

Appendix G: Compliance Calculator Spreadsheet Instructions

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G.1 Introduction

The compliance calculator spreadsheet (Appendix H) was created to allow a designer to quickly analyze multiple LID options, and check them against the watershed area’s water quality design requirements. As is clear from the specifications, each LID BMP has different design requirements, equations, and standards that determine its effectiveness. Depending upon the site, it can become difficult to determine which BMP(s) best meets the requirements. With the compliance calculator, it is easier to examine different combinations of BMPs in order to find the best option or set of options. The compliance calculator is also to be used by the plan reviewer to quickly verify the compliance status of a plan.

It is important to note that the compliance calculator is not a model, and while it can be used as a design tool, it does not replace the needed efforts of a competent designer. The numbers in the spreadsheet don’t guarantee that a BMP meets the specifications, is appropriate for its location, or is generally well-designed.

G.2 Compliance Calculator Spreadsheet Guidance

The following guidance explains how to use each of the worksheets in the compliance calculator spreadsheet (Appendix H).

Note: All cells highlighted in blue are user input cells. Cells highlighted in gray are calculation cells, and cells highlighted in yellow are constant values that generally should not be changed.

Site Data Sheet

1. Enter the name of the proposed project on **line 9**.
2. Enter the pre-development land cover areas (in acres) of forest/open space cover, turf cover, impervious cover and BMP cover for the site for Natural Resource Conservation Service (NRCS) soil types A, B, C, and D in cells C24-C27, E24-E27, G24-G27, and I24-I27, respectively.
3. Verify/enter the NRCS runoff curve numbers for each land use/soil type combination in cells D24-D27, F24-F27, H24-H27, and J24-J27. Default values have already been included in these cells, but they can be changed if necessary.
4. Enter the post-development land cover areas (in acres) of forest cover/open space, turf cover, impervious cover and BMP cover on the site for Natural Resource Conservation Service (NRCS) soil types A, B, C, and D in cells C34-C37, E34-E37, G34-G37, and I34-I37, respectively.
5. Verify/enter the NRCS runoff curve numbers for each land use/soil type combination in cells D34-D37, F34-F37, H34-H37, and J34-J37. As with the pre-development entries, default values have already been included in these cells, but they can be changed if necessary.

BMP Sheet

1. Apply BMPs to the drainage area to address the required water quality volume by indicating the area in square feet (sf) of forest cover, turf cover, and impervious cover to be treated by a given BMP in **Columns B, C, and D**. This will likely be an iterative process. The available BMPs include the following:

- Bioretention – No Underdrain
- Bioretention - IWS
- Bioretention - Standard
- Permeable Pavement - Enhanced
- Permeable Pavement - Standard
- Infiltration
- Green Roof
- Green Roof – Irrigated
- Rainwater Harvesting
- Impervious Surface Disconnection
- Grass Channel
- Grass Channel – Amended Soils
- Dry Swale
- Wet Swale
- Regenerative Stormwater Conveyance (RSC)
- Filtering Systems
- Storage Practices
- Stormwater Ponds
- Stormwater Wetlands
- Proprietary Practice
- Planted Tree
- Preserved Tree

2. Enter the BMP's surface area (sf) in **Column E** and storage volume (cf) in **Column F**.

3. The volume from direct drainage to the BMP is calculated and reported in **Column E**. Note that the total disturbed area is reflected as the sum of impervious cover (**Column D**), turf cover (**Column C**) and forest/open space cover (**Column B**) draining to the practice.

4. If more than one BMP will be employed in series, any overflow from upstream BMPs will be accounted for in **Column M**.

5. The total volume captured by the practice (V_{CAP}) is reported in **Column N** and is equal to the following:

$$V_{CAP} = \text{Minimum}(Sv, V_{US} + V_{DD})$$

Where:

- | | | |
|--------------------|---|--|
| WQV _{CAP} | = | Water Quality Volume captured by the practice (cf) (Column N) |
| Sv | = | Storage Volume (cf) (Column F) |
| V _{US} | = | Volume of runoff from upstream practice (cf) (Column M) |

V_{DD} = Volume of runoff from direct discharge (cf) (**Column L**)

- The Runoff Reduction or Pollutant Removal Efficiency (%) for each BMP (from Table 2.3) is reported in **Columns H-K**.
- The Water Quality Volume Credited is calculated in **Column O**, and is equal to the following:

$$WQv_{CR} = \text{Minimum of } (Sv \times CR, V_{CAP})$$

Where:

WQv_{CR} = Water Quality Volume Credited (cf)
 Sv = Storage Volume (cf) (**Column F**)
 CR = Credit (fraction)
 V_{CAP} = Volume Captured by the Practice (cf) (**Column N**)

- The Remaining Water Quality Volume (**Column P**) is calculated as:

$$WQv_R = V_{US} + V_{DD} - WQv_{CR}$$

Where:

WQv_R = Water Quality Volume Remaining (cf) (**Column O**)
 V_{US} = Volume from Upstream Practices (cf) (**Column M**)
 V_{DD} = Volume from Direct Drainage (cf) (**Column L**)

- Any runoff volume remaining can be directed to a downstream BMP by selecting a practice from the pull-down menu in **Column G**. Selecting a BMP from the menu will automatically direct the runoff volume remaining to **Column M (volume from upstream practices)** for the appropriate BMP.
- Planted Trees. Input the number of planted and preserved trees of each size class in cells F38-F42 (retention values correspond to Table 4.62 and 4.63 in design manual).
- The Target Retention Volume (WQv_T) is reported in **Cell B49**, from corresponding **Cell C42** on the **Site Data Tab**.
- The Water Quality Volume Provided (WQv_P), is calculated in **Cell C49** as a combination of the retention values for all BMPs and trees (Cells O17-O42)
- The fraction of target achieved (either by practice or by the entire site as appropriate) is calculated in **Cells F31-F35**. The % of target achieved is calculated as follows:

$$T = \text{Minimum of } \left(\frac{WQv_P}{WQv_T}, 1 \right)$$

Where:

T = Treatment (fraction)
 WQv_P = Water Quality Volume Provided (cf)
 WQv_T = Water Quality Volume Target (cf)

- Cells **D49, 52, 54, 58, and 61** determine if the site target has been reached as follows:

- Overall Retention Goal

- Target Retention Volume
- General Stormwater Management Watershed Area Minimum Requirements
 - Target TSS Removal
 - Target Nitrogen Removal
 - Target Bacteria Removal
- Savannah River Special Watershed Protection Area Minimum Requirements
 - Target Retention Volume (1.16 in storm)

Channel and Flood Protection

This sheet assists with calculation of Adjusted Curve Numbers that can be used to calculate peak flows associated with the 2- to 50-year storm events.

15. Enter the appropriate depths for the 2-year, 10-year, 25-year, 50-year, and 100-year 24-hour storms (as provided in Table 2.4) on **Line 5**.
16. The Total Site Area (from the **Site Data Tab**), is reported in **Cell C7**.
17. Detention Storage Volume (cf) is calculated in **Cell C8**, and refers to the total storage provided in all LID practices using the following equation:

$$V_{DS} = \sum_{LID\ BMPs} SV_{BMP} \cdot IRD_{BMP}$$

Where:

- V_{DS} = Volume in Site Detention Storage (cf)
- SV_{BMP} = Storage Volume Provided in Each BMP (cf)
(from **Column F** of the **BMPs Tab**)
- IRD_{BMP} = Infiltration, Retention or Detention Credit for Each BMP
(from **Column J** of the **BMPs Tab**)

Note that, while other practices such as ponds provide detention, it is assumed that design engineers will explicitly account for this detention in a Pond Routing program.

18. As indicated in the Site Data sheet, each cover type is associated with a NRCS curve number. **Cells D15–G22** show the pre-development land cover areas and curve numbers that were indicated on the Site Data Sheet. Using these curve numbers, a weighted curve number is calculated in **cell G24**.
19. **Cells D29–G36** show the post-development land cover areas and curve numbers that were indicated on the Site Data Sheet. Using these curve numbers, a weighted curve number is calculated in **cell G38**.
20. Using NRCS methodology, **Line 42** calculates the pre-development runoff volume (inches) for the various storm events.

Potential Abstraction

$$S = \frac{1000}{(CN - 10)}$$

Where:

- S = potential abstraction (in.)
 CN = weighted curve number

Runoff Volume

$$Q = \frac{(P - 0.2 \cdot S)^2}{(P + 0.8 \cdot S)}$$

Where:

- Q = runoff volume (in.)
 P = precipitation depth for a given 24-hour storm (in.)
 S = potential abstraction (in.)

- 21. Line 43** calculates the post-development runoff volume based solely on land cover (without regard to the BMPs selected on the BMP sheet). **Line 44** then subtracts the runoff reduction volume provided by BMPs, from **Cell C8**.
- 22.** Based upon the reduced runoff volumes calculated in line 44, the spreadsheet then calculates corresponding reduced curve numbers for each storm event. This Adjusted Curve Number is reported on **Line 45**.
- 23. Line 46** compares the pre-development runoff volume in line 42 with the post-development (with BMPs) runoff volume in line 44. If the post-development volume (with BMPs) is less than or equal to the pre-development volume for a given storm event, then it is assumed that detention will not be required. If the post-development volume (with BMPs) is greater than the pre-development volume for a given storm event, then detention will be necessary, and the Adjusted Curve Numbers from line 45 should be used to calculate the post-development peak runoff rates.