

Appendix B

**Hydrologic Response of Green Roofs**

## Hydrologic Response of Green Roofs

The following is what I have received so far on green roofs. My thanks to Ted Scott for passing along his communication with Dr. Jarrett of Penn State. And my thanks to Mike Clar for his input as well.

### Pennsylvania State University

“Green roofs do a great job of capturing rain water. My data shows clearly that a 3.5-in extensive GR will capture about 50 to 60% of the annual rain. This is based on PA rain and PA ET rates...MD should be slightly better. I have modeled about 65% capture of annual rain in Raleigh, NC.

When we start looking at individual storms in the context of the NRCS runoff model, we see what looks like a problem with the model (and I am convinced that the NRCS runoff model has major problems when applied to some situations). GRs are one of those. When you try to apply the measured rain to the measured runoff from a GR, the numbers look good. But when you apply those values to the NRCS runoff model to determine what RCN will predict the results you do not get the kind of RCN you expect. My data for our GRs shows RCN of a low of about 85 and a high of about 98. These are based on actual measured rainfall hyetographs and the associated runoff depths.

My GR individual storm GR model yields runoff depths that would produce RCN of 95 for a 2-year storm and 92 for a 100-year storm (These are based on Type II synthetic rainfall distributions).

If you are tied to the NRCS runoff model, I would recommend a RCN of about 92 for extensive GRs. This will still yield annual GR capture rates of 50 to 60% based on all rains within the year.

In my opinion,  $RCN = 75$  is too low. Again based on my modeling of our system and some extrapolation of what happens when the roof media depth is deeper than 3.5 inches, even increasing the media depth to 5 or 6 inches will not improve the GR's rate of capture. This whole system is driven by the ET function and the period since the last rain. It has very little to do with the depth of the roof media.”

**Albert R. Jarrett, Ph.D., P.E., P.L.S.**  
*Pennsylvania State University*

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“We should ask MDE to provide a brief background paper on how they arrived at a CN value of 75 for green roofs. The research that I have conducted revealed that CN values for green roofs are all over the place. The CN value is a function of the media depth and rainfall depth. Green roof research at Penn State Univ and NC State Univ. suggest that the storage volume per inch of media depth is about 0.2 inches. Based on this information I developed the following recommendations for green roof design:

**CN values for various media and rainfall depths**

| <b>Media Depth /<br/>Storage Vol</b> | <b>CN Value for Storm /Rainfall Depth*</b> |           |           |            |             |
|--------------------------------------|--|-----------|-----------|------------|-------------|
|                                      | WQv(1")                                    | 1yr(2.5") | 2yr(3.0") | 10yr(5.0") | 100yr(7.0") |
| 2" / (0.4")                          | 85   | 90        | 90        | 90         | 95          |
| 4" / (0.8")                          | 60   | 85        | 85        | 90         | 90          |
| 5" / (1.0")                          | 60   | 85        | 85        | 88         | 90          |
| 6" / (1.2")                          | 60   | 80        | 80        | 85         | 88          |

\* The CN values shown [above] were computed by subtracting the storage volume from the runoff depth provided in Table 2.1 of TR-55 manual (NRCS, 1986). It should be noted that no allowance has been provided for potential storage depth provided by the drainage, aeration, water storage and roof barrier membrane. This volume, if any is provided, can also be subtracted from the unit runoff volume of Table 2.1 to further reduce the CN value.

I am not suggesting that the values that I developed are right and MDE is wrong. But I am suggesting that there can be different perspectives on this matter, and as a starting point, it would be useful to know what information MDE is using to set statewide guidelines.”

**Michael L. Clar, P.E.**  
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