

Overview of the Stormwater Testing and Evaluation for Products and Practice (STEPP) and How Pennsylvania Communities Can Benefit

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Highlights:

- Stormwater products and practices have uncertain levels of treatment.
- High levels of treatment uncertainty reduce the value of stormwater treatment investments.
- The STEPP program provides trust and understanding of stormwater treatment.
- STEPP was launched in 2024 and continues to grow and evolve.
- The future of the STEPP program will focus on new technologies, pollutants, climate change and maintenance.

Introduction

The level of uncertainty of stormwater treatment product and practice efficacy is well documented (Aguilar and Dymond, 2019; Afrooz et al, 2019) and is a major challenge in the value proposition associated with stormwater infrastructure investments. This challenge potentially undermines the value proposition supporting investments in stormwater infrastructure. In short, why would we expect public tax/rate payers to invest in an infrastructure that provides uncertain treatment

Background

The Stormwater Testing and Evaluation for Products and Practices (STEPP) program, led by the National Municipal Stormwater Alliance (NMSA), is a national-level effort to provide technology verification services. STEPP generates trusted performance data on the efficacy of stormwater proprietary and public domain infrastructure. The lab-testing component of STEPP is based upon the New Jersey Corporation for Advanced Technology (NJCAT) and New Jersey Department of Environmental Protection (NJDEP) program and protocols. The field-testing component of the program, currently in development, is based upon the Washington State Technology Assessment Protocol for Ecology (TAPE) program.

STEPP provides stormwater managers with trusted data to inform communities on the performance of SCMs. In addition, STEPP provides guidance on how to use this performance data in local programs. While the initial focus of STEPP is on high priority pollutants of interest such as sediment, trash and plastics, and nutrients, the vision is to expand the program to include additional pollutants, proprietary products (manufactured treatment devices, or MTDs), and public domain practices, including green infrastructure. The STEPP program basis verification on performance testing standards produced by the ASTM E64 Committee on Stormwater Control Measures. Verification reviews by STEPP include public reviews as well as reviews by a roster of unbiased and unconflicted highly qualified stormwater professionals. The verification process used in STEPP (see Figure 1 - STEPP Verification Process) reflects the ISO 14034 standard on Environmental Technology Verification (ETV) bodies, which is a respected format for objectively evaluating the performance of environmental technologies.

Status of Program and the Value to Pennsylvania Communities

STEPP launched in 2024, with its first technology verifications produced in 2025. Currently, the program provides verification services for trash capture technologies, hydrodynamic separator systems (HDS), and filter products in the context of lab testing. STEPP also concurs on verifications previously gained from programs using the same or very similar testing protocols and standards, including NJCAT-verified/NJDEP-Certified HDS and filter technologies.

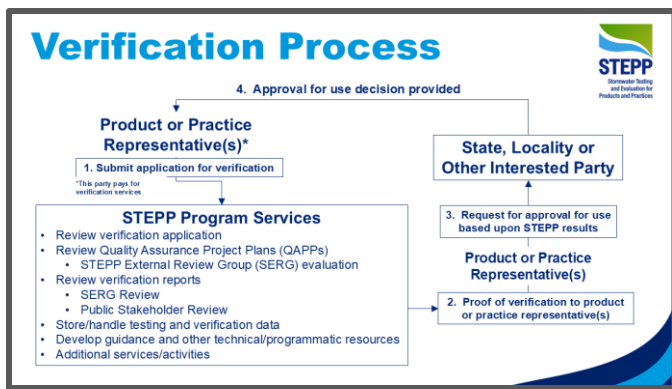


Figure 1 - STEPP Verification Process

The main objective of the STEPP program is to generate performance data on the efficacy of stormwater treatment infrastructure that is trusted, technically-sound, and science-based. Use of this trusted data informs the decision making of communities and others who purchase or implement stormwater treatment products or practices and projects. Using best-available data for stormwater programs also signals commitment by communities using STEPP-verified technologies to do all they can to address water quality challenges associated with stormwater pollution. The new Pennsylvania stormwater manual will likely include STEPP as a referenced verification program that is accepted and acknowledged by PADEP. By becoming a STEPP member, Pennsylvania MS4s can gain access to trusted performance data that will support decisions and policies on the acceptance and use of certain stormwater products and practices in their programs.

Key Findings

The uncertainty in the performance of stormwater treatment infrastructure is problematic to arguments supporting the value of stormwater investments. STEPP addresses the high level of uncertainty in stormwater product and practice performance by producing consistent, robust, and trusted performance information. This trusted information aids communities in their decision-making on stormwater investments. STEPP is modeled after two well-known state-level verification programs and is technically based in ASTM performance testing standards. This is an emerging program functioning to verify the performance of stormwater products through lab-based testing results.

Recommendations

To make significant strides forward, the stormwater community should consider or embrace the following:

- There is a need to increase the confidence in stormwater investments made to treat stormwater runoff.
- A national-scale verification program is needed in the stormwater sector. The STEPP program- has been established to address this need using existing high-quality state verification programs as a model.
- STEPP provides verification services for stormwater treatment products. The program must continue to grow and develop to meet current and future challenges in the sector, including long-term performance, maintenance, shifting precipitation patterns, new and innovative technologies, and emerging pollutants.
- Pennsylvania communities using STEPP-verified data have greater confidence in decisions made to invest in or accept the use of specific stormwater products and practices in their communities.
- Communities, including those in Pennsylvania, should use verified performance data for stormwater products and practices when possible, to assure regulators and the public that care is being taken to provide the highest level of service available.

References

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Plastic Pipe for Deep Cover and Heavy Loading – Profile-Wall HDPE Pipe

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What I will be presenting:

This presentation introduces profile-wall HDPE pipe systems and their increasing application in North American infrastructure. While widely implemented internationally, profile-wall HDPE has only recently gained broadened acceptance in the US. HDPE profile-wall pipe is a type of plastic pipe designed to maximize structural integrity while minimizing material usage. The idea behind its structure is to leverage the moment of inertia of the pipe wall, creating a stiff yet flexible system. This design results in a robust pipe that uses less material compared to solid wall pipes, enabling it to be a suitable material for drainage and sewage systems. These pipes range from two to twelve feet in internal diameter and have adaptable profiles that are varied to meet a wide range of loading and installation conditions. This technology can help municipalities, developers, and contractors to solve a variety of site-specific problems, while maintaining project timelines and long-term integrity of their projects. This will be a progressive presentation of a constructed project starting with the design phase, through production of the pipe and accessory structures, into shipping and delivery, then finally covering the installation and testing of the pipeline.

What the audience will learn:

The audience will learn the differences between profile-wall HDPE pipe and more common stormwater management pipe materials, with detailed comparisons between Reinforced Concrete Pipe, Corrugated Metal Pipe, Corrugated HDPE, and solid-wall HDPE pipes for stormwater and sewerage applications. The presentation highlights cases where profile-wall pipe offers benefits over traditional materials, while also addressing the installation considerations and structural limitations associated with this type of pipe. The presentation introduces the audience to the key factors that help optimize the design of a pipeline or stormwater management system using profile-wall HDPE pipe. This presentation will define the terms and qualities that define this type of pipe, including material, dimensional, and performance standards. With increased storm intensity and frequency, there is an ever-growing need for resilience in our stormwater infrastructure. The goal of this presentation is to add another useful tool to the toolbox for regulators, owners, and designers to help our region handle these stormwater challenges. This presentation will help the audience learn how to utilize profile-wall pipe for all their storage, conveyance, and structural needs.



MRC Expanded Retrofit for a New Public School – Case Study

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What I will be presenting:

An existing elementary school in Southeast PA was constructed in 2000 in an Exceptional Value watershed involving a 30-acre drainage area. A new middle school was proposed on the same site in 2020 that would involve stormwater management integration with the original project. A right to know request for the original stormwater design from the Conservation District yielded a wealth of information. The original project had the cutting-edge goal of infiltrating delta-2. Given that 2000 was in the pre-dawn of the infiltration era with now-dated guidance, the correspondence told a sad story of what not to do. An extreme loading ratio caused an intended infiltration basin to develop a large sinkhole during construction, when it was functioning as the sediment basin. The sinkhole was remediated at the time, but had reopened and was present for the 2020 project survey. The sinkhole remediation eliminated the infiltration goal. Other alternate water quality measures required to offset the remediation were scoured away by peak basin inflows. It was unknown if basin inflow was presently entering the sinkhole, disappearing from the ultimate Point of Analysis, and influencing the allowable discharge rate. The discharge point was on township property, in full view from the public meeting hall window. With the original stormwater design intent in hand, an expanded retrofit design using MRC (Managed Release Concept) was prepared that not only addressed the new development, but brought the 2000 project up to the current standard for the betterment of the Exceptional Value watershed.

What the audience will learn:

It is recommended that every project begin with right-to-know requests to understand any existing designs for redevelopment considerations, particularly before there were established PCSM recording requirements. Project owners may have some records, but they are usually only in plan form and incomplete. A well-timed hurricane can be very useful to understand sinkhole influences, to conclusively address Individual NPDES Technical Review comments. A hydrodynamic stormwater conveyance and routing model was used to demonstrate capacity of existing infrastructure and minimize project costs for upgrades. As part of this exercise, a small “regulator” basin was realized to meter flows into existing piping that crossed a state roadway and a regional petroleum line. A large distribution structure divided the 30-acre flow input to a dedicated forebay basin, MRC basin, and what would now be deemed an Objective D rate control basin. A comparison of 2020 MRC standards and 2026 standards will be noted for this overall design.

Sensored Permeable Pavement for Elevated Performance and Reduced Maintenance

Communities across the nation are faced with growing pressures to better address the persistent challenge of urban stormwater. Permeable pavement was developed to overcome this fundamental challenge by mimicking natural infiltration processes. First-generation systems (porous asphalt, pervious concrete, and permeable pavers) are only suitable for light duty applications (parking stalls, pedestrian walkways, etc.). Furthermore they tend to fail quickly because they were developed by introducing pores and channels into traditional pavement that rapidly clog.

Permeable articulating concrete block (P-ACB) pavements are a next generation permeable surface, developed by turning an erosion control system into pavement. P-ACB systems differ from traditional permeable pavers because they have 1) open joints and 2) are able to handle heavy traffic loads. The open joints means this system handles more rain water, and is easier to maintain (cleaning process is required less frequently and is easier to perform). The suitability to handle heavy traffic loads means that PaveDrain can be used in additional applications like roadways, traffic aisles, and truck stops.

For this presentation, the following sites will be discussed:

Location	Placement	Size (SF)	Drainage Area (SF)	Soil
Cudahy, WI	Alleyway	850	28,000	Clay (HSG D)
Colmar Manor, MD	Intersection (ROW)	2,350	8,705	Clay (HSG D)

In-situ real time sensors have been installed in the stone base to measure the water level. This sensor is coupled with a nearby weather station monitoring rainfall, temperature, barometric pressure, and relative humidity. During a storm, water enters the base quickly during rainfall events, and over time exfiltrates from the stone base into the soil. This movement of water is documented providing sufficient justification to the performance claims.

In both sites, the system has been shown to capture all runoff (run-on to the permeable pavement) and infiltrate much of a rainfall event within 48 hours. Fully capturing and infiltrating all runoff also removes all nitrogen, phosphorous, and total suspended solids that are mobilized over the drainage area. Instantaneous rates of exfiltration with high hydrostatic head pressure have exceeded 5.00 in/hr. Average rates of exfiltration over the first 48 hours is 0.99 in/hr. For most jurisdictions stormwater designs would expect clay soil to infiltrate at 0.18 in/hr, nearly a full order of magnitude less than the rates being measured in the field.

The discrepancy between observed and expected values is attributable to the heterogenous nature of soil. While clay soil is present, so are more permeable soils which form 3-dimensional networks and paths for water to exit the BMP system leading to significantly elevated performance. The sensor has demonstrated that the BMP can handle large rainfall events (>1.5 in) without reaching 75% capacity. Of note, performance has been maintained in the absence of preventative or restorative maintenance.

Presenter Bio. Dr. Aaron Fisher has a PhD in Chemical Engineering from the University of Maryland and a B.S. in Chemistry from Duke University. He is currently the Vice President of Business Development for Ernest Maier; a family-owned company. Dr. Fisher is responsible for PaveDrain a heavy duty, low-maintenance permeable pavement and fiberglass rebar, a stronger, more sustainable, corrosion-proof alternative to steel rebar. Dr. Fisher has a deep technical background in all aspects of sustainability. He

has served as a contractor to several programmatic offices within the U.S. Department of Energy- Energy Efficiency and Renewable Energy Office. He has also led the innovation program at Water Research Foundation on behalf of wastewater, stormwater, and drinking water utilities across the United States.

Leveling the Field: Quality Control of Water Level Sensors for Large Scale GSI Monitoring

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What I will be presenting:

The Philadelphia Water Department (PWD) maintains a fleet of approximately 400 Onset HOBO pressure and temperature data loggers for the testing and monitoring of green stormwater infrastructure (GSI). At a typical time, between 125 and 200 of these data loggers are deployed at stormwater management practices (SMPs) throughout Philadelphia for short-term GSI testing, seasonal shallow well monitoring, and long-term continuous water level monitoring. Over the past 18 years PWD has developed extensive procedures and infrastructure for the management of data loggers, including guidelines for care and cleaning, a regular testing procedure to detect sensor drift, and multiple software applications that track the status, deployment location, and sensor testing history of each data logger. This presentation will cover the development of this infrastructure, the lessons learned in the process, and some limitations of using Onset HOBO data loggers for GSI monitoring.

What the audience will learn:

The audience will learn about common failure modes of Onset HOBO data loggers and methods for detecting them, as well as strategies for tracking data loggers throughout the life cycle of deployments, sensor testing, repairs, and disposal. While the content of this presentation will be most applicable to institutions with a need for large scale GSI monitoring, much of the information will apply to anyone who uses water level sensors for water resources monitoring applications at any scale.