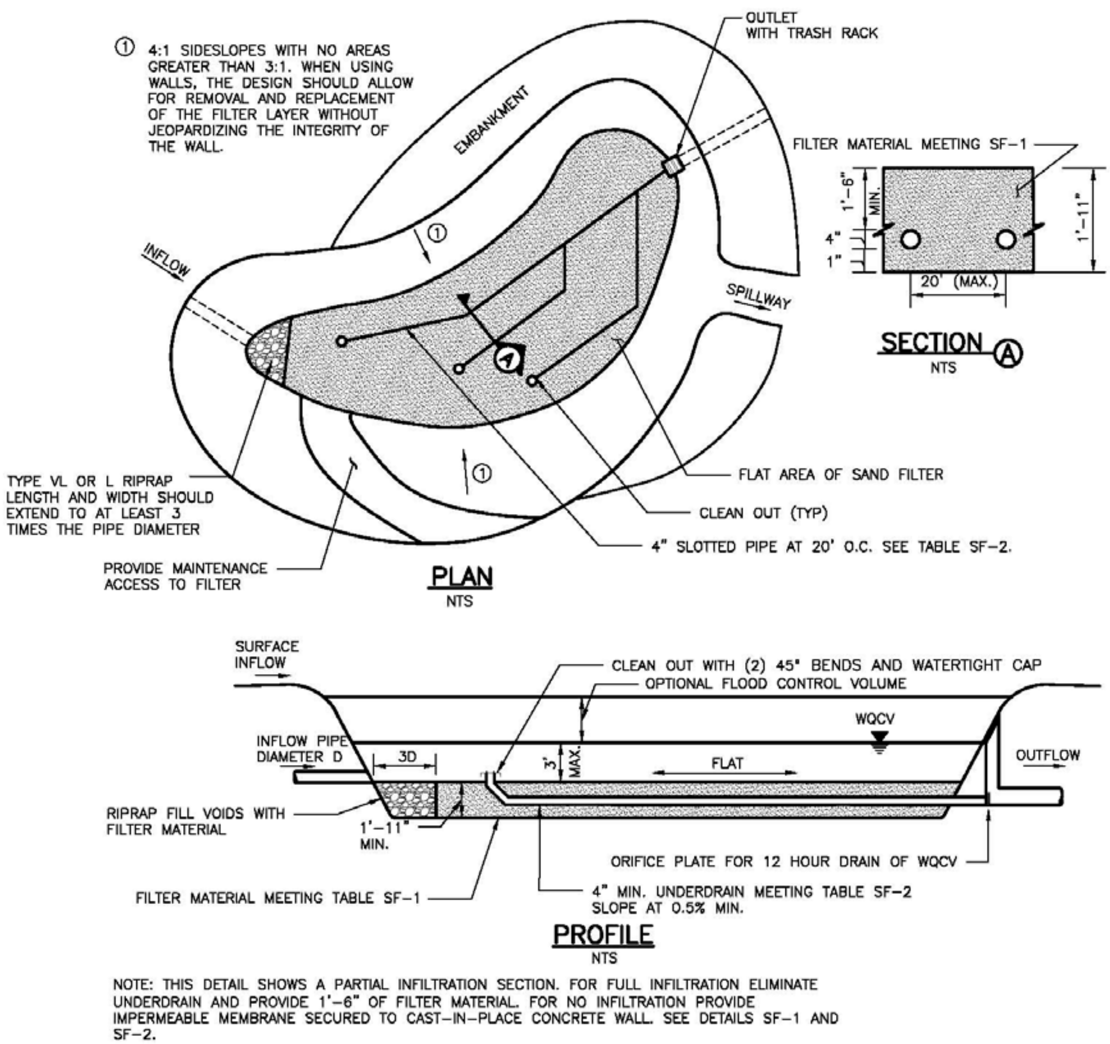
Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

21. Media Filter Design Data

A Media Filter is a facility that uses some form of a granular or membrane filter, with or without a pre-settling basin, to filter pollutants from stormwater. The most typical filter is sand, but other materials, including peat mixed with sand, compost with sand, geotextiles, and absorption pads and beds are commonly used.

Figure 10. Example Sand Filter

(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are <u>required</u> information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Permanent Pool Volume Upstream of Filter Media, If Any. Volume of the permanent pool (if any) if the pool is part of the filter basin installation and not a separate pretreatment retention pond or a detention basin.

Permanent Pool Surface Area of Sedimentation Basin Preceding Filter, If Any. Area of the water surface in the permanent pool (if any).

Permanent Pool Length of Sedimentation Basin Preceding Filter, If Any. Length of the permanent pool (if any) measured as the distance from pool inflow to outflow. If more than one inflow point, use the average length.

Surcharge Detention Volume, Including Volume Above the Filter Bed. The design water quality capture volume, including the volume above the filter.

Surcharge Detention Volume's Surface Area, Including Area Above Filter Bed. The surface area of the design water quality capture volume including the area above the filter.

Surcharge Detention Volume's Length. The length of the design captured runoff volume, including the portion above the filter, measured as the distance along the flow path. If more than one inflow point, use the average length. This information is <u>nice to have</u>.

Surcharge Detention Volume's Design Depth. The design depth of water quality capture volume that can be stored above the filter before overflow or runoff bypass occurs.

Surcharge Detention Volume's Design Drain Time, If Controlled and Known. The design time for complete drawdown (in hours) of the water quality capture volume if the drain time is controlled by a flow regulating device such as an orifice. Leave blank if the drain rate is only a fraction of the filter's flow-through rate.

Media Filter Surface Area. Total surface area of the media filter (e.g., the sand bed or geotextile filter) orthogonal to the flow.

Angle of Sloping or Vertical Filter Media. Is the media filter surface horizontal, sloping or vertical? Provide this information in degrees above the horizontal plane (i.e., 0 to 90 degrees). For example, a horizontal filter media would be entered as 0 degrees and a vertical filter would be entered as 90 degrees.

Number of Media Layers in Filter. The number of layers of each filter material in this BMP.

Describe Depth and Type of Each Filter Media Layer. Describe the type of media used in the filter. (Examples: ASTM C-33 Sand with d50 = 0.7 mm, 50% ASTM C-33 Sand with d50 = 0.6 mm and 50% Peat, Non-Woven Geotextile Fabric with 100 micron effective pore openings, Non-Woven Geotextile with 100 micron effective pore openings above the ASTM C-33 sand with d50 = 0.7 mm, etc.). Also, provide a depth or thickness of each layer.

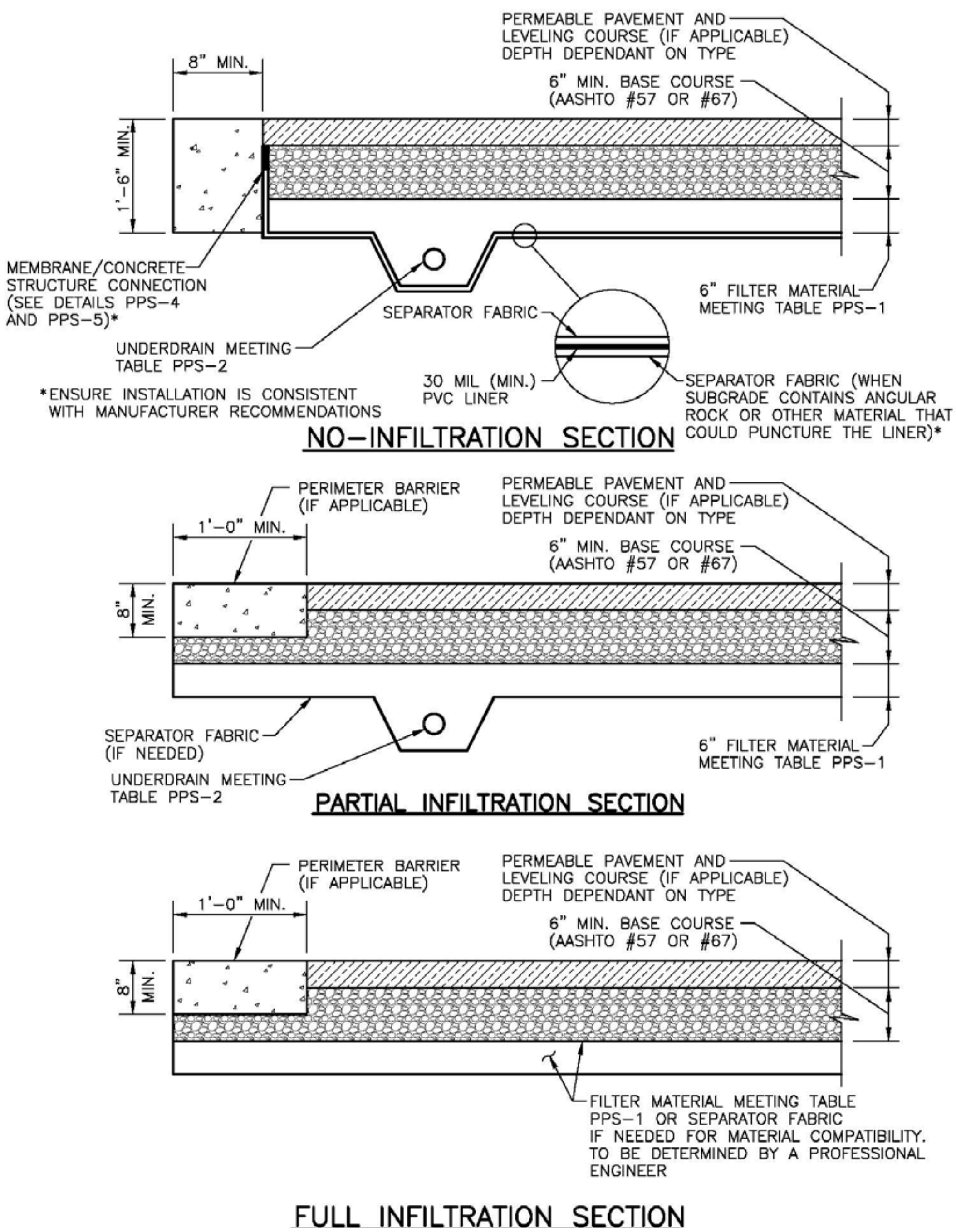
Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered <u>nice to have</u>.

22. Permeable Pavement Design Data

Permeable pavements include a variety of materials and techniques that allow the movement of water into the paving material and subsurface, helping to reduce the effective imperviousness of developed areas. Examples of permeable paving include pervious concrete, porous asphalt, paving stones or bricks, reinforced turf rings, and other designs.

Figure 11. Example Permeable Pavement System Design

(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Modular block is permeable due to its structure, and poured-in-place concrete or asphalt is permeable due to the mix of the materials. Modular block permeable pavement consists of perforated concrete slab units underlain with gravel. The surface perforations are filled with coarse sand or sandy turf. It is used in low traffic areas to accommodate vehicles while facilitating stormwater runoff at the source. It should be placed in a concrete grid that restricts horizontal movement of infiltrated water through the underlying gravels.

Poured-in-place porous concrete or asphalt is generally placed over a substantial layer of granular base. The pavement is similar to conventional materials, except for the elimination of sand and fines from the mix.

If infiltration to groundwater is not desired, a liner may be used below the porous media along with a perforated pipe and a flow regulator to slowly drain the water stored in the media over an extended time period (e.g., 6 to 12 hours).

Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Pavement Type typically describes the wearing surface of the permeable pavement. Types may include pervious concrete, porous asphalt, cobblestone blocks, modular blocks, reinforced grass, permeable friction course, etc.

Design Basis for permeable pavement is commonly specified as a design event with an associated depth, duration, and/or frequency. The design basis also could be a percentile event (e.g., the 90^{th} percentile) or a defined storage volume or depth of runoff over the tributary area.

Ratio of Tributary Area to Pavement Surface Area is obtained by dividing the total area draining to the permeable pavement system by the surface area of the permeable pavement. Units for tributary area and pervious pavement surface area must be the same. This is important information.

Describe Purpose of Permeable Pavement. Describe the purpose(s) of the permeable pavement (e.g., water quality treatment, reduction in peak surface runoff rate and volume, groundwater recharge, etc.) This information is nice to have.

Description and Dimensions of Surface Layer include a narrative description of the shape of the permeable pavement area and principal dimensions of the shape. For example, for a rectangular permeable pavement area, the length and width of the area should be provided.

Type of Asphalt Binder identifies the material that holds the aggregate together in the porous asphalt mix. Most asphalt binders are bitumen-based and may include polymers or other chemicals as additives to modify the elasticity, plasticity, etc., of the mix.

Admixtures Used in Asphalt Mix Design are materials or chemicals that are added to the asphalt mix to improve the strength or durability of the porous asphalt. Common admixtures include polymers, fly ash, and other materials that generally add strength and durability to the asphalt while maintaining infiltration capacity.

Surface Infiltration Rate is the rate, in units of length per time, that runoff is able to penetrate the surface of the permeable pavement system. In most permeable pavement system applications, the surface infiltration rate is not the limiting factor. Rather, the infiltration rate from the aggregate storage layer to the surrounding native soils is typically the controlling factor.

Design Infiltration Rate, including safety factor for clogging provides information related to the design of the BMP, as opposed to measured infiltration at the site. The design infiltration rate is the rate at which the overall permeable pavement system can infiltrate stormwater runoff. Because of potential for clogging over time, a factor of safety is typically applied to the design infiltration rate to account for blockage and/or reductions in infiltration rates over time. Since different layers of a permeable pavement system may have different infiltration rates, the overall system rate is generally the infiltration rate of the slowest layer. In many cases, the saturated hydraulic conductivity of the underlying soils may be the limiting infiltration rate. This information is nice to have.

Permeable Pavement Surface Area is the surface area of the permeable pavement.

Slope of the permeable pavement system can be determined by subtracting the lowest elevation of the pervious surface from the highest elevation of the pervious surface and dividing by the distance between these two points.

Is Grass Growing in Modular Pores? Enter Y=Yes or N=No. This is important information.

If Yes, is Grass Healthy? Enter Y=Yes or N=No. This is important information.

Total Storage Volume Above Pavement, If Any. Give the net available volume of storage above the permeable pavement, if any.

Estimated Drain Time of Storage Volume Above Pavement, If Any. Provide the total emptying time (in hours) for any detention volume above the pavement.

Description and Dimensions of Aggregate Base. The aggregate base is the layer beneath the wearing course and leveling course in a permeable pavement system that provides structural support for the pavement surface as well as pore space storage of runoff. Provide the size of the aggregate used for this layer as well as the thickness of the layer. If multiple aggregate layers are provided, provide size and thickness for each layer as well as any separator fabric used between layers.

Type of Granular or Soil Materials Used in or Below Pavement. Describe the type and depth of each granular material layer under the permeable pavement, if any. Include each layer of geotextile fabric used as though it was a granular layer.

Porosity of Granular or Soil Materials. Provide the porosity (in percent) of the granular or soil filter material. Porosity measures the volumetric portion of the filter material that is not occupied by solid material (for example, clean sands and gravels typically have porosities of 25-50%; this space is occupied by air or water). If the layer is geotextile fabric, give the effective pore size.

Total Storage Volume in the Granular Media Below Pavement. Give the net available volume of the pore spaces in the granular materials under the permeable pavement, if any. This would normally equal the volume of the granular materials multiplied by their porosity adjusted for loss of volume due to sloping surfaces.

Estimated Drain Time of Permeable Media Volume in hours. When granular materials under the pavement are used to detain surface runoff which is then released to the surface drainage system, similar to an underdrain, give the total emptying time (in hours) for this detention volume.

Description and Dimensions of Separation Layer. The separation layer in a permeable pavement system may be a geotextile separator fabric, or it may be a layer of aggregate that meets Terzaghi's filter criteria with respect to the layers it is intended to separate. For geotextile layers, describe the type of geotextile separator fabric used. For filter layers based on Terzaghi's filter criteria, provide the gradation of the layer and the thickness. This is important information.

Description and Dimensions of Water Quality Treatment Layer, if present. For some types of permeable pavement systems, especially those with underdrains, a layer of filter material may be provided within the pervious pavement section to provide water quality treatment. In many systems, this is a sand layer; however, a variety of materials could potentially be used. Provide the types of material used for the water quality treatment/filter layer, if any, as well as the thickness of the layer. This is important information.

Degree of Compaction of Pavement Subbase. Specify compaction criteria for the native material beneath the permeable pavement section. If known, identify whether geotechnical testing from the construction phase confirmed if these criteria were met.

Does Permeable Pavement Have Underdrains? Enter Y=Yes if this BMP has underdrains, N=No if it does not. The granular base under permeable pavement is frequently drained with the aid of perforated pipes installed at set intervals.

Underdrain Description. Provide the diameter, material, slot/perforation dimensions, area of openings per unit length, spacing between separate underdrain lines, and other parameters that describe the underdrain.

Depth of Underdrain Below Surface, if present. This is the depth from the surface of the permeable pavement system to the lowest point of the underdrain pipe.

Hydraulic Conductivity is a property of the soil layers beneath the pavement, providing a measure of the ease with which water can move through pore spaces. It depends on the permeability of the material and on the degree of saturation. This is important information.

Groundwater Flow Gradient. The flow gradient (in unit length per unit length, e.g. feet/feet). of groundwater below the infiltration basin. The flow gradient may be thought of as the slope of the local groundwater table. This is important information.

Describe Depth of Each Soil Layer Below Pavement, If Known. Give the order of stratification (from the surface downward) and the depth of each layer of soils below the permeable pavement, to a depth of at least 10 feet (3.05 meters). This is important information.

Depth to Seasonal High Groundwater. The minimum depth to the seasonal water table below the permeable pavement.

Depth to Impermeable Layer. The depth to the first impermeable layer below the BMP, if known.

NRCS Hydrologic Soil Group. The Natural Resource Conservation Service Hydrologic Soil Group (e.g., A, B, C, or D) comprising the infiltrating surface. This classification reflects the infiltration rate of the soil, with Group A soils having the highest rates of infiltration and Group D soils having the lowest. This is important information.

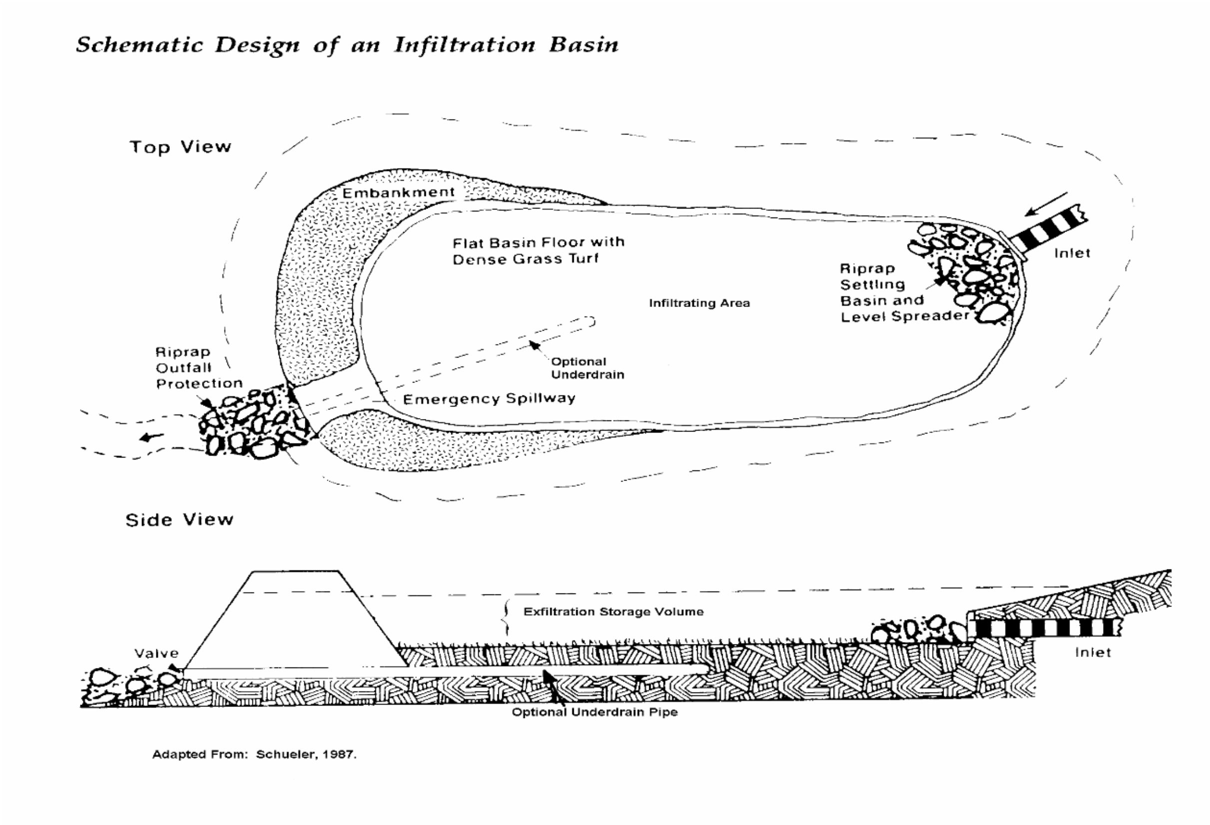
Infiltration Rate. Rate of infiltration for site soils under saturated conditions, based on soil surveys or infiltrometer measurements.

Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

23. Infiltration Basin Design Data

An infiltration basin is a basin that can capture a given stormwater runoff volume and infiltrate it into the ground, transferring this volume from surface flow to groundwater flow. A schematic of an infiltration basin is provided below.

Figure 12. Schematic Design of an Infiltration Basin
(Source: Schueler 1987)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are <u>required</u> information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Capture Volume of Basin. The design runoff capture volume of the basin.

Surface Area of Capture Volume, When Full. The area of the water surface in the infiltration basin, when full.

Infiltrating Surface Area. The plan area of the surface used to infiltrate the water quality volume.

Basin Length. Length of the infiltration basin, measured as the distance between inflow and outflow. This information is <u>nice to have</u>.

Depth to Seasonal High Groundwater Below Infiltrating Surface. Depth to the seasonal high groundwater table.

Depth to Impermeable Layer Below Infiltrating Surface. Depth to the impermeable layer, if any.

NRCS Hydrologic Soil Group. The Natural Resource Conservation Service Hydrologic Soil Group (e.g., A, B, C, or D) comprising the infiltrating surface. This classification reflects the infiltration rate of the soil, with Group A soils having the highest rates of infiltration and Group D soils having the lowest. This is important information.

Depth and Type of Each Layer of Soil Below Basin. Give the order of stratification (from the surface downward) and the depth of each layer of soils at the infiltration basin site, to a depth of at least ten feet (3.05 meters). This is important information.

(Field Measured) Infiltration Rate. The saturated soil infiltration rate, based on soil surveys, infiltrometer measurements or observed drawdown of a new basin. This is important information.

List Plant Species on Infiltrating Surface. List the plant species (by Latin names, if known) and densities of cover on the bottom of the infiltration basin.

Describe Granular Material on Infiltrating Surface, If Any. Describe the granular material, if any, and its depth and porosity, if such material is used to cover basin's bottom instead of grass.

Hydraulic Conductivity of Underlying Soils. The hydraulic conductivity of the soils underlying the infiltration surface. Hydraulic conductivity is an expression of the permeability of a material. This is important information.

Groundwater Flow Gradient. The flow gradient (in unit length per unit length, e.g. feet/feet) of groundwater below the infiltration basin. The flow gradient may be thought of as the slope of the local groundwater table. This is important information.

Flood Control Volume Above Water Quality Detention Volume. It is often feasible and desirable to establish the infiltration basin within a larger flood control facility. If this is the case for this basin, record the volume of the flood control detention volume above the infiltration basin volume. This is important information.

List All Design Flood Control Return Periods. List the flood return periods being controlled by the flood control volume, if the infiltration basin is incorporated within a larger flood control facility. This is important information.

Describe Purpose of Basin. Describe the purpose of the infiltration basin (e.g., surface water quality only, groundwater recharge, etc.). This information is nice to have.

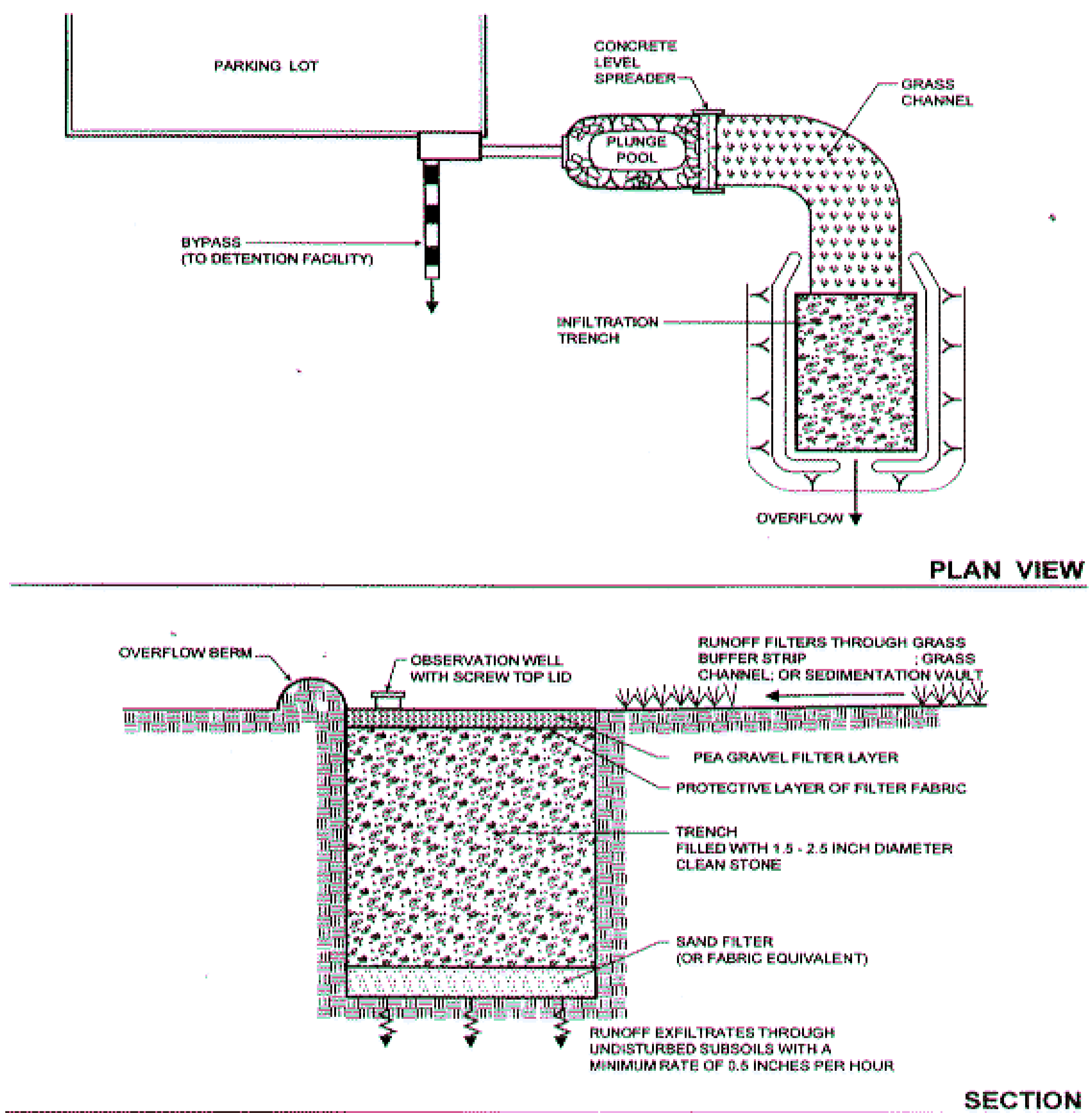
Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

24. Percolation Trench and Dry Well Design Data

Percolation or infiltration trenches can be generally described as a ditch filled with porous media designed to encourage rapid percolation of runoff to the groundwater. A dry well is a drilled well, often drilled through impervious layers to reach lower pervious layers, filled with porous media designed to percolate surface water to groundwater. An illustration of an idealized percolation trench is provided below.

Figure 13. Stormwater Design Example: Infiltration Trench

(Source: http://www.stormwatercenter.net/Manual_Builder/infiltration_design_example.htm)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Percolation Trench/Well Surface Area. The top surface area of the percolation trench or well.

Percolation Trench/Well Length. The length of the percolation trench, or the diameter of the well.

Percolation Trench/Well Depth. The depth at which the trench or well is exposed to permeable soils.

Depth to Seasonal High Groundwater Below Bottom of Trench/Well. The minimum depth to the seasonal high groundwater table below the trench or well.

Depth to Impermeable Layer Below Bottom of Trench/Well. The depth to the first impermeable layer below the trench or well.

Depth and Type of Each Soil Layer Adjacent To and Below Trench/Well. Give the order of stratification (from the surface downward) and the depth of each layer of soils at the BMP site.

Type and Gradation of Granular Materials Used in Trench/Well. Describe the type and depth of granular material used in the trench or well.

Was Geotextile Used Above Granular Trench Fill? Enter Y=Yes or N=No.

Was Geotextile Used On the Sides of Granular Fill? Enter Y=Yes or N=No.

Was Geotextile Used On the Bottom of Granular Fill? Enter Y=Yes or N=No.

Porosity of Granular or Soil Materials, as a Percent. Give porosity (in percent) of the granular fill material. Porosity measures the portion of the fill material volume that is not occupied by solids (for example, clean sands and gravels typically have porosities of 25-50%; this volume is occupied by air or water). If the layer is geotextile fabric, give the effective pore size.

Total Storage Pore Volume in Trench. Give the volume of the available pore space in the granular materials. This will normally equal the product of the volume of granular material and its porosity.

Describe Type of Geotextile Used. Describe the types and locations of the geotextile fabrics used in the trench or well, if any. Include the effective pore opening of the fabrics.

Hydraulic Conductivity of (Adjacent) Soils. The hydraulic conductivity of the soils adjacent to the trench or well infiltration surfaces. Hydraulic conductivity is an expression of the permeability of porous material.

Groundwater Flow Gradient. The flow gradient of groundwater below the infiltration basin (expressed as unit length per unit length, e.g., feet/feet). The flow gradient may be thought of as the slope of the local groundwater table.

Purpose of Trench or Well. Describe the purpose of the percolation trench or well (e.g., water quality treatment, reduction of surface runoff, groundwater recharge, etc.). This information is nice to have.

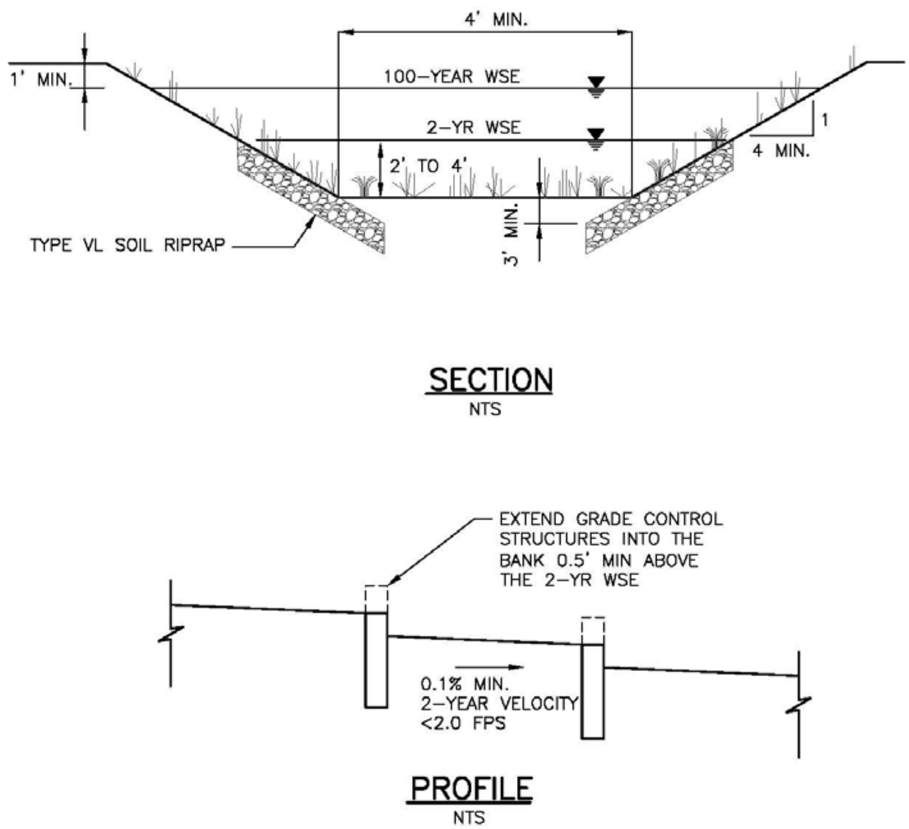
Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

25. Wetland Channel and Swale Design Data

A **wetland channel** is a channel designed to convey flow very slowly, often less than 2 ft/sec at the 2-year flood peak flow rate. A wetland channel is designed to support dense wetland vegetation on its bottom.

Figure 14. Constructed Wetland Channel

(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Length of Channel/Swale. The length of the wetland channel or swale, from the stormwater inflow to outflow point.

Longitudinal Slope of Channel/Swale. The average longitudinal slope (in unit length per unit drop, e.g., feet per feet or meter per meter) of the wetland channel or swale, as measured between grade control structures.

Bottom Width of Channel/Swale. The average width of the nearly-flat bottom of the channel or swale between its side slopes.

Side Slope of Channel/Swale. The average (in vertical unit length per horizontal unit length) of the channel or swale's side slopes.

Average Longitudinal Inflow Spacing. The average longitudinal spacing between all separate stormwater inflow points. This is important information.

2-Yr Flow Design Depth in Channel/Swale. The average depth of water in the channel or swale during the two-year flood peak flow.

2-Yr Peak Design Flow Velocity. The flow velocity in the channel or swale during the two-year flood peak flow.

2-Yr Manning's *n*. The Manning's roughness factor *n* expresses the resistance to surface flow due to roughness such as vegetation; here *n* should be measured or estimated for the 2-year peak flow. The Manning's factor is larger for rougher surfaces (e.g., high, dense vegetation) that increase flow friction. This is important information.

Depth to High Groundwater (or Impermeable Layer). The minimum depth to the water table during the high water table season, or to the first impermeable layer. This information is nice to have.

Hydraulic Conductivity. The hydraulic conductivity of the subsurface materials below the channel or swale. Hydraulic conductivity is an expression of the permeability of porous material. This information is nice to have.

Type of Plant Species in Wetland Zone or Swale. List the plant species, percent of cover and densities.

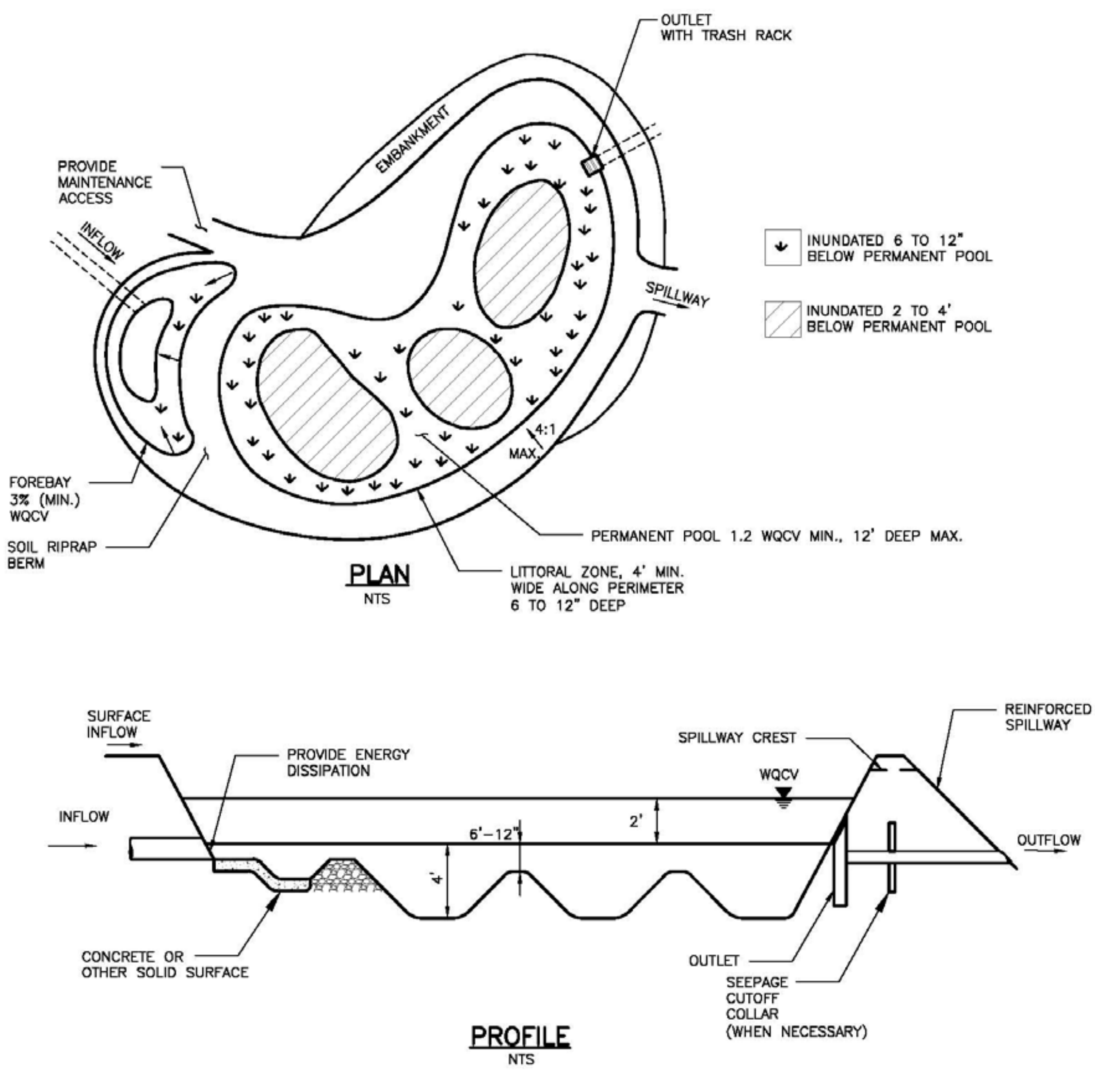
Maximum Design Flow Capacity Return Period of Swale. The flood return period that the channel has been designed to convey within its banks in addition to the water quality design event. (Example: 2-year and 10-year flood). This information is nice to have.

Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

26. Wetland Basin Design Data

A wetland basin is a BMP similar to a retention pond (with a permanent pool of water) with more than 50 percent of its surface covered by emergent wetland vegetation, or similar to a detention basin (no significant permanent pool of water) with most of its bottom covered with wetland vegetation.

Figure 15. Wetland Basin
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are <u>required</u> information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Volume of permanent pool. Volume of the permanent pool of water, if any.

Permanent Pool Surface Area. Area of the water surface in the permanent pool, if any.

Permanent Pool Length. Length of the permanent pool of water, if any, measured as the distance between inflow and outflow. If more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.

Water Quality Surcharge Detention Volume When Full. Wetland basins may be designed to handle a specified volume of runoff above the permanent pool, releasing this surcharge volume to the pool over a specified period of time through an outlet structure. Specify the surcharge detention volume.

Water Quality Surcharge Surface Area When Full. The surface area of any supplementary water quality detention volume above the permanent pool, if applicable.

Water Quality Surcharge Basin Length When Full. Length of the water quality detention volume, measured as the distance between inflow and outflow. If more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.

Brim-full Emptying Time For Surcharge. The period of time (in hours) required for the wetland basins water quality surcharge detention volume to be released to the permanent pool.

Half Brim-full Emptying Time for Surcharge. Period of time (in hours) required for the lower half of the water quality surcharge detention volume to be released to the permanent pool.

Forebay Volume. Volume of the forebay portion of the wetland basin when it is filled to the point of overflow into the rest of the basin. The forebay captures the initial inflow entering the basin to remove the bulk of sediments.

Forebay Surface Area. Surface area of water in the forebay when it is filled to the point of overflow into the rest of the basin.

Flood Control Volume, If Any. It is often feasible and desirable to incorporate the wetland basin within a larger flood control facility. If this is the case for this basin, record the volume of the flood control detention volume above the wetland basin volume.

List Design Flood Return Periods. If the wetland basin is embedded within a larger flood control facility, list the flood return periods (in years) for which the above flood control volume is designed (e.g., 25 for a 25-year flood).

Wetland Surface Area. Surface area of the wetland basin, including all pond areas and meadow wetland areas. Use permanent pool surface area if no other wetland area exists adjacent to the pool.

Describe Wetland Pond Water Depths by Percent Area:

- Percent of Wetland Pond with 6“ (0.15 m) Depth
- Percent of Wetland Pond with 6 -12” (0.3 m) Depth

- Percent of Wetland Pond with 12 - 24" (0.3 - 0.6 m) Depth
- Percent of Wetland Pond with 24 - 48" (0.6 - 1.3 m) Depth
- Percent of Wetland Pond with > 48" (> 1.3 m) Depth
- Percent of wetland basin's area that is meadow wetland

List All Known Plant Species in the Wetland. Provide type and percent cover of the wetland basin by each wetland species, and densities.

Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

27. Manufactured Device Design Data

The Manufacture Device (MD) category represents a wide range of various proprietary and non-proprietary device types. BMPs categorized as manufactured devices incorporate or emphasize a variety of different unit processes and design elements (e.g., storage versus flow-through designs, inclusion of media filtration, etc.) that vary significantly throughout the category.

The BMP Database Project has a written policy regarding inclusion of proprietary products in the BMP Database, which can be downloaded from the project website under "Policies." Representative requirements include:

1. The performance data were collected by a third party and not by staff of the manufacturer or distributor/sellers of the device,

2. The protocols and requirements for monitoring, reporting, and submittal of the data to the International BMP Database were followed, and

3. The data submitted complied with relevant BMP Database QA/QC review procedures.

Mention of trade names or commercial products in the BMP Database, website, or associated work product does not in any way constitute endorsement or recommendation by the Project Sponsors or Project Team for their use as BMPs. Similarly, omission of products or trade names from the BMP Database does not indicate a Project Sponsor or Project Team position regarding the product effectiveness or applicability. Many different vendor technologies are commercially available for which there are no data currently included in the BMP Database. The data that have been included in the BMP Database are voluntarily submitted for inclusion by third parties and accepted into the BMP Database by the Project Team in accordance with the data protocols.

Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Select Device Type from the following dropdown list:

1. Flow through – single-chamber

2. Flow through – multi-chamber

3. Volume Capture – extended detention w/ pool

4. Volume Capture – extended detention w/o pool

5. Media Filter – single-chamber

6. Media Filter – multi-chamber

7. Inlet Insert – screen

8. Multi-chambered Treatment Train

9. Underground infiltration chamber

10. High-rate biofiltration unit

11. Oil and Water Separator

12. Other

Device Name, Model and Purchase Date provide important information for BMP Database users to obtain additional information on the device unit.

Select Unit Treatment Processes present in the BMP from the unit processes pick-list in order of importance, as follows:

- Primary Unit Treatment Process
- Secondary Unit Treatment Process
- Tertiary Unit Treatment Process
- Narrative Description of Additional Treatment Processes

Description of Sizing Methodology. Describe the basis of design for the manufactured device. This may be a design event that is described by depth, duration, frequency, and/or intensity; it may be a predetermined depth of rainfall or runoff; it may be a percentile storm (e.g., 90th percentile event); or it may be a maximum design flow rate.

Targeted Pollutants. Targeted pollutants are the water quality constituents that the manufactured device is best suited for removing from stormwater runoff. For example, a BMP based on coarse screening might target gross solids as a pollutant for removal; however, such a system would not likely target dissolved phosphorus, since there would be no unit process capable of removing this pollutant for this type of BMP. This information is nice to have.

Manufactured Device Unit Treatment Process Pick-list

1. Hydrologic: Volume Reduction
2. Hydrologic: Peak Flow Attenuation
3. Physical: Density/Gravity/ Inertial Separation Including Sedimentation
4. Physical: Screening/Filtration
5. Physical: UV Disinfection
6. Physical: Sorption
7. Biological: Microbially Mediated Transformation
8. Biological: Vegetative Uptake and Storage
9. Chemical: Ion Exchange
10. Chemical: Coagulant/ Flocculent Injection
11. Chemical: Sorption
12. Chemical: Disinfection
13. Other (describe in comments

Describe Design Inflow Rate(s) for Treatment, include maximum rate if different. For manufactured devices that are sized based on a design or maximum flow rate, indicate the range of flow rates that the device is intended to treat. If there is a flow rate above which bypass occurs, also indicate this flow rate.

Describe Design Outflow Rate. Describe outflow rates corresponding to the inflow rate listed above. Note that, for flow-through manufactured devices, outflow rates may equal inflow rates. For storage-based manufactured devices, outflow rates generally are lower than inflow rates, since the storage provides attenuation of peak flow rates.

Describe Design Loading Capacity (flow/unit surface area). The design loading capacity can be calculated by dividing the flow rate for a design event by the plan-view surface area of the manufactured device.

Manufacturer-recommended Maintenance Requirements and Frequency. Describe maintenance practices including sediment removal; disposal of hydrocarbon absorbent mats; pumping out of water, sediment and/or other captured materials; etc. Describe how frequently these maintenance activities should be performed to enable the manufactured device to continue to function as designed. This information is nice to have.

Primary Flow Control, if applicable. Describe hydraulic devices for controlling flow through the manufactured device such as orifices, weirs, pumps, etc. This information is nice to have.

Outfall Type. Identify whether the outfall is controlled by gravity or pumped.

Outlet Description. Provide a geometric description of the manufactured device outlet. Examples would include number of orifices, diameter of orifices, weir length, etc.

Design Water Quality Surcharge Detention Volume When Full. Manufactured devices may be designed to handle a specified volume of runoff above a permanent pool, releasing this surcharge volume over a specified period of time through an outlet structure.

Surcharge Surface Area. The surcharge surface area can be determined by dividing the volume of surcharge by the surcharge depth. For BMPs with a constant surface area in plan view, the surcharged surface area may be equivalent to the plan-view surface area.

Surcharge Length. The surcharge length is the longitudinal dimension of the surcharged volume.

Surcharge Depth. The surcharged depth is the vertical dimension of the surcharged volume.

Brim-full Emptying Time (hrs) for Surcharge. Emptying time (in hours) of the water quality detention volume.

Other Design Parameters. Provide additional design information for these general BMP design types: wet vault, media filter/insert or multi-chambered system. Some manufactured devices will include all of these major components. In such cases, all fields should be completed.

Wet Vault Design Parameters include basic dimensions and associated units for the permanent pool of the vault, including:

- Volume of Permanent Pool
- Permanent Pool Surface Area

- Permanent Pool Depth
- Permanent Pool Length

Media Filter or Insert Design Parameters include basic dimensions of the filter media, including:

- Filter or Insert Surface Area
- Filter or Insert Thickness
- Describe Filter or Insert Media Type/Material.

Multi-chamber System Design Parameters:

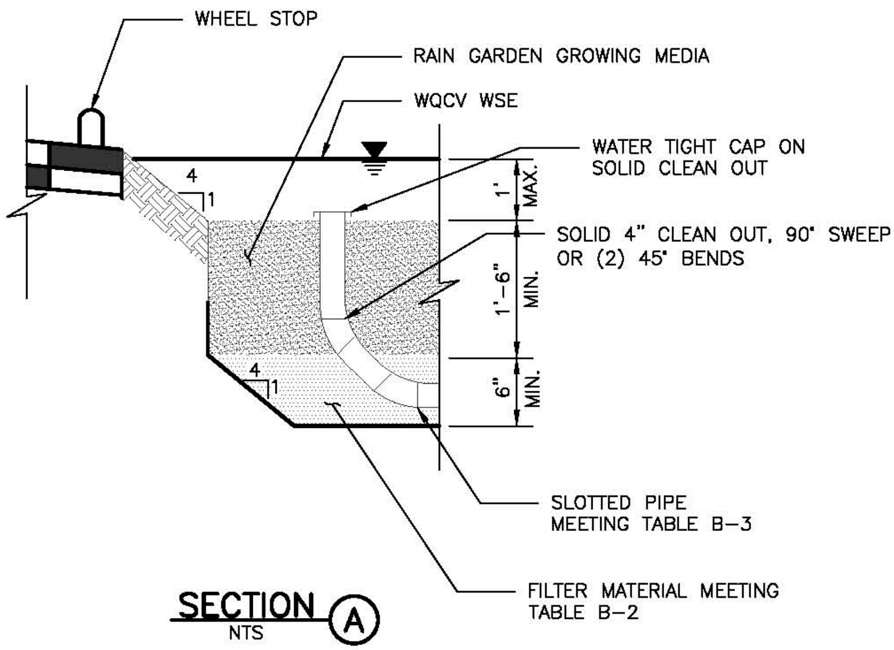
- Overflow Baffle/Weir Description
- Underflow Baffle/Weir Description

Comments enable the user to narratively describe other aspects of the BMP that are relevant to understanding the study. This information is <u>nice to have</u>.

28. Bioretention Design Data

Bioretention areas, or rain gardens, are landscaping features adapted to provide on-site treatment of stormwater runoff. They are commonly located in parking lot islands or within small pockets of residential land uses. Surface runoff is directed into shallow, landscaped areas with engineered soils, with or without underdrain systems. The filtered runoff can be collected in a perforated underdrain and returned to the storm drain system or infiltrated into the ground.

Figure 16. Bioretention Cell with Partial Infiltration Section
(Source: UDFCD 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Choose type of Bioretention from the following dropdown list.

- Bioretention Cell – Non-linear, not associated with conveyance.
- Off-line bioretention area – Placed next to swale at lower elevation to increase storage.
- In-line bioretention area – Linear, incorporating cell and swale characteristics for conveyance as well as retention and treatment, but low velocity.
- Sloped (weep garden) bioretention area – Behind retaining wall on relatively steep gradient.

- Sloped biodetention vegetative barrier – Placed along slope contour to retard runoff.
- Tree box filter – Enlarged planting pit, usually with drain inlet and underdrain.

Ratio of Tributary Area to Bioretention Surface Area. This ratio can be determined by dividing the area of the drainage basin contributing runoff to the bioretention area by the surface area of the bioretention area. Both the tributary area and bioretention surface area should have the same units to calculate a proper ratio.

Is Pretreatment Provided? Provide yes/no answer. Pretreatment for bioretention facilities may include sediment forebays, filtration via a grass buffer or swale, or other methods to remove gross solids and other coarse pollutants. Not all bioretention areas include pretreatment. This is <u>important</u> information.

Description of Pretreatment, if present. If a pretreatment area is provided, describe the pollutants targeted by the pretreatment area, as well as physical characteristics of the pretreatment area, including plan-view and vertical dimensions, construction materials, primary unit processes, etc.

Description of Flow Entrance. Describe how flow enters the bioretention area. Flow may enter the bioretention area via a curb cut, a closed conduit, as surface sheet flow, etc. This is <u>important</u> information.

Bioretention Surface Area. This is the plan-view surface area of a bioretention facility. This is also typically equivalent to the plan-view area of inundation for the design event.

Ponding Volume above Bioretention Media Surface. Describe the volume of temporary storage provided above the ground surface in a bioretention facility for the design event.

Average Ponding Depth above Bioretention Media Surface. The average ponding depth can be calculated by dividing the ponding volume by the surface area.

General Shape of Bioretention Feature. Describe the geometric shape of the bioretention facility (e.g., rectangular, circular, curvilinear, etc.). Provide approximate principal dimensions of shape if available or if they can be estimated from photographs or other documentation.

Is "Internal Water Storage Zone" Created (via underdrain placement above bottom of media layer)? Yes or No. For bioretention facilities with underdrains, an internal water storage zone can be created by "perching" the underdrain pipe above a portion of the media underlying the bioretention facility. The internal water storage zone generally has no outlet other than infiltration into the underlying native soil.

Subsurface Storage Volume. The subsurface storage volume is the volume that is provided in the pore space of the bioretention media beneath the ground surface. The subsurface volume can be calculated by multiplying the volume of media used by the porosity of the media.

If subsurface storage provided, then height of outlet above bottom of bioretention media. Provide the difference between the outlet invert elevation and the bottom of the bioretention media elevation in units of length.

Bioretention Media: Natural or Amended. Most bioretention media are amended to meet engineering specifications; however, some smaller rain gardens in areas with good soil conditions may in some cases rely on natural soils.

Bioretention Media Depth. The bioretention media depth can be determined by dividing the total volume of the media by the surface area over which the media is placed. This will provide an average depth.

Bioretention Media Design Specifications. Describe properties of the bioretention media including composition of the media, compaction criteria, gradation specifications, design infiltration rate, moisture content, organic content, and other physical and chemical characteristics.

Characterize Bioretention Media Phosphorous Content. Phosphorus (P) content of bioretention media can influence phosphorus retention or export from bioretention media. A variety of soil tests are available to characterize the phosphorus content in soil; however, there is some regional variation in how these results are reported. To account for this regional variation, provide phosphorus concentration in mg/kg, where available. A "P" index may also be provided, including the state in which the test is conducted. The NRCS "P" index includes a combination of eight characteristics that include a soil phosphorus test (concentration) but also factors including soil erosion, irrigation erosion, runoff class, P fertilizer application rate, P fertilizer application method, organic P source application rate, and organic P source application method. See http://www.nrcs.usda.gov/technical/ecs/nutrient/pindex.html for more information on "P" Index. This information is important.

Description of Supplemental Bioretention Media Characteristics. Describe other aspects of the bioretention media such as clay content, pH, cation exchange capacity, carbon:nitrogen ratio, moisture content, metals contents, inerts contents.

Description of Vegetation Community. Provide a characterization of the vegetated community present in the bioretention facility such as species, canopy layers and their approximate cover [stems/acre], and other factors.

Description of Mulch (if any). Mulch is often placed in bioretention facilities to provide surface area for trapping sediment and to protect underlying media from raindrop impact erosion and wind erosion. Mulch also may help to retain soil moisture for plant growth and to protect recently germinated plants from intense sunlight. There are many different types of mulch including wood-chip mulch, gravel mulch, etc. Describe the type of mulch and application depth.

Surface Infiltration Rate. The surface infiltration rate is the average rate at which soil percolates into the soil from the surface ponding area.

Design Infiltration Rate (including safety factor for clogging). The design infiltration rate is the rate at which the bioretention system can infiltrate stormwater runoff. Because of potential for clogging over time, a factor of safety is typically applied to the design infiltration rate to account for blockage and/or reductions in infiltration rates over time. Since different layers of a bioretention system may have different infiltration rates, the overall system rate is generally the infiltration rate of the slowest layer. In many cases, the saturated hydraulic conductivity of the underlying soils may be the limiting infiltration rate.

Number of Underdrains Provided (if none, enter 0). Describe the number of perforated underdrain lines provided for the bioretention facility.

Description and Dimensions of Underdrain, if present. Provide the diameter, material, slot/perforation dimensions, area of openings per unit length, spacing between separate underdrain lines, and other parameters that describe the underdrain.

Underdrain Gravel Layer Thickness, if present. If the underdrain pipe is embedded in gravel or if a gravel layer alone is used as an underdrain, provide the thickness of this layer.

Description and Dimensions of Surface Overflow, if present. A surface overflow directs runoff in excess of the ponded storage volume out of the bioretention facility. Typical surface overflow structures include weirs and/or stand pipes.

Is a Hydraulic Restriction Layer (Liner) Provided? Provide yes or no answer. A hydraulic restriction layer may be a geo-membrane (liner) or a naturally occurring or anthropogenic layer of very low permeability (e.g., clay).

Description of Hydraulic Restriction Layer, if present. If a hydraulic restriction layer is present, describe the type and thickness of the layer (e.g., PVC geo-membrane, 30-mil plastic, compacted clay, etc.).

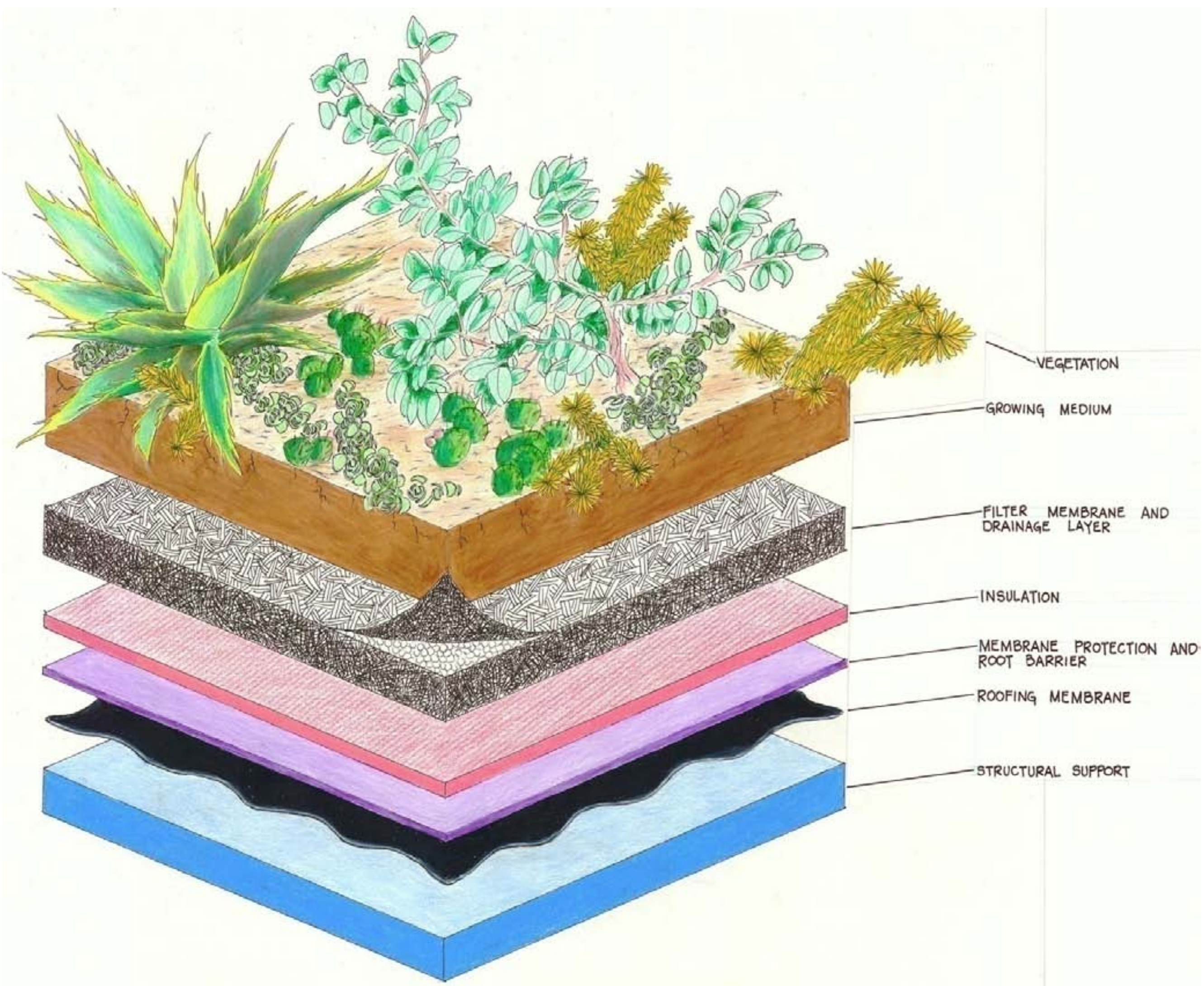
Seasonal High Water Table Position Relative to Invert. This is the depth from the lowest point of the underdrain system to the seasonal high-water table.

Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

29. Green Roof Design Data

Green roofs, also known as vegetated roof covers, eco-roofs or nature roofs, are multi-beneficial structural components that help to mitigate the effects of urbanization on water quality by filtering, absorbing or detaining rainfall. They are constructed of a lightweight soil media, underlain by a drainage layer, and a high quality impermeable membrane that protects the building structure. The soil is planted with a specialized mix of plants that can thrive in the harsh, dry, high temperature conditions of the roof and tolerate short periods of inundation from storm events.[4]

Figure 17. Typical Green Roof Cross Section
(Source: UDFCD 2010, Graphic by Adia Davis)



[4] Definition from Velazquez, Exploring the Ecology of Organic Green Roof Architecture (www.greenroofs.com).

See the LID website (http://www.lid-stormwater.net/greenroofs/greenroofs_home.htm) or the Green Roof (http://www.greenroofs.com/) website for more information about Green Roof design features. All fields associated with Green Roofs are required information.

Roof Type (Intensive or Extensive). Extensive green roofs typically feature a growing medium of four inches or less. An extensive green roof weighs less than an intensive green roof and contains shallow growing medium. These types of green roofs may be continuous or modular consisting of a series of trays that contain the growing media and vegetation. Intensive green roofs feature a growing medium depth of more than four inches. These may resemble conventional gardens due to their deeper growing medium. A wider range of plant material choices is possible on an intensive or semi-intensive green roof.

Purpose of Roof. Green Roofs may be implemented for a variety of environmental and aesthetic reasons. Provide a short description of the purpose of the roof (e.g., stormwater treatment, LEED credit, heat island reduction, outdoor living environment, etc.).

Describe Green Roof. Describe the key features of the green roof design.

Describe Vegetation. Identify the types of vegetation planted on the roof and the general condition of the vegetation. For example, sedum spp. in healthy condition with 90 percent coverage of the green roof surface area.

Supplemental Irrigation Provided? Identify whether supplemental irrigation is provided on the green roof by answering yes (Y) or no (N).

Roof Media's Surface Area. Provide the area covered by the growing medium.

Roof Slope. This field identifies whether the roof is flat or sloping. Enter 0 for a flat roof or the dimensionless slope value, if the roof is sloping.

Number of Media Layers. Identify the number of layers associated with the growing media.

Type and Depth (or Thickness) of Each Media Layer. Describe the type and depth or thickness of each media layer.

Percent Compost or Organic Material of Media at Installation. Organic matter in growing media can affect nutrient export from the roof. This information is nice to have.

Roofing Material. Describe the roofing membrane**.**

Detention Volume. This is the design water quality capture volume for the green roof.

Detention Volume's Design Drain Time, If Controlled and Known. The design time for complete drawdown (in hours) of the water quality capture volume if the drain time is controlled by a flow regulating device such as an orifice. Leave blank if the drain rate is only a fraction of the growing media's flow-through rate.

Comments. Provide any additional information needed to properly evaluate the green roof's performance. This information is nice to have.

30. Stormwater Harvesting (Cisterns/Rain Barrels)[5] Design Data

Stormwater harvesting systems can range from simple residential cisterns (rain barrels) that collect runoff from a single residential rooftop to supplement landscape irrigation to advanced rainwater harvesting systems at the development scale that can be supplemented with potable water and used for toilet flushing, irrigation systems, car washing and other non-potable uses. Key benefits of rainwater harvesting include reduced runoff volumes and reduced potable water demand.

Figure 18. Schematic of a Simple Residential Rainwater Harvesting System
(Source: North Carolina State University[1], http://www.bae.ncsu.edu/topic/waterharvesting/layout.html)

Basic System Description provides a narrative description of the harvesting system components, scale of application, and intended uses.

Number of Units in Watershed provides quantification of the scale on which rainwater harvesting is being implemented in the watershed.

Contributing Rooftop Size determines the expected runoff volume available for harvesting for various storm events.

Roofing and Gutter Material Description provide information potentially affecting water quality of the rooftop runoff (e.g., from metal fixtures).

Storage Volume provides the maximum capture volume of the cistern. The cistern is the main component of a water harvesting system. Cisterns are generally made from either metal or

[5]Rainwater harvesting information adapted from North Carolina State University Biological Agricultural Engineering Program, Stormwater Engineering Group, and Cooperative Extension (http://www.bae.ncsu.edu/topic/waterharvesting/index.html) and personal communication with Dr. William Hunt, North Carolina State University.

plastic and come in a wide variety of sizes. The volume of the cistern depends on rainfall and usage data and can be sized using a computer model.

Drain Time at Capacity (minutes) provides information regarding the storage recovery of the system following a precipitation event.

Expected Long-term Capture Volume (based on computer simulation) provides the researcher's expected benefit from the system based on computer simulation used determine the appropriate cistern size for a given situation. Models are typically based on rainfall data and anticipated usage to establish cistern inputs and outputs. This is important information.

Model Used for Capture Volume Simulation provides supporting information regarding the basis of the expected long-term capture volume. A variety of computer programs are available for this purpose and may yield differing results. This is important information.

Percent Bypass Associated with System provides supporting information relevant to hydrologic performance of the system.

Describe Emergency Spillage (Overflow) Provision. The overflow provision allows runoff to bypass the cistern when it has reached maximum capacity.

Describe Mosquito Prevention (if any). For example, mosquito prevention may include a screen at points where standing water could be exposed to the outside environment to prevent mosquitoes from breeding within the cistern. This information is nice to have.

Intended Use of Captured Water may include a variety of applications such as supplemental irrigation, primary irrigation, toilet flushing, groundwater recharge, or other non-potable uses. This information is nice to have.

Can Potable Water Supplement Tank? Provide yes or no answer. In situations where reliable water availability is important, a supplemental water supply may be an important consideration enabling practical use of the system.

Type of Irrigation System provides supplemental information regarding the manner in which the harvested rainwater is used and can range from simple to complex applications. This information is nice to have.

Reason System Selected provides information on the objectives of the rainwater harvesting system, which may or may not include stormwater runoff reduction as a system objective.

Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

31. Low Impact Development (LID)[6] Design Data

Low Impact Development (LID) is an overall site design approach that is intended to mimic pre-development hydrology through the use of dispersed on-site controls. These sites typically have multiple small BMPs dispersed at the lot level through a development, rather than having the traditional detention pond located at the low corner of the development. See http://www.lid-stormwater.net) for detailed information. All fields provided below are required.

List BMPs Monitored Within LID Site (as entered into BMP Database). Relates overall LID site design to individual practices monitored and/or implemented at the site (e.g., bioretention, permeable pavement).

Describe Site Design enables the user to narratively describe the key features of the site design.

Describe Monitoring Design enables the user to narratively describe the key features of the monitoring design. For example, the data provider may monitor a comparable development as a reference site. Monitoring may occur at multiple BMPs, or may occur at a few separate representative outflow locations. (More detailed guidance on LID monitoring designs may be obtained in the *Urban Stormwater BMP Performance Monitoring Manual* accessible at www.bmpdatabase.org).

Method for Flood Control is used to assess extent to which LID is used for water quality and flood control, or water quality only. Some LID sites have "hybrid" characteristics incorporating LID practices with traditional flood control approaches (e.g., are centralized detention and LID techniques).

Narrative Descriptions of LID Practices

Describe the extent to which the following LID practices are implemented at the overall test site:

- **Conservation Features** include conserving natural areas includes preservation of existing trees, other vegetation, and soils.
- **Minimizing Disturbance** includes minimizing soil excavation and compaction and vegetation disturbance.
- **Minimizing Building Coverage** includes minimizing impervious rooftops and building footprints.
- **Minimizing Travelway Coverage** includes constructing streets, driveways, sidewalks, and parking lot aisles to the minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised.
- **Maintaining Natural Drainage Patterns and Designing Drainage Paths to Increase Time of Concentration** includes measures such as: maintaining depressions and natural

[6] Site-level LID reporting parameters based on communication with Dr. Richard Horner, University of Washington, December 2008.

swales; emphasizing sheet flow instead of concentrated flow; increasing the number and lengths of flow paths; maximizing non-hardened drainage conveyances; and maximizing vegetation in areas that generate and convey runoff.

- **Source Controls** include minimizing pollutants; isolating pollutants from contact with rainfall or runoff by segregating, covering, containing, and/or enclosing pollutant-generating materials, wastes, and activities; conserving water to reduce non-stormwater discharges.

- **Permeable Pavements** include constructing low-traffic areas with permeable surfaces such as porous asphalt, open-graded Portland cement concrete, coarse granular materials, concrete or plastic unit pavers, and plastic grid systems. Representative applications may include driveways, patio slabs, walkways and sidewalks, trails, alleys, and overflow or otherwise lightly-used parking lots.

- **Natural Drainage System Elements** include bioretention areas (rain gardens), vegetated swales, vegetated filter strips and other similar features.

- **Stormwater Harvesting** includes use of cisterns, rain barrels or rain storage units.

- **Green Roof (vegetated)** Green roofs include vegetated roofs with stormwater-related design components.

- **Other Site Features (including traditional BMPs)** enables the user to define other key site features or traditional BMPs.

Comments/Other Description enables the user to narratively describe other aspects of the LID site that are relevant to understanding the study.

<u>Hydrologic Parameters</u>

Several hydrologic parameters are also requested to enable comparisons between LID sites. (More information on these parameters can be obtained in the *Urban Stormwater BMP Performance Monitoring Manual*, which is the source of the descriptions provided below.)

Estimate of Hydrologically Available Temporary Storage at Site This information helps to normalize the relationship between source areas and storage areas, both in terms of routing and relative volume for purposes of comparing LID sites. Tabular estimates of detained, retained and excess volume for a range of storm events are beneficial in developing these estimates. A PDF providing this information can be attached separately, or this information can be summarized narratively. Also provide units of measurement (e.g., acre-feet, watershed inches). This is <u>nice to have</u> information.

The concept of "hydrologically available temporary storage" can be used to describe the storage volume of a LID site. Hydrologically available temporary storage at the site potentially includes the following components:

- Surface storage (e.g., natural, pervious, and impervious depression storage; surface retention) that is not surface discharged. This represents volume that is eventually lost through evapotranspiration and/or infiltration but would not have become surface discharge.

- Surface storage (e.g., natural, pervious, and impervious depression storage; surface detention) that is eventually surface discharged after detention and/or infiltration occurs whereby slowing the surface discharge.

- Subsurface LID practice temporary storage, including all pore space within LID practices (e.g., in bioretention soils, stone infiltration trenches, planter media, green roof media) that is not surface discharged. This also represents the volume that is eventually recovered through evapotranspiration and/or infiltration, but would not have become surface discharge.

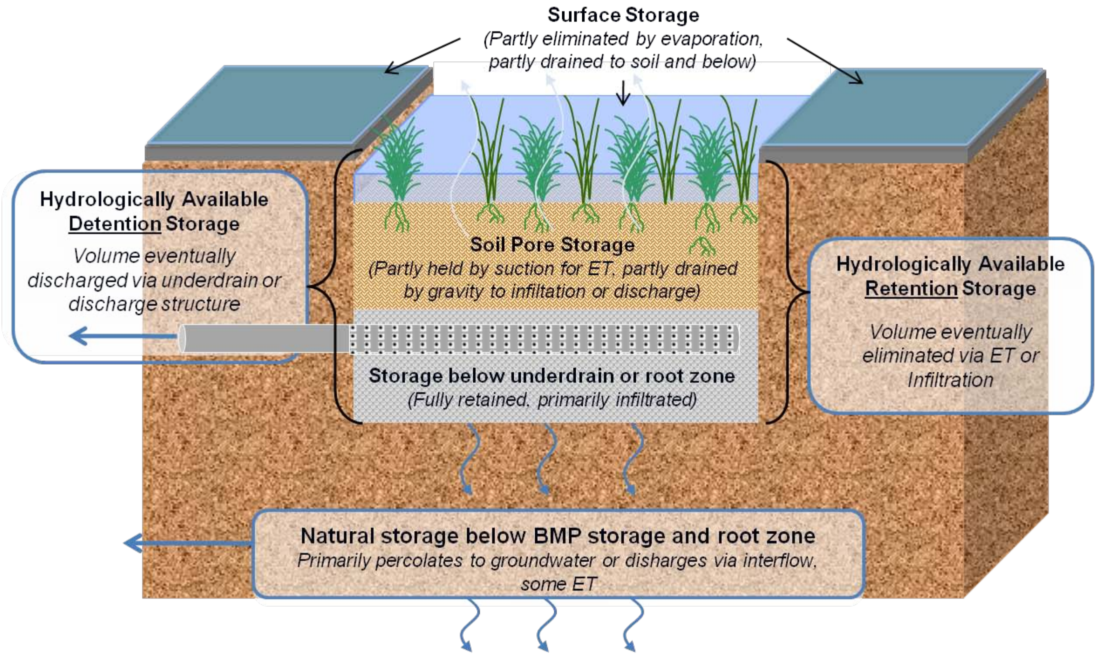
- Subsurface LID practice temporary storage, including all pore space within LID practices (e.g., in bioretention soils, stone infiltration trenches, planter media, green roof media) that is eventually surface discharged via an underdrain system.

- Volume in cisterns and rain barrels in excess of average long-term retained volume that is eventually recovered through evapotranspiration (e.g., irrigation reuse, cooling water makeup reuse, drip hose), infiltration, and/or export (e.g. toilet flushing use).

- Figure 19 illustrates components of hydrologically available temporary storage that may be present in an individual practice. The location of available storage relative to sources of runoff is a critical aspect in determining the amount of storage that is "hydrologically available" to store runoff.

To quantify the effective storage volume, estimate the volume of storage available on the site that is effective in storing stormwater, and divide this estimate between storage volume that is retained and does not discharge to the surface and storage volume that is detained and discharges back to the downstream system via underdrains or discharge structures. If the overall site water balance is an important feature in a study, the storage that is retained can be further divided by the ultimate fate of the retained water: infiltration, evapotranspiration, or exportation off-site (e.g., toilet flushing). The quantity and distribution of storage volume has important theoretical influence on the amount of stormwater expected to discharge from the site.

Figure 19. Components of Hydrologically Available Temporary Storage Typically Present in LID features (Source: Geosyntec and WWE 2009)



Estimated Storage Recovery Rate in Watershed (days) describes the time for the LID site to recover hydrologically available temporary storage. Estimates of minimum, maximum and average recovery rates for retained and detained volumes should be provided. This is <u>nice to have</u> information.

Different storage elements may regenerate storage at different rates depending on their characteristics. For example, a bioretention facility with underdrains may drawdown its stored volume within 12 hours after a storm, while the same storage volume in a cistern used for irrigation may not begin to drawdown its stored volume for a few days following an event and may take a week to drawdown completely. Drawdown rate is also influenced by season of year, day of the week, and/or other factors. For example, seasonal variations in temperature can affect evapotranspiration and infiltration rates. Seasonal conditions can also affect irrigation demand, thus affecting drawdown rates for rainwater harvesting practices that commonly use harvested water to for irrigation. The day of the week can also affect regenerated storage rates. For example, the demand for captured water used for indoor toilet flushing in a commercial office building would be expected to be greater during the business week than on the weekend. The rate of recovery of storage has important theoretical influence on the hydrologic response of watersheds, specifically LID watersheds, in consecutive events. While storage recovery rate is an important component of watershed characterization, it is can be difficult to quantify for a composite site. It is also perhaps one of the aspects of watershed characterization most unique to LID watersheds, and thus has not been well standardized and demonstrated.

Describe Key Weather Parameters During Study Period (e.g., ET, temperature, etc.) Weather conditions can significantly affect the water balance of LID sites. Frozen soils can reduce infiltration rates; conversely, high ET is associated with increased evapotranspiration rates. Characterization of ET, temperature and other similar factors are important in normalizing comparisons among LID sites. This is <u>nice to have</u> information.

32. Non-structural BMP Information

A non-structural BMP can generally be described as a preventative action to protect receiving water quality that does not require construction. Nonstructural BMPs rely predominantly on behavioral changes or effective implementation of certain activities in order to be effective. Major categories of non-structural BMPs include education, recycling, maintenance practices and source controls, as described below.

- **Educational** BMPs include efforts to inform city employees, the public, and businesses about the importance of using practices that protect stormwater from improper use, storage, and disposal of pollutants, toxics, household products, etc. The ultimate goal of educational BMPs is to cause behavioral changes.

- **Recycling** BMPs include measures such as collecting and recycling automotive products, household toxics, leaves, landscaping wastes, etc.

- **Maintenance practices** include measures such as catch-basin cleaning, parking lot sweeping, road and street pavement repair, road salting and sanding, roadside ditch cleaning and restoration, street sweeping, etc.

- **Source controls** include preventing rainfall from contacting pollutant-laden surfaces and preventing pollutant-laden runoff from leaving locations such as automobile maintenance, salvage and service stations; commercial, restaurant and retail sites; construction sites; farming and agricultural sites; industrial sites, etc.

The following non-structural BMP fields should be completed for each non-structural BMP present at the test site. Multiple non-structural BMPs may be present at a test site and be entered into the BMP Database. Enter all data for each non-structural BMP before entering the next non-structural BMP record.

Select the Non-Structural BMP Present at the Site from the dropdown pick-list.

Date Test Began is simply the date (month, day and 4-digit year) that the BMP began (e.g., 01/01/1998).

Describe the quantity or measure of the BMP being practiced in the space provided. For example:

- **Educational** BMP "measurements" could include, as examples: the number of brochures distributed per resident and employee in watershed per year on the quantities of pesticide/herbicide application, automotive product disposal or recycling, household toxics use and disposal, yard waste management, etc. Other examples include the number of elementary school children living in the watershed reached through classes at local schools; number of public notices on TV, radio and/or major newspapers per year; number of billboards per acre of watershed used per year; percent of stormwater inlets in the watershed stenciled.

- **Recycling** BMP "measurements" could include gallons of used oil collected per resident in the watershed; pounds of household toxics collected per resident in the watershed; tons of landscaping waste per resident collected, etc.

- **Maintenance** BMP "measurements" could include percent of stormwater catch basins cleaned once each year, twice each year, etc.; tons of materials removed per average inlet each year; lane miles of street swept each year and tons of material removed per lane mile each year; acres of parking lots swept each year and tons of material removed each year per acre of parking lot swept; type and pounds of deicing materials used per lane mile of road per year; percent of salt in deicing materials used during the year; number of de-icing applications during the year; percent of roadside ditch miles cleaned in watershed during the year; tons of solids removed during the year from roadside ditches; percent of roadside ditch miles stabilized for erosion control during year, etc.

- **Source Control** "measurements" could include percent of industrial storage area in watershed that is covered; percent of materials handling sites in watershed that are covered; percent of gasoline stations with pumps that have overhead cover and how far these covers extend beyond the pumps, etc. The total area, number or mass of sources should be provided as well as the percentages in order to facilitate comparison to other source control BMP tests.

Initial Costs include the time and measures necessary to design and implement a program. For example, if brochures were developed on proper disposal of household waste, the cost of development and initial printing would be the initial cost. Subsequent distribution and reprints of the brochures would be considered annual costs. Another example could include inventorying the types of maintenance practices that should be conducted, creating a routine schedule and assigning personnel to complete the work. This information is nice to have.

Annual Costs are the year-to-year costs once the initial program has been developed. This information is nice to have.

Comments enable the user to narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

33. Other BMP Design Information

An "Other" BMP type spreadsheet is provided to enable users to enter data for other BMP types not included in the BMP Database. **A PDF report on the study must be attached to the data submittal in such cases.** All fields are required information.

Describe Key Structural Features enables the user to narratively describe the key structural or design features that are relevant to understanding the study.

Describe Key Landscaping/Vegetation Features enables the user to narratively describe the key landscaping or vegetation features that are relevant to understanding the study.

Comments enable the user to narratively describe other aspects of the BMP that are relevant to understanding the study.

34. Composite BMP Design Information

A "Composite" BMP type spreadsheet is provided to enable users to enter data for other BMP types not included in the BMP Database. All fields are required information.

Describe Individual BMP Components provides a simple narrative description of the treatment train in place at the site, including the user-defined names of the individual BMPs entered in the Database. Design characteristics of individual BMPs should be entered separately, in addition to the composite BMP.

Number of BMP Components Monitored provides the number of BMPs in the treatment train.

Describe Key Structural Features enables the user to narratively describe the key structural or design features that are relevant to understanding the study.

Describe Key Landscaping/Vegetation Features enables the user to narratively describe the key landscaping or vegetation features that are relevant to understanding the study.

Comments enable the user to narratively describe other aspects of the BMP that are relevant to understanding the study.

References

Driscoll, E. Palhegyi, G., Strecker, E. and P. Shelley. 1989: *Analysis of Storm Event Characteristics for Selected Rainfall Gauges Throughout the United States*. Prepared for the U.S. Environmental Protection Agency.

Geosyntec Consultants and Wright Water Engineers, Inc. 2009. *Urban Stormwater BMP Performance Monitoring.*

Low Impact Development Center: http://www.lowimpactdevelopment.org/.

National LID Clearinghouse: http://www.lid-stormwater.net/clearinghouse/index.html.

North Carolina State University/North Carolina Cooperative Extension Stormwater Engineering Group: http://www.bae.ncsu.edu/stormwater/.

Schueler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban Best Management Practices*. MWCOG. Washington, D.C.

Urban Drainage and Flood Control District. 2010. *Urban Storm Drainage Criteria Manual, Volume 3 Best Management Practices*. Denver, CO.

Pick-lists

As described in the Data Elements section of this User's Guide, certain fields are restricted to "pick-lists", which are provided as dropdown boxes in the spreadsheets.

Units of Measure Codes

Note: After August 2010, all new data submitted to the BMP Database must be in SI units.

Units Type	Units Name	Abbrev.
Area	hectare	ha
Area	square kilometer	km²
Area	square meter	m²
Concentration	colonies per 100 milliliters	#/100mL
Concentration	micrograms per liter	µg/L
Concentration	milligrams per liter	mg/L
Concentration	pH standard unit	SU
Conductivity	micromhos per centimeter	µmhos/cm
Flow	cubic meter per second	cms
Flow	liters per minute	L/min
Flow	liters per second	L/sec
Hydraulic Conductivity	centimeters per second	cm/sec
Intensity	centimeter per hour	cm/hr
Intensity	millimeter per hour	mm/hr
Length	centimeter	cm
Length	kilometer	km
Length	meter	m
Percent	percent	%
Precip	centimeter	cm
Temperature	Celsius	°C
Time	hours	hrs
Time	minute	min
Time	second	sec
Velocity	meters per second	m/sec
Volume	cubic meter	m³
Volume	liter	L

Test Site, Agency and Location Spreadsheet Codes

Code	Type of Study
1	Structural
2	Non-Structural
3	Both
4	Site-level LID

US Time Zones	
-5	Eastern Standard
-6	Central Standard
-7	Mountain Standard
-8	Pacific Standard

Horizontal Reference Datum Codes		
Code	Name	Description
1	NAD27	North American Datum 1927
2	NAD83	North American Datum 1983
3	OTHER	Other
4	UNKWN	Unknown
5	AMSMA	American Samoa Datum
6	ASTRO	Midway Astro 1961
7	GUAM	Guam 1963
8	JHNSN	Johnson Island 1961
9	OLDHI	Old Hawaiian Datum
10	PR	Puerto Rico Datum
11	SGEOR	St. George Island Datum
12	SLAWR	St. Lawrence Island Datum
13	SPAUL	St. Paul Island Datum
14	WAKE	Wake-Eniwetok 1960
15	WGS72	World Geodetic System 1972
16	WGS84	World Geodetic System 1984

Code	Agency Responsibility
1	Sponsoring
2	Monitoring
3	Both

Code	Agency Type	Notes
0	PRIVATE INDUSTRY	A private (non-government) organization representing an industrial operation.
1	US GOVERNMENT/FEDERAL	A United States Federal (National) Government organization.
2	PUBLIC UNIVERSITY/COLLEGE	An organization representing a public college or university.
3	US GOVERNMENT/INTERSTATE COMSN	A United States Interstate Government organization or commission.
4	CANADIAN GOVERNMENT/FEDERAL	Canadian Federal Government (National) Organization
5	MEXICAN GOVERNMENT/FEDERAL	Mexican Federal Government (national) Organization
6	INTERNATIONAL/UNITED NATIONS	An International organization with direct tie to the United Nations
7	CANADIAN GOVERNMENT/PROVINCIAL	Canadian Provincial Government Organization
8	US GOVERNMENT/STATE	United States State Government Organization
9	VOLUNTEER	An organization whose members are not compensated for their activities.
10	US GOVERNMENT/LOCAL	A United States Local (City, county, etc.) government organization
11	TRIBAL	An organization representing a Tribe or other Native American governing body.
12	MEXICAN GOVERNMENT/STATE	Mexican State Government Organization.
13	PRIVATE UNIVERSITY/COLLEGE	An organization representing a private college or university.
14	INTERNATIONAL/INTL COMMISSIONS	Organization with international jurisdiction and/or responsibilities.
15	US GOVERNMENT/TRUST TERRITORY	United States Trust Territory Government organization.
16	MULTI-UNIV/COLLEGE CONSORTIA	Organization consisting of a consortium or multiplicity of Colleges and/or Universities.
17	PRIVATE NON-INDUSTRIAL	A private organization NOT representing an industrial operation.
18	OTHER	None of the above
19	VENDOR	Vendor or manufacturer of proprietary device.

Monitoring Event Spreadsheet Codes

Code	Event Type Description
B	Base Flow
R	Runoff
O	Other

Watershed, Roads and Parking Lots, and Land Use Spreadsheet Codes

Code	Type of Watershed
1	Test
2	Reference

Code	Type of Pavement on Roadways
C	Concrete
A	Asphalt
B	Both

Code	Deicing Method
1	Sand
2	Sand/Salt
3	Magnesium Chloride
4	Other Chemical
5	None

Code	Description		Code	Description
1	Light Industrial		14	Unknown
2	Heavy Industrial		15	Open Space[7] (General)
3	Multi-Family Residential		16	Forest
4	High Density Residential		17	Park & Ride
5	Medium Density Residential		18	Maintenance Station
6	Low Density Residential		19	Roads/Highway
7	Office Commercial		20	College Campus
8	Retail		21	Disturbed/Construction
9	Restaurants		22	Open Space (Undisturbed)
10	Automotive Services		23	Open Space (Manicured)
11	Rangeland		24	Disturbed/Construction
12	Orchard		25	Other
13	Vegetable Farming			

[7] Note: Open Space (15) is the general open space land use category used prior to 2010. Open Space categories 22 Open Space (natural area) and 23 Open Space (maintained) have been provided to differentiate between highly managed urban open spaces such as cemeteries and golf courses, as opposed to unmanicured natural areas, which often have different hydrologic and water quality characteristics.

Climate Station Codes

State Code	Station ID	Station Name
AK	280	ANCHORAGE WSCMO AP
AL	831	BIRMINGHAM FAA AP
AL	5550	MONTGOMERY WSO AP
AR	2574	FORT SMITH
AR	4248	LITTLE ROCK FAA AP
AZ	6468	PETRIFIED FOREST N.P.
AZ	6481	PHOENIX WSFO AP
AZ	8820	TUCSON WSO AP
CA	442	BAKERSFIELD WSO AP
CA	925	BLYTHE
CA	3257	FRESNO WSO AP
CA	5114	LOS ANGELES WSO AP
CA	6335	OAKLAND WSO AP
CA	7295	REDDING 5 SSE
CA	7630	SACRAMENTO FAA AP
CA	7740	SAN DIEGO WSO AP
CA	7769	SAN FRANCISCO WSO AP
CO	2220	DENVER WSFO AP
CO	3005	FORT COLLINS
CO	3488	GRAND JUNCTION WSO AP
CO	6740	PUEBLO WSO AP
CT	806	BRIDGEPORT WSO AP
CT	3451	HARTFORD BRAINARD FLD
DE	9595	WILMINGTON WSO AP
FL	4358	JACKSONVILLE WSO AP
FL	5663	MIAMI WSCMO AP
FL	6638	ORLANDO WSO AP
FL	7886	ST PETERSBURG

State Code	Station ID	Station Name
NC	9457	WILMINGTON WSO AP
ND	819	BISMARCK WSFO AP
ND	2859	FARGO WSO AP
NE	4795	LINCOLN WSO AP
NE	6065	NORTH PLATTE WSO AP
NH	1683	CONCORD WSO AP
NJ	311	ATLANTIC CITY WSO AP
NJ	6026	NEWARK WSO AP
NM	234	ALBUQUERQUE WSFO AP
NM	7609	ROSWELL WSO AP
NV	2573	ELKO FAA AP
NV	4436	LAS VEGAS WSO AP
NV	6779	RENO WSFO AP
NV	7620	SMOKEY VALLEY
NY	1012	BUFFALO WSFO AP
NY	5801	NEW YORK CENTRAL PARK
NY	7167	ROCHESTER WB AP
NY	8383	SYRACUSE WB AP
OH	1786	COLUMBUS WSO AP
OH	9406	YOUNGSTOWN WSO AP
OK	6661	OKLAHOMA CITY WSFO AP
OR	4670	LAKEVIEW 2 NNW
OR	5429	MEDFORD WSO AP
OR	6546	PEDELTON WSO AP
OR	6751	PORTLAND WSFO AP
OR	7500	SALEM WSO AP
PA	2682	ERIE WSO AP
PA	6889	PHILADELPHIA WSCMO AP

State Code	Station ID	Station Name
FL	8758	TALLAHASSEE WSO AP
GA	451	ATLANTA WSO AP
GA	2166	COLUMBUS WSO AP
HI	1919	HONOLULU WSFO 703 AP
IA	2203	DES MOINES WSFO AP
IA	2367	DUBUQUE WSO AP
IA	7700	SIOUX CENTER 2 SE
ID	1022	BOISE WSFO AP
ID	7211	POCATELLO WSFO AP
IL	1577	CHICAGO MIDWAY AP 3 SW
IL	8179	SPRINGFIELD WSO AP
IN	3037	FORT WAYNE WSO AP
IN	4259	INDIANAPOLIS WSFO
KS	1699	COLBY 1 SW
KS	2543	EMPORIA
KY	4746	LEXINGTON WSO AP
KY	4954	LOUISVILLE WSFO
LA	98	ALEXANDRIA
LA	6660	NEW ORLEANS WSCMO AP
LA	8440	SHREVEPORT WSO AP
MA	770	BOSTON WSO AP
MA	9923	WORCESTER WSO AP
MD	465	BALTIMORE WSO AP
ME	6905	PORTLAND WSMO AP
MI	2103	DETROIT METRO WSO AP
MI	4641	LANSING WSO AP
MN	2248	DULUTH
MN	5435	MINN-ST PAUL WSO AP
MO	4379	KANSAS CITY U of

State Code	Station ID	Station Name
PA	6993	PITTSBURGH WSCMO2 AP
SC	1549	CHARLESTON WSO CI
SC	1939	COLUMBIA WSFO AP
SD	5691	MOBRIDGE
SD	6937	RAPID CITY WSO AP
SD	7667	SIOUX FALLS WSFO AP
TN	1094	BRISTOL WSO AP
TN	1656	CHATTANOOGA WSO AP
TN	4950	KNOXVILLE WSO AP
TN	5954	MEMPHIS FAA-AP
TN	6402	NASHVILLE WSO AP
TX	16	ABILENE WSO AP
TX	211	AMARILLO WSO AP
TX	428	AUSTIN WSO AP
TX	1136	BROWNSVILLE WSO AP
TX	2015	CORPUS CHRISTI WSO AP
TX	2244	DALLAS FAA AP
TX	2797	EL PASO WSO AP
TX	3284	FTWORTH MEACH WSO AP
TX	4311	HOUSTON-ALIEF
TX	4329	HOUSTON-SATSUMA
TX	5411	LUBBOCK WSFO AP
TX	5890	MIDLAND/ODESSA WSO AP
TX	7945	SAN ANTONIO WSFO
UT	3418	GREEN RIVER
UT	7516	ST GEORGE
UT	7598	SALT LAKE CITY NWSFO AP
VA	5120	LYNCHBURG WSO AP
VA	6139	NORTHFOLK WSO AP

State Code	Station ID	Station Name
		MO
MO	7455	ST LOUIS WSCMO AP
MO	7976	SPRINGFIELD WSO AP
MS	4472	JACKSON WSFO AP
MT	807	BILLINGS WSO AP
MT	1309	BUTTE 8 S
MT	3558	GLASGOW WSO AP
MT	3751	GREAT FALLS WSCMO AP
NC	312	ASHFORD
NC	1458	CAPE HATTERAS WSO
NC	1690	CHARLOTTE WSO AP
NC	2230	DALTON
NC	2719	ELIZABETH CITY
NC	7069	RALEIGH DURHAM WSFO AP

State Code	Station ID	Station Name
VA	8906	WASH NATL WSCMO AP
VT	1081	BURLINGTON WSO AP
WA	7473	SEATTLE TAC WSCMO AP
WA	7938	SPOKANE WSO AP
WA	9465	YAKIMA WSO AP
WI	3269	GREEN BAY WSO AP
WI	4961	MADISON WSO AP
WI	5479	MILWAUKEE WSO AP
WV	1570	CHARLESTON WFSO AP
WY	1570	CASPER WSO AP
WY	6597	MUD SPRINGS
WY	7105	PATHFINDER DAM

General BMP Type Codes

Code	Description	Code	BMP Category
BI	Biofilter - Grass Strip	GS	Biofilter
BS	Biofilter - Grass Swale	GS	Biofilter
BW	Biofilter - Wetland Vegetation Swale	WC	Wetland Channel
CO	Composite—Overall Site BMPs	CO	Composite Site
CX	Control—No BMP/Control Site	NA	Not Applicable
DB	Detention Basin (Dry) - Surface Grass-Lined Basin That Empties Out After A Storm	DB	Detention Basin
DC	Detention Basin (Dry) - Concrete or Lined Tank/Basin With Open Surface	DB	Detention Basin
DT	Detention - Deep Tunnel	DB	Detention Basin
DU	Detention - Underground Vault, Tank or Pipe(s)	DB	Detention Basin
FB	Filter - Carbon Granules	MF	Media Filter
FC	Filter - Compost Mixed With Sand	MF	Media Filter
FH	Filter - Geotextile Fabric Membrane (Horizontal)	MF	Media Filter
FL	Filter - Combination of Media or Layered Media	MF	Media Filter
FO	Filter - Other Media	MF	Media Filter
FP	Filter - Peat Mixed With Sand	MF	Media Filter
FS	Filter - Sand	MF	Media Filter
FV	Filter - Geotextile Fabric Membrane (Vertical)	MF	Media Filter
GR	Green Roof	GR	Green Roof
MD	Manufactured Devices	MD	Manufactured Device
IB	Infiltration Basin	IB	Infiltration Basin
IT	Infiltration (Percolation) Trench	PT	Percolation Trench/Well
IW	Infiltration (Dry) Well	PT	Percolation Trench/Well
LD	Low Impact Development	LD	LID
NS	Non-structural	NS	Non-structural BMP
OS	Oil & Water Separator	HD	Manufactured Device
OT	Other	OT	Other
PA	Porous Pavement – Porous Asphalt	PP	Porous Pavement
PG	Porous Pavement - Porous Aggregate	PP	Porous Pavement
PT	Porous Pavement - Porous Turf	PP	Porous Pavement
PC	Porous Pavement - Pervious Concrete	PP	Porous Pavement
PM	Porous Pavement - Modular Block	PP	Porous Pavement
RL	Retention Tank (Wet) - Surface Tank With Impervious Liner	RP	Retention Pond
RP	Retention Pond (Wet) - Surface Pond With a Permanent Pool	RP	Retention Pond
RT	Retention Tunnel (Wet) - Deep Tunnel With Permanent Water	RP	Retention Pond
RV	Retention Underground Vault or Pipes (Wet)	RP	Retention Pond
RW	Rainwater Harvesting	RW	Rainwater Harvesting
WB	Wetland - Basin With Open Water Surfaces	WB	Wetland Basin
WC	Wetland - Channel With Wetland Bottom	WC	Wetland Channel
WM	Wetland - Basin Without Open Water (Wetland Meadow Type)	WB	Wetland Basin

Non-structural BMP Type Codes

BMP Code	Description	Category Code	BMP Category
EA	Education - Automotive Product Disposal	ED	Education
EC	Education - Construction Site BMP Design, Installation, Maintenance Training	ED	Education
EE	Education - Schools (Elementary)	ED	Education
EG	Education - General Community Outreach	ED	Education
EH	Education - Schools (High School)	ED	Education
EI	Education - Industrial Good Housekeeping	ED	Education
EJ	Education - Schools (Jr. High School)	ED	Education
EO	Education - Commercial, Restaurant, and Retail Districts Good Housekeeping	ED	Education
EP	Education - Pesticide/Herbicide Use	ED	Education
ES	Education - Inlet Stenciling	ED	Education
MC	Maintenance Practices - Catch Basin Cleaning	MP	Maintenance Practice
MD	Maintenance Practices - Roadside Ditch Cleaning and Restoring	MP	Maintenance Practice
MP	Maintenance Practices - Parking Lot Sweeping	MP	Maintenance Practice
MR	Maintenance Practices - Road and Street Pavement Repair, Sealing, Overlay, etc.	MP	Maintenance Practice
MS	Maintenance Practices - Road Salting and Sanding	MP	Maintenance Practice
MT	Maintenance Practices - Street Sweeping	MP	Maintenance Practice
RA	Recycling - Automotive Products	RC	Recycling
RH	Recycling - Household Toxics Collection & Recycling Programs	RC	Recycling
SA	Source Controls - Automobile Service Stations	SC	Source Controls
SC	Source Controls - Construction Activities	SC	Source Controls
SF	Source Controls - Farming and Agricultural Sites	SC	Source Controls
SI	Source Controls - Industrial Sites	SC	Source Controls
SM	Source Controls - Automobile Maintenance Sites	SC	Source Controls
SO	Source Controls - Commercial, Restaurant and Retail Sites	SC	Source Controls
SS	Source Controls - Automobile Salvage Facilities	SC	Source Controls

Monitoring Station Spreadsheet Codes

ID	Monitoring Station Type	Description
1	Inflow	Inflows to BMP
2	Outflow	Includes outflows from the BMP, including underdrains eventually discharged to the surface.
3	Reference Outflow	Outflows used at control watersheds in paired BMP studies
4	Bypass	Untreated flows bypassing the BMP
5	Overflow	Untreated flows overflowing from the BMP
6	Subsurface	Includes pore water, infiltrate, groundwater or other monitoring of subsurface flows not discharged to the surface. Does NOT include underdrains eventually discharging to the surface.
7	Rain Gauge	Rain gauge
8	Inter	Intermediate monitoring location, may include intermediate lengths on swales, pond/in-lake samples, mid-treatment process samples, etc.
9	Receiving Water	Waterbody receiving discharges from the BMP
10	Sediment/Solids	Accumulated sediment
11	Other	Other type of monitoring location, describe in comments field.

Instrumentation Spreadsheet Codes

Code	Instrument Type Description
0	Bubble Gauge
1	Digital Recorder
2	Graphic Recorder
3	Land Line Telemetered
4	Radio Telemetered
5	Satellite Relayed
6	ADHAS
7	Crest Stage Indicator
8	Tide Gauge
9	Deflection Meter
10	Stilling Well
11	CR Type Recorder
12	Weighing Rain Gauge
13	Tipping Bucket Rain Gauge
14	Acoustic Velocity Meter
15	Electromagnetic Flow Meter
16	Pressure Transducers
17	Other/Describe in Comments
18	Unknown
19	Automatic Water Quality Samplers

Code	Data Type Description
0	Tide Stage Continuous
1	Water Flow/Stage Continuous
2	Water Flow/Stage Intermittent
3	Water Quality Continuous (Automatic)
4	Water Quality Grab
5	Precipitation Continuous
6	Precipitation Intermittent
7	Evaporation (Pan) Continuous
8	Evaporation (Pan) Intermittent
9	Wind Velocity Continuous
10	Wind Velocity Intermittent
11	Air Temperature Continuous
12	Air Temperature Intermittent
13	Tide Stage Intermittent
14	Water Quality Probe Continuous
15	Water Quality Probe Intermittent
16	Other/Describe in Comments
17	Unknown

Water Quality Spreadsheet Codes

Code	Sample Medium Description
0	Groundwater
1	Surface Runoff/Flow
2	Soil
3	Dry Atmospheric Fallout
4	Wet Atmospheric Fallout (*use for rainfall*)
5	Pond/Lake Water
6	Accumulated Bottom Sediment
7	Biological
8	Other/Describe in Comments

Code	Sample Type Description
1	Flow Weighted Composite EMCs
2	Time Weighted Composite EMCs
3	Unweighted (Mixed) Composite EMCs
4	Grab Sample (Single, No Compositing)

Sample Fraction	Description
Total	The total of all fractions of the analyte.
Dissolved	That portion of the analyte found in the liquid medium. Cannot be removed by filtration.
Suspended	That portion of the analyte which is suspended in the sampled medium, either as, or adsorbed to, particles which are more or less uniformly dispersed within the medium.
Settleable	That portion of the analyte which is found in or absorbed to that part of the sample which has settled (fallen out of suspension) to the bottom of the sample container.
Non-settleable	That portion of the analyte which is in or absorbed to particles remaining in suspension in the sample container after a settling process.
Filterable	That portion of the analyte which is extracted from the liquid medium by filtration.
Non-filterable	That portion of the analyte which is in or absorbed to material which passes through the filter during sample filtration.
Volatile	That portion of the analyte which evaporates readily at normal temperature and pressure.
Non-volatile	That portion of the analyte which is in a liquid or solid state under normal temperature and pressure.
Acid Soluble	That portion of the analyte which becomes dissolved within the sample following treatment with an appropriate acid.
Vapor	That portion of the analyte which exists in a gaseous state and that under ordinary conditions is liquid or solid.
Supernate	That portion of the analyte found in the liquid layer above a precipitate produced from the sample.
Fixed	That portion of the analyte found in the liquid layer above a precipitate produced from the sample.
Total Recoverable	Total Recoverable
Comb Available	Combined Available
Total Residual	Total Residual
Free Available	Free Available
Pot. Dissolved	Potentially Dissolved

Code	WQX/Modern STORET Qualifier Description
J	Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
R	Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
U	Not Detected: The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
UJ	Not Detected/Estimated: The analyte was not detected at a level greater than or equal to the adjusted CRQL or the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

Code	Detection Limit Description
1	Instrument Detection Level (IDL)
2	Method Detection Level (MDL)
3	Estimated Detection Level
4	Upper Quantitation Limit
5	Lower Quantitation Limit
6	Long Term Method Detection Level
7	Drinking Water Maximum
8	Water Quality Standard or Criteria
9	Upper Reporting Limit
10	Lower Reporting Limit

Water Quality Spreadsheet Codes: Commonly Reported Analytes

A commonly reported list of water quality analytes is provided in Worksheet 16a "Pick-list--Common WQ" and is also repeated below. For a complete list of analytes, see Spreadsheet 35 "Full Water Quality Pick-list".

WQX Parameter	Sample Fraction
General Water Quality	
Alkalinity	Total
Biochemical oxygen demand, standard conditions	NS
Calcium	Total
Calcium as CaCO3	Total
Chemical oxygen demand	NS
Chloride	Total
Dissolved oxygen (DO)	NS
Fluoride	Total
Hardness, Ca, Mg	NS
Magnesium	Total
Oil and Grease	Total
pH	NS
Potassium	Total
Sodium	Total
Specific conductance	NS
Sulfate	Total
Temperature, water	NS
Turbidity	NS
Biological Parameters	
Enterococcus	NS
Escherichia coli	NS
Fecal Coliform	NS

WQX Parameter	Sample Fraction
Metals	
Aluminum	Total
Antimony	Total
Arsenic	Dissolved
Arsenic	Total
Cadmium	Dissolved
Cadmium	Total
Chromium	Total
Copper	Dissolved
Copper	Total
Iron	Dissolved
Iron	Total
Lead	Dissolved
Lead	Total
Manganese	Dissolved
Manganese	Total
Mercury	Total
Molybdenum	Total
Nickel	Dissolved
Nickel	Total
Selenium	Dissolved
Selenium	Total
Silver	Dissolved
Silver	Total
Zinc	Dissolved
Zinc	Total

Notes:
This short list contains the most commonly reported parameters in the BMP Database. See the full WQX pick-list for other parameters, including organics.
NS = Sample fraction not specified/required.
For solids, test method determines whether suspended sediment concentration or total suspended solids should be selected.

WQX Parameter	Sample Fraction
Nutrients	
Organic carbon	Dissolved
Organic carbon	Total
Phosphorus as P	Dissolved
Phosphorus as P	Total
Phosphorus as PO4	Total
Phosphorus, organic as P	Dissolved
Phosphorus, orthophosphate as P	NS
Phosphorus, orthophosphate as PO4	NS
Nitrogen	Total
Nitrogen, ammonia as N	Total
Nitrogen, nitrate (NO3) as N	NS
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	NS
Nitrogen, Nitrite (NO2) as N	NS
Organic Nitrogen	Dissolved
Organic Nitrogen	Total
Kjeldahl nitrogen	Total
Solids*	
Suspended Sediment Concentration (SSC)	NS
Total suspended solids	NS
Total dissolved solids	NS
Total solids	Total
Total volatile solids	Non-filterable
Total volatile solids	Filterable
Total volatile solids	Total
Settleable solids	NS

Notes:

This short list contains the most commonly reported parameters in the BMP Database. See the full WQX pick-list for other parameters, including organics.

NS = Sample fraction not specified/required.

*For solids, test method determines whether suspended sediment concentration or total suspended solids should be selected.

Other WQX Characteristics
Entries for Reporting Water Level Data)
Water level in well, depth from a reference point
Water level in well, measured from ground surface
Water level in well, measured from MSL
Entries for Reporting Particle Size Distribution
Particle size, Sieve No. 04, 4 mesh, (4.75mm)
Particle size, Sieve No. 05, 5 mesh, (4.00mm)
Particle size, Sieve No. 06, 6 mesh, (3.35mm)
Particle size, Sieve No. 07, 7 mesh, (2.80mm)
Particle size, Sieve No. 08, 8 mesh, (2.36mm)
Particle size, Sieve No. 10, 9 mesh, (2.00mm)
Particle size, Sieve No. 100, 100 mesh, (0.150mm)
Particle size, Sieve No. 12, 10 mesh, (1.70mm)
Particle size, Sieve No. 120, 115 mesh, (0.125mm)
Particle size, Sieve No. 14, 12 mesh, (1.40mm)
Particle size, Sieve No. 140, 150 mesh, (0.106mm)
Particle size, Sieve No. 16, 14 mesh, (1.18mm)
Particle size, Sieve No. 170, 170 mesh, (0.090mm)
Particle size, Sieve No. 18, 16 mesh, (1.00mm)
Particle size, Sieve No. 20, 20 mesh, (0.850mm)
Particle size, Sieve No. 200, 200 mesh, (0.075mm)
Particle size, Sieve No. 230, 250 mesh, (0.063mm)
Particle size, Sieve No. 25, 24 mesh, (0.710mm)
Particle size, Sieve No. 270, 270 mesh, (0.053mm)
Particle size, Sieve No. 30, 28 mesh, (0.600mm)
Particle size, Sieve No. 325, 325 mesh, (0.045mm)
Particle Size, Sieve NO. 35, 32 Mesh, (0.425mm)
Particle size, Sieve No. 40, 35 mesh, (0.425mm)
Particle size, Sieve No. 400, 400 mesh, (0.038mm)
Particle size, Sieve No. 45, 42 mesh, (0.355mm)
Particle size, Sieve No. 450, 450 mesh, (0.032mm)
Particle size, Sieve No. 50, 48 mesh, (0.300mm)
Particle size, Sieve No. 500, 500 mesh, (0.025mm)
Particle size, Sieve No. 60, 60 mesh, (0.250mm)
Particle size, Sieve No. 70, 65 mesh, (0.212mm)
Particle size, Sieve No. 80, 80 mesh, (0.180mm)