Project Summary

Watershed Protection Standard Toolkit

Developer

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Technical Support

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The University of New Hampshire Stormwater Center

Roca Communications

Massachusetts Department of Environmental Protection

Rhode Island Department of Environmental Management

Financial Support

The SNEP Network

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Project Background

The Watershed Protection Standard Toolkit is a suite of materials developed to aid municipalities, designers and other stakeholders in adopting and implementing the Watershed Protection Standard (WPS). The WPS is a stormwater design standard that protects and restores water resources. It applies to sites being developed or redeveloped. Under the WPS, sites must be designed to maintain predevelopment recharge and nutrient loading levels (unless infiltration is demonstrated to be infeasible, in which case alternative requirements are outlined). WPS compliance is measured through meeting a required runoff reduction volume, which varies depending on pre-development hydrologic soil conditions.

Implementing the WPS is practical when designers use smart strategies for site layout and stormwater control measure design. Therefore, the WPS also requires an approach to site design that includes strategies such as minimizing and disconnecting impervious cover, preserving natural areas and maximizing infiltration.

The WPS is based on years of research by the Environmental Protection Agency (EPA), which found that each new development or redevelopment project, even when held to current Massachusetts and Rhode Island state stormwater design standards, incrementally degrades watershed hydrology and water quality. The research also determined the specific recharge and pollutant reduction values that, if met for a project, would attain pre-development conditions on an average annual basis. These values were determined using long-term continuous simulation modeling based on a 29-year rainfall record and serve as the basis of the WPS.

Project Objectives

The objective of developing the WPS Toolkit was to provide resources to motivate municipalities to adopt the WPS, demonstrate to stakeholders that meeting the WPS is feasible, assist municipal staff in promulgating and implementing the WPS, and assist designers in efficiently complying with the WPS. These objectives serve a broader goal of reducing the adverse impacts of development on watershed hydrology and water quality.

Toolkit Components

The WPS Toolkit is comprised of five main components

1. Fact Sheet
    - Succinct summary of the WPS Toolkit
2. Promotional Handout
    - Provides overview of the WPS, offers persuasive arguments for municipal adoption, and presents the foundational EPA research behind the WPS

- Primarily intended for municipal staff, municipal officials and the public

3. Template Regulatory Language for Adopting the WPS
   - Regulatory language that can be used by municipalities to adopt the WPS, annotated with instructions and context
   - Intended to be incorporated into a municipality's existing regulations or implemented in tandem with a model bylaw and associated regulations, which are also provided
4. WPS Compliance Checklist
   - Checklist that pairs with the template regulatory language to help a municipal reviewer assess a project's compliance with the WPS
5. Site Examples
   - Six 11x17 inch sheets, each displaying a three-dimensional model of a real site design that meets the WPS
   - Intended to illustrate to designers and municipal staff the feasibility of meeting the WPS across a range of real-world scenarios
   - Callouts, a catchment map, and calculations guide the user through the stormwater management on each part of the site
   - An 11x 17 inch cover sheet is also included to introduce and orient the audience to the sheets

Methodology

Development of the WPS Toolkit began in April of 2025 and concluded in November of 2025. VHB served as the primary developer, working in close collaboration with the SNEP Project Management Team, which included staff from the University of New Hampshire Stormwater Center (UNHSC), liaisons from the SNEP Network, and a representative from Roca Communications. The first stage of the project involved aggregating and reviewing relevant resources to develop an informed approach for creating WPS Toolkit materials, such as EPA's Holistic Watershed Management study[1] and the New England Stormwater Retrofit Manual.[2] VHB then developed and submitted approach outlines for each component of the WPS Toolkit to the SNEP Project Management Team. Early on, VHB and the SNEP Project Management Team held frequent meetings to clarify and refine certain pieces of the approach, after which the VHB project team met with the SNEP Project Management Team approximately monthly to seek guidance and to confirm that the approach continued to align with project objectives. Three times throughout the project, VHB and the SNEP Project Management Team also met with and received feedback from an advisory committee comprised of state regulators and the SNEP Network Low Impact Development and Nature Based Solutions Strategy Team.

1 Holistic Watershed Management for Existing and Future Land Use Development Activities. https://www.epa.gov/snep/holistic-watershed-management-existing-and-future-land-use-development-activities

2 New England Stormwater Retrofit Manual. https://www3.epa.gov/region1/npdes/stormwater/tools/snep-stormwater-retrofit-manual-july-2022-508.pdf

Methodology for Fact Sheet

The fact sheet was developed as the project was nearing completion. It was written by considering the most essential information that a potential user of the WPS Toolkit would need in order to begin navigating the Toolkit. It pulls elements from other Toolkit resources.

Methodology for Promotional Handout

The promotional handout was designed for municipal staff, including planning and engineering employees, planning board and conservation commission volunteer members, and elected municipal officials, with a secondary audience of state and federal regulators. It was developed to explain the WPS to these audiences, to make a case for municipal adoption of the WPS, and to distill the key takeaways of the foundational EPA research behind the development of the WPS.

To distill the key takeaways of the EPA research, the project team reviewed materials from EPA's study called "Holistic Watershed Management for Existing and Future Land Use Development Activities: Opportunities for Action for Local Decision Makers: Modeling and Development of Flow Duration Curves (FDC 1 and 2 Projects)."[3] The team paid especially close attention to the FDC2A and FDC2B Final Reports. After reviewing this material, the team's scientists and engineers worked with a graphic designer to lay out pages and create figures that communicated the complex content of these reports in a simple manner that could be understood by non-technical audiences. Compelling statistics about the impacts of development were also scattered across these pages. These statistics were taken from the following sources:

- Holistic Watershed Management for Existing and Future Land Use Development Activities: Opportunities for Action for Local Decision Makers. Appendix G for FDC Phase 2. U.S. Environmental Protection Agency, Region 1. October 19, 2022.
- Hibbard, K.A., F.M. Hoffman, D. Huntzinger, and T.O. West. 2017. Changes in land cover and terrestrial biogeochemistry. In Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC. pp. 277–302. doi: 10.7930/J0416V6X.
- Dieter, C.A., Maupin, M.A., Caldwell, R.R., Harris, M.A., Ivahnenko, T.I., Lovelace, J.K., Barber, N.L., and Linsey, K.S., 2018, Estimated use of water in the United States in 2015: U.S. Geological Survey Circular 1441, 65 p., https://doi.org/10.3133/cir1441.
- US Census 2020. https://data.census.gov/profile/Massachusetts?g=040XX00US25

Methodology for Template Regulatory Language

The template regulatory language was developed for local regulators to use as a starting point for adopting the WPS. An introduction explains that if a municipality is establishing stormwater regulations for the first time, the Neponset Stormwater Partnership (NSP) model bylaw and

3 Holistic Watershed Management for Existing and Future Land Use Development Activities. https://www.epa.gov/snep/holistic-watershed-management-existing-and-future-land-use- development-activities

regulations should be used as a starting point, and if a municipality already has stormwater regulations in place, the NSP materials can provide additional context. Because the NSP materials are referenced, the document was structured to align with the organization of the NSP model regulations and explains how to use the Toolkit's model regulatory language in tandem with the NSP language.

WPS targets provided in Table 1 of the model regulatory language were obtained from the FDC2B's Final Report's Appendix G: Methodology for the Development of a WPS, as well as supporting calculations provided in spreadsheets by UNHSC. Many details put forth in the model regulations, such as the land disturbance thresholds for different permit tiers and the performance standards for sites that cannot infiltrate, were decided during meetings with the SNEP Project Management Team.

Methodology for WPS Compliance Checklist

The WPS compliance checklist was developed to help a municipal reviewer assess a project's compliance with the WPS. The document is comprised of two checklists: one for reviewing the implementation of Low Impact Development (LID) practices and one for reviewing if designed SCMs bring the site into compliance with the WPS. The first checklist was based on a checklist from the Rhode Island Stormwater Design and Installation Standards Manual's Appendix A, "Stormwater Management Plan Checklist." From this base, information was adjusted to emphasize the design principles that were important to the project team and to align the checklist with the WPS regulatory language. The second checklist was based on the requirements outlined in the model regulatory language as well as outputs for SCM performance provided by the UNHSC Performance Curve Calculator.

Methodology for Site Examples

Six sites were chosen to represent a range of site conditions and land uses that designers may encounter across the SNEP Network region. Through meetings to discuss project approach, the SNEP Project Management Team decided that two of these examples should illustrate how the same site can be developed in different ways to comply with the WPS's required runoff reduction volume, showing that LID site layout strategies make the WPS's required runoff reduction volume easier to meet.

To create the site examples, engineering plans for real projects were used as templates. Site features on these plans were then adjusted in Autodesk Civil 3D to reduce impervious cover, enhance disconnection, and use other WPS design principles, as well as to ensure a range of site conditions and stormwater controls were represented across the six examples. Autodesk Civil 3D drawing files were then used as a base for three-dimensional modeling of the sites in Infraworks to create surfaces and then taken into Sketchup and Twin Motion where buildings, cars, and other features were rendered. PhotoShop was also used for minor cleanup.

The UNHSC WPS Calculator[4] was used to calculate targets for each catchment, with inputs of impervious drainage area, soil infiltration rate, Hydrologic Soil Group (HSG), and the SCM used for treatment. Note that the calculator currently only outputs targets for conventional infiltration SCMs and impervious cover disconnection; targets for non-infiltrating SCMs were set at 60% (new development) or 50% (redevelopment) total phosphorus removal, per the WPS regulatory language. Catchments were grouped together based on SCM type and soil infiltration rate to simplify outputs. Reduction efficiency targets for each design point were calculated using a weighted average of the reduction efficiency target for each catchment draining to the design point, weighted based on each catchment's soil infiltration rate.

To measure compliance with targets at the catchment level, information for each catchment and SCM were plugged into the UNHSC Performance Curve Calculator, which provided runoff and nutrient loads and reductions for each catchment. These were then summed for each design point to ensure compliance at the design point level.

Data Sources

The following resources were key references in the development of this Toolkit:

Holistic Watershed Management for Existing and Future Land Use Development Activities: Opportunities for Action for Local Decision Makers: Modeling and Development of Flow Duration Curves (FDC 1 and 2 Projects) (EPA; 2022)

- FDC1 Final Report: Modeling and Development of Flow Duration Curves
- FDC2A Final Report: FDC Application Modeling
- FDC2B Final Report: Next-Generation Watershed Management Practices for Conservation Development

State Stormwater Manuals & Design Guidance

- Massachusetts Stormwater Handbook (Massachusetts Department of Environmental Protection (MassDEP); 2008)
- Massachusetts Stormwater Handbook (MassDEP; 2023 Draft)
- Rhode Island Stormwater Design and Installation Standards Manual (Rhode Island Department of Environmental Management (RIDEM) and Rhode Island Coastal Resources Management Council (RICRMC); 2015)
- Massachusetts Small MS4 General Permit (EPA; 2024, Draft)
- New Hampshire Stormwater Manual (UNHSC, Comprehensive Environmental, Inc., and New Hampshire Department of Environmental Services (NHDES); 2025)

4 UNHSC WPS Calculator. https://scholars.unh.edu/stormwater/130/

- Rhode Island Low Impact Development Site Planning and Design Guidance Manual (RIDEM and RI CRMC; 2011)
- Rhode Island LID Site Planning and Design Techniques: A Municipal Self-Assessment (University of Rhode Island, Rhode Island Department of Transportation (RIDOT), and RIDEM; 2019)
- New England Stormwater Retrofit Manual (SNEP Network; 2022)
- Property Owner Guide to Managing Stormwater (SNEP Network; 2024)

Bylaw & Regulatory Guidance

- Mass Audubon Bylaw Review Tool (Mass Audubon; 2022)
- Neponset Stormwater Partnership Model Stormwater Regulations (Neponset River Watershed Association; 2019)
- UNHSC Post Construction Model Stormwater Management Standards (UNHSC; 2025 Update, Draft)
- Recommended Improvements to Stormwater Regulations in the Charles River Watershed (Charles River Watershed Association; 2025, Draft)

Tools & Calculators

- UNHHSC Watershed Protection Standard Calculator (UNHSC; 2025)
- UNHSC Performance Curve Calculator (UNHSC; 2025)

Project Team

The SNEP Project Management Team consisted of staff from VHB, staff from the University of New Hampshire Stormwater Center (UNHSC), liaisons from the SNEP Network, and a representative from Roca Communications. The SNEP Network Low Impact Development and Nature Based Solutions Strategy Team and state regulators from MassDEP and RIDEM served on an advisory committee. Individual contributors are listed below, grouped by organization.

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Conclusions & Next Steps

The development of the WPS Toolkit marks a significant step forward in supporting municipalities and designers in the implementation of a stormwater design standard that preserves pre-development hydrology and water quality. The WPS Toolkit, by providing promotional and background materials, templates for regulatory language and compliance review, and practical examples of implementation, establishes a strong foundation for WPS adoption.

To build on this progress and promote the successful adoption and implementation of the WPS, the following next steps are recommended for the SNEP Network and its partners:

- **Toolkit rollout and promotion:** Coordinate a comprehensive outreach campaign to introduce and promote the WPS Toolkit, including hosting webinars, presenting at conferences, and engaging with watershed associations, stormwater coalitions, and other stakeholder groups. These efforts will demonstrate the toolkit's key features, foster knowledge exchange among users and potential adopters, and build awareness of the WPS within the New England water resources and stormwater management community. Select webinars could be recorded and posted to SNEP's website for broader distribution.
- **Support pilot WPS implementation:** Provide technical assistance to a selected municipality in the SNEP region to pilot the adoption and implementation of the WPS. This will help refine best practices, identify gaps in WPS Toolkit resources that the SNEP Network can then work to fill, and produce a case study to inspire broader adoption. Support may include:
    - Technical assistance in understanding the WPS
    - Support integrating the WPS into municipal code, including incorporating WPS regulatory language and ensuring other code does not contradict or inhibit WPS implementation
    - Refinement of the compliance review checklist (e.g., the LID portion of the checklist could be updated to align with MassDEP's Environmentally Sensitive Site Design checklist once MassDEP releases new wetlands regulations)
    - Development of additional review support tools (e.g., a decision tree to help users identify scenarios where infiltration is not feasible)
    - Support reviewing and commenting on project applications subject to the WPS
- **Enhance site examples:** Each of the six site examples was created by developing a three-dimensional model, and these models offer considerable opportunity for further development. For example, supplementary pages could be developed for each site example that include additional angles and close-up images of the models as well as engineering

details of featured stormwater controls, helping practitioners better visualize and understand the promoted practices. Additionally, model refinements could incorporate features suggested by the project advisory team that could not be incorporated in the current versions due to project constraints (e.g., add park benches or basketball hoops to emphasize recreational benefits of WPS site design). An additional pair of side-by-side comparison site examples could also be created if the townhouse comparison proves particularly compelling.

- **Create cost comparison for two site layout examples:** Enhance the two townhouse site examples by including cost estimates for each site, demonstrating that the LID townhouse design yields lower overall costs compared to the conventional design. This will provide stakeholders with valuable financial context to inform decision-making and encourage adoption of the WPS.
- **Training for designers and technical review staff:** Produce focused training modules for municipal technical staff and design engineers on how to approach site design to meet the WPS and how to calculate WPS design targets and evaluate WPS compliance. Training modules on calculating targets and compliance would demonstrate how to use the UNHSC WPS Calculator and UNHSC Performance Curve Calculator, and how to perform supplementary calculations required beyond these tools. Training could be recorded and posted to SNEP's website for broader distribution.
- **Augment WPS calculator tools:** Continue to improve calculator resources to ensure they address all user needs and project scenarios. This might include developing a workflow diagram to clarify how and when to use the available UNHSC Calculators and/or exploring the potential for creating a single integrated calculator that streamlines WPS target setting and compliance evaluation.
- **Compare WPS to state requirements:** Conduct a detailed comparison of the WPS with existing state regulations to identify areas of alignment, gaps, and potential scenarios where requirements may conflict. This will help municipalities understand how the WPS fits into the broader regulatory landscape and may also support state and local regulators in working towards more unified stormwater standards.

By pursuing these next steps, the SNEP Network and its partners can further support stormwater practitioners and advance watershed protection across the region.

SNEP Network Background

The Southeast New England Program (SNEP) Network brings together local environmental organizations, academic institutions, regional planners, and consultants who collaborate to provide municipalities, tribes and organizations in Rhode Island and Southeast Massachusetts access to free training and technical assistance to advance stormwater management, ecological restoration, and sustainable financing goals across the region. The SNEP Network is administered through EPA's partnership with the New England Environmental Finance Center, a non-profit technical assistance provider for EPA Region 1.

The WPS Toolkit has been developed by SNEP Network Partners and external consultants as a key resource for municipalities to adopt and implement a stormwater design standard that protects Southeast New England's water resources. Find out more about the SNEP Network at www.snepnetwork.org.

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