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2 Data Applicability

This chapter includes information on former, existing and proposed stormwater performance data repositories and programs. Descriptions of the programs are included here to inform the user about what is available, not to direct anyone toward any particular program. To do a thorough review of any particular stormwater best management practice (BMP), it is useful to review information from as many programs as possible. This document recognizes this division of BMP types and focuses on the post-construction BMPs.

Outputs vary from each of the programs described below. The programs can be generally categorized as focused on field data, laboratory data or a combination of both. Some programs described in this section provide third-party verification and published monitoring data. The data collected for these programs followed specific protocols developed by their respective program. One program provides field data on stormwater BMP treatment capabilities in a central location available to all stormwater professionals.

Information from the data repositories listed in this chapter will assist engineers and regulators in assessing a stormwater BMP's pollutant removal potential. In the next chapter, a BMP Screening Tool is presented to help the user access data from various sources for applicable stormwater BMPs.

2.1 Data Quality

This section describes basic protocols and procedures that engineers should use while measuring the effectiveness of stormwater BMPs. When using performance data to inform stormwater BMP selection, consider the level of testing that produced the data, including the protocols and procedures used (Figure 1-1). In general, BMPs that undergo a robust testing process will provide a higher level of confidence that the BMP will perform as expected. That is not to say the technology with a lower testing quality protocol will not be sufficient. However, the documented effectiveness may not be as reliable due to a less-robust data set.

2.1.1 Testing Protocols for Assessing Pollutant Removal Effectiveness

The use of well-defined protocols during BMP testing helps to ensure reliability that BMPs will remove the selected contaminants. Users should collect stormwater quality data to document the effectiveness of BMPs using a developed and standardized protocol. This minimizes variations that may occur through use of inconsistent sampling methodologies. Numerous BMP evaluation programs have developed testing protocols, such as the following:

- Washington State Technology Assessment Protocol – Ecology (TAPE) Program
- New Jersey Department of Environmental Protection (NJDEP)
- Technology Acceptance and Reciprocity Partnership (TARP)
- Georgia Technology Assessment Program (GTAP)
- S. Environmental Protection Agency's (USEPA) Environmental Technology Verification (ETV) Program (discontinued)
- Environmental Technology Evaluation Center (EvTEC)

Other agencies, academia and BMP vendors have created independent testing and evaluation programs. The programs are similar in that they all use some standardized method to test and evaluate stormwater BMPs to provide water quality performance information.

2.1.2 Laboratories

There are two types of testing laboratories: one that does the actual performance testing of the unit and another that does the analytical testing of the samples generated during performance testing. A single lab may perform both functions but in this case it must meet the requirements of both types of laboratory. These requirements are outlined in the following

sections.

2.1.2.1 Performance Testing Laboratories

Performance testing laboratories or hydraulics labs, generate, control and measure flow through stormwater BMPs. Hydraulics labs should maintain a regularly audited and documented quality system. The National Environmental Laboratory Accreditation Program (NELAP) or the International Organization for Standardization (ISO) can accredit these labs. The lab should follow an approved protocol for the actual testing. A Quality Assurance Project Plan (QAPP) details the protocol. The protocol can be a pre-existing publically available protocol such as NJDEP or TAPE, or it can be a specific protocol developed in consultation with the organization that will verify the results. An example of this is a Technology Specific Test Plan (TSTP) developed for the verification by the Canadian Environmental Technology Verification (CETV) program. A TSTP should contain all the elements of a QAPP, in addition to describing the proposed protocol.

2.1.2.2 Analytical Testing Laboratories

All analytical laboratories should follow standardized test methods (e.g., USEPA SW-846) and should be NELAP or ISO accredited and have appropriate accreditation for testing not covered under the NELAP certification. Accreditation is particularly appropriate for analytical labs. All laboratory samples should have the appropriate chain of custody and quality control documentation. Researchers should flag and further investigate samples that fail Quality Assurance and Quality Control (QA/QC) or violate hold times. Researchers should document any violations of the QA/QC program.

The user should review the results and the data quality issues to evaluate if the data are usable. Additionally, researchers should review the lab QA/QC protocols to ensure that they are appropriate for stormwater. Procedures that warrant special attention include sample spike/recovery procedures and method detection limit determination.

Many labs do work for other industries, which may dictate in-house sample spike/recovery procedures and use unreasonably high sample spikes. These may not accurately represent typical stormwater concentrations. Sample spike amounts should be consistent with the expected concentration of stormwater. A lab using a total nitrogen (TN) spike of 10 mg/L as Nitrogen (N) does not show the lab's ability to recover concentrations as low as 1 mg/L as N and thus makes the reported results unreliable. This could also result in data that may be biased high (over reported) or low (under reported).

Method detection limits (MDLs), are the smallest amounts that a lab can routinely and repeatedly detect. For labs that work for other industries, total suspended solids (TSS) may not be a common test and there may be a tendency to report values based on the accuracy of the scale used in the weighing step, usually 0.001 g. This can lead to Total Suspended Solids (TSS) values of 0.1 mg/L or lower.

2.1.3 Field Data Quantity & Quality

The collection of stormwater samples from the field should be done under a controlled chain of custody according to the project-approved QAPP, or following the relevant sampling protocols established by the appropriate testing regulatory agency that will later review the data. Stormwater sampling points should be located to ensure that a representative sample of the parameter in question will be collected, (i.e., inflows, treated outflows). The sampling technique (e.g., grab, volume paced, time paced) used at any collection point should not change between storms to ensure consistency. Field sampling methods must minimize contamination potential and ensure proper sample preservation. A sufficient volume of samples should be collected so that the analytical laboratory can perform the requested testing, meet the approved laboratory test methods and allow for adequate laboratory QA/QC.

2.2 Historic Evaluation Programs

Various jurisdictions have implemented a number of programs to evaluate and/or store performance data and other stormwater BMP information. Unfortunately a number of these programs and are no longer active due to inadequate funding. These programs may still serve as a valuable source of credible performance data and other information useful in the design, operation and maintenance of stormwater BMPs. Prior to using data generated by one of these programs, users should understand the original intent of the program and the related protocols.

2.2.1 U.S. Environmental Protection Agency Environmental Technology Verification (ETV)

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The ETV Program was a public-private partnership administered by National Science Foundation (NSF) International, under a

cooperative agreement and with support from USEPA. The goal of the program was to verify the performance of innovative technologies intended to protect ground and surface waters. Between 2000 and 2007, the program evaluated and subsequently verified 10 different stormwater BMPs.

The program developed a comprehensive field monitoring protocol with the input from a diverse group of stormwater industry stakeholders. The ETV Verification Protocol has a considerable amount of overlap with protocols like the TARP Tier II Field Protocol. To receive ETV field verification, third-party practitioners are required to carry out long-term field monitoring in accordance with QAPPs developed and approved before the start of monitoring.

The studies executed under the ETV field monitoring protocol occurred at several locations around the country by independent contractors with varying levels of expertise in field monitoring. At the time, USEPA considered the resulting verification reports and data credible for making regulatory decisions relative to the evaluated BMPs.

Engineers should use data from the ETV Program with caution. Findings from ETV Program studies should be evaluated carefully so that you obtain a comprehensive understanding of the study and how researchers obtained the resulting data before making decisions based on the reported findings.

USEPA has posted Verification Statements and the Full Verification Reports on their website. Use the “Stormwater source-area treatment devices” link in the bulleted list to see the reports.

2.2.2 Technology Assessment Reciprocity Partnership (TARP)

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The TARP Tier II Field Protocol for Stormwater BMP Demonstrations was a field monitoring protocol developed and endorsed by a consortium of states that included California, Massachusetts, Maryland, New Jersey, Pennsylvania and Virginia. Recognizing that field monitoring to collect local data in every state is expensive and impractical, the group established a protocol with sufficient rigor to encourage the acceptance of resulting data from TARP compliant studies in all participating states. Participating states were not obligated to grant approval based on TARP data; however, the participating states agreed to consider the resulting data credible since the researchers use a recognized testing protocol. The idea behind the partnership was that it would accelerate acceptance of evaluated BMPs when applicable.

During development of the TARP Protocol (TARP 2001), each of the participating states provided a representative to the TARP governing body. After completion of the protocol, New Jersey included the protocol into their certification requirements for innovative stormwater BMPs. From 2003 to 2013, New Jersey maintained an active BMP certification program that required participants to complete a field test in accordance with the TARP field protocol to receive final certification.

After utilizing the TARP Protocol for three years, New Jersey chose to issue a number of amendments to the TARP criteria in the original protocol (TARP 2006). The TARP participants did not formally adopt these amendments, but most still consider granting reciprocity for studies completed as part of the New Jersey certification process. In 2013, New Jersey transitioned to a new certification process (Section 2.4.2) that relies only on laboratory testing.

Currently the TARP partnership is inactive, but many of the original states continue to accept data collected in accordance with this protocol and stormwater practitioners continue to regard the protocol as reliable.

The New Jersey Corporation for Advanced Technology (NJCAT) website contains current archives of the TARP field studies conducted as part of the New Jersey Certification Process.

2.2.3 The Massachusetts Stormwater Technology Evaluation Project (MASTEP)

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MASTEP consisted predominantly of a web-based stormwater BMP clearinghouse created by the University of Massachusetts Amherst (UMass) with funding from the Massachusetts Department of Environmental Protection (MassDEP). The purpose of the database is to provide access to water quality performance data and other relevant information on Stormwater BMPs evaluated using recognized protocols. The website is no longer active, although UMass still has the data available.

The database currently contains water quality information data for more than 100 different BMP studies. MASTEP does not rate BMP water quality performance or serve as a regulatory entity. Their primary function is to compile available water

quality data and rate the quality of that data against industry accepted protocols. Since Massachusetts is a member of the TARP partnership and participated in the creation of the protocol, the MASTEP project uses the TARP Field protocol as the gold standard in rating the quality of collected water quality data.

MASTEP uses a scale of 1 to 4 to rate BMP water quality data, based on the adherence of the testing program to recognized protocols and the representativeness of their test data. A rating of "1" has the highest credibility and a rating of "4" indicates the lowest credibility. A higher rating from MASTEP does not mean the technology is a top performer, but instead means users should have a high degree of confidence in the collected data. In addition to the numeric ratings, MASTEP includes relevant notes about the studies it reviews for each BMP and provides links to the studies themselves.

Assigning pollutant removal expectations to a BMP remains the responsibility of the user. As of 2014, MassDEP was no longer able to provide funding to the MASTEP project and the website no longer exists, although the information remains available. The database has not received any new content since that time. However, the database currently remains and the past work is available for review.

2.2.4 The Canadian ETV (CETV) program

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The CETV program developed an overarching protocol, the General Verification Protocol (GVP) for verifying any environmental technology. It also developed, with stakeholder input, a specific Procedure for Laboratory Testing of Oil-Grit Separators. Readers may find these protocols on the website ETV Canada Protocols and Procedures. In March 2017, the Canadian government stopped financially supporting the CETV program, preferring to rely instead on the newly published ISO 14034 standard. However, the ETV website will accept technologies verified according to ISO14034 requirements.

In addition to the protocols, the Canadian ETV website has verified performance data on five stormwater technologies evaluated in 2016 and 2017 under the old CETV program. This data is valid for three years, so those technologies may continue to use the "Canada Verified" logo and no changes will occur on the website.

2.2.5 ISO 14034:2016 Environmental Management — Environmental Technology Verification (ETV)

▼*Read more*

The ISO 14034 standard, published in November 2016, describes an overall process for ETV. Transparent, scientifically rigorous testing and verification conducted by independent parties is the focus of the program. The testing lab should be accredited to ISO 17025:2005 General requirements for the competence of testing and calibration laboratories and the verifier should be accredited to ISO 17020:2012 Conformity assessment – Requirements for the operation of various types of bodies performing inspection. All of these standards are available for purchase at ISO Store ISO 14034 does not specify any test protocols, so the existing NJDEP and TAPE protocols could be used for obtaining ISO certification.

The advantage of the ISO 14034 process is that it is designed to deliver very reliable results, which are also internationally recognized. The disadvantage of the ISO 14034 process is that it is very new and not all the necessary pieces are in place yet. For example, neither the Canadian nor American, national accrediting bodies (Standards Council of Canada and American National Standards Institute) have programs in place to accredit verifiers according to ISO 17020. In the stormwater space, this gap is currently being filled by (VerifiGlobal). VerifiGlobal is performing peer assessments of potential verifiers, in accordance with ISO 17040:2005 "*Conformity assessment – General requirements for peer assessment of conformity assessment bodies and accreditation bodies.*"

2.3 Existing Data Verification Programs

Table 2-1 includes general information on the five existing programs discussed in this section.

View Table 2-1 in Adobe PDF format.

Criteria	TAPE	NJCAT	STTC	BMPDB	STEPP
Region	Region	New Jersey	Oregon	International	National
Lab Tests	✓	✓	✓	✓	✓
Field Tests	✓	NA	✓	✓	✓
Long Term Testing	NA	NA	✓	NA	✓
Testing Parameters	TSS, Dissolved Copper, Dissolved Zinc, phosphorus, oil/grease	Remove 80% TSS, or 50% TSS when used in conjunction with other BMP	Under Final Development (match TAPE, at a minimum)	Varies Based on researcher inputs	Proposed
Stakeholder Involvement	✓ Throughout	✓ Initial Set-up	✓ Throughout	✓ Varies	✓
Guidance Documents	✓	✓	✓	NA	✓
Publicly Accessible	✓	✓	✓	✓ Provides statistical comparison	✓
Certifies	✓	✓	NA	NA	NA

NA = Not Applicable
✓ = Applicable

2.3.1 Technology Assessment Protocol – Ecology (TAPE)

The Washington State Department of Ecology (Ecology) manages three separate municipal stormwater general permits. Within the three permits are requirements for installation of water quality treatment BMPs on new and redevelopment projects. Depending on the water quality characteristics of the inflow to the BMP and receiving waters, the BMPs must meet certain criteria for removal of TSS, dissolved copper (Cu), dissolved zinc (Zn), total phosphorus (TP) and oil/grease.

In October 2002, Ecology released TAPE, the first version of the testing and evaluation protocol for BMPs. Ecology staff and volunteer experts provided the initial technical expertise. Ecology suspended the program for new applications between 2008 and 2011 due to the loss of available volunteer reviewers and Ecology staff. Ecology continued to review submittals from BMPs already in TAPE.

In late 2009, Ecology provided two grants to the City of Puyallup, to create a statewide stormwater center and to re-establish the TAPE program. Under the grant, Ecology created the Washington Stormwater Center and brought the TAPE program back to life. Ecology created a stakeholder advisory group (SAG) to assist in restarting the TAPE program and developing a new guidance manual and overview documents, which took approximately one year to complete. Ecology reopened the program for BMP testing and certification in late 2011.

The reconstituted TAPE program provides a peer-reviewed regulatory certification process for emerging stormwater BMPs. Ecology administers the TAPE program with assistance from staff at the Washington Stormwater Center, which provides assistance including guidance on certification of emerging stormwater BMPs.

Recognizing that an all-volunteer BMP evaluation process is unsustainable, Ecology and the Washington Stormwater Center established and paid a board of external reviewers (BER) comprised of stormwater experts including academia, regulators, consultants and manufacturers to:

- Review emerging BMP design and water quality performance data and resulting in a recommendation on whether or not to certify the BMP.

- Provide overall advice and guidance as the TAPE program evolves and improves.

Based on BER technical reviews, which include discussions with applicants as needed, Washington Stormwater Center staff members advise Ecology on whether a new stormwater BMP meets the state's performance goals. Ecology adds BMPs that meet the water quality treatment goals to the list of approved BMPs in both of Washington's two stormwater management manuals. Ecology makes the final decision to certify new stormwater BMPs.

Evaluation of BMPs is an important part of Ecology's stormwater work, which is why Ecology prioritizes and is committed to maintaining the TAPE program.

2.3.1.1 TAPE Testing Protocols

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Under TAPE, applicants must demonstrate water quality performance through testing their stormwater BMP under rainfall conditions typical to the Pacific Northwest. Ecology specifically designed the testing protocol to evaluate flow-through BMPs, which do not provide significant upstream storage, resulting in relatively short detention times. As a result this protocol may not be suitable for all stormwater BMPs. Ecology began a process to create a long-detention time monitoring procedures manual for BMPs, which provides significant storage and attenuation in 2008, but have not finalized the protocol as of 2017.

The Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol – Ecology (TAPE) contains Ecology's set of protocols for testing emerging technologies BMPs. A less detailed overview of the program is available at Technology Assessment Protocol – Ecology (TAPE) Process Overview.

Certification of BMPs depends on their water quality performance relative to one or more of the five performance goals described in (Table 2-2).

Table 2-2. TAPE performance goals.

Performance Goal	Influent Range [a]	Criteria [a, b]
Basic Treatment	20-100 mg/L TSS	Effluent goal ≤ 20 mg/L TSS
	100-200 mg/L TSS	≥ 80% TSS removal
	> 200 mg/L TSS	> 80% TSS removal
Dissolved Metals Treatment	Dissolved copper 0.005 – 0.02 mg/L	Must meet basic treatment goal and better than basic treatment currently defined as >30% dissolved Cu removal
	Dissolved zinc 0.02 – 0.3 mg/L	Must meet basic treatment goal and better than basic treatment currently defined as > 60% dissolved Zn removal
Phosphorus Treatment	Total phosphorus (TP) 0.1 to 0.5 mg/L	Must meet basic treatment goal and exhibit ≥ 50% TP removal
Oil Treatment	Total petroleum hydrocarbon (TPH) > 10 mg/L	*1)* No ongoing or recurring visible sheen in effluent *2)* Daily average effluent TPH concentration < 10 mg/L *3)* Maximum effluent TPH concentration of 15 mg/L for a discrete (grab) sample
Pretreatment[c]	50-200 mg/L TSS	≤ 50 mg/L TSS
	≥ 200 mg/L TSS	≥ 50% TSS removal

Performance Goal	Influent Range [a]	Criteria [a, b]
1. Samples with influent concentrations that are greater than the range may be included by artificially setting the value at the upper end of the concentration range prior to completing the pollutant removal efficiency calculations. If the applicant opts to include samples with concentrations that are greater than the influent range, they must include all valid samples that are greater than the range (i.e., applicants cannot “cherry pick” data. 2. See TAPE Technical Guidance Manual for further details. 3. Pretreatment technologies generally apply to (1) project sites using infiltration treatment and (2) treatment systems where pretreatment is needed to ensure and extend performance of the downstream basic or dissolved metals treatment facilities.		

2.3.1.2 Information Available to the Public

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Ecology evaluates the existing data provided by an applicant for a stormwater BMP to assign use level designations that determine how many installations may occur in Washington and what the monitoring requirements are for obtaining additional data on treatment performance. Depending on the relevance, amount and quality of the water quality performance data provided with the application for certification, Ecology initially places the technology BMP into one of two use level designation categories: Pilot Use Level Designation (PULD) or Conditional Use Level Designation (CULD) (Table 2-3). PULDs are typically given when there are sufficient laboratory data available to indicate that a BMP may meet the water quality performance goals for TAPE that are described in the previous subsection. Ecology typically establishes a CULD when there are both laboratory and field water quality data available of sufficient quality for a BMP that would indicate an even greater likelihood of meeting the TAPE performance goals. The PULD and CULD allow installation and operation of the BMP in the State of Washington in order to gather the additional water quality performance data required for a final General Use Level Designation (GULD) certification. GULD designations allow use of a BMP with water quality performance data assumed to be consistent with certification testing data. BMPs with the GULD certification require no further verification testing. Ecology accepts devices with a GULD as meeting water quality treatment requirements for new and redevelopment projects. Ecology has posted use level designations for manufactured treatment devices on their website at Emerging Stormwater Treatment Technologies (TAPE).

Table 2-3. TAPE use levels.

Use level designation	Minimum data required for Designation [a]	Time limit (months) [b]	Maximum number of installations in Washington State	Field testing required under designation
Pilot (PULD)	Laboratory	30	5[c]	A minimum of one site indicative of, or located in, the Pacific Northwest; the applicant must monitor *all* sites installed in Washington State [d]
Conditional (CULD)	Field data required; laboratory data may supplement	30	10[c]	A minimum of one site indicative of, or located in, the Pacific Northwest
General (GULD)	Field data required; laboratory data may supplement	Unlimited	Unlimited[e]	None

Use level designation	Minimum data required for Designation [a]	Time limit (months) [b]	Maximum number of installations in Washington State	Field testing required under designation
1. Proponent must supply all available water quality performance data with the initial certification application. PULD and CULD approvals will depend on the relevance, amount and quality of data. Submittal of data does not ensure approval. 2. Length of time pilot and conditional certifications are valid following the time Ecology produces the original use level designation. Ecology typically allows proponents with a PULD or CULD a maximum of 30 months to prepare a QAPP, receive QAPP approval, conduct stormwater monitoring according to the QAPP, and prepare a Technical Evaluation Report (TER) requesting CULD or GULD certification for their stormwater BMP. Proponents requiring extensions on the 30-month use level designation, or the submittal of a QAPP or TER, must submit a request to Ecology at least two weeks before the due date. Ecology will grant extensions only if the proponent shows progress toward completing required TAPE components. 3. No installation limit on implementation of BMP for retrofit projects. 4. Local governments covered by a municipal stormwater National Pollutant Discharge Elimination System (NPDES) permit must submit a Notice of Intent form to Ecology when they propose to use a PULD BMP in their jurisdiction. 5. Subject to conditions imposed by Ecology (i.e., maximum flow rates, limitations on drainage basin size, locations for use, and others as appropriate) listed in the GULD document posted on Ecology's website. Local jurisdictions may impose other conditions or decline to accept a device with a GULD.				

Ecology designed the TAPE certification process to ensure that the approved BMPs meet applicable design criteria and water quality performance goals for new development and redevelopment. GULD designation means that the new BMP has successfully met the TAPE performance goals. However, TAPE certification does not mean the BMP is appropriate for all stormwater treatment applications. Stormwater management authorities should use TAPE certification as one of many factors when selecting or allowing specific stormwater BMPs and water quality treatment solutions in their jurisdiction. Authorities must base their selection of a BMP on a cost-benefit analysis and not simply on the fact that a BMP is TAPE-certified. Although TAPE is a Washington State protocol, several other states, counties and cities such as St. Louis, MO; New York State; and Bend and Eugene, Oregon use TAPE certification to determine whether to allow installation of a BMP within their jurisdiction.

2.3.1.3 Benefits and Drawbacks

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The TAPE performance goals do not address capital costs, costs for operation and maintenance (O&M), or costs for material disposal; however, proponents are encouraged to provide this supplemental information in their TER. In addition, the TAPE certification process represents specific influent concentration ranges and does not typically include an assessment of long-term performance. Local stormwater authorities should consider these and other factors when evaluating the potential use of a TAPE-certified treatment technology.

2.3.2 New Jersey Corporation for Advanced Technology (NJCAT)

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The New Jersey Department of Environmental Protection (NJDEP) works in partnership with the New Jersey Corporation for Advanced Technology (NJCAT) to implement an evaluation program for manufactured treatment devices (MTDs), which are a subset of BMPs. MTDs are treatment BMPs that are manufactured and sold by businesses as standalone treatment systems and do not typically have available information on treatment capabilities like more generic BMPs, such as swales and wet ponds. Historically, NJDEP implemented a two-phase process that included an initial laboratory-testing component completed in accordance with a NJDEP-specific laboratory protocol followed by a field test component executed in accordance with the TARP Tier II field-testing protocol. In 2013, NJDEP opted to relaunch their program and moved to an entirely laboratory based process. After an extensive stakeholder process, NJDEP published two different laboratory protocols to evaluate filtration technologies and hydrodynamic separator technologies respectively. Additionally, a process document accompanies the protocols, and defines the steps for implementation of and reporting results of the verification/certification process.

NJCAT is a public/private partnership originally created to help facilitate the growth and use of innovative energy and

environmental technologies in New Jersey. It functions as an independent technical entity and often works with other relevant independent experts in evaluating a technology. NJCAT serves to verify that any MTD seeking NJDEP certification has completed the applicable testing and otherwise complied with all of the standards established by the verification/certification process. NJCAT works with BMP providers from the time they first apply to participate in the process through final determinations, such as the issuance of a final verification report that serves as the basis for NJDEP certification. Once NJCAT issues a final verification report, they post it to a database on NJCAT's Website and NJ DEP issues a certification letter for those MTDs meeting all current program requirements.

NJCAT verifies BMP testing, which does not comply with the current NJDEP protocols due to the development of a new process or technology that may require different techniques to properly evaluate water quality performance. However, jurisdictions in New Jersey may use only those studies that also receive NJDEP certification to meet New Jersey's stormwater regulations. Additionally, the NJCAT Verification Database includes historic verifications completed under the old NJDEP process. NJDEP maintains a separate database that includes all of the MTDs with active/current certifications.

The NJDEP protocols are written based on the stormwater quality standards in the State of New Jersey that require removal of 80% of the (TSS) load from new development. At this time, NJDEP does not evaluate or rate stormwater BMPs for their ability to remove pollutants other than TSS.

NJDEP does not consider hydrodynamic separators to be primary treatment practices on new development so the hydrodynamic separator protocol calls for achieving >50% TSS removal using a weighted formula that is tied to the expected distribution of rainfall intensity in New Jersey. MTDs that achieve >50% TSS removal and otherwise comply with the hydrodynamic separator protocol are awarded 50% TSS credit for regulatory purposes. This essentially requires use in combination with other BMPs in a treatment train to meet the 80% TSS requirement. The hydrodynamic separator protocol also includes a mandatory scour testing provision to ensure retention of previously captured pollutants during peak flows. The testing process also identifies the maximum treatment flow rate a given technology can handle while treating the expected peak flow rate from the water quality storm. Relevant sizing information for each is included in the resulting verification report and certification letter.

Since filters rely on different removal mechanisms than hydrodynamic separators, and are generally capable of achieving higher levels of pollutant removal, the NJDEP developed a filter potocol. Filters must demonstrate >80% TSS removal over a series of test runs at their intended or design maximum operating rate in order to receive 80% TSS certification by NJDEP. Acquiring this certification makes filters eligible to be primary treatment practices and used as standalone BMPs on new development projects in New Jersey. In addition to water quality performance, the filter protocol also evaluates the amount of mass a filter can capture before occluding to the extent of losing more than 10% of its hydraulic capacity or exceeding the available design driving head. NJDEP uses this information to ensure the filter design includes sufficient capacity to handle expected annual sediment loads without excess clogging. The filter protocol also includes an optional scour provision for filters/providers that wish consideration for online installation.

2.3.3 Stormwater Technology Testing Center (STTC)

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In 2009, a group of stormwater professionals representing the Oregon Department of Transportation (ODOT) and several local agencies in Oregon (City of Portland, City of Gresham, City of Lake Oswego, City of Eugene, Clean Water Services, and the Port of Portland) convened to discuss the challenges of, and ways to improve, the management of large stormwater programs. They found that Ecology and a few other agencies had facilities or protocols established for the evaluation of the pollution removal effectiveness of newly installed stormwater BMPs. They determined that none of the existing facilities or protocols had the capability to demonstrate a stormwater BMP's ability to treat water over the long-term. There are no programs to determine maintenance requirements, how much it costs to conduct that maintenance, and at what point in the service life the product would need replacement. ODOT viewed these findings as a significant gap in their understanding of BMPs and their ability to create a qualified BMP list that improves environmental protections and protects local, state and federal transportation investments.

After discussions with Ecology and other stakeholders, the concept of the Stormwater Technology Testing Center (STTC) was born. ODOT created an advisory committee and developed a business plan and protocols for evaluating stormwater BMP maintenance requirements and lifecycle costs. ODOT obtained, designed and constructed a testing center in Portland, Oregon. The STTC site is equipped to evaluate up to three BMPs simultaneously and in accordance with the appropriate TAPE

protocols. Additionally, the STTC applies the recently created maintainability protocols. The remotely operated computer control center receives information from three weather stations and the refrigerated samplers installed throughout the 1,000-acre contributing mixed-urban watershed and the computer controlled positive displacement pumps. ODOT expects the site to be an efficient location for testing stormwater BMPs due to the large amount of stormwater generation potential available and the ease of access. They expect the new standard of maintainability testing to be extremely useful for regulators, owners and operators of all sizes of facilities or programs.

ODOT owns the STTC site and is responsible for the facility. A board of directors containing representatives from local agencies, ODOT, Oregon Department of Environmental Quality (DEQ), and the Washington State Departments of Transportation (WSDOT) and Ecology provides oversight and policy direction. A technical advisory committee (TAC), created by the board, provides technical support and guidance. The STTC Board hopes to share the maintenance metrics on each of the BMPs with other stormwater bodies across the United States.

ODOT completed construction of the STTC in Portland, Oregon in November 2016. However, the STTC program is not yet operational as of the date of this publication. ODOT has selected the initial site operator. The operator's scope of work (the division of work to be performed under a contract or subcontract in the completion of a project, typically broken out into specific tasks with deadlines) includes site preparation, calibration and preliminary facility testing. The operator is also responsible to for developing an operations budget, seeking funding and ensuring the facility operates in accordance with the developed protocols.

2.3.3.1 Testing Protocols

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ODOT developed draft stormwater BMP general water quality performance testing protocols for the site during the initial site design. The site operator will create BMP specific testing protocols for each device once they are selected for testing. These protocols control installation and monitoring of BMPs on the facility for the TAPE and maintenance evaluations. The protocols are subject to modification prior to opening the STTC site for testing. The TAC will review the operational protocol and suggest modifications, if necessary.

Once open for testing, the STTC will quantify the requirements to maintain water quality performance characteristics and the associated costs of commercially ready stormwater treatment BMPs that have the potential to improve and protect water quality and the environment.

2.3.3.2 Information Available to the Public

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Information from the tests performed at the STTC is public information, subject to the limitations of confidentiality of business information to include copyright protections. Information developed for submission to the TAPE program is available through their website. The STTC will make the results of the O&M monitoring available to the public. The precise manner of this depends on decisions made over the next year. The STTC can serve as a national laboratory for the professional stormwater community to provide regulators, designers, owners and permittees of stormwater BMPs with an independent assessment of the BMP. This type of testing facility can provide an additional level of comfort that the BMP will perform as expected. STTC has a level of credibility due to its non-profit status, and transparent assessment mechanisms.

2.3.3.3 Benefits and Drawbacks

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The STTC can evaluate maintenance characteristics of properly functioning stormwater BMPs, which is a necessary aspect to the successful design and operation of stormwater BMPs. Any new information on maintenance needs for stormwater BMPs will benefit water quality. There are currently no other testing facilities providing this type of long-term field performance data on full-size BMPs.

The facility is not in place yet, with no history of BMP evaluations. STTC has not confirmed its ability to fulfill its mission and it is unclear if the facility will perform as designed. However, ODOT is confident that the STTC facility and the selected operator can take the facility forward to produce valid treatment, operations and maintenance information.

2.3.4 International Stormwater BMP Database (BMPDB)

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The International Stormwater BMP Database (BMPDB) is a publicly-accessible repository for stormwater BMP performance, design and cost information. The overall purpose of the project is to provide scientifically sound information to improve the design, selection and performance of stormwater BMPs. Continued population of the database and assessment of its data has, and will continue to, lead to an improved understanding of the factors influencing BMP water quality performance and continue to help to promote improvements in BMP design, selection and implementation.

Since the initial development of the BMPDB in 1996, the Water Research Foundation (WRF) and various funding partners, including the Federal Highway Administration (FHWA), the American Public Works Association (APWA), the Environmental and Water Resources Institute (EWRI), and USEPA, have contributed to its continued development and growth. The original release of the BMPDB occurred on a compact disc in 1999, containing 73 studies conducted in the 1980s and early 1990s. As of November 2016, the BMPDB contains data sets from nearly 650 BMP studies that are accessible on the project website (www.bmpdatabase.org). Interested parties may access study data using a study query tool, web-based map interface, a statistical analysis tool, and/or by downloading the entire database to a Microsoft Access file. Additionally, the BMPDB team periodically produces and posts statistical summary reports on the website.

WRF, a water quality focused non-profit research organization, is the current manager of the BMPDB project. WRF has been conducting research on water quality for over 25 years and has conducted approximately 570 projects over a wide range of topics from biosolids to water quality criteria, including multiple stormwater related projects. WRF contracts with Wright Water Engineers (WWE) and Geosyntec Consultants to support the technical development, maintenance and expansion of the BMPDB. WWE and Geosyntec served as the co-principal investigators on the project since inception over 20 years ago. The project team and sponsors do not endorse any specific BMP or BMP design attributes and they admit all studies that meet the minimum data reporting protocols for entry.

The BMPDB is the largest known comprehensive database of stormwater BMP water quality performance study data that is regularly updated and maintained. Additionally, the BMPDB contains data from many parts of the United States, as well as several other countries. Updates occurred approximately annually since the initial release of the database in 1999. Given the longevity and long-term commitment of support from WRF, EWRI, FHWA, and the project team, the BMPDB is likely to continue to expand as a resource for stormwater professionals and interest groups.

2.3.4.1 Testing Protocols

▼*Read more*

The BMPDB project is not a BMP verification/certification program; it is an information and data repository. The database managers periodically produce reports on the water quality performance of stormwater BMPs based upon the entered data and information in the BMPDB. Poor water quality performance of a studied BMP is not a reason for data exclusion. In fact, poor-performing studies can be as valuable in understanding BMP water quality performance related to design characteristics as studies that document well-performing BMPs. The intended purpose of the BMPDB is to provide a data exchange tool that permits characterization of BMPs solely upon their measured water quality performance using consistent protocols for measurements and reporting data.

The BMPDB team produced a detailed stormwater BMP monitoring guidance manual in 2002 to promote the 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 BMPDB. Since that time both the BMPDB project and stormwater BMPs have continued to evolve, prompting an update and second release of the manual in 2009. The revised manual reflects the current state of the practice for BMPs and describes low impact development (LID) monitoring and reporting methods, as well as describing robust statistical data evaluation techniques.

Researchers may enter all types of stormwater BMPs into the BMPDB. However, the database includes developed fields for:

- Detention Pond
- Retention Basin
- Buffer Strip
- Swales
- Media Filter

- Permeable Pavement
- Infiltration Basin
- Percolation Trench (including Dry Wells)
- Wetland Channel
- Wetland Basin
- Manufactured Device (Multiple Types)
- Bioretention
- Green Roof
- Rainwater Harvesting
- LID sites

Users can also enter data for Non-structural BMPs, “Other” BMPs (general), and Composite BMPs (treatment trains). For each of these general categories, researchers can specify sub-types, as summarized in Table 2-4 for structural BMP types.

Table 2-4. Summary of structural BMP categories and subcategories in the BMP Database.

Category Code	Category Code Description	BMP Code	BMP Subcategory Description
BI	Grass Strip	BI	Biofilter – Grass Strip
BR	Bioretention	BR	Bioretention
BS	Grass Swale	BS	Biofilter – Grass Swale
CO	Composite	CO	Composite – Overall Site BMP
CX	Control	CX	Control – No BMP/Control Site
DB	Detention Basin	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)
GR	Green Roof	GR	Green Roof
IB	Infiltration Basin	IB	Infiltration Basin
LD	LID	LD	Low Impact Development-Site Scale
MD	Manufactured Device	HD	Hydrodynamic Devices (e.g., Swirl Concentrators, Separation Systems, etc.)
MD	Manufactured Device	MD	Manufactured Device
MD	Manufactured Device	OS	Oil & Water Separator
MF	Media Filter	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)
OT	Other	OT	Other – Uncategorized BMP
PF	Permeable Friction Course	PF	Permeable Friction Course

Category Code	Category Code Description	BMP Code	BMP Subcategory Description
PP	Porous Pavement	PA	Porous Pavement – Porous Asphalt
PP	Porous Pavement	PC	Porous Pavement – Pervious Concrete
PP	Porous Pavement	PG	Porous Pavement – Porous Aggregate
PP	Porous Pavement	PM	Porous Pavement – Modular Blocks
PP	Porous Pavement	PT	Porous Pavement – Porous Turf
PT	Percolation Trench/Well	IT	Infiltration (Percolation) Trench
PT	Percolation Trench/Well	IW	Infiltration (Dry) Well
RP	Retention Pond	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)
RW	Rainwater Harvesting	RW	Rainwater Harvesting
WB	Wetland Basin	WB	Wetland – Basin with Open Water Surfaces
WB	Wetland Basin	WM	Wetland – Basin without Open Water (Wetland Meadow Type)
WC	Wetland Channel	BW	Biofilter – Wetland Vegetation Swale
WC	Wetland Channel	WC	Wetland – Channel with Wetland Bottom

Researchers can enter practically any monitored pollutant into the BMPDB. The database developers based the list of pollutants on the USEPA's Water Quality Exchange (WQX) framework. Researchers can also provide precipitation and flow data for storm events. Metadata about the study site including watershed characteristics, monitoring system configuration, and the BMP design information supports the monitoring data.

The BMPDB web tools and performance reports summarize influent and effluent concentrations based on basic summary statistics, including both non-parametric and parametric statistical parameters (e.g., mean, median, quartiles, geometric mean). The performance reports also provide confidence intervals and graphical summaries along with selected hypothesis test results that evaluate whether there are statistically significant differences between influent and effluent concentrations. The BMPDB does not report load reduction and percent removal metrics due to the many well-documented limitations regarding use of such metrics. Table 2-5 and Figure 2-1 provide sample statistical output summary for various BMP categories for TSS.

Table 2-5. BMP performance summary statistics for total suspended solids (EMC = Event Mean Concentration)
(Consultants 2016)

BMP Type	Total Suspended Solids (mg/L)										
	BMP		EMC Count		25th		Median			75th	
	In	Out	In	Out	In	Out	In	Out	Statistical Difference	In	Out
Bioretention	25	25	520	463	18	4	40.6 (36.0, 46.0)	10.0 (8.0, 10.0)	◆◆◆	99.2	18.5
Composite	10	10	202	174	42	8	85.7 (75.0, 101.3)	18.0 (13.7, 19.3)	◆◆◆	178.8	36.5
Detention Basin	32	32	411	426	24	11	68.0 (57.4, 76.2)	24.4 (21.9, 27.1)	◆◆◆	129	49.4
Grass Strip	19	19	361	282	20	10	44.0 (39.0, 48.0)	19.0 (16.0, 21.0)	◆◆◆	90	35
Grass Swale	24	24	442	418	9.2	11	28.6 (23.0, 34.9)	24.0 (19.0, 26.0)	◇◇◆	67.5	46.7
LID	3	3	131	62	26	13	51.0 (32.9, 54.0)	29.5 (15.0, 49.0)	See note.	87.5	82
Media Filter	25	25	400	377	22	3.9	56.4 (46.0, 62.0)	9.0 (6.4, 10.0)	◆◆◆	120	22.8
Porous Pavement	9	9	404	248	37	15	93.7 (74.7, 126.0)	26.0 (20.8, 27.0)	◆◆◆	243	53.2
Retention Pond	56	56	923	933	15	4.3	47.2 (40.0, 54.0)	11.7 (10.0, 12.1)	◆◆◆	139.8	28
Wetland Basin	22	22	492	486	13	4.7	31.0 (26.2, 35.4)	14.1 (11.6, 15.2)	◆◆◆	75.9	31
Wetland Basin/ Retention Pond	78	78	1415	1419	14	4.5	38.9 (35.5, 43.5)	12.0 (11.1, 13.0)	◆◆◆	110.3	29.6
Wetland Channel	12	12	199	178	13	8	22.0 (18.0, 24.0)	17.0 (12.3, 19.0)	◇◆◆	98.4	40.5

Notes: In = Inflow; Out = Outflow. Values in parentheses are the 95% confidence intervals for the median values. Statistical differences are not evaluated for LID, due to a small number of studies and volume reduction, reducing the number of effluent EMCs.

A black diamond indicates statistical differences for BMPs for three comparison methods as illustrated below:

- ◆◇◇ – *95% confidence intervals around influent/effluent medians do no overlap.*
- ◇◆◇ – *P-value of the Mann-Whitney test is less than 0.05.*
- ◇◇◆ – *P-value of the Wilcoxon test is less than 0.05.*

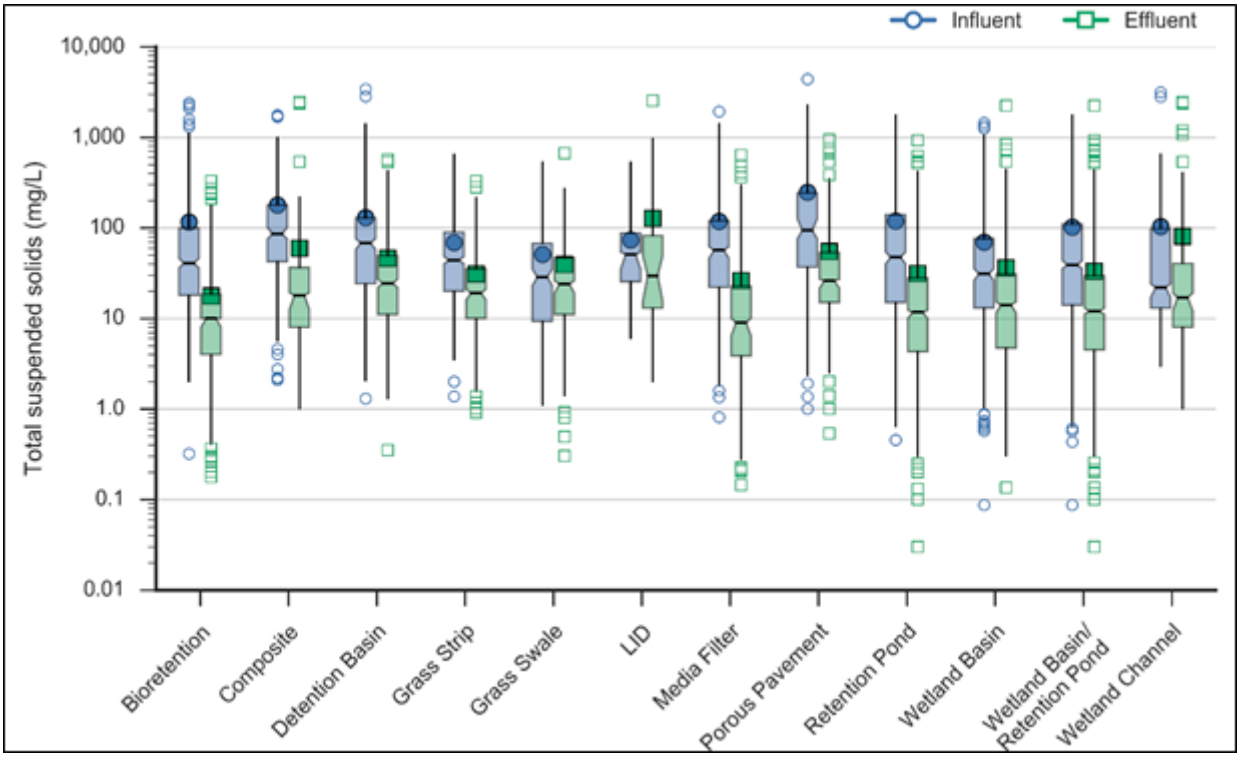

Figure 2-1. BMP performance boxplots for total suspended solids. (Consultants 2016)

2.3.4.2 Information Available to the Public

▼*Read more*

The BMPDB project website (International Stormwater Database) provides consolidated access to a variety of guidance and interpretive reports related to BMP water quality performance, in addition to access to the BMPDB itself. For example, monitoring guidance, recommendations for statistically sound approaches for performance analysis, reporting protocols (e.g., data entry spreadsheets and user's guide), online statistical analysis tools, presentations, and summary reports are freely available and accessible to the public on the website. Pollutant summary reports have generally focused on analyzing solids, nutrients, metals, and bacteria for the most commonly monitored and reported BMP types. These include:

- Grass strips
- Bioretention
- Bioswales
- Composite/treatment train BMPs
- Detention basins (surface/grass-lined)
- Media filters (mostly sand filters)
- Porous pavement
- Retention ponds (surface pond with a permanent pool)
- Wetland basins (basins with open water surface)
- Wetland channels (swales and channels with wetland vegetation
- A combined category including both retention ponds and wetland basins

Table 2-6 contains a summary of the types of BMPs accessible in the BMPDB as of 2016 and the number of studies for each BMP type.

There are several viable approaches to evaluating water quality performance data in the BMPDB. The two general approaches include "BMP-weighted" and "storm-weighted" approaches. The BMP-weighted approach represents each BMP with values representing the central tendency and variability of each individual BMP study, whereas the storm-weighted approach combines all of the storm events for the BMPs in each category and analyzes the overall storm-based data set. The storm-weighted approach has been the method of choice for the categorical analysis reports because it provides a much larger data set. As the BMPDB grows, the BMPDB team may revisit the BMP-weighted analysis approach.

All the BMP studies include design information, but the level of detail varies greatly as many design parameters are optional data entry elements. The BMPDB protocols request that the data provider include the sizing criteria or design basis for each BMP type. Minimum design sizing or design criteria have not been established for the inclusion of data (i.e., studies are not excluded for BMPs being undersized or oversized). Database users are able to query the datasets to investigate relationships between BMP sizing and performance.

Table 2-6. BMPs in the International Stormwater BMP Database as of 2016

Category	Description	Number
BR	Bioretention	58
CO	Composite – Overall Site BMP	29
DB	Detention – Underground Vault, Tank or Pipe(s)	3
DB	Detention Basin (Dry) – Concrete or Lined Tank/Basin With Open Surface	4
DB	Detention Basin (Dry) – Surface Grass-Lined Basin	46
GR	Green Roof	17
GS	Biofilter – Grass Strip	45
GS	Biofilter – Grass Swale	44
IB	Infiltration Basin	2
LD	Low Impact Development-Site Scale	10
MD	Manufactured Device	113

Category	Description	Number
MF	Filter – Combination of Media or Layered Media	3
MF	Filter – Geotextile Fabric Membrane (Vertical)	1
MF	Filter – Other Media	5
MF	Filter – Peat Mixed With Sand	2
MF	Filter – Sand	30
MP	Maintenance Practices – Catch Basin Cleaning	8
MP	Maintenance Practices – Street Sweeping	21
OT	Other – Uncategorized BMP	6
PP	Permeable Friction Course	6
PP	Porous Pavement – Modular Blocks	20
PP	Porous Pavement – Pervious Concrete	11
PP	Porous Pavement – Porous Aggregate	1
PP	Porous Pavement – Porous Asphalt	10
PT	Infiltration (Dry) Well	1
PT	Infiltration (Percolation) Trench	12
RP	Retention Pond (Wet) – Surface Pond With a Permanent Pool	75
RP	Retention Underground Vault or Pipes (Wet)	3
RW	Rainwater Harvesting	1
WB	Wetland – Basin with Open Water Surfaces	35
WB	Wetland – Basin without Open Water (Wetland Meadow Type)	4
WC	Biofilter – Wetland Vegetation Swale	4
WC	Wetland – Channel with Wetland Bottom	19
Total BMPs		**649**
CX	Control – No BMP/Control Site (for comparison)	30
Total Data Sets		**679**

2.3.4.3 Benefits and Drawbacks

▼*Read more*

Benefits of the BMPDB include:

- Long-term support and establishment over a 20-year period have enabled development of a large BMP and associated water quality and hydrology data set. This data set has grown to nearly 650 BMPs and nearly 400,000 water quality records. It is the largest centralized repository of BMP performance information in the world.
- Users can access both traditional and proprietary BMP performance information through one centralized location along with metadata providing watershed context and design information.
- Federal, state and local governments, as well as private and non-governmental organizations, frequently reference and rely upon the BMPDB.
- Developed over a number of years, analysis protocols suitable for evaluation of BMP performance utilized input from national experts.

Drawbacks of the BMPDB include:

- Although the database requests design-related metadata with study submission, the level of completeness

varies depending on the availability of such information and time constraints of the researcher or project sponsor/owner to develop and/or enter the design information.
- There is a need for increased training and guidance so that a wider range of users can understand how to extract and properly utilize the data sets.
- The database needs modernization of the manufactured device metadata table. Many of the manufactured devices in the BMPDB have been through certification programs (e.g., TAPE, TARP, NJCAT); however, more explicit flagging of certification studies through these programs would be beneficial to users of the data sets. There is also a need to categorize manufactured devices based on fundamental treatment processes to enable objective comparisons of performance.
- Growth of the database is dependent on annual renewal of funding, along with voluntary submittal of data. Substantial outreach and communication with data providers is necessary to maintain the database and to grow the amount of data. Organizations financially supporting the BMPDB include WRF, FHWA, and ASCE-EWRI. The BMPDB would benefit from additional partnering sponsors with multi-year funding commitments to ensure the longevity of the effort.

2.4 A Future Data Verification Program

▼*Read more*

The National Stormwater Testing and Evaluation for Products and Practices (STEPP) initiative aims to develop standardized, nationally recognized-level procedures for testing and evaluating stormwater BMPs, thereby spurring innovation, reducing stormwater management costs, and improving the confidence of consumers in the water quality performance of BMPs. STEPP aims to improve the cost-effectiveness of water quality improvements by speeding implementation and adoption of innovative stormwater BMPs across the United States. The STEPP initiative is in its preliminary recruitment stage and is not yet an operational program. However, its proposed structure builds on the TAPE and NJCAT (Sections 2.3.1 & 2.3.2) programs, providing participants in those programs a clear path forward into the national program.

Stakeholder groups at the 2012 Water Environment Federation Technical Exhibition and Conference (WEFTEC) saw a need for a national testing program for stormwater BMPs because the USEPA's ETV program was due to end in early 2014. At that time, ETV was the only national stormwater technology evaluation program. In 2013, the WEF initiated STEPP and formed the STEPP Steering Committee.

The STEPP Steering Committee released a white paper in February 2014 (WEF 2014) that verified the need for and feasibility of a national testing and evaluation program for stormwater products (i.e., proprietary devices) and practices. This conclusion prompted the formation of the STEPP Advisory Committee in 2015. The committee's task was to research and assess the current range of activities and knowledge about stormwater BMP water quality performance testing and evaluation throughout the United States.

The STEPP Advisory Committee assessed five related programs to consider how they dealt with similar issues and if STEPP might incorporate any of their program elements. The programs assessed were:

- Technology Assessment Protocol – Ecology (TAPE) (Washington State)
- New Jersey Corporation for Advanced Technology (NJCAT)
- National Transportation Product Evaluation Program (NTPEP) (Washington, D.C.)
- Interstate Technology & Regulatory Council (ITRC) (Washington, D.C.)
- Sustainable Technologies Evaluation Program (STEP) (Ontario, Canada)

The STEPP Advisory Committee also sent two informal surveys to relevant states agencies and Municipal Separate Storm Sewer Systems (MS4s) to determine their requirements and needs for a national program. Based on the results of these efforts, the STEPP Advisory Committee collaborated with the STEPP Workgroup to draft a program concept framework document in June 2016. This document, Framework for a National Testing and Evaluation Program Based Upon the National Stormwater Testing and Evaluation for Products and Practices (STEPP) Initiative, based upon the National STEPP Initiative, presented the general organizational components of STEPP as well as the STEPP Advisory Committee's findings and recommendations to further the initiative. The committee focused their recommendations on the architecture, protocol development, business framework, and leadership organization(s) of the national program.

The STEPP Advisory Committee's recommendations for the next steps in establishing STEPP include a 24-month period during which the following will occur:

- Either STEPP will find a permanent home outside of WEF with a well-positioned, existing organization to implement the program sustainably, or they will consider creating a new organization to host STEPP.
- Develop a business plan that considers multiple funding streams to ensure sustainability using the STEPP Steering Committee and/or Board of Directors.
- Affirm continued USEPA support of the STEPP initiative.
- Establish a stakeholder outreach strategy.
- Affirm continued support from the NJDEP/NJCAT and TAPE programs.

As these activities are completed, the STEPP program can establish an operational program.

2.4.1 Testing Protocols

▼*Read more*

Once launched, STEPP aims to provide BMP water quality performance national testing and evaluation protocols for TSS, suspended sediment concentration (SSC), total phosphorus, metals (total and dissolved, Cu and Zn), and oil and grease. The STEPP program plans to include protocols for nitrogen and bacteria in the future.

STEPP will initially adopt and integrate the field-testing protocols from TAPE and laboratory testing protocols from the NJDEP. This strategy will decrease STEPP's startup time and costs, thereby increasing the initiative's probability of success. Additionally this process provides assurance to BMP manufacturers that use proponents of a specific technology that investments made in historically proven evaluation programs will continue to have relevance over time.

STEPP aims to accommodate the needs of individual states by providing them the flexibility to decide which requirements for BMP water quality performance information data are applicable for their needs. The performance data includes the type of testing (field or lab), pollutants treated, and BMP design information. STEPP will be available to states and federal agencies as a voluntary resource. Those states that currently have BMP testing and evaluation programs will likely continue using their own protocols until full establishment of the STEPP program.

The testing protocols will include the following components and considerations:

- Standard methods for sample collection and analysis
- Analysis of a variety of BMP types
- BMP design information (e.g., sizing) for the system
- BMP installation and operational guidance
- Evaluation of water quality performance results over changing operating conditions
- An ongoing process that will allow for STEPP evolution over time (e.g., inclusion of future pollutants of concern such as nitrogen and bacteria)

The STEPP program considers all types of BMPs. The STEPP Advisory Committee also believes that it is important to emphasize research of the BMP lifecycle performance time curve for its applicability to the development of testing protocols. However, the STEPP Advisory Committee recommends that STEPP should initially focus on testing and evaluating BMPs utilizing the appropriate testing protocols.

Noting the variety and diversity of post-construction stormwater management programs throughout the United States, the STEPP Advisory Committee recommends that STEPP only go as far as BMP water quality performance verification. The STEPP Advisory Committee recognizes that in order for any BMP evaluation and verification program to be applicable, the states will need to certify the BMPs per their individual stormwater regulations – specifically, ensuring that proper BMP designs account for individual state regulatory design storms or water quality parameters. At this time, it would be logistically impractical for any one entity to account for the regulatory variability among all states. The most appropriate course of action to account for this is to develop BMP sizing guidance for the states that detail how to incorporate innovative BMPs into their individual regulatory programs.

2.4.2 Information Available to the Public

▼*Read more*

STEPP proposes to maintain a centralized, publicly accessible database that includes data on performance, cost, operation and O&M, and BMP longevity needs. Through this database, the public and regulatory agencies can access both lab and field testing data as well as evaluation and verification protocols for BMPs. This program differs from the BMPDB in that it provides a standard protocol that applicants must follow for inclusion. Additionally, it provides review and verification of any BMP water quality performance data submitted that follows the protocol. This information will increase consumer confidence in BMPs by generating technically sound results based on standardized evaluation procedures. Scientific standards used to evaluate all BMPs will assist in closing the gap between public domain practices and proprietary products. This information will help to inform federal, state, and local regulatory programs in their decision-making.

2.4.3 Benefits and Drawbacks

▼*Read more*

Benefits of STEPP include:

A national stormwater program to improve stormwater management by increasing innovation and competition, providing cost-effective stormwater mitigation practices, and reducing the burden on state and local governments by providing an independent resource for assessing BMP water quality performance. STEPP could eliminate duplicative evaluations and create consistent protocols and standards for BMP testing and evaluation. Removing duplicate evaluations will make new technology development more affordable for stormwater BMP manufacturers, representatives and other consumers, thereby increasing competition in the market. Consumers will benefit from these cost efficiencies as more affordable new stormwater technology BMPs will help them attain their water quality objectives and restoration goals.

STEPP will include information on testing protocols for all regions of the country to help standardize and streamline the testing and evaluation of BMPs, and deliver timely BMP water quality performance data to resource managers and the public. This data, based on standardized evaluation procedures, will increase the confidence of stormwater and natural resource professionals as they make more informed decisions regarding BMP products and practices.

Drawbacks of STEPP include:

Variable stormwater, precipitation and geographic characteristics will prevent a national program from providing specific information to address the wide ranges of stormwater conditions, state and local goals and regulations, and BMP design requirements throughout the country. For these reasons, STEPP will not be a certification program.

Due to the current shortage of resources experienced by federal, state and local governments, it will be difficult to sustain STEPP utilizing a funding mechanism that solely relied upon public sector dollars. Funding will most likely come from several sources, including federal agencies, grants, the selected host organization, in-kind donations, private sector contributions, fees for assessments, and potentially an annual membership fee for all participating entities.

2.5 Other Data Repositories

In addition to TAPE, NJCAT, STTC, the BMPDB, and STEPP, there are a number of other existing and proposed repositories for stormwater BMP information. Other sources include university research centers, independent organizations, state and regional environmental agencies, and industry literature. The following is a general description of the information presented with each of the listed source types:

- University research centers present findings from research of BMPs, specifically the water quality effectiveness and performance of those systems as well as maintenance requirements.
- State stormwater manuals provide information on suitable applications, design considerations, and maintenance requirements of stormwater BMPs and how they comply with specific states' stormwater regulations.
- The "Other Organizations" category sources offers varied information. The Urban Drainage and Flood Control District (UDFCD) in Colorado offers a detailed stormwater manual similar to other state stormwater manuals. The Center for Watershed Protection (CWP) website contains an Online Watershed Library (OWL) with access to CWP

publications and other resources (e.g., research papers, tools, and stormwater manuals) that support best practices in watershed and stormwater management.
- Industry literature presents new research findings on new stormwater BMPs as well as design and maintenance considerations for stormwater BMPs similar to the state stormwater manuals.
- Peer review literature, which may not be captured by other repositories

In addition to the state manuals listed, some states have Erosion and Sediment Control manuals and/or Department of Transportation (DOT) stormwater manuals.

2.6 Evaluating Data Repository Information

Once water quality performance data have been collected and made available for a specific BMP, whether manufactured, green infrastructure (GI) or a traditional land based practice, users can apply simple principles when evaluating the quality of data. This can provide regulatory agencies with guidance for the acceptance of new BMPs for inclusion within any local regulatory program. Please refer to Section 3.4 of this document for specific insight on utilization of available performance data for regulatory purposes.