pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Clean Water

Managed Release Concept – Frequently Asked Questions

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Version 1.1

1. **If field testing shows an infiltration rate less than 0.1 in/hr, is there an assumed minimum infiltration rate for the MRC BMPs (e.g., 0.05 in/hr)?**

   No, there is no assumed minimal infiltration rate for the underlying soils of an MRC BMP. The design infiltration rate of an MRC BMP should be based upon the field testing with an appropriate Safety Factor applied (as recommended in Appendix C of the Stormwater BMP Manual (as revised)). For the purposes of an MRC BMP, extremely low infiltration rates can be utilized in the design to account for the minimal volume reduction that is occurring through infiltration.

   When field testing identifies that there is zero infiltration for the underlying soils, then infiltration cannot be a function of the MRC BMP. When this is the case, ET can still be utilized for a vegetated MRC BMP.

2. **In the example computations, the infiltration rate is 0.1 in/hr even though this BMP appears to be for SWMs with limited or no infiltration. The infiltration volume constitutes 56% of the total credit in the example.**

   For the design examples, when infiltration is included, it is assumed that proper testing was performed, and the design infiltration is based upon the observed field infiltration rate with a proper Safety Factor applied. This shows the value of the MRC in limited infiltration regions. By limiting the release rate and extending the period of infiltration from the media to include the Internal Water Storage, even a small rate of infiltration can substantially reduce runoff volume.

3. **If there is no assumed infiltration rate, is the target for the site still net change in runoff volume calculated by Worksheet 4 or is it CG-2 (i.e., 1 inch over the proposed impervious area)?**

   The target stormwater management in Pennsylvania is Chapter 102.8(g)(2), which aligns with Worksheet 4. CG-2 is no longer utilized. A properly constructed MRC BMP manages up to the 1.2-inch/2-hour storm, regardless of the infiltration rate. That coupled with the internal water storage and peak flow reduction of the 2- to 1-year/24-hour storm is considered to satisfy the requirements of Chapter 102.8(g)(2) for all storms up to and including the 2-year/24-hour storm.

   NOTE – the 1.2-inch/2-hour storm is equivalent to 1” of runoff from impervious surfaces.

4. **How is the 72 hr max surface dewatering computed – is it based on release rate of the orifice (0.01 cfs/impervious acre) or 2-6 in/hr rate of the soil media?**

   Because the flow rate from the 0.01 cfs/equivalent impervious acre will be more restrictive than the flow rate from the soil media, the draw down calculations should utilize the flow rate from the 0.01 cfs/equivalent impervious area and any applicable infiltration flow rate. The flow rate through the soil media will have no bearing on the functionality of the MRC BMP and does not need to be included in any hydrologic routing calculations. The designer needs to route the 1.2-inch/2-hr storm and show that the volume detained drains down to the surface of the soil media in less than 72 hours. It is anticipated that the orifice release rate will control in the routing calculations.

5. If the target is the Worksheet 4 volume (for sites with infiltration rates of 0 in/hr), does the entire Worksheet 4 volume need to be statically held in the soil media (0.2 void rate for storage + 0.1 void ratio for ET)?

No, static storage is not required to be calculated. The designer can route the design storms using generally accepted hydrologic software. The volume of the 2-year/24-hour storm that is managed in accordance with MRC guidance can be entered on Worksheet 5 and then subtracted from the volume determined on Worksheet 4.

6. It is understood that vegetated MRCs (and porous pavement MRCs with adequate street sweeping) provide adequate water quality management for TSS, TP, and N. However, how can adequate water quality management be demonstrated for underground MRCs?

Non-vegetated, non-porous pavement MRC BMPs must be provided with adequate pre-treatment. For these MRC BMPs, adequate water quality management can be demonstrated through the use of Worksheets 11-13. A non-vegetated, non-porous pavement MRC is considered a primary BMP due to the required inclusion of the IWS for nitrate removal (see MRC Design Standard 6.c).

7. For vegetated MRCs with an IWS, it appears that Worksheet No. 10 may not be required to be provided to demonstrate an adequate water quality compliance. Is this correct?

This is correct. If 90% of the proposed impervious area (including equivalent offset impervious area) is being managed by a vegetated MRC BMP, then the MRC BMP is adequately managing the water quality, and no additional water quality demonstration has to be provided (i.e., Worksheet 10 does not have to be provided).

NOTE – Management of 90% of the proposed impervious area is in compliance with Flow Chart D from Chapter 8 in the Stormwater BMP Manual (as revised).

8. Why is a 2-hour distribution used for the 1.2-inch rainfall event?

A shorter duration of rainfall distribution is used for the 1.2-inch event instead of the typically used 24-hour distribution since it better mimics naturally occurring rainfall patterns in a smaller event size, such as 1.2-inches, compared to the larger storms defined by a return period (i.e. 1-, 2-…100-year). A 2-hour duration was adapted as it has been established as the NJ DEP water quality storm and has “intermediate rainfall intensities that have the same probability or recurrence interval as the storm’s total rainfall and duration” (NJDEP 2004). The 1.2-inch/2-hour event used for the MRC designs can be evenly distributed over the 2 hours (i.e., 0.6 in/hr intensity). The NJ DEP 2-hour rising and falling distribution may be used but is not necessary and a uniform distribution of 0.6 in/hr is acceptable for this application.

9. Why is a NOAA type C distribution used in the design examples for the 24-hour rainfall events?

NOAA rainfall values are used with a NOAA type C distribution for the 24-hour rainfall events. NRCS Type II distribution has been used previously; however, the developer of the Type II distribution no longer recommends this distribution where NOAA distributions have been established: “To use a Type II or other legacy rainfall distribution with the updated NOAA Atlas 14 data could introduce errors by application of inaccurate rainfall intensities during the storm…Very little documentation is available that describes the development of the Type II and other legacy rainfall distributions. Study of what is available leads to the conclusion that their use be discontinued in areas covered by NOAA Atlas 14 data.…There is no doubt that when these legacy rainfall distributions were developed, they were developed using the best available data, technology, and engineering judgment available at the time. With current data of improved quantity and quality, geographic information systems, and computer capabilities, a higher standard may be set with respect to developing and using updated rainfall distributions” (USDA-NRCS 2015). In addition, other

refereed journals have also recommended against the use of "Type" distributions in lieu of other, newer distributions (Chin 2018, Chin and Ross 2018). The type C curve was specifically used as the example took place in Philadelphia. Type A, B, C and D curves have been developed for Pennsylvania and the surrounding area and should be used in conjunction with NOAA rainfall values depending on site location (Merkel et al. 2015). See:

Chin David A. (2018). "Effect of Return Period on Normalized Rainfall Distributions in the United States." *Journal of Hydrologic Engineering*, 23(11), 04018046.

Chin David A., and Ross Eboné A. (2018). "Canonical Rainfall Distributions in the United States." *Journal of Irrigation and Drainage Engineering*, 144(11), 04018031.

Merkel, William H., Moody, Helen Fox, Quan, Quan D. (2015) "Design Rainfall Distributions based on NOAA Atlas 14 Rainfall Depths and Durations USDA-NRCS, Beltsville, MD.

United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS). (2015). "Chapter 4: Storm Rainfall Depth and Distribution- DRAFT" Part 630 Hydrology, National Engineering Handbook.

10. Design Standard 10 identifies "If on-site undisturbed soils are unsuitable for the purpose of providing IWS, an additional one to two feet of suitable soil media should be provided below the underdrain." If in-situ soils are unfavorable for infiltration, what is the design intent of doing additional suitable soil?

The design intent is to create an IWS (internal water storage). Runoff needs to enter the IWS during the storm event. If the undisturbed soil can't infiltrate, then they are not suitable for the IWS. The IWS provides a volume for denitrification, added water for plants to evapotranspirate, as well as temperature mitigation. An IWS will maximize any potential infiltration.

11. Why are we are reducing the 2-yr/24-hr storm peak flows down to the 1-yr/24-hr storm level? Will the receiving stream not be protected by just meeting the 2-yr/24-hr pre-development rate?

Pennsylvania's current 2-year/24-hour storm volume control is based on recharge, water quality, and geomorphologic protection. As the MRC design is targeting a smaller rainfall, additional protection is needed. Note that in many designs it is expected that the 1.2-inch capture will meet this requirement with minimal additional storage, especially as the larger storms still require peak controls.

12. Regarding the up-turned elbow, how will it be protected from cracking each year due to freezing conditions?

The upturned elbow should be at the bottom of the storage media, so several feet below the surface, and the frost line. Minnesota (which typically has harsher winter conditions than Pennsylvania) recommends that outfalls not be connected to a shallow structure (like a road) that could be affected by frost heave.

13. What about having an IWS for an underground BMP and lined BMPs. Will this not create a dead zone which will hold water constantly? For non-vegetated, underground MRC BMPs, what can we use for nitrate removal efficiency?

The "dead zone" is intended to reduce nitrogen which requires anerobic conditions. For non-vegetated systems, the underdrain is required to be at the bottom, so a new storm will push out the collected runoff from the previous storm. Vegetated systems have the advantage of ET reducing the IWS storage.

14. How do we calculate the soil moisture recovery from the media above the IWS?

Research shows it should be removed within 7 days (there is no need to model).

15. When you say you need 75% vegetative coverage, what area do you mean?

This refers to the surface infiltration footprint. Note, it is a good idea to have vegetative coverage (or another form of permanent stabilization) on the side banks to prevent accelerated erosion.

16. Do you need to have the orifice flow rate restricted to the manage release rate?

No, the overall system outflow peak has to be less than or equal to the managed release rate for the 1.2-inch rainfall event without overtopping. This requires a restricted orifice, but that does not mean you can't have larger outflows during larger events.

17. Design Standard No. 4 identifies that the peak flow attenuation for the 2-year/24-hour storm event must be to the pre-development 1-year/24-hour storm or per an approved and current Act 167 Plan. If the municipality grants a waiver under their Act 167 ordinance to the 2-year/24-hour storm event's attenuation, will the design standard still be met?

No. It the municipality grants a waiver to their Act 167 ordinance requirements, then this would be viewed as an MRC alternative design standard.

For example, the municipality's Act 167 ordinance requires the post-construction 2-year/24-hour storm event peak flow rate to be equal to or less than the pre-development 1-year/24-hour storm event. However, during the municipal review process a waiver is granted such that the post-construction 2-year/24-hour peak rate can be equal to or less than the pre-development 2-year/24-hour storm event. The design would not be consistent with the Act 167 Plan that was approved DEP; therefore, the design would be viewed as an alternative design standard.

18. The local municipal ordinance does not allow for the use of Managed Release Concept; however, the municipality has granted a waiver to allow MRC to be used. Can MRC be used?

Yes, in this case MRC can be used.

19. What is the ponding time for storm events larger than the 2-yr/24-hr storm?

In accordance with Design Standard No. 9, the drawdown time for any storm event is 72 hours. This is from when the storm event ends.

20. If we have an MRC BMP can we rely upon the Common Law Easement for an offsite discharge analysis?

To answer this question, you should engage your or your client's legal counsel.

21. If there is a "hotspot" and the municipality won't allow infiltration, will DEP/CCD waive the 7-day dewatering time for the IWS and the testing?

In the general sense, no. DEP will not automatically accept that infiltration is not appropriate or feasible just because the municipality will not allow it. You will have to provide the demonstration that infiltration is not appropriate or feasible. Additionally, the drawdown time would still have to be met in accordance with Design Standard No. 9, or you would have to provide an alternative design standard.

22. Is a liner a deviation from the design standards; meaning an individual permit?

The use of a liner in and of itself will not trigger the potential for an individual permit. However, if a liner is proposed, an adequate justification on the necessity of a liner will be required. You may not assume a liner must be used just because the project is in a karst area.

23. If there is a liner, then the IWS is not required; correct?

No. If a liner is needed, then the IWS still must be provided. If you don't provide an IWS, then you will have an MRC alternative design standard and trigger the potential for an individual permit.

24. What is more important, the 72-hr draw down time or the 0.01 cfs/impervious acre; as designed our MRC BMP cannot meet both?

Both are equally important. If your design is having trouble meeting the drawdown time and the discharge rate, then a larger BMP or more BMPs are needed. If you exceed either of these criteria, then you will trigger the potential for an individual permit.

25. Do I use the loading ratio from the Pennsylvania Stormwater BMP Manual?

No, follow the MRC Design Standards.

Version History

Date	Version	Revision Reason
6/27/2019	1.1	Added FAQs #14 - #25
5/15/2019	1.0	Original