The MPCA estimator was compared to the MIDS calculator for different BMP combinations in treatment train configurations. One of the goals of this is to determine how to apply the estimator to treatment train scenarios since the estimator does not consider BMPs in series. The comparisons were made for total phosphorus and total suspended solids. Recommendations are provided at the end of this discussion.

Default values used for the estimator are as follows.

* Zip Code = 55105, corresponding to an Annual rainfall of 30.65 inches (similar to MIDS calculator)
* Phosphorus EMC = 0.30 mg/L (consistent with MIDS calculator)
* TSS EMC = 54.5 mg/L (consistent with MIDS calculator)
* Runoff coefficient = 0.45 (similar to MIDS calculator)

All infiltration BMPs in the MIDS calculator were sized to treat 1.0 inches of runoff from impervious surfaces. This is consistent with the calculations used in the estimator. B soils and forest land for pervious surfaces were assumed.

For each example, all acres were combined into a single land use in the estimator and the data was entered as a User Specified land use (Column B, row 16 in the estimator).

**Example 1:** A treatment train was established that consisted of permeable pavement (no underdrains), bioinfiltration, and a constructed pond. Summary data is shown below. The MIDS calculator removes about 3 percent more total phosphorus and 4.5 percent more TSS compared to the estimator. NOTE that in the estimator, permeable pavement (no underdrain) and bioinfiltration are classified as infiltrator BMPs.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Impervious acres** | **Pervious acres** | **MIDS calculator** | | | **MPCA estimator** | | |
| **P load to BMP (lbs)** | **P removed (lbs)** | **% P removed** | **P load to BMP (lbs)** | **P removed (lbs)** | **% P removed** |
| Permeable pavement | 0.5 | 0.5 | 0.96 | 0.9 | 93.75 | 0.94 | 0.85 | 88.95 |
| Bioinfiltration | 1 | 1 | 1.97 | 1.75 | 88.83 | 1.88 | 1.69 | 89.4 |
| Constructed pond | 1.5 | 1.5 | 2.87 | 1.54 | 53.65 | 2.82 | 1.41 | 49.8 |
|  |  |  |  |  |  |  |  |  |
| TOTAL | 3 | 3 | 5.74 | 4.19 | 73 | 5.65 | 3.95 | 69.9 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Impervious acres** | **Pervious acres** | **MIDS calculator** | | | **MPCA estimator** | | |
| **TSS load to BMP (lbs)** | **TSS removed (lbs)** | **% TSS removed** | **TSS load to BMP (lbs)** | **TSS removed (lbs)** | **% TSS removed** |
| Permeable pavement | 0.5 | 0.5 | 174 | 169 | 97 | 171 | 153.6 | 89.8 |
| Bioinfiltration | 1 | 1 | 352 | 312 | 89 | 341 | 307.1 | 90.1 |
| Constructed pond | 1.5 | 1.5 | 554 | 465 | 84 | 512 | 430 | 84 |
|  |  |  |  |  |  |  |  |  |
| TOTAL | 3 | 3 | 1043 | 946 | 91 | 1024 | 890.7 | 86.5 |

**Example 2:** The same scenario as above was used except the permeable pavement was replaced by a swale and the bioinfiltration was replaced by a sand filter. Summary data is shown below. The MIDS calculator removes about 10 percent more total phosphorus and 14 percent more TSS compared to the estimator.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Impervious acres** | **Pervious acres** | **MIDS calculator** |  |  | **MPCA estimator** |  |  |
| **P load to BMP (lbs)** | **P removed (lbs)** | **% P removed** | **P load to BMP (lbs)** | **P removed (lbs)** | **% P removed** |
| Swale | 0.5 | 0.5 | 0.96 | 0.48 | 50 | 0.94 | 0.34 | 36.2 |
| Sand filter | 1 | 1 | 2.39 | 0.99 | 41.4 | 1.88 | 0.8 | 42.55 |
| Constructed pond | 1.5 | 1.5 | 4.27 | 1.68 | 39.3 | 2.82 | 1.41 | 50 |
| ` |  |  |  |  |  |  |  |  |
| TOTAL | 3 | 3 | 5.74 | 3.15 | 55 | 5.65 | 2.54 | 45 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Impervious acres** | **Pervious acres** | **MIDS calculator** | | | **MPCA estimator** | | |
| **TSS load to BMP (lbs)** | **TSS removed (lbs)** | **% TSS removed** | **TSS load to BMP (lbs)** | **TSS removed (lbs)** | **% TSS removed** |
| Swale | 0.5 | 0.5 | 174 | 128 | 73 | 171 | 104.4 | 61.1 |
| Sand filter | 1 | 1 | 394 | 335 | 85 | 341 | 261.1 | 76.6 |
| Constructed pond | 1.5 | 1.5 | 580 | 487 | 84 | 512 | 430 | 84 |
| ` |  |  |  |  |  |  |  |  |
| TOTAL | 3 | 3 | 1043 | 950 | 91 | 1024 | 795.5 | 77.3 |

**Example 3:** Three constructed ponds are used in series. Summary data is shown below. The MIDS calculator removes about 8 percent more total phosphorus and 10 percent more TSS compared to the estimator.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Impervious acres** | **Pervious acres** | **MIDS calculator** | | | **MPCA estimator** | | |
| **P load to BMP (lbs)** | **P removed (lbs)** | **% P removed** | **P load to BMP (lbs)** | **P removed (lbs)** | **% P removed** |
| Constructed pond | 10 | 10 | 19.13 | 9.53 | 49.81 | 18.79 | 9.39 | 50 |
| Constructed pond | 10 | 10 | 28.73 | 11.57 | 40.27 | 18.79 | 9.39 | 50 |
| Constructed pond | 10 | 10 | 36.29 | 12.38 | 34.11 | 18.79 | 9.39 | 50 |
| ` |  |  |  |  |  |  |  |  |
| TOTAL | 30 | 30 | 57.39 | 33.29 | 58 | 56.36 | 28.18 | 50 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Impervious acres** | **Pervious acres** | **MIDS calculator** | | | **MPCA estimator** | | |
| **TSS load to BMP (lbs)** | **TSS removed (lbs)** | **% TSS removed** | **TSS load to BMP (lbs)** | **TSS removed (lbs)** | **% TSS removed** |
| Constructed pond | 10 | 10 | 3476 | 2920 | 84 | 3413 | 2867 | 84 |
| Constructed pond | 10 | 10 | 4032 | 3387 | 84 | 3413 | 2867 | 84 |
| Constructed pond | 10 | 10 | 4121 | 3462 | 84 | 3413 | 2867 | 84 |
| ` |  |  |  |  |  |  |  |  |
| TOTAL | 30 | 30 | 10428 | 9769 | 94 | 10238 | 8600 | 84 |

**Example 4:** This scenario combined multiple BMPs across a large area, using a typical treatment train employed across that area. Assume that a city utilizes biofiltration, infiltration (includes bioinfiltration, permeable pavement, infiltration trenches and basins, underground infiltration, and tree trenches/boxes), swales, and sand filters, and typically utilizes constructed ponds at the end of the treatment system. In this scenario, all these practices were lumped into single BMPs (e.g. all biofiltration practices employed by the city were lumped as a single biofiltration practice). Summary data is shown below. The MIDS calculator removes about 13 percent more total phosphorus and 14.5 percent more TSS compared to the estimator. NOTE that the fraction of water infiltrated for biofiltration in the estimator was increased to 0.3 from the default of 0.2 because this simulation was for B soils.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Impervious acres** | **Pervious acres** | **MIDS calculator** | | | **MPCA estimator** | | |
| **P load to BMP (lbs)** | **P removed (lbs)** | **% P removed** | **P load to BMP (lbs)** | **P removed (lbs)** | **% P removed** |
| Biofiltration | 5000 | 5000 | 9566 | 5569 | 58.2 | 9393 | 5297 | 56.4 |
| Infiltration | 5000 | 5000 | 9566 | 8467 | 88.5 | 9393 | 8453 | 90 |
| Swale | 5000 | 5000 | 9566 | 3841 | 40.2 | 9393 | 3381 | 36 |
| Sand filter | 5000 | 5000 | 9566 | 4472 | 46.7 | 9393 | 3973 | 42.3 |
| Constructed pond | 10000 | 10000 | 19132 | 13814 | 72.2 | 18785 | 9393 | 51.7 |
| Constructed pond | 10000 | 10000 | 19132 | 12908 | 67.5 | 18785 | 9393 | 51.7 |
|  |  |  |  |  |  |  |  |  |
| TOTAL |  |  | 76529 | 50509 | 66 | 75142 | 39890 | 53.1 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Impervious acres** | **Pervious acres** | **MIDS calculator** |  |  | **MPCA estimator** |  |  |
| **TSS load to BMP (lbs)** | **TSS removed (lbs)** | **% TSS removed** | **TSS load to BMP (lbs)** | **TSS removed (lbs)** | **% TSS removed** |
| Biofiltration | 5000 | 5000 | 1737855 | 1102888 | 63 | 1706339 | 1382135 | 81 |
| Infiltration | 5000 | 5000 | 1737855 | 1538297 | 89 | 1706339 | 1535705 | 90 |
| Swale | 5000 | 5000 | 1737855 | 1181741 | 68 | 1706339 | 1044280 | 61.2 |
| Sand filter | 5000 | 5000 | 1737855 | 1477177 | 85 | 1706339 | 1305239 | 76.5 |
| Constructed pond | 10000 | 10000 | 4296033 | 3608668 | 84 | 3412678 | 2866650 | 84 |
| Constructed pond | 10000 | 10000 | 5127026 | 4306702 | 84 | 3412678 | 2866650 | 84 |
|  |  |  |  |  |  |  |  |  |
| TOTAL |  |  | 13902838 | 13215473 | 95 | 13650713 | 11000659 | 80.6 |

**Discussion and Recommendations**

* The estimator appears to provide reasonable results when infiltration practices are employed in a treatment train. Values could be adjusted slightly upward (e.g. 2 to 3 percent).
* The estimator underestimates treatment when filtration and settling practices are utilized. Removal fractions should be adjusted by 0.10 units.
* Bacteria were not included in the analysis. If bacteria are assumed to primarily be associated with sediment, the above recommendations could be applied to bacteria.

|  |  |  |
| --- | --- | --- |
| **Default values** |  |  |
| **BMP** | **Phosphorus removal (fraction)** | **TSS removal (fraction)** |
| **MPCA Values** | **MPCA Values** |
| [Biofiltration](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_bioretention) | 0.44 | 0.85 |
| Infiltration (basin, trench, tree trench, vault, bioinfiltration)\* | 0.00 | 0.00 |
| Filter strip | 0.00 | 0.68 |
| [Permeable pavement](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_permeable_pavement) | 0.45 | 0.74 |
| [Sand filter](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_sand_filter) | 0.47 | 0.85 |
| [Swale](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_swale) | 0.40 | 0.68 |
| [Wet basin](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_stormwater_ponds) | 0.50 | 0.84 |
| [Wetland](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_stormwater_wetlands) | 0.38 | 0.73 |
|  |  |  |
| **Recommended values in treatment train scenarios** | | |
| **BMP** | **Phosphorus removal (fraction)** | **TSS removal (fraction)** |
| **MPCA Values** | **MPCA Values** |
| [Biofiltration](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_bioretention) | 0.54 | 0.95 |
| Infiltration (basin, trench, tree trench, vault, bioinfiltration)\* | 0.00 | 0.00 |
| Filter strip | 0.00 | 0.78 |
| [Permeable pavement](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_permeable_pavement) | 0.55 | 0.84 |
| [Sand filter](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_sand_filter) | 0.57 | 0.95 |
| [Swale](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_swale) | 0.50 | 0.78 |
| [Wet basin](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_stormwater_ponds) | 0.60 | 0.94 |
| [Wetland](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_stormwater_wetlands) | 0.48 | 0.83 |