BMP Effectiveness Values and Performance Standard Curves

MS4 Workshops – Pollutant Reduction and TMDL Stormwater Plans

Fall 2016

Training Goals

Describe BMP pollutant load removal calculations using:

1. Effectiveness Values Table
2. Performance Standards

Why is this Important?

Calculations for pollutant load reduction occurs in two stages of the process:

1. Reductions from existing BMPs (optional)
2. Reductions from proposed BMPs to meet the target load reduction
Methods - Effectiveness Values

1. DEP's BMP Effectiveness Values document (3800-PB-BCWO100m)

2. Chesapeake Bay Program Expert Panel Reports

3. For BMPs not listed in either of the above, M54s may use effectiveness values from other technical resources; such resources must be documented in the PRP.

Method 1 - Effectiveness Values

<table>
<thead>
<tr>
<th>BMP Name</th>
<th>BMP Efficiencies Values</th>
<th>BMP Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Maintenance</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

How to Use the Effectiveness Values

Calculate the reductions from a vegetated open channel
**How to Use the Effectiveness Values**

- Two sediment removal values for a vegetated open channel, depending on the soil type
- Hydrologic soil group must be determined

<table>
<thead>
<tr>
<th>BMP Type</th>
<th>BMP Description</th>
<th>BMP Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal Alternative BMPs</td>
<td>Vegetated Open Channels (C/D Soils)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vegetated Open Channels (A/B Soils)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Erosion</td>
<td></td>
</tr>
</tbody>
</table>

**USDA Web Soil Survey**

- Soil map showing the location of the Linsdale silty loam C soil type

**How to Use the Effectiveness Values**

Now we know with C soils the effectiveness value for sediment is 50%
How to Use the Effectiveness Values

We now need to determine what is draining to and being treated by the proposed BMP

1. Analysis yields that 27 acres is being treated by the vegetated open channel

2. The 27 acres is composed of
   • 9 impervious acres
   • 18 pervious acres

How to Use the Effectiveness Values

• Please recall that the existing loading values are located in Attachment B of the PRP Instructions
• For our example we will use sediment loading rates for Dauphin County

<table>
<thead>
<tr>
<th>County</th>
<th>Category</th>
<th>Acre</th>
<th>Sediment</th>
<th>TSS Sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dauphin</td>
<td>Impervious</td>
<td>1,999.14</td>
<td>38.89</td>
<td>17,992.26</td>
</tr>
<tr>
<td></td>
<td>Pervious</td>
<td>299.62</td>
<td>0.34</td>
<td>23,385.16</td>
</tr>
</tbody>
</table>

How to Use the Effectiveness Values

Total estimated pollutant load draining to the BMP

9 impervious acres × 1,999.14 lb/ac/yr = 17,992.26 lb/yr
18 pervious acres × 299.62 lb/ac/yr = 5,393.16 lb/yr

50% (0.5) sediment removal effectiveness value

23,385 lb/yr X 0.5 = 11,693 lb/yr
How to Use the Effectiveness Values

23,385 lb/yr into the vegetated open channel

11,693 lb/yr removed by the channel

11,692 lb/yr discharging from the channel

Method 2 - Expert Panel Reports

Four key expert panel reports:

1. Performance Standards
2. Urban Stormwater Retrofit Projects
3. Individual Stream Restoration Projects
4. Street and Storm Drain Cleaning Practices

BMP effectiveness values are being phased out and replaced by expert panel methodologies

Performance Standard Curves

Advantages:

1. Provides a simple method to account for the type of BMP and the flow to that BMP
2. Approved by the Chesapeake Bay Program
Equation X is a site specific conversion factor equation:

\[ \frac{(12 \times EP)}{IA} \]

Where:
- EP = State-Specific Engineering Parameter (in acre-feet)
- IA = Impervious Area (acres)

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**Performance Standard Curves**

- Curves can be used for any volume of water treated
- If used for new development requiring an NPDES permit, or for existing BMPs constructed for NPDES compliance after November of 2010, the 2-year 24-hour storm will be the runoff volume used

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**Performance Standard Curves**

1. Determine volume treated
2. Calculate EP
3. Insert into Equation X
4. Determine if runoff reduction (RR) or stormwater treatment (ST)
5. Determine removal efficiency from the appropriate curve
6. Apply % Removal
### Method 2 - York Twp Example

![Image of York Twp Example](image)

### Precipitation Frequency Estimates: PA

#### Description
- [Description text]

#### Replication
- [Replication text]

#### Table

<table>
<thead>
<tr>
<th>Station</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>25</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.05</td>
<td>0.10</td>
<td>0.25</td>
<td>0.50</td>
<td>1.00</td>
<td>2.00</td>
<td>4.00</td>
</tr>
<tr>
<td>2</td>
<td>0.08</td>
<td>0.15</td>
<td>0.30</td>
<td>0.60</td>
<td>1.20</td>
<td>2.40</td>
<td>4.80</td>
</tr>
</tbody>
</table>

### 2-Year 24-Hour Storm

#### Precipitation Frequency (PPI) Estimates

- [Estimates text]

<table>
<thead>
<tr>
<th>Station</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>25</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.03</td>
<td>0.06</td>
<td>0.15</td>
<td>0.30</td>
<td>0.60</td>
<td>1.20</td>
<td>2.40</td>
</tr>
<tr>
<td>2</td>
<td>0.05</td>
<td>0.10</td>
<td>0.25</td>
<td>0.50</td>
<td>1.00</td>
<td>2.00</td>
<td>4.00</td>
</tr>
</tbody>
</table>

#### Graph

![Graph of 2-Year 24-Hour Storm](image)
The drainage area to the BMP is composed of 4.3 acres of impervious area and 10.8 acres of pervious area.
Post Runoff Volume

**LAND COVER CLASSIFICATION**  **COVER (Acres)**  **Runoff Volume**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Acres</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawn, Low-Input</td>
<td>10.781</td>
<td>0.3212</td>
</tr>
<tr>
<td>Medium Traffic Street</td>
<td>4.284</td>
<td>0.9811</td>
</tr>
</tbody>
</table>

Post-development conditions = 1.3023 ac-ft of runoff volume

Impervious area (IA) = 4.284 ac

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Using Equation X

EP = Post - Predevelopment volume increase
EP = 1.3023 ac-ft - 0.2379 ac-ft
EP = 1.0644 ac-ft

Post-dev impervious acres (IA) = 4.284 ac

Insert into Equation X

\[ X = \frac{12 \cdot EP}{IA} \]

\[ X = \frac{12 \text{[in/ft]} \cdot 1.0644 \text{ ac-ft}}{4.284 \text{ ac}} \]

\[ X = 2.98 \text{ in} \]

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RR or ST?

Runoff Reduction (RR) Practices

Infiltration (aka Infiltration Basin, Infiltration Bed, Infiltration Trench, Dry Well/Seepage Pit, Landscape Infiltration)
Performance Standard Curve

[Diagram showing standard curve for sediment removal]

Figure 3. New BMP Removal Rate Adjustor Curve for Sediment

Calculate Load to BMP

- Impervious area = 4.284 ac
- Pervious area = 10.781 ac
- Impervious sediment load:
  \[4.284 \text{ ac} \times 1,614.15 \text{ lb/ac/yr} = 6914.929 \text{ lb/yr}\]
- Pervious sediment load:
  \[10.781 \text{ ac} \times 220.4 \text{ lb/ac/yr} = 2376.112 \text{ lb/yr}\]
- Total sediment load:
  \[6914.929 \text{ lb/yr} + 2376.112 \text{ lb/yr} = 9291 \text{ lb/yr}\]

Apply Percent Removal

- Curve yields 90% sediment removal
- Apply 90% removal to post-development load
  \[9,291 \text{ lb/yr} \times 0.90 = 8,361.9 \text{ lb/yr removed}\]
- Remaining discharge
  \[9,291 \text{ lb/yr} - 8,361 \text{ lb/yr} = 929.1 \text{ lb/yr}\]
Model Methodology

Appendix 1 Preliminary Existing Loading without Accounting for Existing BMPs

<table>
<thead>
<tr>
<th>Station</th>
<th>Impacted</th>
<th>Sediment loading w/o BMP (lb/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>7,532.34</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>16,567.75</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3,694</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>8,527.14</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1,630.5</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>5,480.25</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>4,240.27</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>4,485.75</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>2,630.5</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>3,430.5</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>3,430.5</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>3,543.25</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>3,430.5</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>3,430.5</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>3,430.5</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>3,023.6</td>
</tr>
</tbody>
</table>

Existing Loading Summary

- Total Sediment Load without accounting for existing BMPs:
  
  \[362,118 \text{ lb/yr}\]

- Sediment removed from the existing load calculations by BMPs:

  \[115,419 \text{ lb/yr}\]

- Overall existing load for “Model Municipality”:

  \[362,118 \text{ lb/yr} - 115,419 \text{ lb/yr} = 246,699 \text{ lb/yr}\]

Local Impaired vs Bay

- Appendix D & E requirements
- Meet local impairment requirements first
- Local impairment reduction also count for Bay
- Divide list of storm sewersheds into Local Impairment and Bay
- Calculate reduction requirements for each

<table>
<thead>
<tr>
<th>Total</th>
<th>Local Impaired</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bay</td>
</tr>
</tbody>
</table>
Required Reductions

1. Existing load to locally impaired sewershed areas is 126,698 lb/yr
   • Required reduction from locally impaired waters
     \[ 126,698 \text{ lb/yr} \times 0.10 = 12,670 \text{ lb/yr} \]

2. Existing load to Bay sewershed areas is 120,001 lb/yr
   • Required reduction from Bay sewersheds are
     \[ 120,001 \text{ lb/yr} \times 0.10 = 12,000 \text{ lb/yr} \]

Summary

1. Describe BMP pollutant load removal calculations using the Effectiveness Values Table
2. The Performance Standard Approach
## Crediting Reductions to Current Load and 2023 Goal

<table>
<thead>
<tr>
<th>BMP Reductions to Current Load</th>
<th>BMP Credit to 2023 Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow crediting of BMPs currently operating as designed?¹ (all, including 102s)</td>
<td>Yes</td>
</tr>
<tr>
<td>Allow crediting of BMPs currently providing less than design level of WQ treatment?² (all, including 102s)</td>
<td>Yes³ (requires the permittee to calculate the current reduction)</td>
</tr>
</tbody>
</table>

¹ Using the CB Performance Curve methodology
² Same as 1
³ Allow this here rather than as part of the credit against the 10% goal
⁴ To whatever degree it was functional it could have been used to reduce the current load
⁵ Same as 4