Memorandum

To: New England Stormwater Retrofit Manual Technical Advisory Committee

Date: July 2022

Project #: 14997.00

From: Jamie Houle
Mark Voorhees
Theresa McGovern, PE
Nate Pacheco, EIT

Re: Basis for decisions for the New England Stormwater Retrofit Manual

VHB has worked collaboratively with the UNH Stormwater Center (Jamie Houle), EPA Region 1 (Mark Voorhees) and the SNEP advisors (Elizabeth Scott and Kimberly Groff) (collectively called the SNEP Team for the purposes of this memorandum) in the development of the New England Stormwater Retrofit Manual (the Manual). We were aided by the input of a Technical Advisory Committee (TAC) consisting of the following members:

- Tom Ballestero – UNHSC
- Henry Barbaro – MassDOT
- Eric Beck – RIDEM
- Ian Dombrowski – EPA
- Kathleen Knight – CTDEEP
- Daniel Macadam – UNHSC
- Padraic Monks – VTDEC
- Nick Pisani – RIDEM
- Alisa Richardson – RIDOT
- Michael Sadler – VTDEC
- Laura Schifman – MADEP
- Newt Tedder – EPA

The process of developing the manual consisted of providing review drafts of technical content to the TAC for review, comment and discussion. This process brought many good ideas and considerations to the attention of the SNEP Team. When possible these direct edits or ideas were incorporated into the manual. There is a subset of comments that were not directly accepted or incorporated and this memorandum describes those comments and the rationale for how the Manual addresses them.

Non-structural and source controls

Approach and Basis for Decision: Non-structural and source controls are not discussed in this manual. We had discussed potentially omitting this topic at the August 2020 TAC meeting and have decided not to include. Credits for these measures are evolving, including upcoming work by SNEP and EPA. These credits would be hard to finalize for this document and would not reflect current data soon after publication. Non-structural controls could be the subject of its own manual or supplement to this one in the future and are easily separated from the discussion of structural controls.

Pretreatment

Written comment: Consider revising the statement: "For retrofit scenario, pretreatment may not always be incorporated due to constraints and therefore other components of the system may require more frequent

inspections and maintenance." This statement should be removed or revised to state that at a minimum the designer should provide a deep-sump catch basin or a grass filter strip."

Approach and Basis for Decision: The purpose of the Retrofit Manual is to provide guidance and best practices for the retrofit scenario. Because it is not a regulatory document (and does not intend to be) it does not include minimum requirements, in general. For the topic of pretreatment, the manual acknowledges the benefit of pretreatment for the long-term function of downstream SCMs. The philosophy in the manual is that incorporating some stormwater treatment on a retrofit site is better than omitting altogether. Along that line, the Manual promotes the incorporation of SCMs without pretreatment over no SCMs and acknowledge that those cases may arise in highly constrained scenarios and will require more inspection and maintenance.

Separation to Groundwater

Written comment: "Is the one-foot vertical separation to seasonal high groundwater table adequately protective of private wells?" and "The perforated storage chamber requires a minimum of 2 ft separation to the seasonal high groundwater table/bedrock. However, section 8.21 of the RIDEM Stormwater Management Design and Installation Rules indicates that the bottom of the infiltration facility shall be separated by at least 3 ft vertically from the seasonal high groundwater table. Please correct this discrepancy."

Approach and Basis for Decision: The retrofit manual indicates that 1 foot of separation to groundwater for infiltrating systems with a filter layer is adequate. We understand that this guidance conflicts with the guidance in the RIDEM Stormwater Management Design and Installation Rules and other state stormwater manuals which provide requirements for new and redevelopment projects. This manual seeks to provide more flexible guidance for the retrofit scenario that encourages providing treatment over nothing at all. The guidance of allowing 1 foot of separation is based on the research presented in Appendix F. We understand this appendix was not available during the time of commenter's review.

Lateral Spread of Infiltrated Runoff within SCMs

Written comments "Please provide this study. In our understanding, at least in sandy soils, lateral spread between the bottom of practice and the water table is small, with vertical travel in the water table being quicker. " and "Please provide the study. Please note that this appears to be conflict with an item in the RIDEM Stormwater Management Design and Installation Rules that does not allow for side flow credit, with exceptions"

Approach and Basis for Decision: The referenced study is included in Appendix F. We understand this appendix was not available during the time of commenter's review. We understand that traditional practice is to conservatively assume no lateral infiltration for infiltration SCMs. This assumption may be so conservative that it implies that infiltration practices in certain soils or below a certain size may not be useful. As current research shows, this is not the case

In addition, EPA's most recent pollutant reduction performance curves for infiltration practices included within the Manual include credits for infiltration within Hydrologic Soil Group D (infiltration rate of 0.10 in/hr) including the assumption of only vertical infiltration. These curves are based on long-term continuous simulation and show that on

an annual average basis these systems can provide significant recharge and pollutant reduction even without lateral infiltration.

Based on this information, the Manual promotes the installation of infiltration measures even under these soil and groundwater separation conditions to provide improvement in groundwater recharge and volume and pollutant reductions.

Manufactured Devices

Written comment: "The section doesn't mention manufactured filter devices that utilize filter fabric cartridges like the Jellyfish and Kraken. It should also be noted that these types of devices are more geared toward removing sediments and additional pollutants that are particulate bound (not dissolved) since they don't contain any actual media." And "We suggest mentioning that some manufactured treatment devices can be designed to infiltrate. They can also be combined with upstream detention (which requires increased maintenance frequency due to higher pollutant loading), as well as downstream detention/infiltration after being treated by the manufactured device." And "The manufactured devices section could use some more attention since they are going to become more and more prevalent in urban areas with limited space."

Approach and Basis for Decision: We agree that there are more creative technologies and devices that are being developed and that they have a role in the stormwater retrofit process. The Manual intentionally leaves the Manufactured Devices section brief due to the larger range of products on the market and how quickly they can change. Highlighting specific devices would not be fair to others. To present a fair representation of what is on the market currently would be beyond the scope of this manual and also be quickly out of date.

Prescriptive Guidance in Text and Figures

Written comment: "Should specify minimum distance and not just include in graphic[s]?"

Approach and Basis for Decision: This manual intentionally does not present prescriptive guidance in the text and graphics in order to allow flexibility in the typical prescriptive design mindset for retrofit scenarios. For certain items, prescriptive guidance is provided where necessary for the function of the measure. Appendix F provides justification for the proposed retrofit guidance.

Performance Curves Included within the Manual

Approach and Basis for Decision: This manual presents the EPA Stormwater Control Measure (SCM) Performance Curves as a means of estimating pollutant reduction performance for various SCMs. This manual presents the SCM Performance Curves included in the 2016 Massachusetts and New Hampshire Municipal Separate Storm Sewer System (MS4) Permits, which are administered by EPA. The Massachusetts and New Hampshire MS4 Permits currently include pollutant reduction performance values for Total Phosphorus (TP), and Total Nitrogen (TN). EPA has also developed curves for Zinc (Metals), and Total Suspended Solids (TSS), and Bacteria for various SCMs. EPA is currently in the process of updating the SCM Performance Curves with updated pollutant reduction performance values and creating new Performance Curves for additional SCMs. These updated and new Performance Curves are anticipated to be

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released some time in 2023/2024. However, since these updated SCM Performance Curves are not publicly available at this time, they have not been included in this manual.

The Massachusetts and New Hampshire MS4 Permits present infiltration SCM Performance Curves based on the infiltration rate of the underlying soils. This manual presents Infiltration SCM Performance Curves based on Hydrologic Soils Group (HSG) as opposed to infiltration rate, since HSG is a more commonly used and accessible soils classification system. Table 1 below presents the infiltration rate assumed for each HSG for the Infiltration SCM Performance Curves presented in this manual. The full set of Infiltration Performance Curves can be found in Attachment 3 to Appendix F of the Massachusetts MS4 Permit[1].

Table 1. HSG and Corresponding infiltration rate assumed in this manual (in/hr)

HSG	**Corresponding Infiltration Rate (in/hr)**
A	8.27
B	1.02
C	0.17
D	0.10

Additionally, this manual includes some new SCM Performance Curves, specifically for infiltration in HSG D. The SCM Performance Curves currently included in the Massachusetts and New Hampshire MS4 do not currently include reduction values for infiltration in HSG D soils (infiltration rate of 0.10 in/hr or less). However, new modeling performed by EPA and additional research performed by non-EPA entities[2][3] suggest that significant infiltration can still take place in these soils with low infiltration rates and significant pollutant reduction can be achieved. Since these reduction values are planned to be included in the Massachusetts and New Hampshire MS4 permits moving forward and are entirely new, they have been included in this manual since this manual aims to support designers in installing retrofit SCMs wherever possible based on site constraints.

This manual also presents pollutant reduction values for Bacteria, which are not included in the Massachusetts and/or New Hampshire MS4 Permits. However, these reduction values have been developed and approved by EPA Region 1 for select SCMs and as such are worthwhile for inclusion in this manual since Bacteria may be a pollutant of concern in retrofit scenarios.

[1] https://www3.epa.gov/region1/npdes/stormwater/ma/2016fpd/appendix-f-attach-3-2016-ma-sms4-gp-mod.pdf

[2] Alessandra S. Braswell, Ryan J. Winston, William F. Hunt, "Hydrologic and water quality performance of permeable pavement with internal water storage over a clay soil in Durham, North Carolina", *Journal of Environmental Management*, Volume 224, 2018, Pages 277-287, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2018.07.040. (https://www.sciencedirect.com/science/article/pii/S0301479718307928)

[3] Ryan J. Winston, Jay D. Dorsey, William F. Hunt, "Quantifying volume reduction and peak flow mitigation for three bioretention cells in clay soils in northeast Ohio", *Science of The Total Environment*, Volume 553, 2016, Pages 83-95, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2016.02.081. (https://www.sciencedirect.com/science/article/pii/S0048969716302911)

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Similarly, this manual presents pollutant reduction values for effective impervious area removal, which are also not included in the Massachusetts and/or New Hampshire MS4 Permits. These Effective Impervious Area reduction values were developed by VHB for the Rhode Island Department of Transportation (RIDOT) based on similar modeling and techniques used to develop the EPA SCM Performance Curves. These Effective Impervious Area reduction values have been reviewed and approved by EPA and the Rhode Island Department of Environmental Management (RIDEM) and as such are worthwhile for inclusion in this manual since Effective Impervious Area reduction may be a pollutant of concern in retrofit scenarios.

Smaller Omitted Topics

Written comment: "It might be useful to discuss how the performance curves would work if you created a "treatment train" utilizing several BMPs in series"

Approach and Basis for Decision: SCMs in series and treatment chains are not discussed in this manual as they will not be commonly used in retrofit scenarios and the crediting scheme is beyond what we present in this manual.

Written comment: "It might be useful to also include trash racks in the discharge portion, to protect BMP outlet devices from clogging and ensuring that the BMP discharges as designed. Also, it might be worthwhile to mention the various types of trash racks (i.e., conical, beehive, slanted, etc.) and how some are better than others when it comes to preventing clogs."

Approach and Basis for Decision: Trash racks are mentioned in the Pretreatment section. We also mention outlet control structures, which typically contain a trash rack, in this section. The level of detail suggested by the comment is beyond the scope of this manual. The guidance included leaves the designer with flexibility to choose from multiple options.

Written comment: "Include discussion on how best to receive runoff from adjacent areas (when proposed/desired)."

Approach and Basis for Decision: This manual is not encouraging routing additional runoff to permeable pavement. In addition, the approaches for routing additional runoff to permeable pavement do not involve much more than ensuring sheet flow from adjacent areas, so additional guidance is not needed for a design to alter their design in this way.

Written comment: "An alternative (e.g., [highway in municipality]) is to let the pavement voids slowing fill in / compact, and then when the pavement has served its life, tear up and repave. Again, this is a disadvantage/ limitation that should be mentioned."

Approach and Basis for Decision: Although we acknowledge that it may be cost effective during specific situations to avoid regular maintenance until failure and replacement, we would prefer to propose guidance of continuing to maintain SCMs to provide treatment performance at or close to design levels on a regular basis.

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Written comment: "It's fair to say that Filter SCMs are the most maintenance intensive, given that if they work, and capture pollutants, then the filters must be replaced on a regular basis."

Approach and Basis for Decision: This is not necessarily true. If the filter is a soils layer that is supported by vegetation (i.e. biofiltration) and the SCM has effective pretreatment then the SCM may not require as much maintenance. We do not rank maintenance level of effort with this manual since the maintenance requirements can vary widely based on site-specific considerations and SCM design.

Written comment: "General: Additional guidance on BMP's overflow/spillway weirs would be useful. This could include things like material specifications, such as a concrete curb-weir for large ponds or rip-rap anti-scour pads. It should also be noted that exit velocities should be non-erosive (3-5 fps)."

Approach and Basis for Decision: This manual does not intend to provide prescriptive guidance on functional components. The manual does not provide this level of detail for any other functional components.