DEP POST-CONSTRUCTION STORMWATER MANAGEMENT (PCSM) SPREADSHEET INSTRUCTIONS

Revised, December 23, 2019

Introduction

The Department of Environmental Protection (DEP) has developed the DEP PCSM Spreadsheet ("spreadsheet") to facilitate calculations necessary for completing the stormwater analysis required by § 102.8(g) for PCSM Plans. The spreadsheet is intended to streamline PCSM calculations and help applicants demonstrate compliance with the regulations when a permit under Chapter 102 is required.

The spreadsheet contains default calculations that may in most cases be overridden by the user’s own calculations, providing flexibility. However, if the user overrides any of the spreadsheet’s calculations, the applicant should attach additional documentation explaining what specifically was overridden with justification. The use of the spreadsheet and attachment of spreadsheet printouts to Chapter 102 applications is encouraged, and in certain cases is required, because the reviewing agency will receive calculations in a consistent format, which is intended to provide for more efficient and timely reviews.

NOTE – It is important that the user follow these instructions carefully. Omission of data in any cell designed for data entry may result in the failure of important calculations on the same or different worksheets.

Questions on the use of the spreadsheet can be directed to the Bureau of Clean Water at (717) 787-2137.

General Information

If prompted by Excel after opening the spreadsheet, enable editing and macros. Note that you may need to add additional Trusted Locations in the Trust Center Settings of Excel in order to run the macros. These locations may include server drives and/or locations where you intend to save the file for use. The following steps may be taken:

1. Excel Options > Trust Center > Trust Center Settings > Trusted Locations
2. Check the box to “Allow Trusted Locations on my network”
3. Select “Add new location”
4. Browse to select the folder (or server) where the file will be saved, check the “Subfolders of this location are also trusted” box, and then OK.

The spreadsheet consists of five hyperlink tabs: Instructions, General, Volume, Rate and Quality. Each tab has a corresponding worksheet. A versions tab is also visible to identify changes made to the spreadsheet over time. To begin, click on the General tab.

The top of each worksheet contains a “Clear Form” button. The user may click on the “Clear Form” button at any time to delete all data from the current worksheet.

NOTE - The spreadsheet is intended for the evaluation of volume, rate, and water quality for discharges to a single receiving surface water. If for example there are 3 post-construction discharge points to Mud Run and 3 post-construction discharge points to Clear Creek, two spreadsheets should be completed (one for Mud Run and one for Clear Creek). Alternatively, the spreadsheet can be used on a discharge point basis.

All cells available for data entry or selection from a drop-down menu are highlighted. The user may use the Tab key to move from cell to cell. The spreadsheet is protected. Formulas are not visible but are explained in this document.

Validation that exists in the spreadsheet is highlighted and explained in this document. Note that using the Tab key on your keyboard to move between cells instead of using your mouse to click on cells may alleviate some validation errors.
NOTE – Throughout the spreadsheet decisions were made concerning cell formatting with respect to the number of decimal places displayed. The number displayed in a cell is not necessarily the number that is stored by the spreadsheet. Therefore, you may not be able to replicate a calculated value using only the numbers displayed in the cells due to the spreadsheet’s rounding of input values to meet formatting requirements.

Example – Cell A1 is formatted to 1 decimal place. The user enters “2.171”, which is displayed as “2.2”. Cell A2 is formatted to 1 decimal place also. The user enters “0.5421”, which is displayed as “0.5”. Cell A3 is the product of A1 and A2 and is formatted to 2 decimal places. The actual result calculated by the spreadsheet is “1.1768991” and “1.18” is displayed. This is different than the product of the input values displayed on the screen (i.e., 2.2 x 0.5 = 1.10).

General Worksheet

- **Project Name** – Enter the name of the project as it will be recorded on the Chapter 102 permit application.
- **Application Type** – Select the type of Chapter 102 permit application that will be submitted to DEP or a county conservation district (CCD) for the project.
- **County** – Select the county where the project is located from the drop-down list. If the project is located in multiple counties, select the county with the greatest area of earth disturbance.
- **Municipality** – Select the municipality where the project is located from the drop-down list. If the project is located in multiple municipalities, select the municipality with the greatest area of earth disturbance.
- **Project Type** – Select the applicable project type from the drop-down list. If the project type is not shown, select “Other”. For mixed uses select the primary use or select “Other”.
- **New Project or Minor / Major Amendment** – Select the appropriate radio button to indicate whether the spreadsheet is being completed for a new project or for a minor or major amendment to an existing project (e.g., additional phases of a larger common plan of development or sale).
- **Total Project Site Area** – Enter the total number of acres for the project site in the watershed of interest, including both the earth disturbance area and any other areas owned by the applicant that drain to PCSM BMPs or discharge points for the project. See [25 Pa. Code § 102.1](https://www.pacode.pa.gov/102/102.1.html) for the definition of Project Site.
NOTE – If there will be post-construction discharges to two or more surface waters, and therefore multiple spreadsheets must be completed in order to analyze all sitewide discharges, the Total Project Site Area must be divided amongst the analyses. For example, if the Total Project Site Area is 10 acres and there will be post-construction discharges to Mud Run and Clear Creek, the user should determine the portion of the project site area that drains to each surface water (e.g., 6 acres to Mud Run and 4 acres to Clear Creek).

- **Total Earth Disturbance** – Enter the total number of acres of earth disturbance within the project site for the watershed of interest.

VALIDATION – The value for **Total Earth Disturbance** may not exceed the value for **Total Project Site Area**.

- **No. of Post-Construction Discharge Points** – Select the number of post-construction discharge points (“DPs”) (also known as “points of interest”) that are proposed for a specific receiving surface water. The term “discharge point” means all engineered structures, drainageways and areas of concentrated flow where runoff leaves a project site, except for areas of shallow concentrated flow that are controlled by perimeter BMPs during construction. Discharge points are not only pipes (outlets from BMPs) but may also include areas where stormwater flows will concentrate by design and areas of concentrated flow prior to level spreaders or other diffusion of flows. Discharge points may be situated at or near surface waters or at another location, at or prior to the project site boundary.

NOTE – All discharge points reported on the spreadsheet should be identified on site maps and/or PCSM Plans.

A maximum of 10 discharge points can be selected; if a project involves more than 10 discharge points, additional discharge points should be recorded on a separate spreadsheet. Selection of the number of post-construction discharge points will open a table for data entry.

![Spreadsheet Table]

An explanation of the columns in this table is as follows:

- **Discharge Point (DP) No.** – Discharge points are automatically assigned a sequential number starting at 001. In addition to discharge points, at the bottom of the table the user is requested to enter information on “Undetained Areas.” These are areas that are part of the project site but do not drain to a discharge point; for example, areas that due to final grade will not drain to a BMP or discharge point should be considered undetained areas.

- **Drainage Area (DA) (acres)** – For each discharge point, report the post-construction drainage area tributary to the discharge point. The surface area of BMPs, if present, should be included in this value.
VALIDATION – The Drainage Area for individual discharge points and undetained areas may not exceed the Total Project Site Area entered on this worksheet. In addition, the sum of all drainage areas and undetained areas may not exceed the Total Project Site Area.

- Earth Disturbance in DA (acres) – For each discharge point, report the area of earth disturbance within the post-construction drainage area.

VALIDATION – The Earth Disturbance area for individual and all discharge points and undetained areas may not exceed the Total Earth Disturbance Area entered on this worksheet. In addition, the Earth Disturbance area for any discharge point or undetained areas may not exceed the value entered for Drainage Area.

- Existing Impervious in DA (acres) – For each discharge point, enter the actual acres of impervious surface – prior to construction – within the post-construction drainage area.

NOTE – If pre-construction drainage areas will be modified as a result of construction, this determination may require an applicant to superimpose the post-construction drainage area onto an existing site map in order to delineate existing impervious surfaces.

- Proposed Impervious in DA (acres) – For each discharge point, enter the acres of impervious surface that are planned within the post-construction drainage area.

- Receiving Waters – The user may select a value from the dropdown list, if applicable, or enter the name of the surface water receiving stormwater discharges from the discharge point. If the surface water is not named, use “unnamed tributary to XXX”, where “XXX” is the name of the first named surface water downstream.

NOTE – If the discharge is to non-surface waters (e.g., via a level spreader or other flow diffusing device), the applicant must investigate the flow path and ultimate discharge point to verify safe and non-erosive conveyance to the surface water.

- Ch. 93 Class – Select the existing or designated use of the named surface water from the drop-down list. Users should check DEP’s Existing Use website first, and if not found on this website, use the designated use as contained in Chapter 93.

- Structural BMP(s) – Select “Yes” if stormwater in the drainage area of the discharge point will be treated by a structural BMP, otherwise select “No”.

Based on the project and entries made on this worksheet, the following message may be displayed below the table:

**PROJECT SITE MEETS SMALL SITE EXCEPTION - RATE WORKSHEET NOT REQUIRED**

If the following two items are true, the applicant does not need to complete the Rate Worksheet or otherwise complete an analysis of peak rates: 1) the Total Earth Disturbance area is less than 5 acres; and 2) the area of post-construction impervious surface within the watershed is less than or equal to one acre.

**Volume Worksheet**

The Volume Worksheet utilizes the design standard under 25 Pa. Code § 102.8(g)(2) that applicants must manage the net change in volume for storms up to and including the 2-year/24-hour storm event when compared to pre-construction runoff volume. Use of the Volume Worksheet may not be appropriate when a design standard under an approved Act 167 Plan or other alternatives is used.
### 2-Year / 24-Hour Storm Event (NOAA Atlas 14)

DEP recommends that applicants utilize the NOAA Atlas 14 online service to locate the weather station closest to the project site and select the 2-year / 24-hour storm event total, in inches. If this value is entered, it will be used throughout the spreadsheet for calculations.

**Alternative 2-Year / 24-Hour Storm Event**

If the user decides to use a different source of information for precipitation data, the NOAA Atlas 14 field may remain blank and the user may enter an alternative rainfall amount in the appropriate box, in inches. If an alternative is selected, the user should report the source of the alternative data.

### Pre-Construction Volume Calculation Table

The purpose of this table is to calculate the total pre-construction runoff volume for the project site (or portion of the project site within a specific watershed). By default, the program will automatically calculate curve number (“CN”), initial abstraction (“Ia”), “Q Runoff (in)”, and “Runoff Volume (cf).” If the user prefers to calculate these values independently, uncheck the box for **Automatically Calculate CN, Ia, Runoff and Volume**. All existing land covers for the project site must be identified in this table.

**NOTE** — The user may select the number of rows, up to 8, for the number of land covers to be reported. This selection controls the number of land cover rows for both the Pre-Construction and Post-Construction Volume Calculation Tables.

**NOTE** — The **Automatically Calculate CN, Ia, Runoff and Volume** box controls the user’s ability to manually enter values for CN, Ia, Runoff and Volume for both tables. In addition, when checked, this box allows the user to select Land Cover options from a drop-down list (otherwise Land Covers must be entered manually).

**Land Cover** — Select the Land Cover description(s) that best characterize pre-construction conditions within the project site. For pre-construction conditions, the Land Cover options are Impervious, Impervious as Meadow, Pervious as Meadow, and Forested (Good Condition). If the **Automatically Calculate CN, Ia, Runoff and Volume** box is not checked, the user must enter pre-construction Land Cover options manually.

**Area (Acres)** — Enter the area, in acres, associated with the Land Cover selected.

**VALIDATION** — The entry of an area for an individual Land Cover as well as the sum of all Land Cover areas may not exceed the **Total Project Site Area** that was entered in the General Worksheet.

**Soil Group** — Select a Hydrologic Soil Group (HSG) from the drop-down list for the Land Cover. Soil groups are based on NRCS’ National Engineering Handbook (**Chapter 7, Hydrologic Soil Groups**). The **NRCS Web Soil Survey** tool may be used to determine the soils present at a site (instructions on using the...
Survey tool to determine HSG are available – use this link). For soils assigned dual soil groups (e.g., A/D, B/D, etc.), use the first group for your selection.

NOTE – An option of “N/A” is available to select for impervious surfaces where any HSG would result in a CN value of 98. If accidentally selected for any other Land Cover, the spreadsheet assumes that HSG “D” was intended.

- **Curve Number (CN)** – The spreadsheet uses CN values from TR-55 by looking up the combination of Land Cover and Soil Group. If the Automatically Calculate CN, Runoff and Volume box is unchecked, the user may enter user-defined values for CN (from 30 to 98). DEP/CCD may request additional documentation for user-defined CN values.

The following CN values are used when pre-construction Land Cover is selected in combination with the Hydrologic Soil Group (HSG):

<table>
<thead>
<tr>
<th>Pre-Construction Land Cover</th>
<th>Curve Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HSG A</td>
</tr>
<tr>
<td>Impervious</td>
<td>98</td>
</tr>
<tr>
<td>Impervious as Meadow</td>
<td>30</td>
</tr>
<tr>
<td>Pervious as Meadow</td>
<td>30</td>
</tr>
<tr>
<td>Forested (Good Condition)</td>
<td>30</td>
</tr>
</tbody>
</table>

The CN values are based on NRCS’ Urban Hydrology for Small Watersheds (TR-55) (“TR-55”), as follows:

<table>
<thead>
<tr>
<th>Pre-Construction Land Cover</th>
<th>Equivalent TR-55 Land Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impervious</td>
<td>Impervious Areas: Paved Parking Lots, Roofs, Driveways, Etc. (Excluding ROW)</td>
</tr>
<tr>
<td>Impervious as Meadow</td>
<td>Meadow-Continuous Grass, Protected from Grazing and Generally Mowed for Hay</td>
</tr>
<tr>
<td>Pervious as Meadow</td>
<td>Meadow-Continuous Grass, Protected from Grazing and Generally Mowed for Hay</td>
</tr>
<tr>
<td>Forested (Good Condition)</td>
<td>Woods (Good Condition)</td>
</tr>
</tbody>
</table>

NOTE – Select “Impervious” and “Impervious as Meadow” as appropriate to implement the requirement at 25 Pa. Code § 102.8(g)(2)(ii) that 20% of the existing impervious area to be disturbed must be considered meadow in good condition or better (with specific exceptions). For example, if a redevelopment project will disturb one acre of existing impervious surface, enter 0.8 acre as “Impervious” and 0.2 acre as “Impervious as Meadow.”

- **Initial Abstraction (Ia)** – The initial abstraction, in inches, is calculated and displayed based on methodology in TR-55: 0.2 x (1000 / CN) – 10.

- **Q Runoff (in)** – The depth of runoff, in inches, is calculated by the following equation based on TR-55, where P equals the 2-year/24-hour storm event rainfall in inches:

  \[
  (P - Ia)^2 / (P + 0.8 \times (1000 / CN) - 10)
  \]

  Where the user does not utilize the default calculation, the user must attach a copy of the runoff calculation. If P - Ia is less than or equal to zero, the depth of runoff is zero.

- **Runoff Volume (cf)** – Runoff volume, in cubic feet (cf), is calculated from Q Runoff and Area as follows:

  \[
  \text{Runoff Volume (cf)} = \text{Area (acres)} \times 43,560 \text{ ft}^2/\text{acre} \times (\text{Q Runoff (in)} \times 1 \text{ ft} / 12 \text{ inches})
  \]

  Where the user does not utilize the default calculation, the user must attach a copy of the runoff calculation.
**Post-Construction Volume Calculation Table** – The purpose of this table is to calculate the total post-construction runoff volume for the project site. This table is completed the same way the Pre-Construction Volume Calculation Table is completed. The only difference between the tables is that the Post-Construction Volume Calculation Table provides all TR-55 Land Cover options.

**Net Change in Volume to Manage (cf)** – After the Pre- and Post-Construction Volume Calculation Tables are completed, the Net Change in Volume to Manage (cf) will be displayed in the red box, based on the total runoff volume for pre-construction conditions subtracted from the total runoff volume for post-construction conditions at the 2-year, 24-hour storm event.

The remainder of the worksheet deals with management of this net change in volume.

**Non-Structural BMP Volume Credits** – Select one or more of the optional checkboxes to pursue credit for non-structural BMP volume credits.

**NOTE** – There is no limit on the amount of non-structural BMP volume credit that can be claimed where valid non-structural BMPs from the Pennsylvania Stormwater BMP Manual will be implemented.

- **Pervious Undetained Areas** – Users may check the box to obtain non-structural BMP credit if the following criteria are met:
  1) There are undetained areas on the project site, as indicated on the General Worksheet;
  2) The undetained areas that are not impervious are permanently stabilized with vegetated cover; and
  3) The undetained areas were not previously forested.

This credit recognizes that there will be volume reduction through evapotranspiration (ET) and/or infiltration in undetained areas that do not flow to a structural BMP. DEP provides a credit of 1.7 millimeters/day (a conservative statewide ET estimate) over a 7-day period for areas that are pervious and are undetained, as specified on the General Worksheet. The calculation is as follows:

Pervious Undetained Areas Credit (cubic feet (CF)) = \((100 – \text{Future } \% \text{ Impervious in Undetained Areas}) \times \text{Drainage Area of Undetained Areas (acres)} \times 43,560 \text{ ft}^2/\text{acre} \times 0.039 \text{ ft/week volume reduction} \)

- **Tree Planting Credit** – Check the box if native trees (minimum 2-inch caliper, minimum height 6 feet) will be planted within disturbed areas following construction. However, do not include trees planted as part of a riparian forest buffer. Enter the number, if any, of deciduous and evergreen trees planted. Credits of 6 and 10 cubic feet are provided per deciduous and evergreen tree planted, respectively, per DEP’s Stormwater BMP Manual.

- **Other Credit** – The user may enter a description of any other non-structural BMP volume credit that is calculated separately and is attached to the permit application or Volume Worksheet. Enter the amount of the credit, if applicable, in the space provided.

**NOTE** – Any Non-Structural BMP is still considered a PCSM BMP, and adequate plan information must be provided (details, notes, long-term operation and maintenance schedule, etc.).

**Structural BMP Volume Credits**

Identify all proposed structural BMPs for the project site in the table provided to calculate volume reduction credits. Select the number of structural BMPs that will be installed (**No. Structural BMPs**), up to 20. If the proposed number of BMPs will exceed 20, a separate spreadsheet will need to be completed.
NOTE – The selection of BMPs in this section will carry through to the Rate and Quality Worksheets. If there are planned BMPs that are not intended for volume reduction, these BMPs should nonetheless be identified in this table.

An explanation of the columns in this table is as follows:

- **DP No.** – Select the discharge point (DP) associated with the structural BMP. Only those DPs where the user indicates a structural BMP will be installed on the General Worksheet will be available for selection.

- **BMP No.** – A sequential ID number is automatically assigned to each BMP.

- **BMP Name** – Select a BMP name from the drop-down list. BMP names generally correspond with the names identified in the Stormwater BMP Manual. If the name of a structural BMP is not available, the user may manually enter it. If the user manually enters a BMP name, the box for **Use default BMP Outflows and Median BMP Outflow Concentrations** on the Quality Worksheet must be unchecked (see below).

**NOTE** – BMPs that are “self-crediting” including Riparian Buffer, Landscape Restoration and Vegetated Roof should not be used in this table since credit should already be received through selection of appropriate land covers in the calculation of post-construction runoff volume.

- **Series** – BMPs that are in series should be entered in the same order they will be configured in the field. For example, a vegetated swale that is followed by a rain garden should be entered with the vegetated swale first and the rain garden in the next row. When BMPs are in series, select the BMP number that the BMP is in series with. If a BMP is not in series, select the “-” indicator. The first BMP selected for a DP will only have the option to select the “-” indicator.

**NOTE** – A BMP that is in series with another BMP for the same discharge point should 1) have the same drainage area and 2) should have a volume routed to the BMP that is no less than the preceding BMP in the series, minus infiltration and ET credits.

**NOTE** – BMPs that are in series are separate and distinct BMPs, such as a vegetated swale followed by a rain garden. A BMP’s components cannot be broken down and treated as separate BMPs. For example, a rain garden that dewaters in more than 24-hours cannot be broken into soil amendments followed by a dry extended detention basin.

- **BMP DA (acres)** – Enter the drainage area, in acres, that is tributary to the reported BMP. This value may be different than the drainage area reported on the General Worksheet for the discharge point (i.e., the discharge point may receive flows that are not treated by the BMP).

- **DA Impervious (acres)** – Enter the impervious surface area within the BMP drainage area. This value should be less than or equal to the BMP drainage area.
- **Volume Routed to BMP (CF)** – Calculate and report the volume routed to the BMP during the 2-year/24-hour storm event, in cubic feet (CF). The spreadsheet does not calculate this volume automatically due to the possibility that additional flows may be routed to a BMP that are outside of the BMP’s drainage area.

**NOTE** – Include the area associated with the BMP as part of the volume calculation, as applicable. For example, the volume routed to an infiltration basin must include stormwater from the drainage area routed to the BMP along with direct precipitation on the infiltration basin.

**VALIDATION** – The volume routed to any individual BMP and the sum of all volumes routed to BMPs may not exceed the total runoff volume for post-construction conditions. In addition, where BMPs are in series, the volume routed to a downstream BMP may not be less than the volume routed to the preceding BMP, minus infiltration and ET credits.

- **Infiltration / Vegetated Area (SF)** – Enter the infiltration area of the BMP in square feet (SF), if applicable. If the BMP is not designed as an infiltration BMP, but will maintain vegetation, enter the area of vegetation in which the root zone is expected to be in contact with stormwater at the 2-year/24-hour storm event.

**NOTE** – The spreadsheet does not consider hydraulic loading to BMPs. The BMP designer is responsible for selecting appropriate design criteria using the Stormwater BMP Manual or other published and defensible resources.

- **Infiltration Rate (in/hr)** – Report the design infiltration rate or saturated hydraulic conductivity (Ksat) associated with the infiltration area, in inches per hour (in/hr) utilizing methods contained in Appendix C of the Stormwater BMP Manual or other published and defensible methods. If the BMP is not designed as an infiltration BMP, leave this field blank. The value entered is reduced by 10% as a factor of safety in the calculation of Infiltration Credit. The design infiltration rate value entered should be the tested infiltration rate adjusted with factors of safety (and other additional factors) where appropriate.

- **Infiltration Period (days)** – Select the infiltration period, in days, for site-wide structural BMPs. DEP may accept infiltration periods up to 4 days (96 hours). However, 1) the maximum ponding depth for infiltration and bioretention BMPs may not exceed 2 feet at the 2-year/24-hour storm event, and 2) local ordinance requirements must be met, where applicable. Many local ordinances require infiltration periods no greater than 3 days (72 hours).

- **Vegetated?** – Select “Yes” if the structural BMP will be “vegetated.” A vegetated PCSM BMP is a permanent BMP where vegetation is a dominant or significant component within the storage area. Vegetation must include species other than grasses. Grasses may be used, but may not be the only species planted.

- **Media Depth (ft)** – Enter the design depth of media used for the BMP, in feet (e.g., 1.5 feet of planting soil for a rain garden or 2 feet of stone for an infiltration trench). This does not apply to certain BMPs. If an underdrain is used, report the depth from the bottom of the media to the invert of the underdrain.

- **Storage Volume (CF)** – Enter the design storage volume for the BMP – associated with the 2-year/24-hour storm event – in cubic feet (CF). This would include both surface and subsurface storage, as applicable. For storage within media, utilize an appropriate void space percentage for the chosen media (typically 30-40%).

**NOTE** – Storage volume is not calculated automatically due to the number of variables required for certain BMPs to do so. Storage volume is not a credit because it does not represent volume reduction; when storage volume infiltrates, evapotranspires, is released or otherwise reused, storage volume converts to credit.

**VALIDATION** – Storage volume may not exceed the value entered for Volume Routed to BMP. It is understood that BMPs may be designed for storms larger than the 2-year/24-hour storm event, but storage volume as used in the Volume Worksheet pertains only to storage of stormwater associated with the 2-year/24-hour storm event.
**Infiltration Credit (CF)** – The infiltration credit for a BMP is automatically calculated once the Infiltration Rate, Infiltration Period, Infiltration Area, Storage Volume and Volume Routed to BMP data are entered. The calculation in narrative form is as follows:

\[
\text{Infiltration Credit (CF)} = \text{Infiltration Rate (in/hr)} \times 0.9 \times 12 \text{ hrs (infiltration during storm)} \times \text{Infiltration Area (ft}^2) + \left( \text{the lesser of Storage Volume or (Infiltration Period (hrs)} - 12 \text{ hrs} \times \text{Infiltration Rate (in/hr)} \times 0.9 \times 12 \text{ in/ft}) \times \text{Infiltration Area (ft}^2) \right), \text{where Infiltration Credit may not exceed the Volume Routed to the BMP.}
\]

This equation conservatively estimates infiltration in a manner consistent with soil physics models and assumes that infiltration at saturated hydraulic conductivity occurs at only 12 hours of a 24-hour storm event.

**ET Credit (CF)** – The evapotranspiration credit for a vegetated BMP is automatically calculated when the user selects “Yes” in the “Vegetated?” column and when Volume Routed to BMP and Media Depth data are entered.

DEP recognizes that over the infiltration period there will be evapotranspiration (ET) that occurs in these vegetated BMPs, even in poorly drained soils. ET credit is based on DEP-funded research conducted by Villanova University on volume reduction credit within rain gardens (or generally, bioretention facilities). The research is most applicable to stormwater control measures utilizing vegetative growth in engineered media above native soils, but may also be used to estimate ET in native soils.

Although DEP has categorized this credit as ET, the research on which the credit is based evaluated the full volume reduction credit potential for vegetated systems, including infiltration during storm events as well as void space credit. In order to put the findings of this research into practice, DEP decided to utilize total void space credit results from experiments on sandy loam soil with a medium-range crop coefficient at various soil/rooting depths over a six-day period following a one-inch storm event (see “Appendix M” of research). This is highly simplified but is nonetheless considered to be representative of actual volume reduction potential for most vegetated systems. The spreadsheet utilizes Table 1, below, to determine the percentage of captured stormwater that is reduced through vegetated systems.

The spreadsheet executes the following calculation in narrative form:

\[
\text{ET Credit (CF)} = \text{ET Volume Reduction (% from Table 1)} \times \text{Media Depth (ft)} \times \text{Infiltration Area (ft}^2), \text{where ET Credit plus Infiltration Credit may not exceed Volume Routed to BMP.}
\]

**NOTE** – This calculation assumes that all infiltrating area is vegetated.

DEP recognizes that this method is a simplification of the site-specific and regional factors that go into estimating potential ET. If an applicant wishes to pursue estimation of ET Credit in a different or more comprehensive manner, a separate analysis may be conducted and attached to the permit application or Volume Worksheet.

**Table 1: Total Void Space (ET) Credit Used by Spreadsheet for Vegetated Systems**

<table>
<thead>
<tr>
<th>Media Depth (ft)</th>
<th>ET Volume Reduction (% Volume)</th>
<th>Media Depth (ft)</th>
<th>ET Volume Reduction (% Volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>34.3</td>
<td>2.8</td>
<td>25.5</td>
</tr>
<tr>
<td>0.6</td>
<td>33.6</td>
<td>2.9</td>
<td>25.4</td>
</tr>
<tr>
<td>0.7</td>
<td>32.9</td>
<td>3.0</td>
<td>25.3</td>
</tr>
<tr>
<td>0.8</td>
<td>32.2</td>
<td>3.1</td>
<td>25.2</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Media Depth (ft)</th>
<th>ET Volume Reduction (% Volume)</th>
<th>Media Depth (ft)</th>
<th>ET Volume Reduction (% Volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>31.5</td>
<td>3.2</td>
<td>25.1</td>
</tr>
<tr>
<td>1.0</td>
<td>30.7</td>
<td>3.3</td>
<td>25</td>
</tr>
<tr>
<td>1.1</td>
<td>30</td>
<td>3.4</td>
<td>25</td>
</tr>
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<td>1.2</td>
<td>29.3</td>
<td>3.5</td>
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<td>28.5</td>
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<td>24.9</td>
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<td>1.4</td>
<td>28.2</td>
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</tr>
<tr>
<td>1.5</td>
<td>27.9</td>
<td>3.8</td>
<td>24.8</td>
</tr>
<tr>
<td>1.6</td>
<td>27.6</td>
<td>3.9</td>
<td>24.7</td>
</tr>
<tr>
<td>1.7</td>
<td>27.3</td>
<td>4.0</td>
<td>24.7</td>
</tr>
<tr>
<td>1.8</td>
<td>27</td>
<td>4.1</td>
<td>24.6</td>
</tr>
<tr>
<td>1.9</td>
<td>26.6</td>
<td>4.2</td>
<td>24.6</td>
</tr>
<tr>
<td>2.0</td>
<td>26.3</td>
<td>4.3</td>
<td>24.5</td>
</tr>
<tr>
<td>2.1</td>
<td>26.2</td>
<td>4.4</td>
<td>24.5</td>
</tr>
<tr>
<td>2.2</td>
<td>26.1</td>
<td>4.5</td>
<td>24.4</td>
</tr>
<tr>
<td>2.3</td>
<td>26</td>
<td>4.6</td>
<td>24.4</td>
</tr>
<tr>
<td>2.4</td>
<td>25.9</td>
<td>4.7</td>
<td>24.3</td>
</tr>
<tr>
<td>2.5</td>
<td>25.8</td>
<td>4.8</td>
<td>24.3</td>
</tr>
<tr>
<td>2.6</td>
<td>25.7</td>
<td>4.9</td>
<td>24.2</td>
</tr>
<tr>
<td>2.7</td>
<td>25.6</td>
<td>5.0</td>
<td>24.2</td>
</tr>
</tbody>
</table>

**NOTE** – ET Credit is balanced with Infiltration Credit so that the sum of these Credits does not exceed the Volume Routed to BMP. Therefore, the actual volume of stormwater removed through ET is not necessarily shown. For example, if the Volume Routed to BMP is 100 CF and the Infiltration Credit is determined to be 70 CF, the ET Credit may be displayed as 30 CF, although actual ET Credit may be higher. Actual ET Credit is shown when the sum of ET and Infiltration Credits is less than the Volume Routed to BMP.

- **Infiltration & ET Credits (CF)** – The sum of all Infiltration and ET Credits for all BMPs is calculated and presented.

- **Managed Release Credit (CF)** – Enter the amount of Managed Release Credit for the project, if applicable. Please refer to DEP’s [Alternative E&S and PCSM BMPs](#) list and documentation for Managed Release Concept (MRC) BMPs. The credit that can be claimed must be as identified on the MRC BMP Design Summary Sheet (2-Yr/24-Hr Volume Managed), with supporting calculations as appropriate.

- **Capture and Reuse Credit (CF)** – If any selected BMP is a “Capture and Reuse” BMP, the Volume Routed to BMP is converted to a credit and the total of all credits is displayed. No further entries are required to the right of Volume Routed to BMP.

- **Total Credits** – The bottom of the worksheet displays the cumulative credits (non-structural, structural, managed release and capture and reuse credits) and compares it to the net change in volume to manage, calculated previously. When the number of credits meets or exceeds the net change in volume, satisfaction of the volume management requirement will be shown in green text; in the interim, red text will indicate the volume requirement is not satisfied.
Rate Worksheet

The Rate Worksheet utilizes the design standard that applicants must manage the net change in peak rate for the 2-, 10-, 50- and 100-year/24-hour storm events. Peak rates are determined using the Graphical Peak Discharge Method in TR-55. Use of this worksheet may not be appropriate for drainage areas with multiple land covers or for other reasons specified in TR-55. This worksheet does not replace hydrologic modeling software, and the output of such software should be attached to permit applications to demonstrate rate control calculations when applicable.

- Precipitation Amounts – Enter the NOAA Atlas 14 storm event totals for the 10-, 50- and 100-year/24-hour storm events (the 2-year/24-hour storm event total is reported as entered in the Volume worksheet). If a different source of data was used for precipitation amounts, enter those values in the cells labeled for alternatives.

  NOTE – If alternative precipitation amounts are utilized for the Rate Worksheet, they must be derived from the same source as the alternative precipitation amount used in the Volume Worksheet.

- Report Summary of Peak Rates Only – Users may select this box if modeling using software or other calculations are performed and the Rate Worksheet is not used for these calculations. Checking the box will reveal a table where the user can manually enter pre- and post-construction peak rates for the storm events.
• **Time of Concentration (Tc) – Pre- and Post-Construction** – The time of concentration for pre- and post-construction runoff uses the methodologies contained in Chapter 3 of TR-55. The designer should be knowledgeable in determining the types of runoff and establishing hydraulic flow paths. A typical stormwater flow routing diagram is shown below (“D” is the BMP location or discharge point).

The user may check the box for “Use Default (0.1 hr)”, if appropriate, to automatically set Tc values to 0.1 hour (6 minutes), which is the minimum recognized by the TR-55 method, in lieu of conducting further analysis. **Note that you should check the Time of Concentration boxes first, and then check the “Use Default (0.1 hr)” box, in order for automated calculations to occur.**

Otherwise, click on the appropriate boxes for Sheet Flow, Shallow Concentrated Flow and Open Channel Flow to determine the travel time for each of these types of runoff. Each runoff type provides for two flow segments. Once the minimum necessary information is entered by the user into the highlighted cells, travel time is computed using Equations 3-3, 3-1 and 3-4 of TR-55 for Sheet Flow, Shallow Concentrated Flow and Open Channel Flow, respectively. The average velocity for Shallow Concentrated Flow is calculated by the spreadsheet using Figure 3-1 of TR-55 for paved and unpaved surfaces. Velocity for open channel and piped flow is computed using Manning’s equation.

The Tc values for Pre- and Post-Construction are summed for all flow conditions and are presented for each storm event.

• **Peak Discharge Rates** – Upon completing the Time of Concentration section, the Peak Discharge Rates table will be completed to show the difference in the estimated peak rates between pre- and post-construction (without BMPs) for each storm event.

  - **Disturbed Area (mi²)** – The Area of Earth Disturbance in Drainage Area (acres) entered on the General Worksheet is divided by 640 to present the disturbed area in terms of square miles for both pre- and post-construction conditions.

  - **Runoff Depth (inches)** – An area-weighted CN value is computed from the values entered into the Pre-and Post-Construction Volume Calculation Tables (i.e., one weighted CN for pre-construction and one for post-construction). The depth of runoff associated with the weighted CN values is then looked up using the default or user-entered peak design storm events, based on NRCS’ National Engineering Handbook (*Chapter 10, Estimation of Direct Runoff from Storm Rainfall, Appendix 10A*).

  - **Unit Peak Discharge (csm/in)** – Unit peak discharges are calculated using the Graphical Peak Discharge Method (Chapter 4 of TR-55). The following steps are taken in the spreadsheet for this calculation:
Using the County selected on the General worksheet, the rainfall distribution type (A, B, C or D) is determined using a lookup chart based on the NRCS National Engineering Handbook Pennsylvania Notice 34 Supplement.

The initial abstraction (Ia) for the area-weighted CN is determined using Table 4-1 of TR-55.

Unit Peak Discharges are calculated using equation PA2-2 of the Pennsylvania Notice 34 Supplement, as shown below. Coefficients are derived using Tables A2-1 through A2-4 of the Supplement, which use the rainfall distribution type and the ratio of Ia to the various storm event totals (inches).

\[ q = 10^{(\text{Coeff}_1 + \text{Coeff}_2 \times \log(Tc) + \text{Coeff}_3 \times (\log(Tc))^2)} \]

- **Peak Discharge Rates (cfs)** – The peak discharge rate for each storm event is calculated as the product of Disturbed Area (m²), Runoff Depth (inches) and Unit Peak Discharge (csm/in).

**Peak Rate Mitigation** – BMPs that were selected on the Volume Worksheet are shown. The user must then enter the peak inflow and outflow rates to and from the BMP for the various storm events (calculations must be attached). A separate table is populated to show the differences between pre-construction rates, post-construction rates without BMPs, and post-construction rates with BMPs. Peak rates will be satisfied when green text is visible to the right of each storm event row.

**Quality Worksheet**

The Quality worksheet utilizes a design standard that applicants must manage the net change in pollutant loads for Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) up to and including the 2-year/24-hour storm event when compared to pre-construction pollutant loads.

**Water Quality**

- **Pre- and Post-Construction Pollutant Load Tables** – If the Automatically Calculate CN, Ia, Runoff and Volume box is checked in the Volume Worksheet, the Pre- and Post-Construction Pollutant Load tables are completed automatically.
The Land Covers selected or entered in the Volume Worksheet are shown in these tables and a crosswalk is used to show the Land Covers for Water Quality purposes. A crosswalk is necessary because available research on pollutant concentrations has not categorized concentrations by TR-55 land uses. The crosswalk, pollutant concentrations, and data sources are presented in Attachment A.

If the **Automatically Calculate CN, Ia, Runoff and Volume box** is not checked in the Volume Worksheet, the user must enter pollutant concentrations for TSS, TP and TN. Entry of “Land Cover for Water Quality” is optional.

Pollutant Loads are calculated by the equation:

\[
\text{Event Mean Pollutant Concentration (mg/L) } \times \left( \text{Runoff Volume (calculated in Volume Worksheet) (CF) / 43,560 CF/acre-ft} \right) \times 2.72 \text{ (conversion factor)}
\]

Below the Pollutant Load Tables the Pollutant Load Reduction Requirements for TSS, TP and TN are presented in lbs (Post-Construction – Pre-Construction Loads). The remainder of this worksheet addresses credits to ensure Post-Construction Pollutant Loads do not exceed Pre-Construction Pollutant Loads.

- **Non-Structural BMP Water Quality Credits** – If the user is claiming non-structural BMP water quality credits, the user should enter a description of the non-structural BMP(s), enter the pollutant load reductions in the appropriate cells, and attach the supporting documentation to the permit application or the Quality Worksheet.

- **Structural BMP Water Quality Credits** – The BMPs that were selected in the Volume Worksheet will be displayed on the Quality Worksheet. As noted above, if there are BMPs that function only to improve water quality, such as inlet filters, such BMPs should be recorded on the Volume Worksheet, so that those BMPs are added to the Quality Worksheet.

The box for **Use default BMP Outflows and Median BMP Outflow Concentrations** is checked by default. When checked, Structural BMP Water Quality Credits will be calculated automatically for each BMP.

**NOTE** – If the name of a BMP is entered by the user (rather than selected from the drop-down list) in the Volume Worksheet, the user must de-select the **Use default BMP Outflows and Median BMP Outflow Concentrations** box so that outflow concentrations (as described below) can be manually entered.

The following describes the calculations in this table:

- **Outflow (CF)** – The Volume Routed to BMP, Infiltration (Inf.) & Evapotranspiration (ET) Credits, and (Reuse and) Capture Credits are displayed as entered or calculated on the Volume Worksheet. Outflow is calculated as the difference between Volume Routed to BMP and Inf. & ET Credits or in the case of Capture Credits, zero. This volume, which represents the volume not permanently removed by a BMP, is then used to calculate pollutant loads.

If the user wishes to use a BMP-specific outflow volume, uncheck the box for **Use default BMP Outflows and Median BMP Outflow Concentrations**.
**Outflow Concentrations (Conc.) (mg/L)** – Median BMP outflow concentrations are utilized from the [International Stormwater BMP Database, 2016 Summary Statistics, Final Report](#) (The Water Environment & Reuse Foundation). As additional research is completed and new data are available, DEP will update BMP Outflow Concentrations accordingly. The following table presents the outflow concentrations used in the Quality Worksheet for the standard BMPs:

<table>
<thead>
<tr>
<th>BMP</th>
<th>Median Outflow TSS</th>
<th>Median Outflow TN</th>
<th>Median Outflow TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porous Pavement w/Infiltration Bed</td>
<td>26</td>
<td>1.19</td>
<td>0.11</td>
</tr>
<tr>
<td>Infiltration Basin</td>
<td>10</td>
<td>1.04</td>
<td>0.24</td>
</tr>
<tr>
<td>Infiltration Bed</td>
<td>24.3</td>
<td>1.19</td>
<td>0.19</td>
</tr>
<tr>
<td>Infiltration Trench</td>
<td>24.3</td>
<td>1.19</td>
<td>0.19</td>
</tr>
<tr>
<td>Rain Garden / Bioretention</td>
<td>10</td>
<td>1.04</td>
<td>0.24</td>
</tr>
<tr>
<td>Dry Well / Seepage Pit</td>
<td>24.3</td>
<td>1.19</td>
<td>0.19</td>
</tr>
<tr>
<td>Constructed Filter</td>
<td>9</td>
<td>1.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Vegetated Swale</td>
<td>24</td>
<td>0.85</td>
<td>0.2</td>
</tr>
<tr>
<td>Vegetated Filter Strip</td>
<td>19</td>
<td>1.13</td>
<td>0.17</td>
</tr>
<tr>
<td>Infiltration Berm &amp; Retentive Grading</td>
<td>24</td>
<td>0.85</td>
<td>0.2</td>
</tr>
<tr>
<td>Vegetated Roof</td>
<td>19</td>
<td>1.13</td>
<td>0.17</td>
</tr>
<tr>
<td>Capture and Reuse</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Constructed Wetland</td>
<td>12</td>
<td>1.31</td>
<td>0.1</td>
</tr>
<tr>
<td>Wet Pond / Retention Basin</td>
<td>11.7</td>
<td>1.2</td>
<td>0.09</td>
</tr>
<tr>
<td>Dry Extended Detention Basin</td>
<td>24.3</td>
<td>1.19</td>
<td>0.19</td>
</tr>
<tr>
<td>Water Quality Filters &amp; Hydrodynamic Devices</td>
<td>9</td>
<td>1.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Floodplain Restoration</td>
<td>10</td>
<td>1.04</td>
<td>0.24</td>
</tr>
<tr>
<td>Soil Amendment</td>
<td>19</td>
<td>1.13</td>
<td>0.17</td>
</tr>
</tbody>
</table>

**NOTE** – A crosswalk is used to align BMP descriptions in the International Stormwater BMP Database with BMPs identified in the Pennsylvania Stormwater BMP Manual.

If the user wishes to use alternative BMP outflow concentrations for TSS, TP and TN, uncheck the box for *Use default BMP Outflows and Median BMP Outflow Concentrations*.

- **Pollutant Loads (lbs)** – Pollutant Loads in BMP Outflows are calculated by the equation:

  Median BMP Outflow Concentration (mg/L) x (Outflow (CF) / 43,560 CF/acre-ft) x 2.72 (conversion factor)

- **Pollutant Load Summary Table** – Below the table for Structural BMP Water Quality Credits is a summary of pollutant loading data:

<table>
<thead>
<tr>
<th>Description</th>
<th>TSS</th>
<th>TP</th>
<th>TN</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLLUTANT LOADS FROM STRUCTURAL BMP (TREATED) OUTFLOWS (LBS):</td>
<td>0.71</td>
<td>0.01</td>
<td>0.08</td>
</tr>
<tr>
<td>POLLUTANT LOADS FROM UNTREATED STORMWATER (LBS):</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>NON-STRUCTURAL BMP WATER QUALITY CREDITS (LBS):</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>NET POLLUTANT LOADS FROM SITE, POST-CONSTRUCTION (LBS):</td>
<td>0.71</td>
<td>0.01</td>
<td>0.08</td>
</tr>
<tr>
<td>POLLUTANT LOADS FROM SITE, PRE-CONSTRUCTION (LBS):</td>
<td>3.03</td>
<td>0.01</td>
<td>0.14</td>
</tr>
</tbody>
</table>

**WATER QUALITY REQUIREMENT SATISFIED**

- 16 -
- **Pollutant Loads from Structural BMP (Treated) Outflows (lbs)** – The total pollutant loads flowing out of structural BMPs is calculated and displayed.

- **Pollutant Loads from Untreated Stormwater (lbs)** – The volume of untreated stormwater is calculated by the difference between the volume of stormwater routed to BMP(s) at the 2-year/24-hour storm event and the total volume of runoff generated at the 2-year/24-hour storm event in the post-construction condition, both determined on the Volume Worksheet. The pollutant load associated with the untreated volume of stormwater is then calculated by:

  Area-Weighted Event Mean Pollutant Concentration (mg/L) x (Untreated Runoff Volume (CF) / 43,560 CF/acre-ft) x 2.72 (conversion factor)

  An area-weighted event mean pollutant concentration is calculated and used to represent the average pollutant concentration in stormwater runoff site-wide, regardless if the runoff is collected for treatment.

- **Non-Structural BMP Water Quality Credits (lbs)** – Credits entered in the worksheet for non-structural BMPs, if applicable.

- **Net Pollutant Loads from Site, Post-Construction (lbs)** – The Net Pollutant Loads from the project site following construction is calculated by:

  \[
  \text{Pollutant Loads from Structural BMP (Treated Outflows) (lbs) + Pollutant Loads from Untreated Stormwater (lbs) – Non-Structural BMP Water Quality Credits (lbs)}
  \]

  If the Net Pollutant Loads from Site, Post-Construction, are less than or equal to the Pollutant Loads from Site, Pre-Construction, the calculated values will be shown in green text and a statement will be displayed, “Water Quality Requirements Satisfied.” Otherwise, pollutants that have post-construction loads greater than pre-construction loads will be shown in red text.
# ATTACHMENT A
LAND COVER CROSSWALK AND POLLUTANT CONCENTRATIONS

## Pre-Construction Land Covers

<table>
<thead>
<tr>
<th>Land Cover for Volume (Based on TR-55)</th>
<th>Land Cover for Water Quality</th>
<th>Event Mean Pollutant Concentrations</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impervious</td>
<td>Impervious (Mixed Use)*</td>
<td>TSS (mg/L)</td>
<td>TP (mg/L)</td>
</tr>
<tr>
<td>Impervious as Meadow</td>
<td>Grassland/Herbaceous</td>
<td>116</td>
<td>0.35</td>
</tr>
<tr>
<td>Pervious as Meadow</td>
<td>Grassland/Herbaceous</td>
<td>48.8</td>
<td>0.22</td>
</tr>
<tr>
<td>Forested (Good Condition)</td>
<td>Deciduous Forest/Even Forest</td>
<td>45</td>
<td>0.13</td>
</tr>
</tbody>
</table>

* Average event mean pollutant concentrations are used for residential, urban highway, and highway (general).

## Post-Construction Land Covers

<table>
<thead>
<tr>
<th>Land Cover for Volume (TR-55)</th>
<th>Land Cover for Water Quality</th>
<th>Event Mean Pollutant Concentrations</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallow - Bare Soil</td>
<td>Cultivated Crops</td>
<td>TSS (mg/L)</td>
<td>TP (mg/L)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Fallow - Crop Residue Cover (Poor Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Fallow - Crop Residue Cover (Good Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Row Crops - Straight Row (Poor Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Row Crops - Straight Row (Good Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Row Crops - Straight Row &amp; Crop Residue (Poor Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Row Crops - Straight Row &amp; Crop Residue (Good Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Row Crops - Contoured (Poor Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Row Crops - Contoured (Good Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Row Crops - Contoured &amp; Crop Residue (Poor Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Row Crops - Contoured &amp; Crop Residue (Good Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
</tbody>
</table>
Land Cover for Volume (TR-55) | Land Cover for Water Quality | Event Mean Pollutant Concentrations | Source |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Row Crops - Contoured &amp; Terraced (Poor Condition)</td>
<td>Pasture/Hay</td>
<td>TSS (mg/L)</td>
<td>TP (mg/L)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Row Crops - Contoured &amp; Terraced (Good Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Row Crops - Contoured, Terraced &amp; Crop Residue (Poor Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Row Crops - Contoured, Terraced &amp; Crop Residue (Good Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Small Grain - Straight Row (Poor Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Small Grain - Straight Row (Good Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Small Grain - Straight Row &amp; Crop Residue (Poor Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Small Grain - Straight Row &amp; Crop Residue (Good Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Small Grain - Contoured (Poor Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Small Grain - Contoured (Good Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Small Grain - Contoured &amp; Crop Residue (Poor Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Small Grain - Contoured &amp; Crop Residue (Good Condition)</td>
<td>Cultivated Crops</td>
<td>216</td>
<td>1.07</td>
</tr>
<tr>
<td>Close-Seeded or Broadcast Legumes or Rotation Meadow - Straight Row (Poor Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
<tr>
<td>Close-Seeded or Broadcast Legumes or Rotation Meadow - Straight Row (Good Condition)</td>
<td>Pasture/Hay</td>
<td>145</td>
<td>0.55</td>
</tr>
</tbody>
</table>
### Land Cover for Volume (TR-55) and Land Cover for Water Quality

<table>
<thead>
<tr>
<th>Land Cover for Volume (TR-55)</th>
<th>Land Cover for Water Quality</th>
<th>Event Mean Pollutant Concentrations</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-Seeded or Broadcast Legumes or Rotation Meadow - Contoured (Poor Condition)</td>
<td>Pasture/Hay</td>
<td>TSS (mg/L) 145, TP (mg/L) 0.55, TN (mg/L) 5.71</td>
<td>1</td>
</tr>
<tr>
<td>Close-Seeded or Broadcast Legumes or Rotation Meadow - Contoured (Good Condition)</td>
<td>Pasture/Hay</td>
<td>TSS (mg/L) 145, TP (mg/L) 0.55, TN (mg/L) 5.71</td>
<td>1</td>
</tr>
<tr>
<td>Close-Seeded or Broadcast Legumes or Rotation Meadow - Contoured &amp; Terraced (Poor Condition)</td>
<td>Pasture/Hay</td>
<td>TSS (mg/L) 145, TP (mg/L) 0.55, TN (mg/L) 5.71</td>
<td>1</td>
</tr>
<tr>
<td>Close-Seeded or Broadcast Legumes or Rotation Meadow - Contoured &amp; Terraced (Good Condition)</td>
<td>Pasture/Hay</td>
<td>TSS (mg/L) 145, TP (mg/L) 0.55, TN (mg/L) 5.71</td>
<td>1</td>
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<tr>
<td>Pasture, Grassland, or Range-Continuous Forage for Grazing (Poor Condition)</td>
<td>Grassland/Herbaceous</td>
<td>TSS (mg/L) 48.8, TP (mg/L) 0.22, TN (mg/L) 2.3</td>
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<tr>
<td>Pasture, Grassland, or Range-Continuous Forage for Grazing (Fair Condition)</td>
<td>Grassland/Herbaceous</td>
<td>TSS (mg/L) 48.8, TP (mg/L) 0.22, TN (mg/L) 2.3</td>
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<tr>
<td>Pasture, Grassland, or Range-Continuous Forage for Grazing (Good Condition)</td>
<td>Grassland/Herbaceous</td>
<td>TSS (mg/L) 48.8, TP (mg/L) 0.22, TN (mg/L) 2.3</td>
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</tr>
<tr>
<td>Meadow-Continuous Grass, Protected from Grazing and Generally Mowed for Hay</td>
<td>Grassland/Herbaceous</td>
<td>TSS (mg/L) 48.8, TP (mg/L) 0.22, TN (mg/L) 2.3</td>
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<tr>
<td>Brush-Forbs-Grass Mixture with Brush the Major Element (Poor Condition)</td>
<td>Shrub/Scrub</td>
<td>TSS (mg/L) 39, TP (mg/L) 0.15, TN (mg/L) 0.19</td>
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<tr>
<td>Brush-Forbs-Grass Mixture with Brush the Major Element (Fair Condition)</td>
<td>Shrub/Scrub</td>
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<tr>
<td>Brush-Forbs-Grass Mixture with Brush the Major Element (Good Condition)</td>
<td>Shrub/Scrub</td>
<td>TSS (mg/L) 39, TP (mg/L) 0.15, TN (mg/L) 0.19</td>
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<tr>
<td>Woods-Grass Combination (Orchard or Tree Farm) (Poor Condition)</td>
<td>Deciduous Forest/Even Green Forest/Mixed Forest</td>
<td>TSS (mg/L) 45, TP (mg/L) 0.13, TN (mg/L) 1.05</td>
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</tr>
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<td>Woods-Grass Combination (Orchard or Tree Farm) (Fair Condition)</td>
<td>Deciduous Forest/Even Green Forest/Mixed Forest</td>
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## Land Cover for Volume (TR-55)  
<table>
<thead>
<tr>
<th>Land Cover for Water Quality</th>
<th>Event Mean Pollutant Concentrations</th>
<th>Source</th>
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<tbody>
<tr>
<td></td>
<td>TSS (mg/L)</td>
<td>TP (mg/L)</td>
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<tr>
<td>Woods (Fair Condition)</td>
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<td>0.13</td>
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<tr>
<td>Woods (Good Condition)</td>
<td>45</td>
<td>0.13</td>
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<tr>
<td>Farmstead-Buildings, Lanes, Driveways and Surrounding Lots</td>
<td>Residential</td>
<td>65</td>
</tr>
<tr>
<td>Roads (Including ROW) - Dirt</td>
<td>Highway (general)</td>
<td>141</td>
</tr>
<tr>
<td>Roads (Including ROW) - Gravel</td>
<td>Highway (general)</td>
<td>141</td>
</tr>
<tr>
<td>Open Space (Lawns, Parks, Golf Courses, Cemeteries, Etc.) - Poor Condition</td>
<td>Open Space</td>
<td>78</td>
</tr>
<tr>
<td>Open Space (Lawns, Parks, Golf Courses, Cemeteries, Etc.) - Fair Condition</td>
<td>Open Space</td>
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<td>Open Space (Lawns, Parks, Golf Courses, Cemeteries, Etc.) - Good Condition</td>
<td>Open Space</td>
<td>78</td>
</tr>
<tr>
<td>Impervious Areas: Paved Parking Lots, Roofs, Driveways, Etc. (Excluding ROW)</td>
<td>Residential</td>
<td>65</td>
</tr>
<tr>
<td>Impervious Areas: Streets and Roads - Paved; Curbs and Storm Sewers (Excluding ROW)</td>
<td>Urban Highway</td>
<td>142</td>
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<tr>
<td>Impervious Areas: Streets and Roads - Paved; Open Ditches (Including ROW)</td>
<td>Highway (general)</td>
<td>141</td>
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<tr>
<td>Impervious Areas: Streets and Roads - Gravel (Including ROW)</td>
<td>Highway (general)</td>
<td>141</td>
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<td>Impervious Areas: Streets and Roads - Dirt (Including ROW)</td>
<td>Highway (general)</td>
<td>141</td>
</tr>
</tbody>
</table>

Sources:

2. International Stormwater BMP Database – Median values of TSS, TP, and TN (TKN + (NO2+NO3)).