# STEPP & ASTM: Roadmap for unifying regional approaches to innovative stormwater products and practices.

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## Abstract

Urban areas worldwide face increasing challenges in managing stormwater runoff and its associated environmental impacts. Effective Stormwater Control Measures (SCMs) are critical to sustainable urban water systems. This article reviews the efforts of the National Municipal Stormwater Association (NMSA) of the USA, the Stormwater Testing and Evaluation of Products and Practices (STEPP) programme, and ASTM International E64 Stormwater Control Measures Committee in developing standardised, robust performance testing methods for SCMs. Additionally, it explores how these initiatives can address the challenges faced by Australia's Stormwater Quality Improvement Device Evaluation Protocol (SQIDEP) and the broader benefits of adopting a global standard for stormwater management.

## Introduction

Stormwater management is a pressing issue in urban landscapes, where the complexity and density of development exacerbate the challenges of runoff control and pollution mitigation. The need for reliable and innovative SCMs has never been more critical. However, ensuring these solutions are evaluated consistently and effectively remains a significant hurdle. The NMSA, through its STEPP programme, and the American Society for Testing and Materials (ASTM) International's E64 Committee are pioneering efforts to establish standardised, credible testing methodologies that promise to set new benchmarks for the industry. STEPP and ASTM adopt inclusive and consensus-based approaches.

Stormwater Australia released SQIDEP in November 2018. This protocol looked to provide a standardised framework for evaluating the performance of stormwater treatment devices in an Australian context. SQIDEP was developed through a consultative process, with all stakeholders invited to give feedback to Stormwater Australia, which ultimately made decisions on behalf of the industry.

In the five years since the introduction of SQIDEP, a wide range of stakeholders have raised concerns about the programme. With Stormwater Australia looking to undertake a review of SQIDEP, this paper reviews the American approach and discusses how this approach may help address some of the challenges with SQIDEP.

## The STEPP Initiative

The STEPP programme was initiated in response to the discontinuation of the Environmental Protection Agencies (EPAs) Environmental Technology Verification (ETV) programme, which left a void in national stormwater technology evaluation. The EPA ETV programme was dissolved mainly because of budgetary constraints to sustain the programme and the development of specific state programmes with particular needs.

The Water Environment Federation (WEF) spearheaded the initial investigations, leading to the formation of STEPP under the NMSA in 2021. The NMSA is a U.S.-based coalition of state stormwater English, municipal stormwater programmes, regional stormwater management agencies, non-profit organisations, manufacturers and other stakeholders involved in stormwater management. It was established to represent the interests of municipal separate storm sewer systems (MS4s) and to advocate for effective and sustainable stormwater management practices.

The NMSA and Stormwater Australia share a common mission of advancing effective stormwater management practices. Both organisations support municipalities and other stakeholders by providing resources, advocating for regulatory improvements, and promoting best practices in stormwater management. They emphasise the importance of standardisation in evaluating stormwater treatment technologies, as seen in their respective initiatives like STEPP and SQIDEP.

### The Value of STEPP

The value of the STEPP programme lies in its ability to enable informed decisions, foster a national marketplace, lower barriers to entry, and accelerate innovation. By providing verified performance data from a trusted source, STEPP helps municipalities become more effective. The programme's flexible "café plan" approach allows states and jurisdictions to develop their own certification requirements based on verified data rather than a one-size-fits-all model. This enhances trust in the data and ensures that the verified performance is applicable across various contexts and conditions, ultimately improving water quality and stormwater management practices.

### Goals and Objectives of STEPP

The primary objective of STEPP is to develop a national testing and evaluation programme for stormwater products and practices. Key goals include:

- Increasing overall performance of stormwater systems.
- Creating a level playing field for proprietary and public domain practices.
- Providing greater confidence in the performance of stormwater management solutions.
- Improving water quality through verified and effective SCMs.

STEPP and SQIDEP both aim to standardise and provide transparent performance data for stormwater treatment technologies, but they have distinct focuses. STEPP, managed by the NMSA, emphasises fostering innovation and collaboration among stakeholders and promoting national-level coordination. In contrast, SQIDEP, developed by Stormwater Australia, concentrates on consistent evaluation methods, regulatory support, and enhancing market clarity by providing credible performance data and supporting local compliance.

**STEPP GOVERNANCE FRAMEWORK**

The STEPP programme, housed within the National Center for Stormwater Testing and Evaluation for Products and Practices under NMSA, is not an independent entity but part of a larger governance framework. This framework includes various councils and subcommittees with specific roles and stakeholder representation to provide strategic leadership, technical oversight, and stakeholder engagement (Figure 1).

The STEPP Leadership Council (SLC) oversees the programme's financial health and strategic direction. At the same time, subcommittees, such as the Stakeholder Subcommittee and the Verification Protocol and Process Subcommittee, focus on disseminating information for product verification and addressing technical issues, respectively. The STEPP External Reviewer Group (SERG) comprises paid experts who review technical materials to ensure compliance with STEPP protocols. STEPP staff are responsible for engaging with the SLC, developing budgets, overseeing operations, managing fundraising, and representing the programme externally.

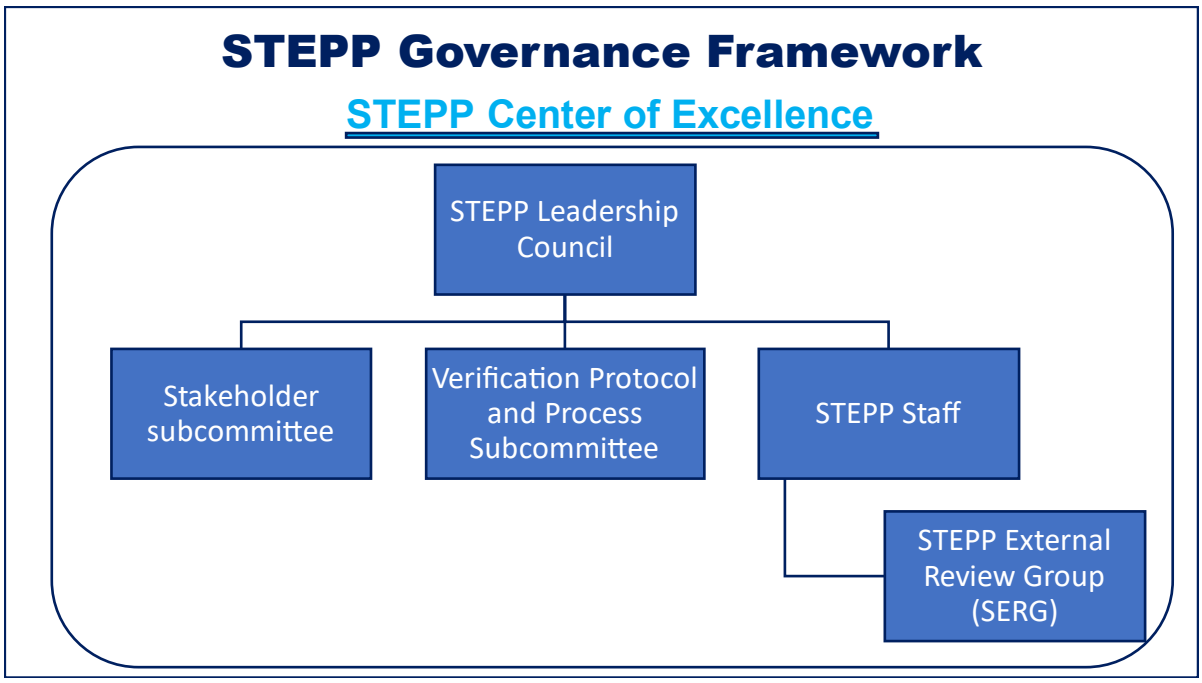


**Figure 1. Overview of the STEPP Governance Framework.**

## THE STEPP VERIFICATION PROCESS

STEPP's process is a structured approach that focuses on verification rather than certification. The programme aims to provide consistent and credible data that states and localities can use to make informed decisions in certifying SCMs.

It is important to note that the STEPP verification is not an approval. Stormwater pollution is highly variable as the performance of any one performance test is not readily transferable to another location. Certification agencies are the city councils, state water boards, or other agencies that regulate stormwater. These agencies need to assess the verified performance data against the local characteristics of stormwater pollution. Upon review of this verified data, the certification agency can approve the device under any conditions they feel are appropriate. An example is that a verified test result may show a TSS removal of 80%. However, the certification agency may feel their local stormwater particle size is finer than the site tested and only certifies the technology for 50%.

The STEPP process is as follows.

1. Application Submission: Representatives submit applications to verify their products or practices.

2. Quality Assurance Project Plan (QAPP) Review: Proper testing procedures are established and externally reviewed by the SERG.

3. Standard Identification: Appropriate ASTM testing standards are identified and applied.

4. Verification Testing: Conducted by approved testing facilities using standardised methods.

5. Independent Review: Third-party reviewers from the SERG assess the test results to ensure objectivity.

6. Verification Report: A detailed report is compiled and provided to the representatives.

7. Public Review Process: A draft verification report is published on the STEPP website. Public comment is accepted for a month. When all comments are addressed, the technology will be verified.

7. Certification Request: Representatives can then request certification from relevant authorities based on the verified results.

This process is very similar to SQIDEP, except that SQIDEP allows a body of evidence evaluation and the public review process. STEPP will only verify testing and performance data from an ASTM protocol testing protocol. Only the ASTM testing standard ensures the testing and assessments are standardised. The body of evidence pathway is not standardised, as data from different testing and evaluation protocols is used. The public review process allows items that may be overlooked or adequately addressed to be examined. This is useful as new or innovative technologies may require slight protocol modification; the review process intends to provide transparency. And strengthen the technical aspects of the verification process. Applicants may be required to undertake further testing after the public review process to address issues raised in the public review process. Another difference is that the detailed framework for the verification report ensures all relevant information for certification is provided in the verification report transparently and consistently.

A future initiative of STEPP that has just been initiated is to create guidance documents for certification agencies on how to interpret and use verified performance data in a local context, as the Canadian Stormwater ETV programme has done.

**Future Steps with STEPP**

STEPP aims to expand its verification services to include field testing and public domain practices such as bioretention facilities and green roofs. The programme will continue to adapt to new technologies and pollutants of interest, ensuring its relevance and effectiveness. Additionally, STEPP focuses on increasing state and jurisdictional support, providing guidance documents and developing specific testing protocols for emerging or localised stormwater management challenges.

Plans include the development of long-term performance testing protocols for microplastic filtration and retention devices.

STEPP is aware of similar work happening in different countries and plans to engage with other international organisations to learn and find synergies, broadening the expertise and resource base. Ultimately, STEPP will look to establish reciprocity between programmes to minimise the duplication of effort.

## ASTM E64 Committee of Stormwater Control Measure: Establishing Robust Repeatable Standards

ASTM International, formerly known as the American Society for Testing and Materials, is a globally recognised leader in developing and delivering voluntary consensus standards. They develop and publish technical standards for various materials, products, systems, and services. ASTM International is known for its diverse and inclusive efforts, bringing together experts from various backgrounds to shape standards that support innovation and compliance across industries worldwide.

The ASTM process is effective for complex and new industries like Stormwater management because it involves expert collaboration, ensuring comprehensive and well-informed standards. Its consensus-building approach considers all stakeholders' views, leading to balanced and widely accepted standards. Additionally, the process is flexible, adapting to emerging technologies and industry changes, ensuring relevance. ASTM standards are globally recognised, providing high credibility and facilitating international trade and regulatory compliance, making them particularly valuable for evolving industries.

The ASTM E64 Committee on Stormwater Control Measures comprises 130 experts from various sectors, including municipalities, regulators, suppliers, consultants, universities, researchers, and field practitioners. This diverse group ensures a balanced and comprehensive approach to standard development. The committee's scope includes creating a framework that integrates quantitative and qualitative assessment methods to capture the multifaceted aspects of innovative stormwater management.

The E64 Committee strives to balance technical rigour with practical applicability, enabling practitioners and decision-makers to effectively evaluate and compare different stormwater management practices. Subcommittees within E64 focus on lab evaluation, field evaluation, component evaluation, and nonpoint control measures.

**Why a Standards approach?**

Standards are crucial for stormwater management as they ensure consistency, reliability, and effectiveness in the design, implementation, and evaluation of stormwater practices and technologies. They foster innovation and provide a common framework that enhances understanding, supports evidence-based decision-making, and facilitates continual improvement. ASTM E64's efforts emphasise inclusiveness, transparency, and collaboration among stakeholders. Providing clear guidelines and standards helps maintain regulatory compliance and environmental protection, promote the adoption of best practices and innovative technologies, and enhance stormwater management systems' overall performance, safety, and sustainability.

Consensus-based decision-making offers several benefits to diverse industry groups like stormwater management. Some examples are as follows:

- Inclusivity: It ensures that all voices are heard, allowing diverse perspectives and ideas to be considered, leading to more comprehensive decisions.
- Commitment and Buy-in: Participants are more likely to support and implement decisions they helped shape, enhancing commitment and follow-through.
- Quality of Decisions: Thorough discussions and collaborative problem-solving often lead to better-informed and higher-quality decisions.
- Conflict Resolution: Encourages dialogue and understanding, reducing conflicts and building stronger relationships.
- Fairness and Equity: Ensures equal participation, promoting a sense of fairness and equity within the group.
- Sustainability: Decisions often reflect long-term interests and are more sustainable and ethical.

**Developed and Progressing ASTM E64 Standards**

Significant work has been undertaken on various standards in the four years since its inception. The initial focus has been to review and produce standards that currently support the USA's leading field and testing protocols. This intends to build on the work and experience already gained and provide a platform to expand these protocols to meet other stakeholders' needs. Collaboratively working on the existing evaluation protocols first removes barriers to adopting the standards. In addition to the existing protocols, a new testing and evaluation standard has been developed for trash in response to industry concerns and regulation of trash.

*Completed Standards*

1. Terminology Standard (E3318-23)
   This standard standardises the language and definitions used across different regions and practices to ensure everyone refers to the same concepts. This helps eliminate confusion and improve communication.

2. Silica-Based Test Sediment (E3317-22):
   This standard provides guidelines for creating standardised test sediments for laboratory testing. It ensures consistency in material laboratory testing for sediment removal efficiency. The standard includes variable particle sizes for different jurisdictions.

3. Trash Capture Devices (E3332-23):
   This standard specifies testing methods for evaluating the performance of devices that capture trash and debris, addressing concerns such as clogging and particle resuspension.

*Standards in Progress*

1. Settling Devices and Hydrodynamic Separators C1745/C1745M-18 (WK83543:
   This standard Test Method measures the Hydraulic Characteristics of Hydrodynamic Stormwater Separators and Underground Settling Devices. The hydraulics is a critical aspect of the design of SCM compliance with stormwater regulations.

2. Measurement of Suspended Sediment Removal Efficiency of Hydrodynamic Stormwater Separators and Underground Settling Devices. - C1746/C1746M-19:
   The goal of the standard is to benchmark the removal efficiency of underground settling devices in a repeatable and practical manner.

3. Standard Test Method for Scour of Hydrodynamic Separators and Settling Devices. E3373-23:
   This standard assesses the resuspension of capture material in the settling device.

4. Standard Test Method for Measurement of Hydraulic Characteristics of Stormwater Filtration Elements C1814/C1814M-20.
   This is like the standard for settling devices focusing on the treatment mechanisms used in stormwater filtration. This is a laboratory standard, as the hydraulic characteristics of stormwater filters are difficult to evaluate.

5. New Practice for Field Pollutant Removal Assessment of Stormwater Control Measures using Automated Samplers ASTM WK80881
   This practice provides a method for measuring the efficacy of stormwater control measures in removing pollutants from natural stormwater runoff in a field setting using automated composite samplers. It is intended to be used with contaminants that do not require grab sampling techniques. Data collected following this practice will allow for a side-by-side pollutant removal comparison of stormwater control measures. In addition, data will provide confidence that the stormwater control measure will provide a water quality benefit.

6. Laboratory Assessment of Hydraulic Conductivity of stormwater filtration media WK86873 \
   The work item's scope is to provide a standard test method for laboratory evaluation of stormwater filtration media hydraulic conductivity.

## Addressing SQIDEP Challenges with learnings from STEPP and ASTM E64

Released in November 2018, Australia's Stormwater Quality Improvement Device Evaluation Protocol (SQIDEP) has faced several challenges, including inefficiency and inconsistency in the approval process, limited governance and transparency leading to potential conflicts of interest, and fragmented adoption by local government agencies, which undermines the protocol's effectiveness. Technical issues related to testing conditions and unrealistic maintenance regimes have also complicated the implementation and reliability of SQIDEP. Stakeholders such as Stormwater Queensland, Stormwater NSW, and Stormwater Victoria have publicly raised concerns. Stormwater Queensland highlighted the need for a clear governance policy and better management of conflicts of interest. (Stormwater Queensland, 2024) Stormwater NSW pointed out inefficiencies in the approval process and limited independence of evaluators. (SQID Task Force, 2024)Stormwater Victoria emphasised a lack of transparency and inadequate industry consultation during the development and implementation of the protocol. (Stormwater Victora,, 2024).

While STEPP and SQIDEP have the same goals and structure, minor differences in the implementation of the two programmes may cause these challenges, particularly in inclusion, transparency, consensus-based decision-making, standardised evaluation and testing protocols.

STEPP promotes inclusion and transparency in data and decision-making, ensuring all parties understand and agree on the evaluation criteria and outcomes. This helps maintain a consistent approval process. Leveraging only standardised and transparent evaluation protocols developed by an independent standards organisation can significantly reduce inefficiency and inconsistency in the approval process. A standard-based approach ensures that all devices are evaluated against the same criteria, leading to more reliable and predictable outcomes.

ASTM's consensus-based and open process ensures evident governance. It allows all stakeholders, including those from the public sector, industry, and academia, to participate, reducing potential conflicts of interest and ensuring that decisions are made visibly. Inclusion and broad participation can help build consensus and trust among all stakeholders, encouraging wider adoption of the standards.

## Conclusion

Establishing standardised inclusive approaches like those developed by STEPP and ASTM E64 is a significant step forward for urban stormwater management. These initiatives provide a model

for other regions, including Australia, to enhance their stormwater protocols and address current challenges. By embracing and aligning international standards, much-needed innovation in stormwater management will be more rapidly developed and adopted. In doing so, we can ensure that urban areas worldwide are better equipped to manage stormwater runoff effectively, fostering a cleaner and more sustainable environment.

Many countries worldwide want to develop their own stormwater evaluation and testing protocols. Working together could result in consistency across borders, and the global standards would ensure uniform evaluation and performance comparison. Globally, we could achieve improved product innovation by encouraging innovation while providing clear benchmarks.

A streamlined approval process would reduce the time and costs for developers and regulators, enhance collaboration, and foster international cooperation and knowledge sharing. Ultimately, greater market access expands opportunities for manufacturers globally while building Increased trust in the reliability of stormwater solutions via confidence in standards and performance and the application of such.

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