Fox River NPS Phosphorus Load Reduction Screening Tool User Guide

Prepared for:
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1 Background

The Fox River NPS Phosphorus Load Reduction Screening Tool (the Tool) is a spreadsheet-based custom user interface that allows users to develop and evaluate different non-point source (NPS) management scenarios within the FRIP study area. The tool uses unit area loads (UALs) for total phosphorus (TP, pounds per acre per year) derived using output from the Hydrologic Source Program FORTRAN (HSPF) watershed models developed for the Fox River Implementation Plan by the Illinois State Water Survey. These UALs are specific to land cover types in the HSPF model, as well as subwatershed. Two versions of the tool were developed:

- A subwatershed-based version that allows the user to test load reduction scenarios on a subwatershed basis (potentially of interest for tributary watershed groups and others)
- A version based on MS4 jurisdictions that allows the user to test load reduction scenarios for specific MS4 jurisdictions

The Tool calculates baseline TP loads for each land use in each subwatershed or MS4 jurisdiction, then allows the user to select from a menu of NPS control measures to evaluate how different TP reduction scenarios will impact the TP load delivered to the Fox River. Specifically, the Tool has three main functions:

1. The modification of TP loads on an MS4 jurisdiction or subwatershed basis via the implementation of NPS controls;
2. The presentation of summary information by MS4 jurisdiction or subwatershed basis to allow the user to understand changes in loadings; and,
3. The storage and retrieval of scenarios.

Both versions of the Tool use the same user interface and perform the same functions. The file names of the tools are:

- FOXRIP_spreadsheet_tool_MS4.xlsm
- FOXRIP_spreadsheet_tool_WS.xlsm

These files should not be renamed because of code dependencies; renaming them could interfere with their function.

Both Tools use average annual UALs derived from the Fox River HSPF models (averaged for the 1991 to 2011 simulation period) to calculate baseline TP loads. The following subsections provide some details about the use of the Tools.
2 Description of the Tool

The Tool was developed in Microsoft Excel for the Windows operating system and will run on personal computers with that software installed. The Tool has been tested on the following Windows and Microsoft Office versions:

- Windows 8.1, Office 2013
- Windows 10, Office 2013

Each version of the Tool is contained in a single Excel spreadsheet file.

2.1 General Appearance and Layout

Upon opening the Tool, the user should see the user interface, which consists of two windows, as shown in Figure 1.

![Figure 1: Fox River NPS Phosphorus Load Reduction Screening Tool User Interface](image-url)
The left hand window is called the Summary window and reports information and results to the user; no changes are made by the user to this window. The right hand window is called the editor window; this is where the user will make entries and save scenarios. Each of these windows is discussed below.

2.1.1 Editor Window

The editor window is used to create TP management scenarios by allowing the user to define simple representations of best management practices (BMPs) that might be installed in each MS4 jurisdiction (Figure 2). The user can select one of the 76 MS4 jurisdictions from the dropdown list in the upper left corner. For each land use category, the user can enter the percentage of acres where BMPs are installed, along with the removal efficiency of that BMP. If the user does not enter a BMP removal efficiency then the default value (in gray) will be used to calculate TP load removed. The editor then calculates the TP load removed, as well as the removal efficiency, for each land use and for the entire MS4 jurisdiction.

![Figure 2: Fox River NPS Phosphorus Load Reduction Screening Tool Editor Window](image)

2.1.2 Summary Window

The summary window summarizes phosphorus loads for all 76 MS4 jurisdictions in the Fox River Watershed (Figure 3). The window displays the TP load from the baseline scenario, the current scenario that the user has created, and the percent load reduction between the two scenarios. These values are
calculated on a jurisdiction-by-jurisdiction basis, and also on a watershed total basis (visible in the Summary table by scrolling to the bottom). If a difference in TP load is detected between the baseline scenario and the current one, the circle next to the corresponding MS4 jurisdiction will change from red to green. This provides the user a quick visual reference of progress. The summary window automatically updates when the user changes from one MS4 jurisdiction to another in the editor window. Details on the calculation method used for each column are presented in Section 4.

Figure 3: Fox River NPS Phosphorus Load Reduction Screening Tool Summary Window

2.2 Tool Attributes and Functions

The following Tool attributes and functions are discussed in this section:

- TP Unit Area Loads Used in Tool
- Control Measure Default Efficiencies
- Storage and Retrieval of Scenarios

2.2.1 TP Unit Area Loads Used in Tool

TP UALs for each of the 33 subwatersheds were derived using the output of the 33 Fox River HSPF models developed by the ISWS. The 20-year average total phosphorus (TP) load was calculated for each land use within each subwatershed. To calculate the unit area load for each land use within each subwatershed, the 20-year average annual TP load for each land use within each subwatershed was then divided by the corresponding total acreage of each land use within each subwatershed.

TP UALs for each of the land uses in the MS4 jurisdictions were derived using the subwatershed land use UALs. For each land use within an MS4 jurisdiction a new UAL was calculated using an area-weighted average of the land use UALs associated with each subwatershed located within the boundary of the MS4 jurisdiction.
2.2.2 Control Measure Default Efficiencies

Default removal efficiencies are provided within the Tool for user convenience. These default values are based on literature review, as well as review of Illinois-specific and Fox River-specific project reports obtained from the Illinois Environmental Protection Agency (IEPA) and FRSG stakeholders. Attachment B of the Fox River Implementation Plan documents the derivation of these default values and contains a complete list of references that were consulted. The default removal efficiencies are summarized in Table 1.

Table 1: Default TP Removal Efficiencies in the Fox River NPS Phosphorus Load Reduction Screening Tool

<table>
<thead>
<tr>
<th>NPS Control Measure</th>
<th>TP Removal Efficiency (%)</th>
<th>Rational</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cropland</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservation tillage</td>
<td>66</td>
<td>Most recent data; Low end of range from Iowa study with same crops as Fox River watershed</td>
</tr>
<tr>
<td>Constructed wetlands</td>
<td>44</td>
<td>Average of literature review values; consistent with IEPA value for urban watersheds</td>
</tr>
<tr>
<td>Field borders</td>
<td>61</td>
<td>USEPA approved value for IEPA projects</td>
</tr>
<tr>
<td>Grassed waterways</td>
<td>30</td>
<td>Most recent USEPA literature review value</td>
</tr>
<tr>
<td>Nutrient management</td>
<td>35</td>
<td>Most recent USEPA literature review value</td>
</tr>
<tr>
<td><strong>Urban</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bioretention</td>
<td>65</td>
<td>USEPA approved value for IEPA projects</td>
</tr>
<tr>
<td>Constructed wetland</td>
<td>44</td>
<td>USEPA approved value for IEPA projects</td>
</tr>
<tr>
<td>Dry detention</td>
<td>26</td>
<td>USEPA approved value for IEPA projects</td>
</tr>
<tr>
<td>Street sweeping (weekly)</td>
<td>6</td>
<td>USEPA approved value for IEPA projects</td>
</tr>
<tr>
<td>Vegetated swales</td>
<td>25</td>
<td>USEPA approved value for IEPA projects</td>
</tr>
<tr>
<td>Extended wet detention</td>
<td>68</td>
<td>USEPA approved value for IEPA projects</td>
</tr>
</tbody>
</table>

The user can override the default removal efficiencies in the Tool.

2.2.3 Storage and Retrieval of Scenarios

The storage and retrieval of scenarios happens within the Fox River TP Load Reduction Tool workbook (no external files are created) and is done from the editor window (Figure 4). In the lower left corner of the editor window, the user has the option to name the scenario and to add a brief description. The “Store Scenario” button allows the user to store the current scenario. The workbook is capable of storing up to 10 scenarios (Figure 5). The “Load Scenario” button will load any one of the stored scenarios (Figure 6).
Figure 4: Portion of the Editor Window Associated With the Storage and Retrieval of Scenarios

Figure 5: Store Scenario Pop-up Window

Figure 6: Load Scenario Pop-up Window
3 Instructions for Use of the Tool

This section of the User Guide provide instruction in using the Tool, including a basic walkthrough of the Tool and discussion of additional features.

3.1 Basic Walkthrough of the Tool

After opening the Fox River Total Phosphorus (TP) Load Reduction Tool the user will be presented with two windows: the editor and the summary (Figure 7). The editor window is used to create management scenarios. The summary window summarizes the resulting changes to TP loads that result from management scenarios created in the editor. The walkthrough is for the MS4-based version of the Fox River TP Load Reduction Tool, but the subwatershed-based version of the tool has the same functionality.

![Figure 7: User Interface Immediately After Opening](image)

While the editor displays loads for eight different land uses, only four are available to edit: crop, urban—high density, urban—low/medium density, and urban—open space. To begin creating a management scenario, the user selects one of the four land uses available for editing (Figure 8). After selecting a land use a display window that displays the BMPs available for that land use will open. The user determines the
BMP enrollment and removal efficiency. If no enrollment is specified then the BMP is not considered active and TP removal will not be calculated. After selecting the BMP enrollment the user can then specify the removal efficiency. If the user does not specify a removal efficiency then the provided default value will be used. User-specified removal efficiencies appear in black, while default removal efficiencies appear in gray (Figure 9).

![Figure 8: Select Land Use](image-url)
The tool does not prevent the user from enrolling greater than 100% of the land use acreage in BMPs, but BMP enrollment values will change to red to indicate a problem (Figure 10). To switch to editing BMPs for another land use, the user selects it with the mouse. The previous land use display window will close and a new one will open (Figure 11).
Figure 10: BMP Enrollment Turns Red When Greater Than 100%

Figure 11: Continue Editing Land Use BMPs
Once all of the desired BMPs have been implemented in an MS4 jurisdiction, the user can select a new MS4 jurisdiction from the dropdown list in the upper left portion of the editor window (Figure 12). After changing MS4 jurisdictions, the editor will update with the scenario information associated with the newly selected MS4 jurisdiction, and the TP load information in the summary window will refresh to reflect the updates made to the previously active MS4 jurisdiction (Figure 13). The user can then continue building the management scenario for the newly selected MS4 jurisdiction. As the user builds a scenario, comments may be added to each BMP. The user also has the option to specify a custom BMP that may not have been included in the original list of land use BMPs (Figure 14). Scenario building continues until the user has modified all of the desired MS4 jurisdictions. The summary window will update each time the user switches to a new MS4 jurisdiction (Figure 15).

Figure 12: To Switch MS4 Jurisdictions, Select a New MS4 from the Dropdown List
Figure 13: Summary Window Will Automatically Update the MS4 That the User Just Finished Editing
Figure 14: Custom BMPs and Comments for Each BMP Can Be Added

Figure 15: The Summary Window Accounts for All Load Changes Associated With the Scenario
Once editing has been completed, the user can save the newly created management scenario. First the user should enter a scenario name in the title box located in the lower left corner of the editor window (Figure 16). Then, immediately below the title, the user has the option to add a brief comment associated with the scenario. Once complete, the user selects the “Store Scenario” button in the lower right corner of the editor window. A pop-up window will appear, and the user must select a location to store the scenario (Figure 17).

The scenario has now been stored within the Fox River TP Load Reduction Tool. To permanently save the scenario, the user must click the “Save Workbook” button in the upper right portion of the editor window.
If the user tries to close the workbook without saving updates, a pop-up window will appear and ask if the workbook should be saved or closed without saving (Figure 18).

Figure 18: Pop-up Window That Appears if the User Attempts to Close Without Saving First

To load a stored scenario the user clicks on the “Load Scenario” button in the lower right corner of the editor window and then selects the desired scenario from the dropdown list (Figure 19). The tool will then reload the stored scenario (Figure 20).

Figure 19: Pop-up Window That Appears After Selecting “Load Scenario”
3.2 Additional Features

The Fox River Total Phosphorus Load Reduction Tool includes a few additional features that were not mentioned in the basic walkthrough above. These features are available through controls in the upper right portion of the editor window.

3.2.1 Change Land Use Button

The “Change Land Use” button allows the user to change the land use for all MS4 jurisdictions from current to future land use (Figure 21).
3.2.2 BMP Bulk Edit Button

The “BMP Bulk Edit” button should be used to change the BMPs associated with all MS4 Jurisdictions in the exact same way (Figure 22). For example, if the user wishes to have every MS4 Jurisdiction implement bioretention in 10% of urban—high density land use, then the user would open the bulk editor and update the enrollment and removal efficiency for the corresponding BMP (Figure 23). After clicking the “Store BMP Edits” button, the tool would then update every MS4 Jurisdiction in the Fox River watershed. Bulk BMP edits should precede individual MS4 Jurisdiction BMP edits. The “Close BMP Editor” button will close the BMP bulk editor without making any changes.
Figure 22: The “BMP Bulk Edit” Button
Figure 23: BMP Bulk Editor Window

3.2.3 Reset Windows Button

The user is allowed to adjust the size and location of both the summary window and the editor window. The “Reset Windows” button (located in the upper right portion of the editor window) will restore these two windows to their original sizes and locations.

3.2.4 Save Workbook

The “Save Workbook” button (Figure 24) will save the current workbook.
3.2.5 Close Workbook

The “Close Workbook” button (Figure 25) will close the workbook. If the user attempts to close with workbook without saving changes then a warning pop-up window will appear, otherwise the workbook will close.
Figure 25: “Close Workbook” Button
4 Formulas Used for Subwatershed-Based Tool & MS4 Jurisdiction-Based Tool

The formulas used in the tool are described below.

**TP Load Removed by BMP**

BMP enrollment × removal efficiency × land use acres = TP load removed by BMP

**BMP Enrollment by Land Use**

\[ \sum \text{BMP enrollment} = \text{BMP enrollment by land use} \]

**TP Removal Efficiency by Land Use**

TP load removed ÷ land use baseline TP load = TP removal efficiency by land use

**TP Load Removed by Land Use**

\[ \sum \text{TP load removed by BMP} = \text{TP load removed by land use} \]

**TP Baseline Load by Land Use**

land use acres × land use unit area load = TP baseline load for land use

**BMP Enrollment by Subwatershed/MS4 Jurisdiction**

\[ \frac{\sum \text{land use BMP enrollment} \times \text{land use area}}{\text{total area of subwatershed/MS4}} = \text{BMP enrollment by subwatershed/MS4} \]

**TP Removal Efficiency by Subwatershed/MS4 Jurisdiction**

TP load removed by subwatershed/MS4 ÷ baseline TP load for subwatershed/MS4 = TP removal efficiency for subwatershed/MS4

**TP Load Removed by Subwatershed/MS4 Jurisdiction**

\[ \sum \text{TP load removed by land use} = \text{TP load removed by subwatershed/MS4} \]

**TP Baseline Load by Subwatershed/MS4 Jurisdiction**

\[ \sum \text{TP baseline load by land use} = \text{TP baseline load by subwatershed/MS4} \]