Estimating Load Reductions using STEPL

(Spreadsheet Tool for the Estimation of Pollutant Load)

Before You Get Started

- Sort out your 12-digit HUC information
  - How many 12-digit HUCs had BMP implementation this year?
  - Organize BMPs installed by HUC.
  - Which ones have BMPs that will have load reduction estimates?
- Determine how many stream bank protection projects were implemented for the year, and which 12-digit HUC(s) they are in.

Overview of the STEPL Process

1. **Download and Install the latest version of STEPL program**

2. **Gather standard land use information about the project for use in the STEPL calculations.**

3. **Run the STEPL program with appropriate BMPs selected and the gathered land use info copy/pasted into the necessary spots.**

4. **Pull the total estimates from the STEPL Total Load page to submit as your project's load reduction numbers.**

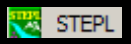
STEPL PROCESS DIAGRAM

Download STEPL 4.3 Installation Package (at http://it.tetratech-ffx.com/steplweb/models$docs.htm)

Install STEPL 4.3

Collect appropriate land use information

Run the STEPL program

(from Start menu, Programs folder, STEPL folder, 

)

Enter the land use information into the STEPL Input fields

Select the BMPs installed in the project area, and enter percentages of the total land use area that the BMP(s) cover

If needed, use the BMP Calculator to get values for "Combined Watershed BMP Efficiencies", when multiple BMPs are being applied within a single land use area

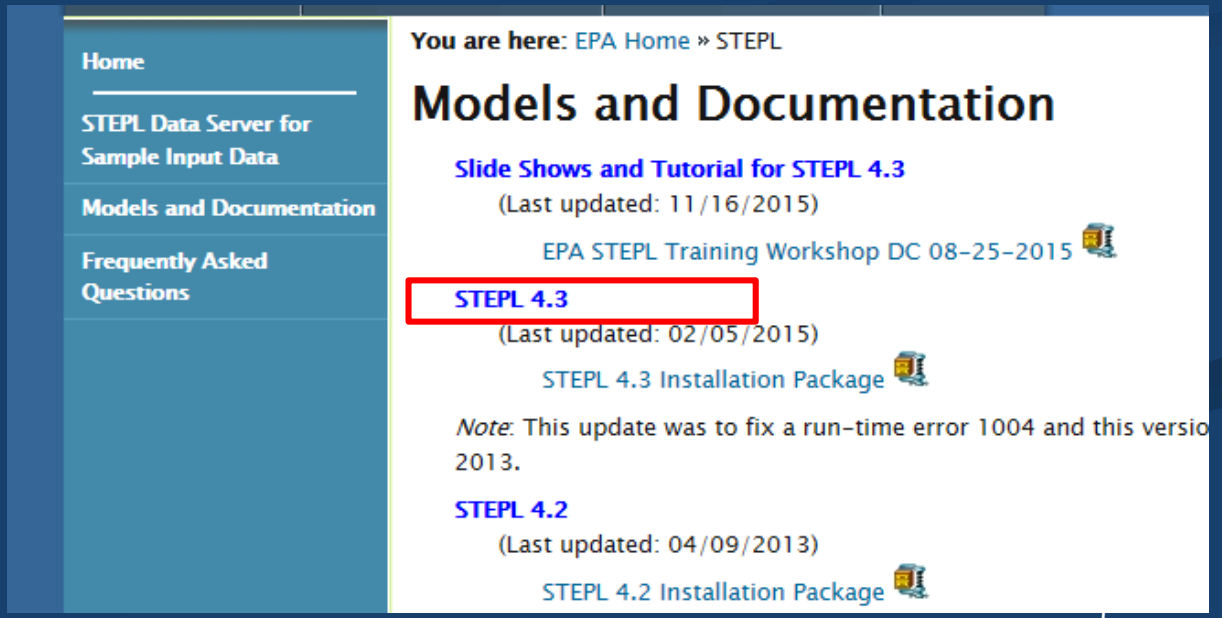
Pull load reduction totals (not the %) for reporting form

Downloading the STEPL Program

1. Go to: http://it.tetratech-ffx.com/steplweb/ and click on "Models and Documentation" in left menu to find the latest version of the model.

   Or

   Search "EPA STEPL" in Google, Bing, etc.



Downloading the STEPL Program

2. Click on STEPL 4.3 Installation Package
   - Choose to save the STEPL403.zip file on your computer in an easy to find location.
3. The Winzip software must be installed on your computer in order to open the .zip file:
   - Locate the file you just saved and double click it.
   - Click the “Extract” or “Unzip” button in Winzip, and choose a location to save the files extracted from this .zip file.
   - After extracting the files, go to the folder and double click the STEPLSetup.exe file to begin the installation process.

Installing the STEPL Program

4. Once you have double-clicked the STEPLSetup.exe file in the folder where you saved the STEPL files, go to step #2.

5. When the setup wizard opens, click “Next”, and repeat clicking “Next” few more times until a window provides an “Install” button. Click the “Install” button and then when it gets done installing, click the “Finish” button it provides.

6. The program is now installed and available in the STEPL folder in the Programs folder on the Windows Start menu.

Gathering Land Use Information

Note: During this process each step will require the webpage to reload. It is vital to let the page load fully to avoid malfunctions and having to restart from the beginning.

1. Open EPA's STEPL web page: http://it.tetratech-ffx.com/steplweb/

2. Click on the left side link titled "STEPL Data Server for Sample Input Data".

Gathering Land Use Information

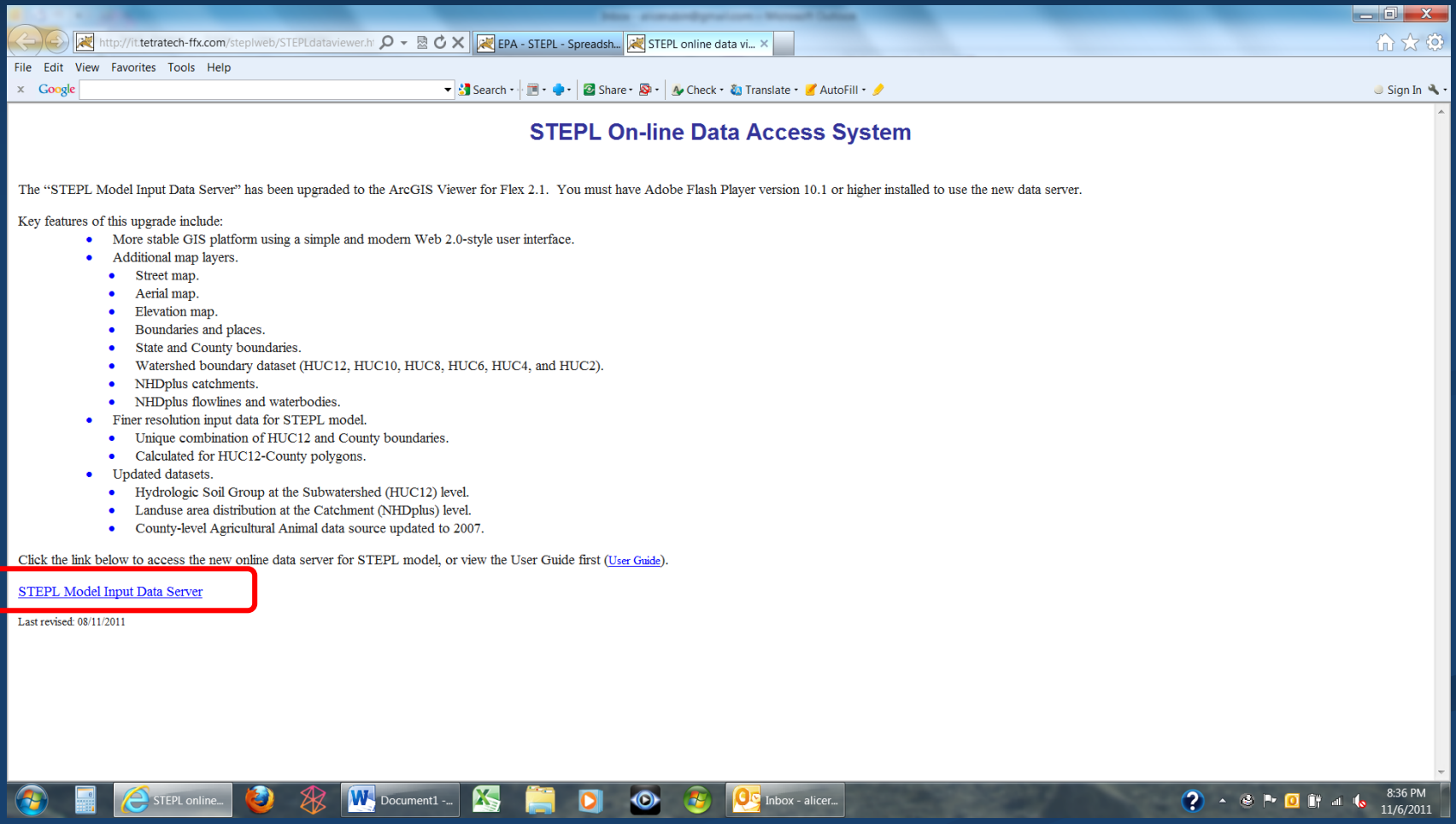
3. Click the bottom link to open the STEPL Model Input Data Server.

4. Select Washington State.

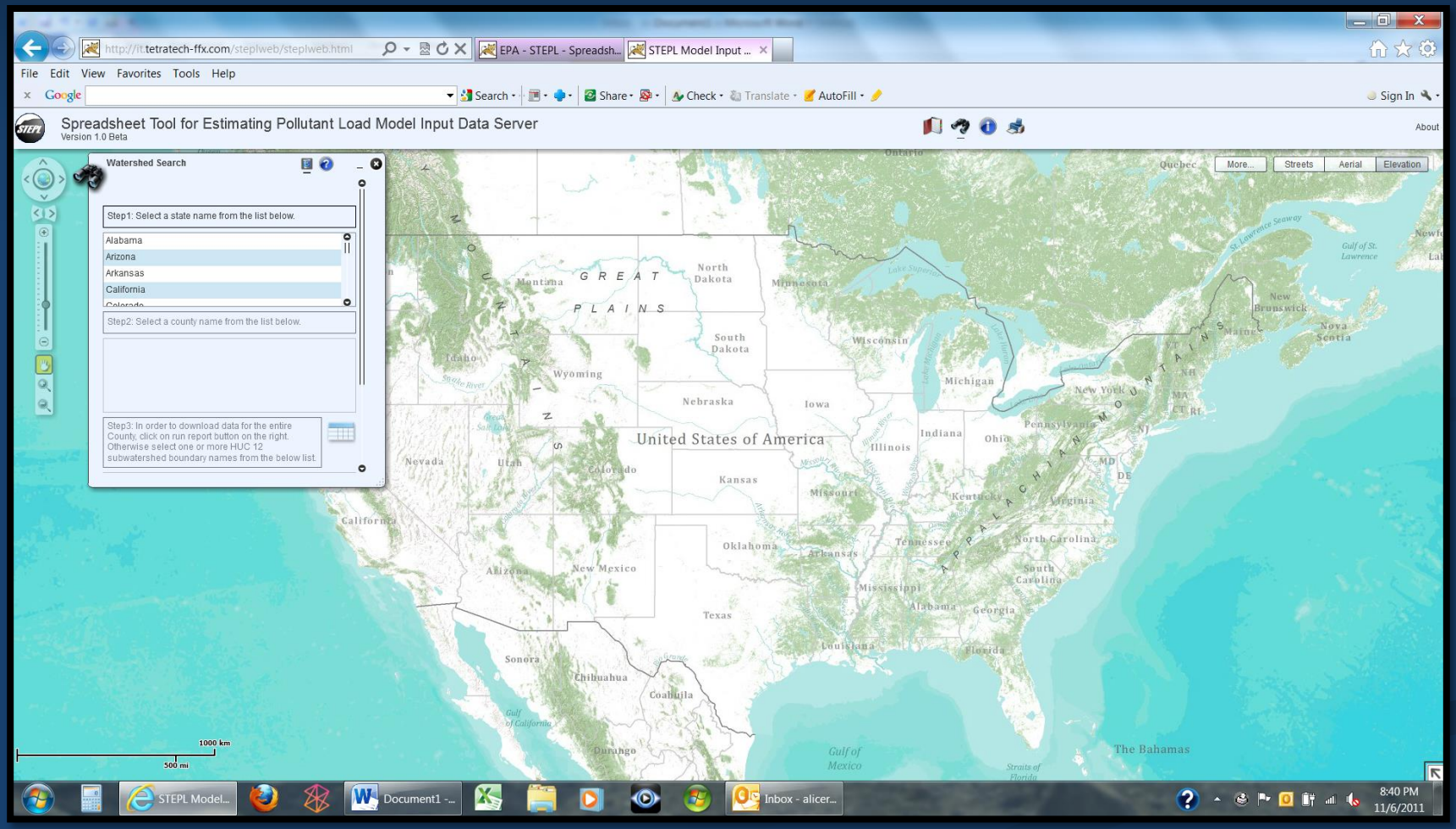
5. Select the County where BMPs were installed. If the BMPs are located across multiple counties, you will need to repeat all these Land Use Gathering steps for each county.

6. Scroll down and select the all sub watersheds (same as 12-HUCs) where the BMP work was done. Select multiple watersheds by holding down the Ctrl key while clicking in the list.

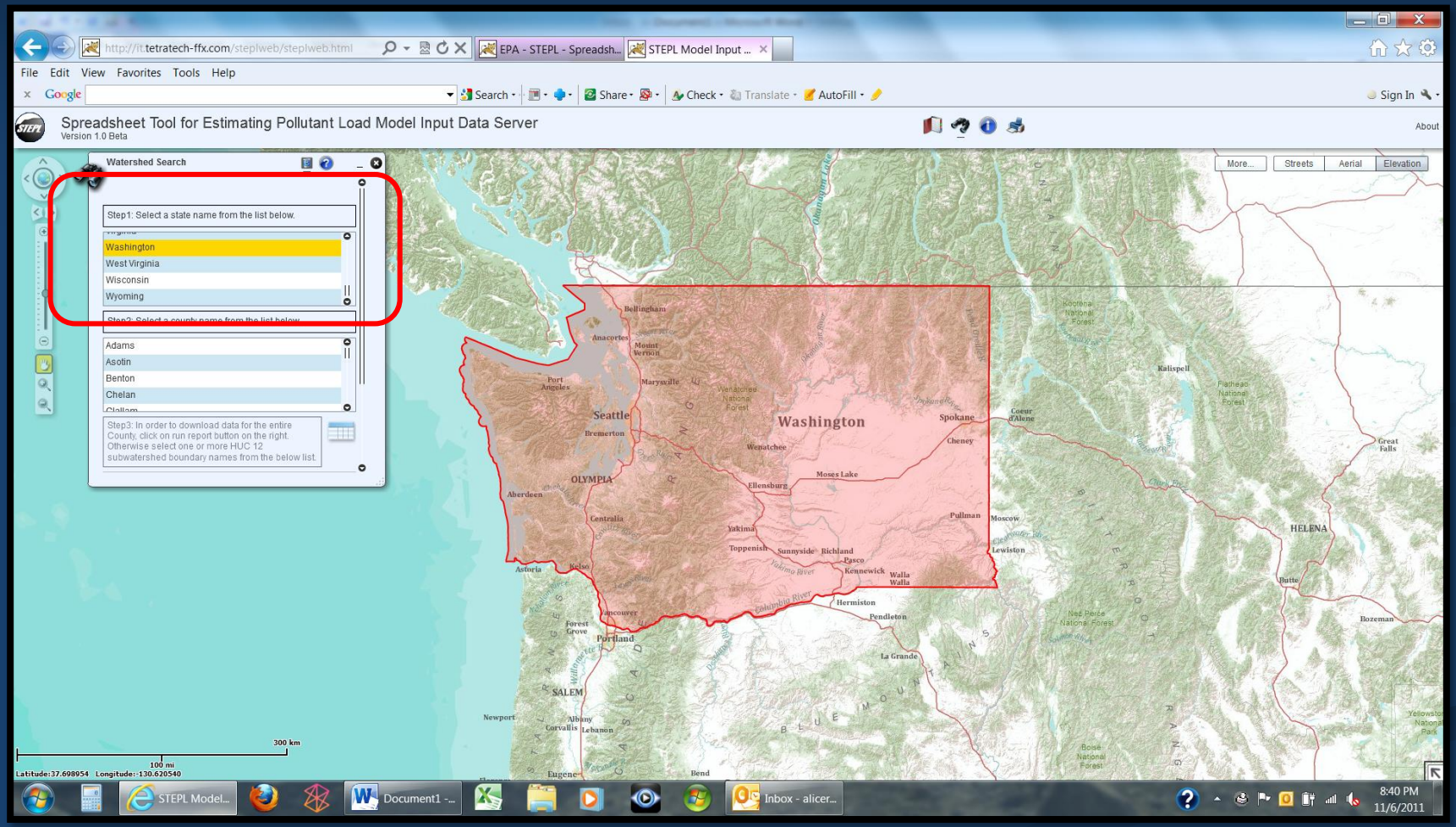
STEPL Data Server



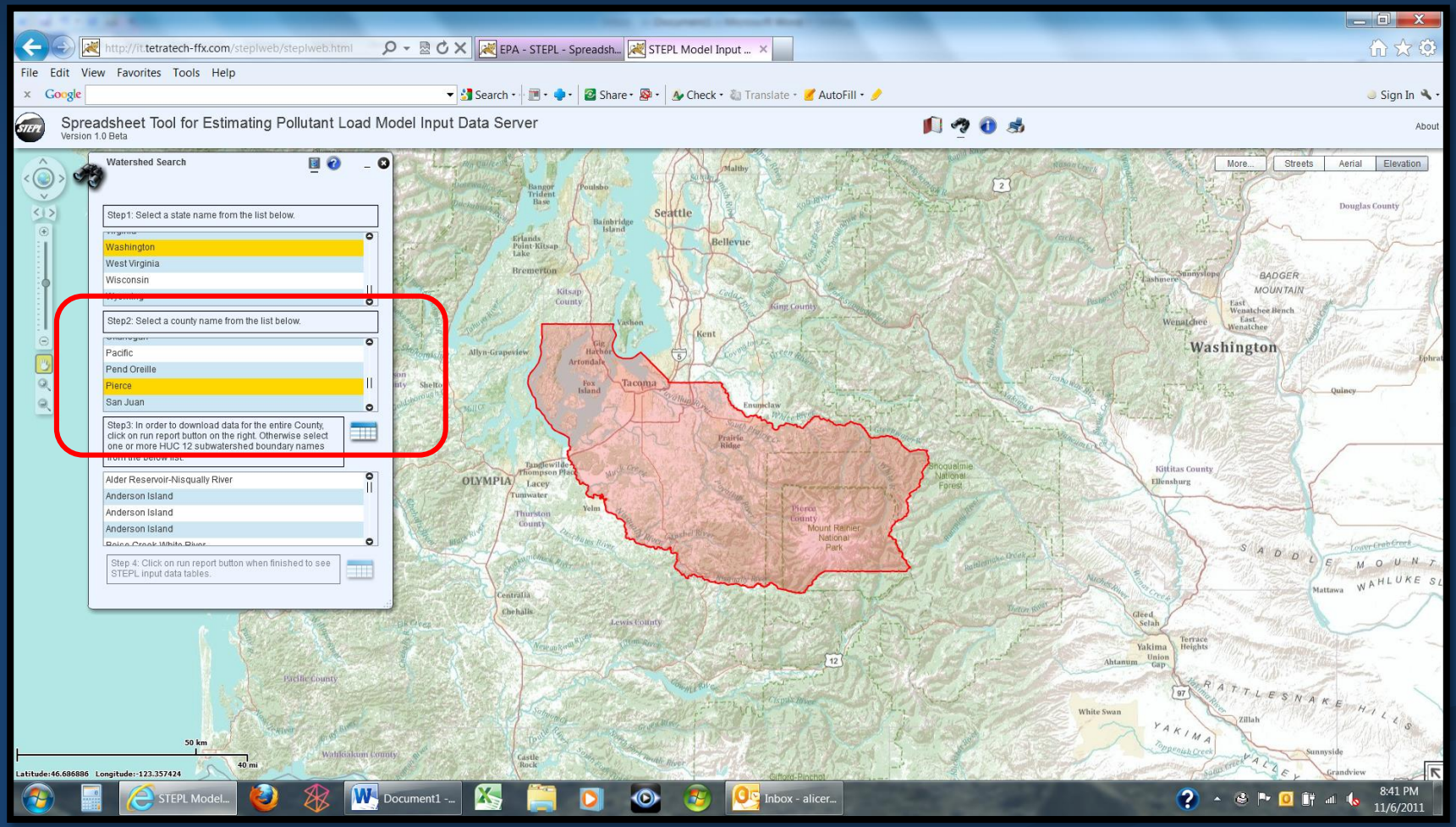
Load the STEPL Data Server



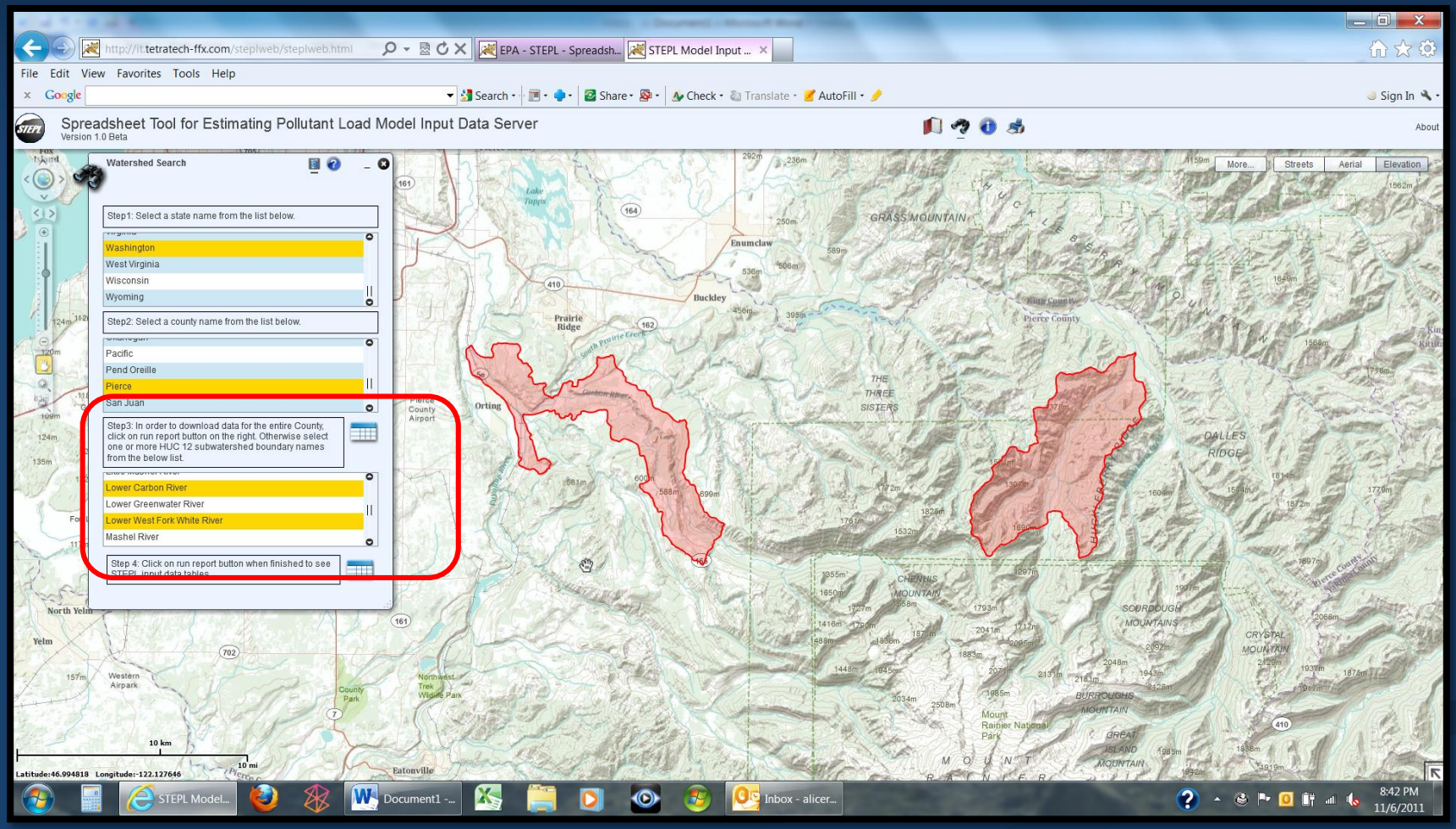
Step 1: Select the state



Step 2: Select the county



Step 3: Select the watersheds



Gathering Land Use Information

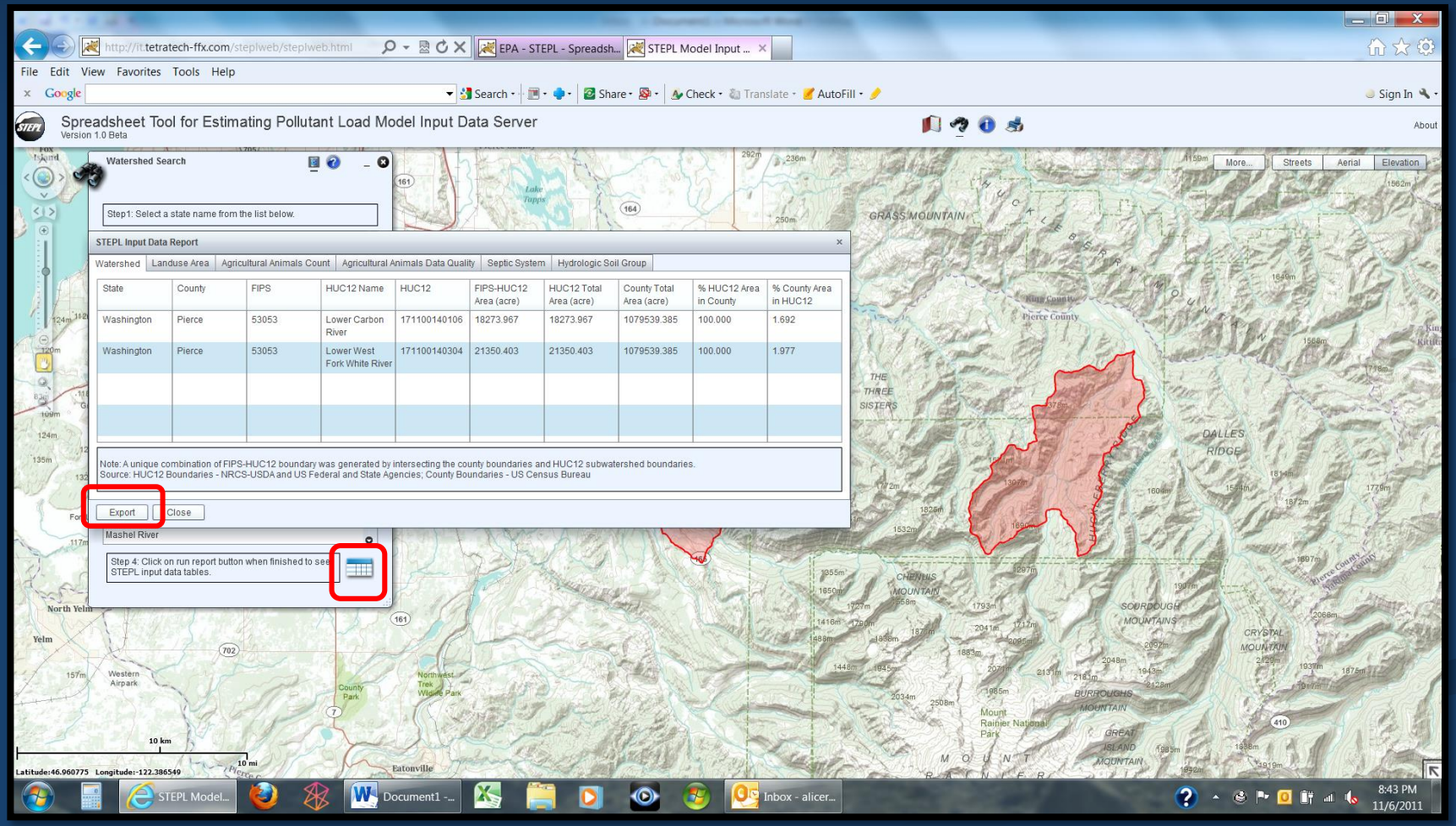
6. Once you have the sub watersheds selected, click on the report button. 

7. Click the Export button in the lower left corner of the Report screen. If the watersheds need to be revised, click the close button on the report box, reselect sub watersheds, and rerun the report.

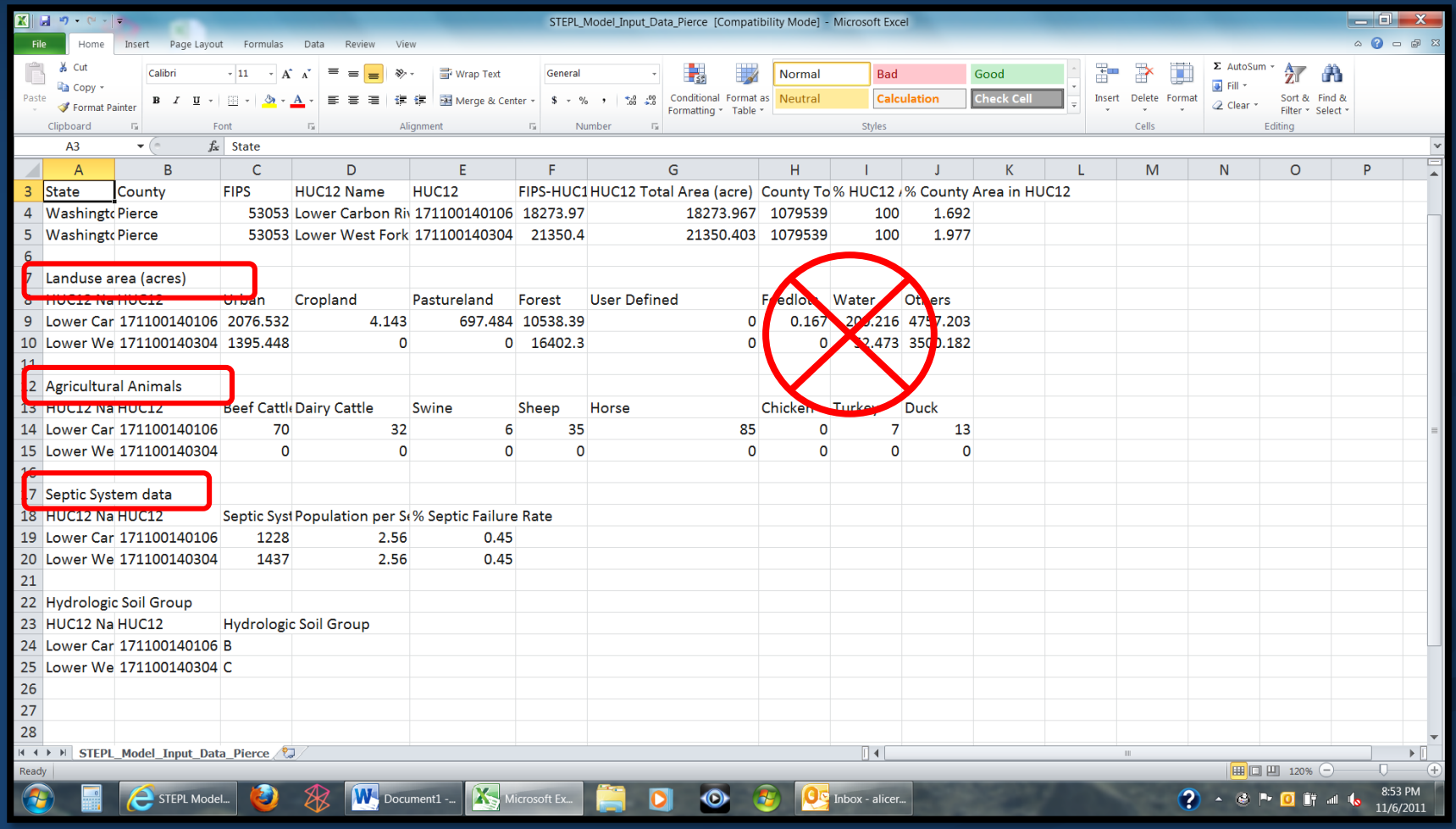
8. Save the Land Use Data report and remember where you saved that Excel file for later use in the STEPL process.

9. Now its time to run the STEPL program to get load reduction estimates for installed BMPs.

Step 4: Get the land use data for the selected watersheds



Land use Information will be used in the model



STEPL_Model_Input_Data_Pierce [Compatibility Mode] - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J
3	State	County	FIPS	HUC12 Name	HUC12	FIPS-HUC1	HUC12 Total Area (acre)	County To	% HUC12 A	% County Area in HUC12
4	Washingtc	Pierce	53053	Lower Carbon Ri	171100140106	18273.97	18273.967	1079539	100	1.692
5	Washingtc	Pierce	53053	Lower West Fork	171100140304	21350.4	21350.403	1079539	100	1.977
6										
7	Landuse area (acres)									
8	HUC12 Na	HUC12	Urban	Cropland	Pastureland	Forest	User Defined	Feedlot	Water	Others
9	Lower Car	171100140106	2076.532	4.143	697.484	10538.39	0	0.167	209.216	4757.203
10	Lower We	171100140304	1395.448	0	0	16402.3	0	0	52.473	3500.182
11										
12	Agricultural Animals									
13	HUC12 Na	HUC12	Beef Cattl	Dairy Cattle	Swine	Sheep	Horse	Chicken	Turkey	Duck
14	Lower Car	171100140106	70	32	6	35	85	0	7	13
15	Lower We	171100140304	0	0	0	0	0	0	0	0
16										
17	Septic System data									
18	HUC12 Na	HUC12	Septic Syst	Population per Si	% Septic Failure Rate					
19	Lower Car	171100140106	1228	2.56	0.45					
20	Lower We	171100140304	1437	2.56	0.45					
21										
22	Hydrologic Soil Group									
23	HUC12 Na	HUC12	Hydrologic Soil Group							
24	Lower Car	171100140106	B							
25	Lower We	171100140304	C							
26										
27										
28										

Sample data for example

Landuse area (acres)

HUC12 Na	HUC12	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Water	Others
Lower Car	171100140106	2076.532	4.143	697.484	10538.39	0	0.167	200.216	1757.203
Lower We	171100140304	1395.448	0	0	16402.3	0	0	52.473	3500.132

Agricultural Animals

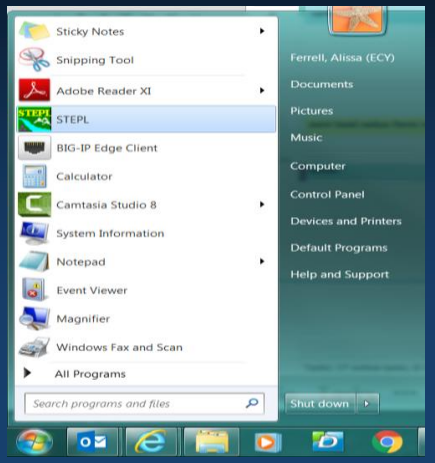
HUC12 Na	HUC12	Beef Cattle	Dairy Cattle	Swine	Sheep	Horse	Chicken	Turkey	Duck
Lower Car	171100140106	70	32	6	35	85	0	7	13
Lower We	171100140304	0	0	0	0	0	0	0	0

Septic System data

HUC12 Na	HUC12	Septic Syst	Population per Se	% Septic Failure Rate
Lower Car	171100140106	1228	2.56	0.45
Lower We	171100140304	1437	2.56	0.45

Using the STEPL Model for Load Reduction Estimates

Running the STEPL Program



1. Go to the Start menu, Programs folder, STEPL folder, and click on STEPL.

2. Click Start ⟹ A Settings Option window follows. Using the information you put together before you started:
   - Set "Number of Sub watersheds" to the number of sub watersheds (12-digit HUCs) you selected in the Data Server (where the BMPs were installed). This gives you the right amount of spaces needed for the spreadsheet data. Add an extra watershed/line if you'd like.
   - Set Gully formation and Impaired stream bank to the number of streambanks or gullies where BMPs were installed.
   - Under Option for Initialization-click on "Set initial land use areas and animal numbers to zeros".
   - Click "OK".

Running the STEPL Program

3. Ensure security settings are set to allow STEPL to be fully functional. STEPL provides directions for Excel macros settings in a pop-up window. **Steps can vary by software version.

(Excel 2013: Options>Trust Center>Trust Center Settings>Macro Settings>Enable all macros)

4. The “Save As” box appears. STEPL automatically sets the file name, NutrTool1.xls to be saved in the STEPL folder where the program stores your information and makes calculations. Accept the name and location provided by the program and save.
   - Click continue each time the compatibility checker appears.

(If the program asks, click “Yes” to replace the existing NutrTool1.xls file. This will reset any previously saved data.)

Running the STEPL Program

This NutrTool1.xls file is important if you encounter complications where you may need to retrieve the data before reinstalling the program.

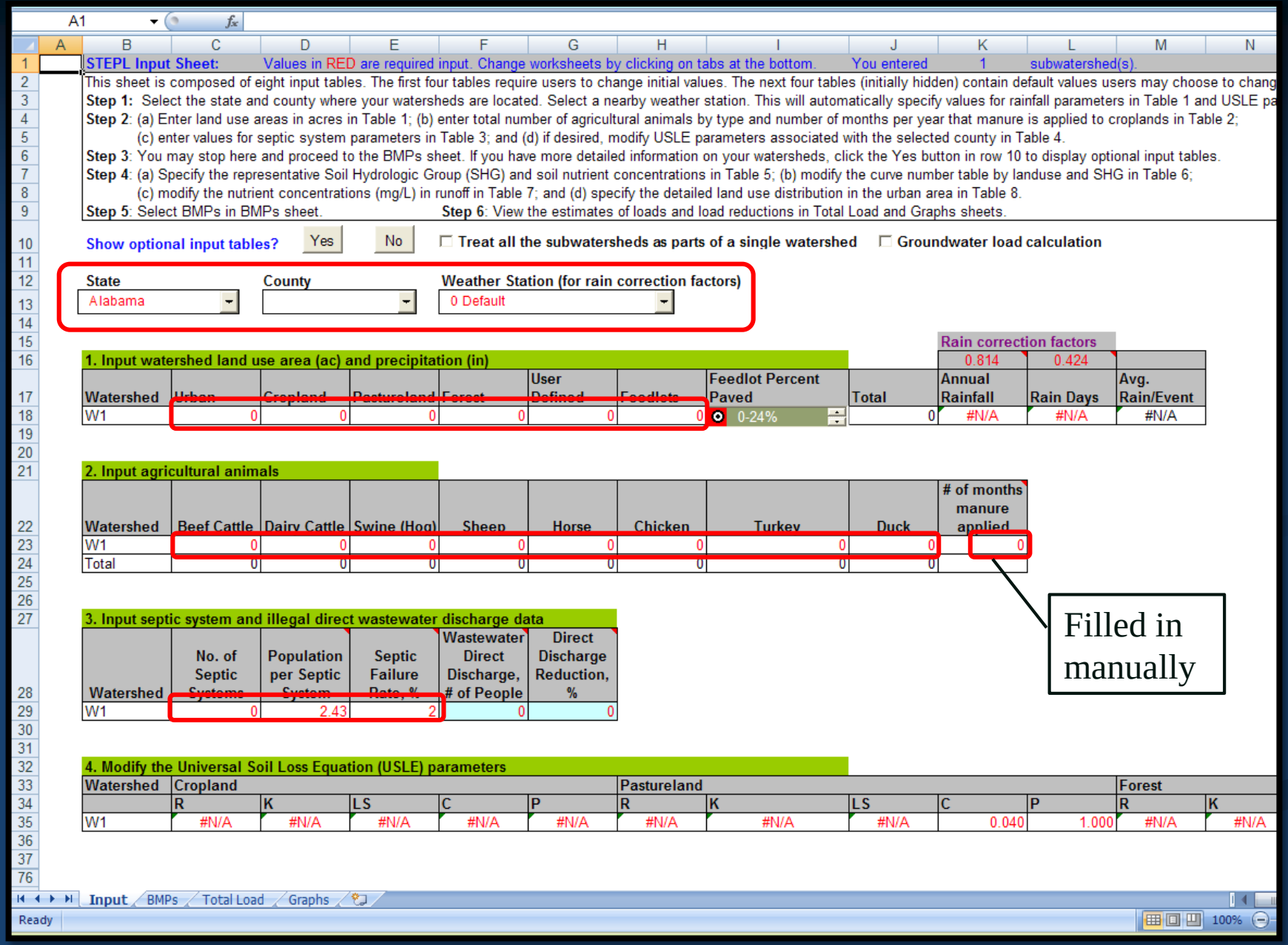
5. The spreadsheet will open. Start on the "Input" worksheet tab. Select the weather station closest to your BMP sites and insert the land use information from the Data Server.

Complete the following before going to the next worksheet tab:

- "State", "County", and "Weather Station".
- Sections 1, 2, and 3.
- Months per year that manure is applied to cropland (in #2).

6. Select the  radio button next to the item in order for it to be activated.

Required items for the Input Tab are bound in red



STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom. You entered 1 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to chang

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE pa

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2; (c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in row 10 to display optional input tables.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table 6; (c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6**: View the estimates of loads and load reductions in Total Load and Graphs sheets.

Show optional input tables? Yes No ☐ Treat all the subwatersheds as parts of a single watershed ☐ Groundwater load calculation

State	County	Weather Station (for rain correction factors)
Alabama		0 Default

1. Input watershed land use area (ac) and precipitation (in)

									Rain correction factors		
									0.814	0.424	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1	0	0	0	0	0	0	0-24%	0	#N/A	#N/A	#N/A

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied
W1	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	

Filled in manually

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	0	2.43	2	0	0

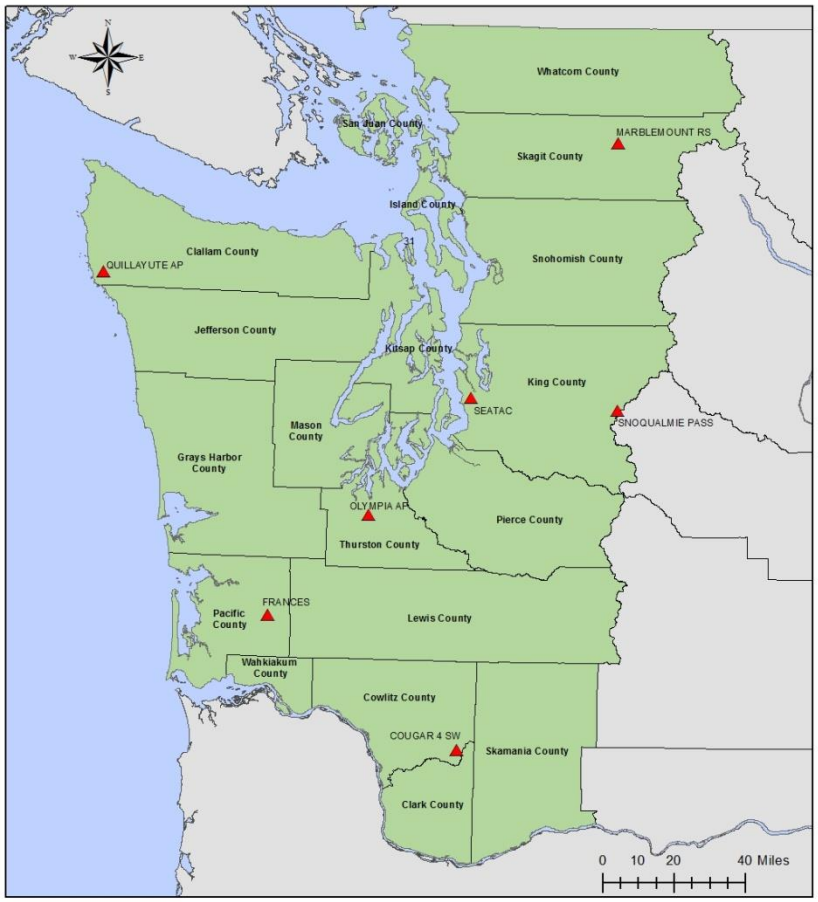
4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest	
	R	K	LS	C	P	R	K	LS	C	P	R	K
W1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.040	1.000	#N/A	#N/A

Input | BMPs | Total Load | Graphs

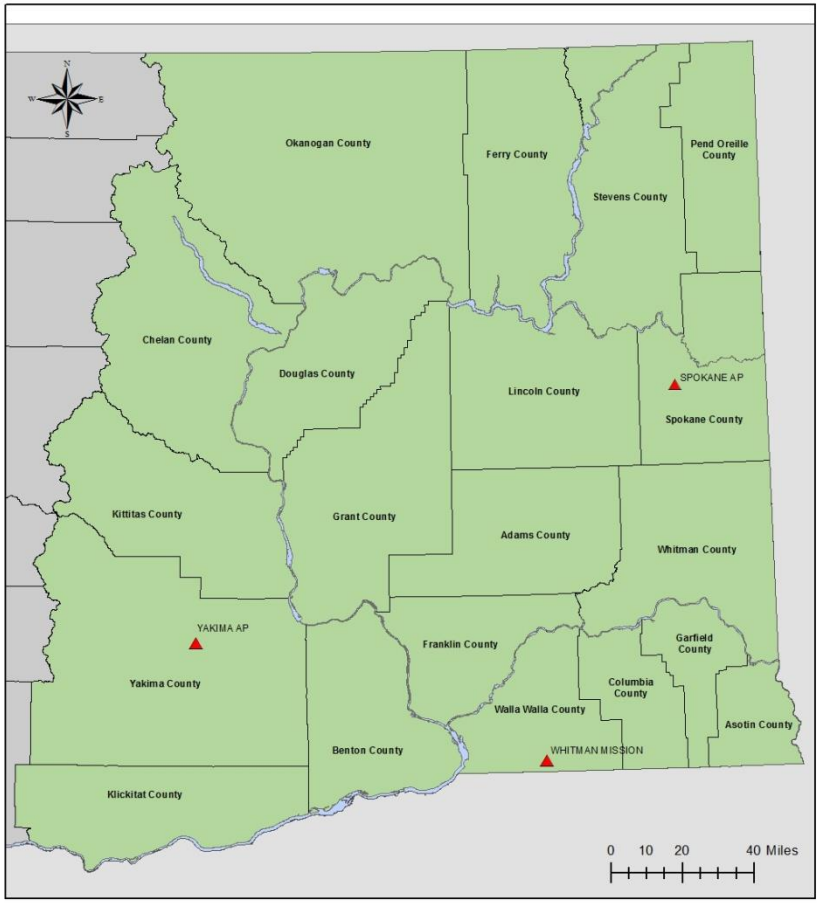
Ready

STEPL Weather Stations
Western Washington



▲ STEPL Weather Station

STEPL Weather Stations
Eastern Washington



▲ STEPL Weather Station

Running the STEPL Program

7. Now open the Excel file saved from the Data Server, and fill in the required data for the Input tab.

   - Under "1. Input watershed land use area", copy the numbers for the different Land Use areas (in acres) directly from your Excel data sheet over to their respective columns ("Urban" through "Feedlots"), with each row used for each one of the sub watersheds.
   - Repeat for "2. Input agricultural animals".
   - Based upon your knowledge of the project area, fill in the "# of months manure applied" box with your best estimate.

Running the STEPL Program

- Repeat for "3. Input septic system and illegal direct wastewater discharge data".

Next Step

8. Go to the BMPs worksheet tab in the spreadsheet.

BMP category/section headings, as well as required field to complete, are bounded in red

NutrTool1.xls

Best Management Practice Select an appropriate BMP except "Combined BMPs-Calculated" for each subwatershed in each land use table using the pull-down list-box if interactions between BMPs are not considered. Select "Combined BMPs-Calculated" if multiple BMPs and their interactio in the subwatersheds are considered; use BMP calculator (under STEPL menu) to obtain the combined BMP efficiencies and enter them in Table 7.

Urban BMP Tool

Gully and Streambank Erosion

1. BMPs and efficiencies for different pollutants or CROPLAND, ND=No Data

Watershed	Cropland					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0	0	0	0	0 No BMP	100

2. BMPs and efficiencies for different pollutants on PASTURELAND ND=No Data

Watershed	Pastureland					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0	0	0	0	0 No BMP	100

3. BMPs and efficiencies for different pollutants on FOREST, ND=No Data

Watershed	Forest					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0	0	0	0	0 No BMP	100

4. BMPs and efficiencies for different pollutants on USER DEFINED land use, ND=No Data

Watershed	User Defined					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0	0	0	0	0 No BMP	100

5. BMPs and efficiencies for different pollutants on FEEDLOTS ND=No Data

Watershed	Feedlots					
	N	P	BOD	Sediment	BMPs	%Area BMP Applied
W1	0	0	0	0	0 No BMP	100

Running the STEPL Program

9. Select the most appropriate land use category where your BMP(s) were installed. Scroll through the BMP options in the dropdown list and select the type of BMP installed.
   - Be sure to click the round radio button  to the left of the BMP for it to be selected.
   - If the BMPs that were installed are not listed in the land use category, you may add additional BMPs.
     - See next steps.

Running the STEPL Program

10. Add additional BMPs to land use category
    - There may be additional BMP selections that you will want to use that are not listed under a land use category.
    - Click on the Add-Ins tab from the main menu (at top) to get the STEPL menu.
    - Select "View/Edit BMP List" from dropdown.
    - Insert a row under the land use heading where you would like to add the new BMP option.

Running the STEPL Program

10. Add additional BMPs to land use heading (continued)
    - Copy and paste the BMP name and efficiency data you want from another land use category. Make sure the land use label is correct.
    - Click the "Update BMP Data" button for info to be updated in BMP tab.
    - Click "Save Updates" for changes to be saved permanently for the next time you use STEPL.

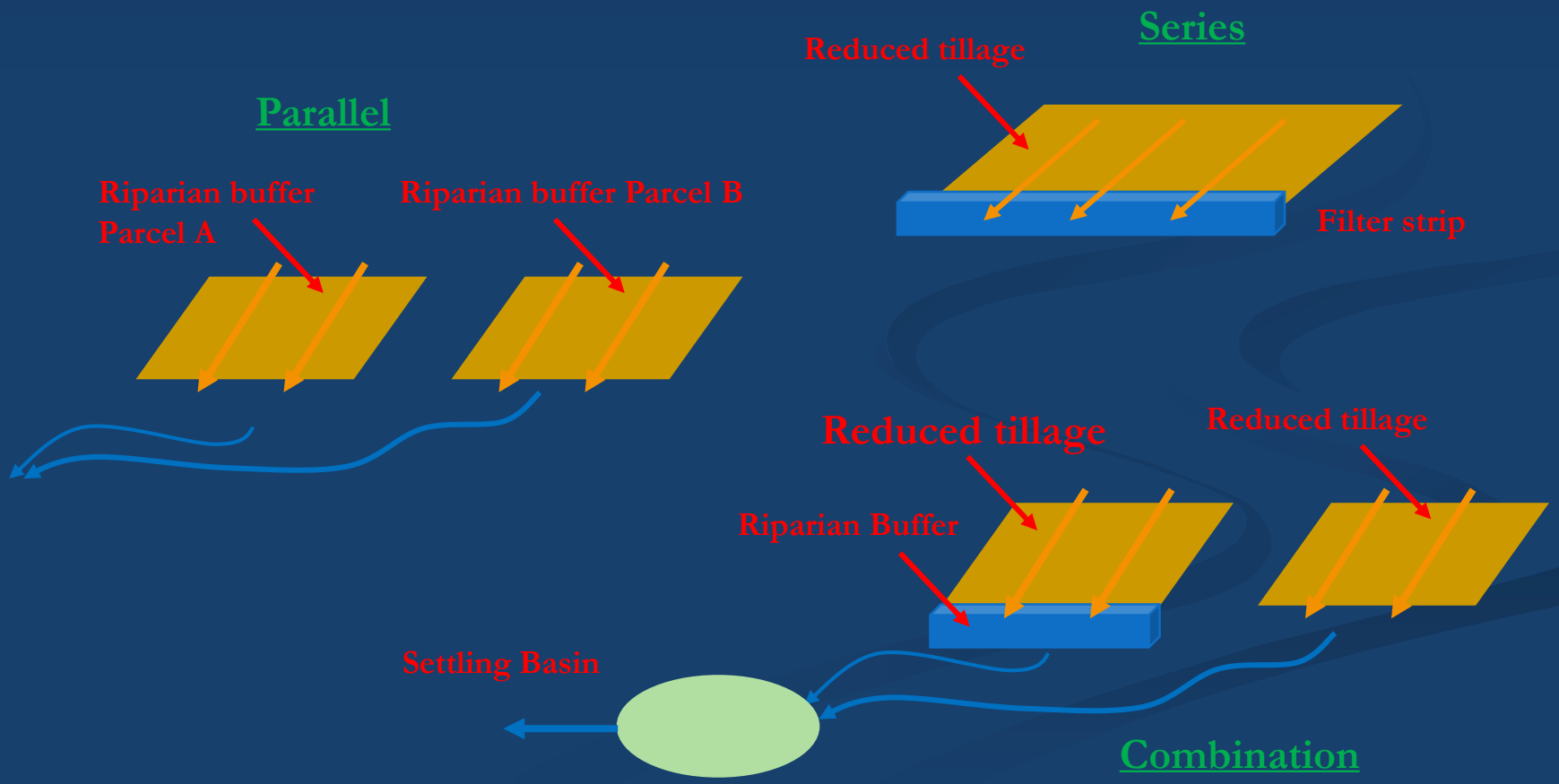
Running the STEPL Program

10. Add additional BMPs to land use heading (continued)
    - Click the BMPs worksheet tab. The added BMPs should be listed under the land use category where they were entered.

When you have multiple types of BMPs working together in a single land use area, in series or parallel, you will need to use the BMP Calculator to calculate the combined BMP Efficiencies.

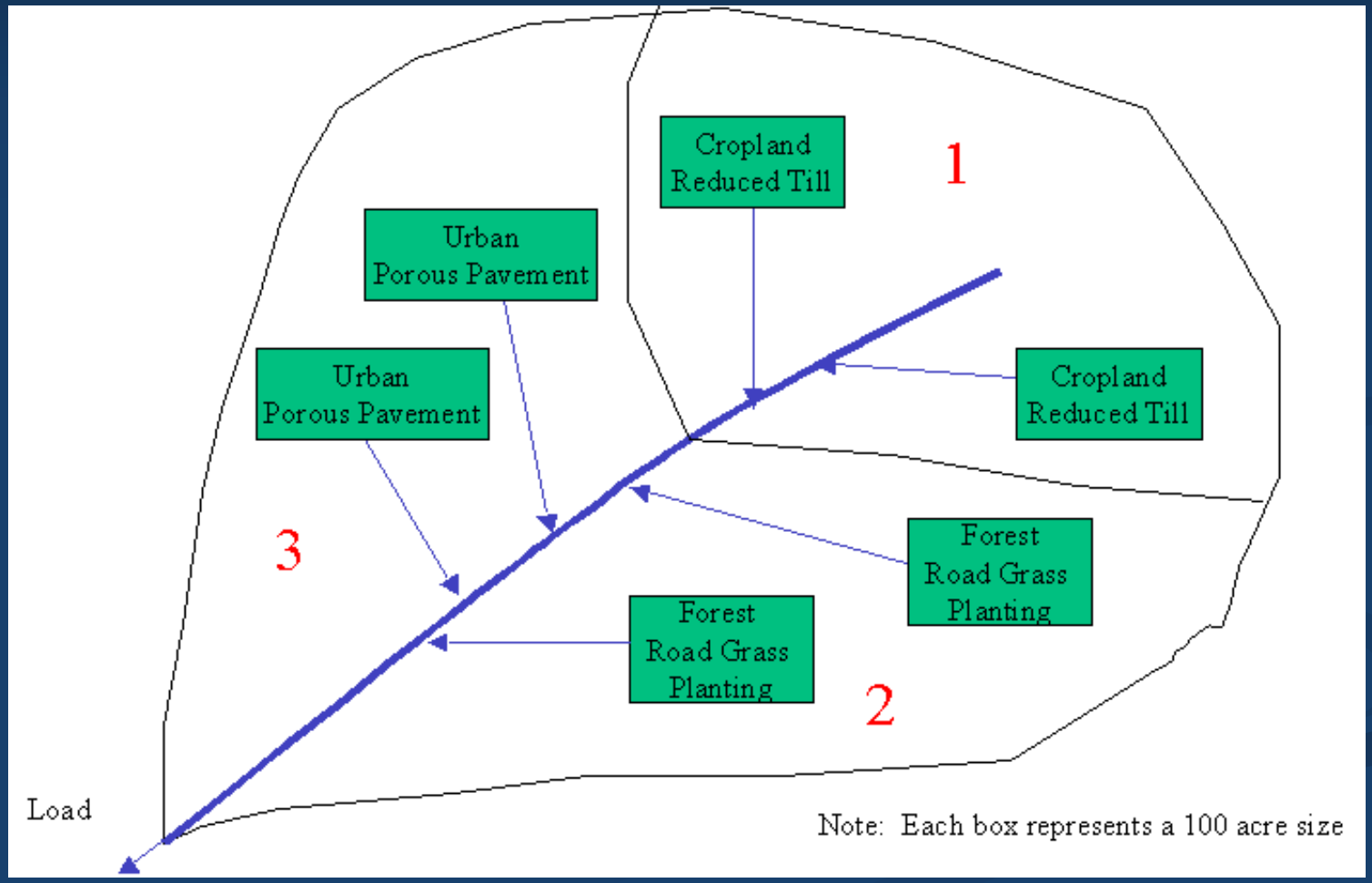
STEPL BMP Calculator

- Calculates combined efficiency of multiple BMPs for a given land use. The use of BMP calculator requires the understanding of BMPs and their placement in the watershed.



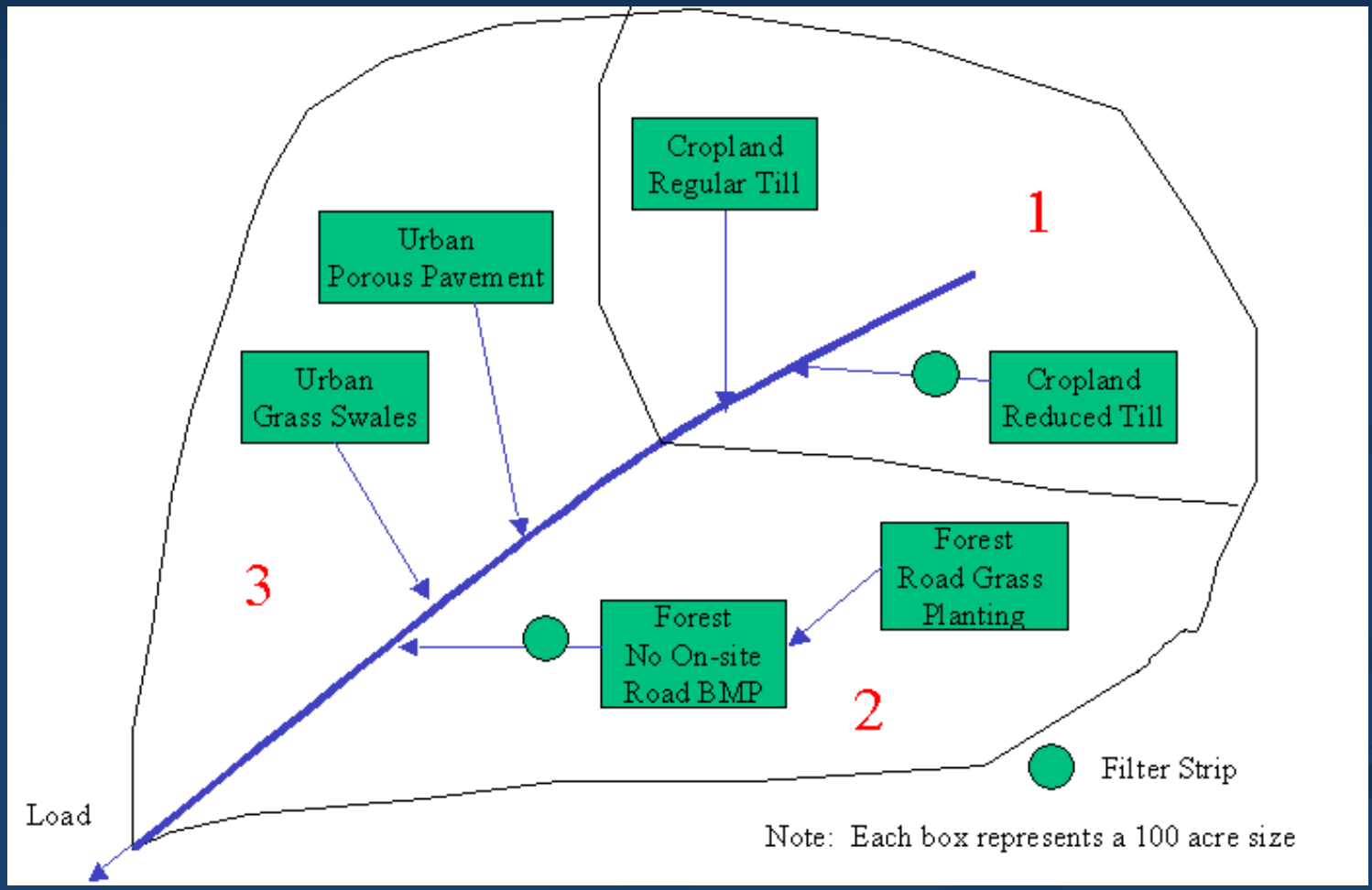
Example: BMP Calculator Not Needed

A land use category has only one type of BMP.



Example: BMP Calculator Is Needed

A land use category has more than one type of BMP.



Running the STEPL Program

11. Running the BMP Calculator (if needed):

- Examples: reduced tillage system and a filter strip or riparian buffer; waste storage facility and stream bank stabilization and fencing (riparian buffer).
- STEPL describes it as the “Watershed Combined BMP Efficiencies” for that land use area.
- In this scenario, select “Combined BMPs-Calculated” under the appropriate land use area (in either table #1, 2, 3, 4, or 5 on the BMPs worksheet tab). Then run the BMP Calculator. The combined BMP efficiencies will be entered in table #7 on the BMPs tab worksheet.

Running the STEPL Program

11. Running the BMP Calculator (continued):

- Go to the STEPL menu option (top of the Excel window under Add-Ins menu tab).
- Select the BMP Calculator ⟹ opens a blank box to perform the calculation.
- Click on the Add BMP button  to insert a box for each BMP working together in the land use area. Each click inserts a single box.
- Now click  one more time to add a placeholder box for the Combined BMP Efficiencies (total).

Tip: To delete a box, click it and press the DELETE key on keyboard.

Next-enter data into the boxes representing BMPs.

Running the STEPL Program

11. Running the BMP Calculator (continued):

- For each BMP placeholder box (except the total box):
  1. Double-click on the box.
  2. Click the drop-down list and select the BMP with land use category that most closely matches this placeholder's BMP.
  3. Enter the BMP area (in acres) into the Total Pollutant Load or Area box. The efficiency rates will automatically populate.
  4. Click the OK button to close that BMP's data entry window.

Running the STEPL Program

11. Running the BMP Calculator (continued):

Now, establish the relationship between the BMP boxes you've created.

- Click and drag from one box to another. This creates an arrow between the BMPs to indicate the sequence in which the BMPs are applied.

Two ways to align your BMP boxes:

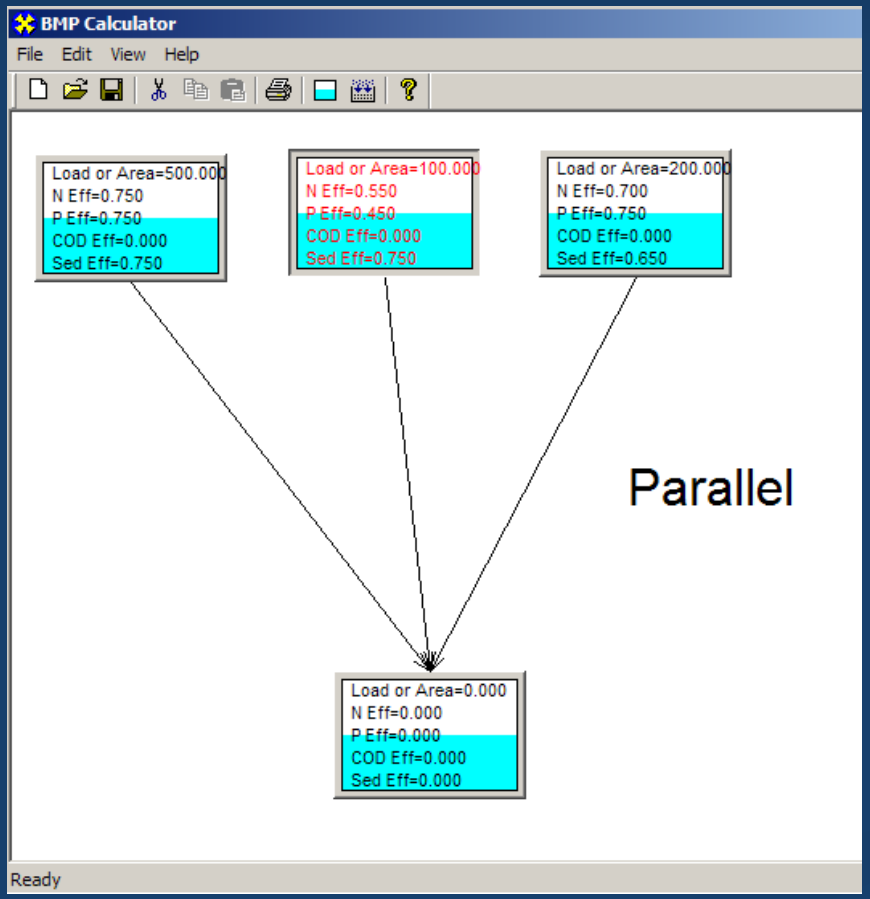
- Parallel--independent of each other: each BMP/box has an arrow pointing directly to the Total box/placeholder.
- Sequential or Series--one following on another: arrows point from one BMP to the next (in the logical order) and finally pointing to the Total box/placeholder.

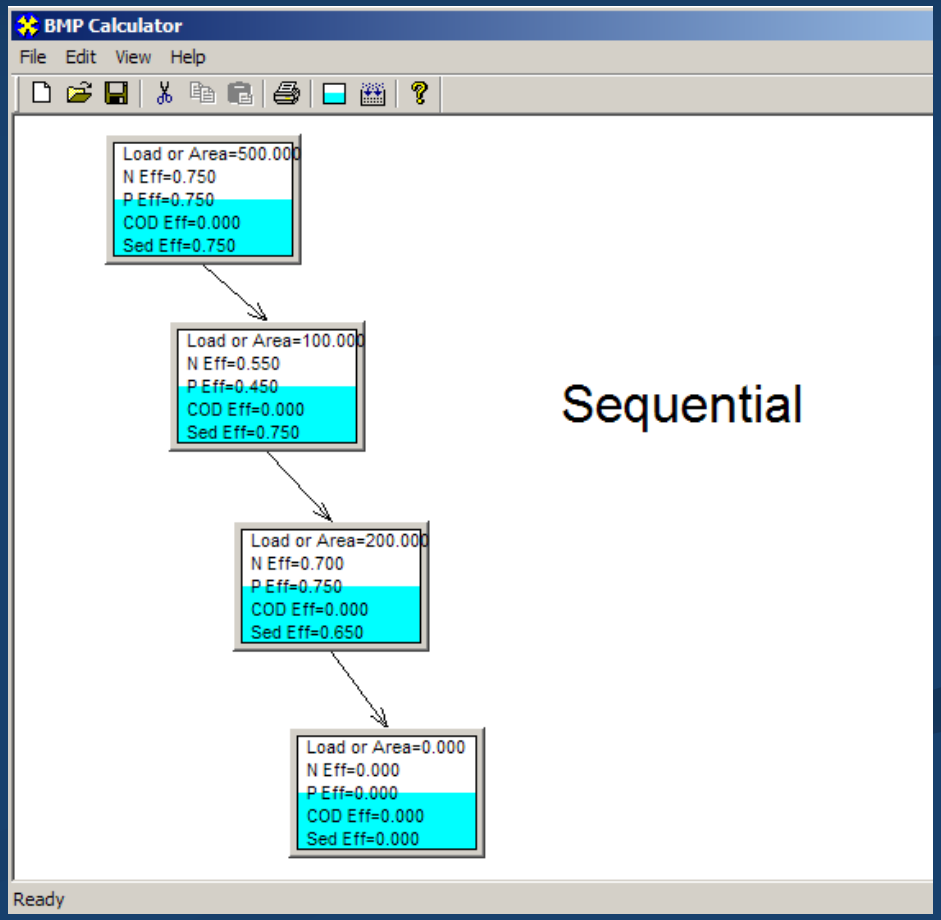
Tips: Dragging from inside the box will move the entire box. To delete an arrow, click it then press DELETE key on keyboard.

Running the STEPL Program

11. Running the BMP Calculator (continued):

- Associating BMPs:

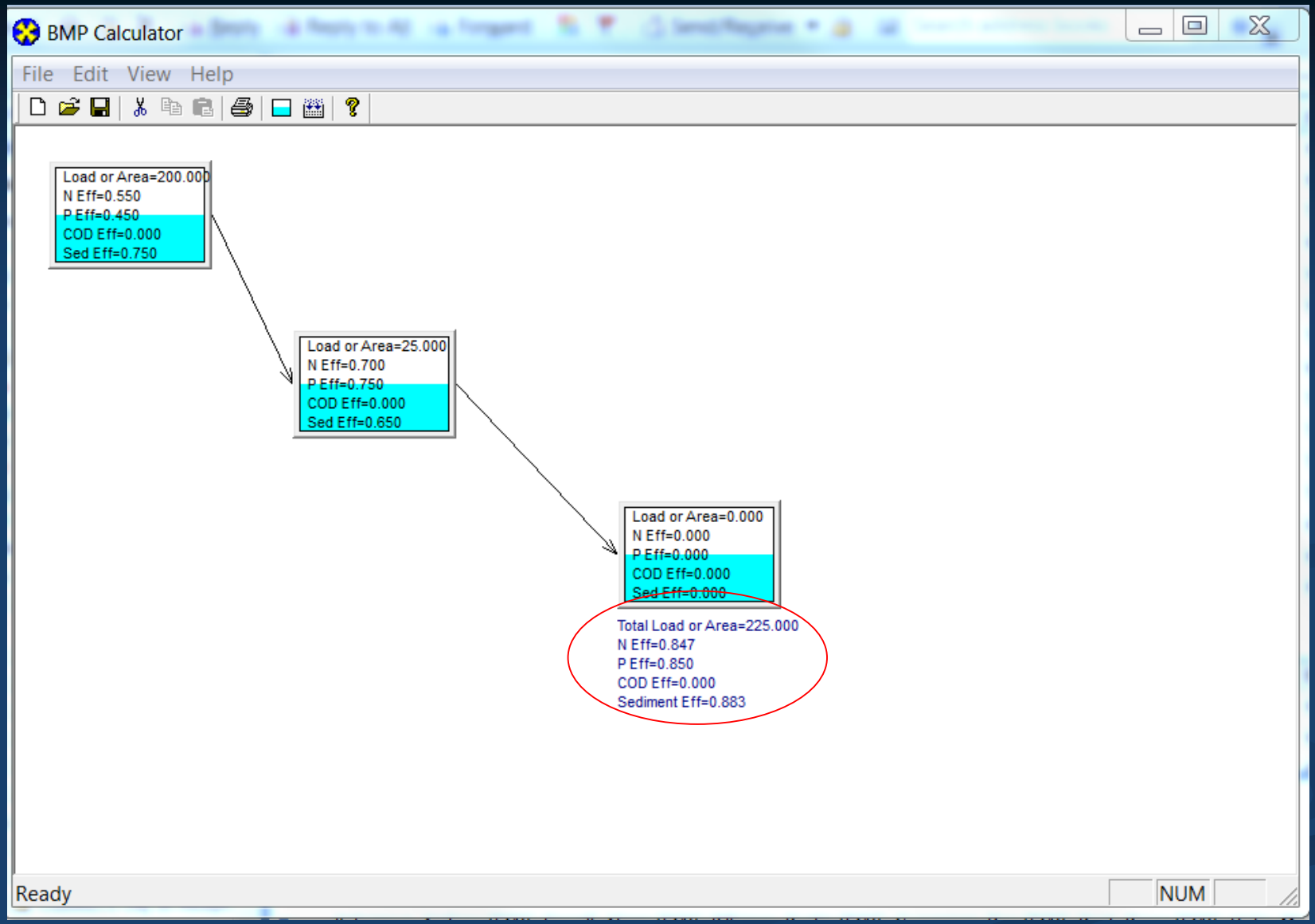




Running the STEPL Program

11. Running the BMP Calculator (continued):

- Next, press the  to calculate your Combined BMP Efficiencies in the Total box.
- Totals will appear in blue text below the Total box.
- Enter these calculated efficiencies (N, P, BOD, and Sediment) into their respective columns in table #7 on the BMPs tab. Be sure you are on the correct land use area row.


BMP Calculator
File Edit View Help
Load or Area=200.000
N Eff=0.550
P Eff=0.450
COD Eff=0.000
Sed Eff=0.750
Load or Area=25.000
N Eff=0.700
P Eff=0.750
COD Eff=0.000
Sed Eff=0.650
Load or Area=0.000
N Eff=0.000
P Eff=0.000
COD Eff=0.000
Sed Eff=0.000
Total Load or Area=225.000
N Eff=0.847
P Eff=0.850
COD Eff=0.000
Sediment Eff=0.883
Ready
NUM

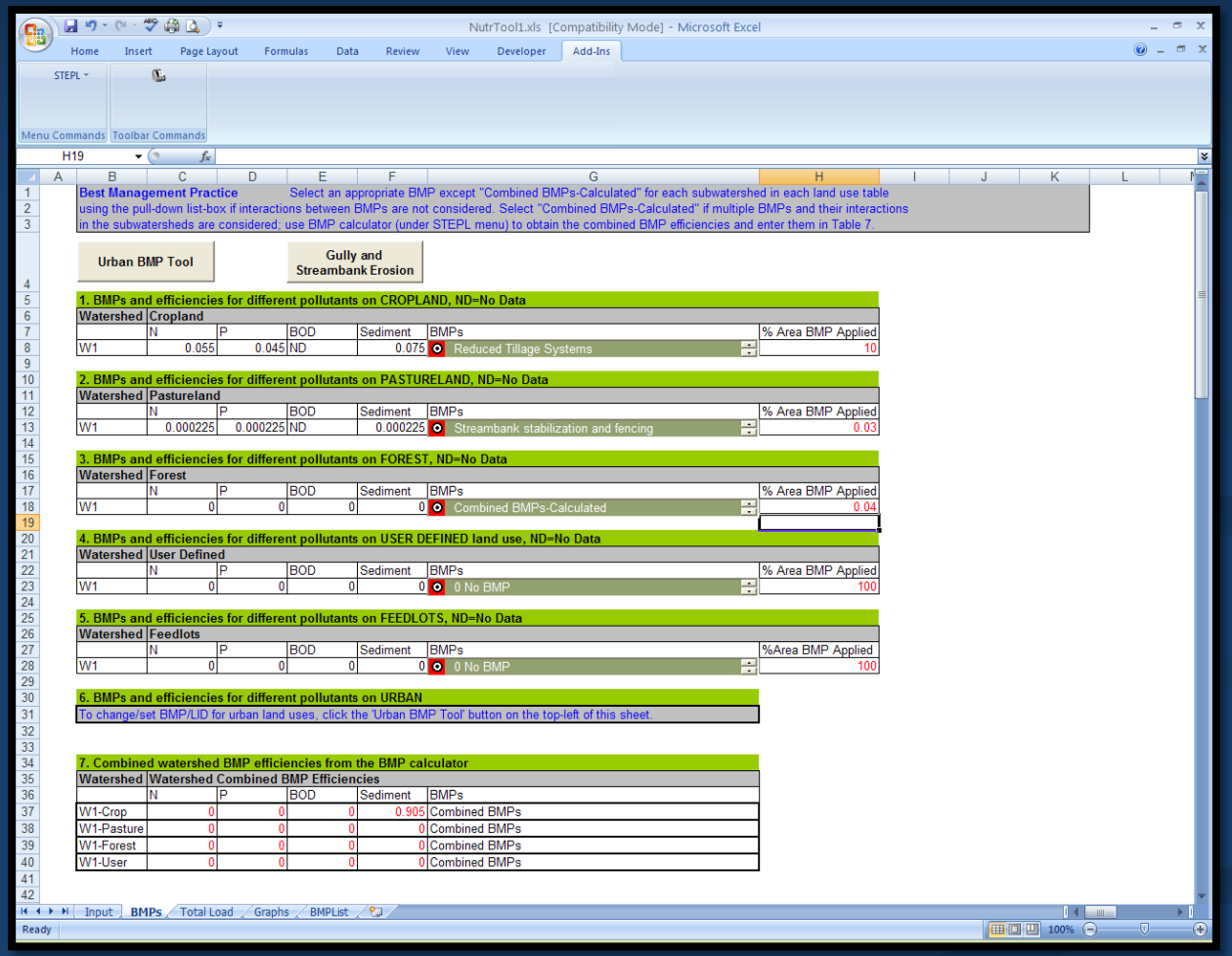
Running the STEPL Program

12. Enter "% Area BMP Applied" in the last column. This number is a best estimate of the percentage of area, of that particular land use type, that is benefiting from the BMP. 100% is STEPL's default number. (This is usually a small number.)

    Example: If the pastureland (from Data Server) is 65.94 acres and your riparian buffer covers 1.5 acres, then (1.5 / 65.94) x 100 = 2.27%

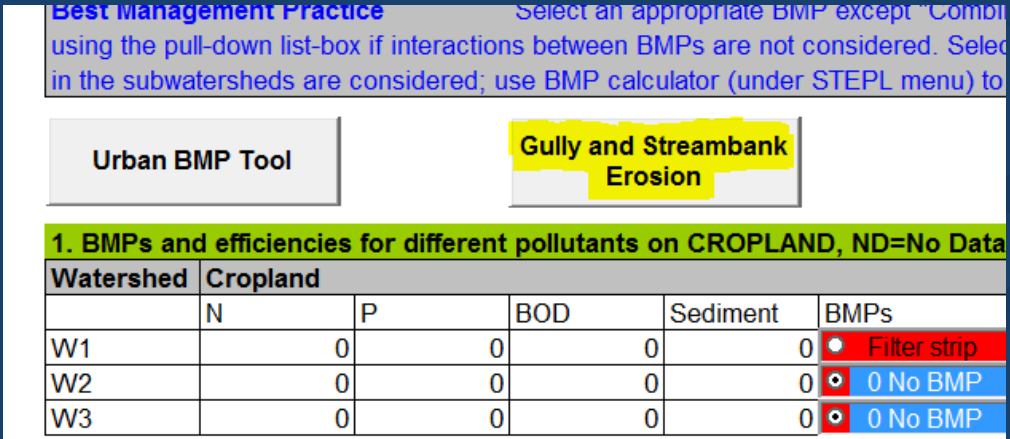
13. All the required spaces should now be complete under the STEPL "Input" and "BMPs" worksheet tabs.

Example of a Filled-in BMPs Tab



Running the STEPL Program

14. Using the Stream bank and Gully Tool
    - Use this tool for any stream bank stabilization project that was implemented.
    - In the BMP tab click on the "Gully and Stream bank Erosion" button
    - There should be the same number of rows available as the number of stream bank projects you indicated when first starting the STEPL software.



Running The STEPL Program

14. Using the Stream bank and Gully Tool

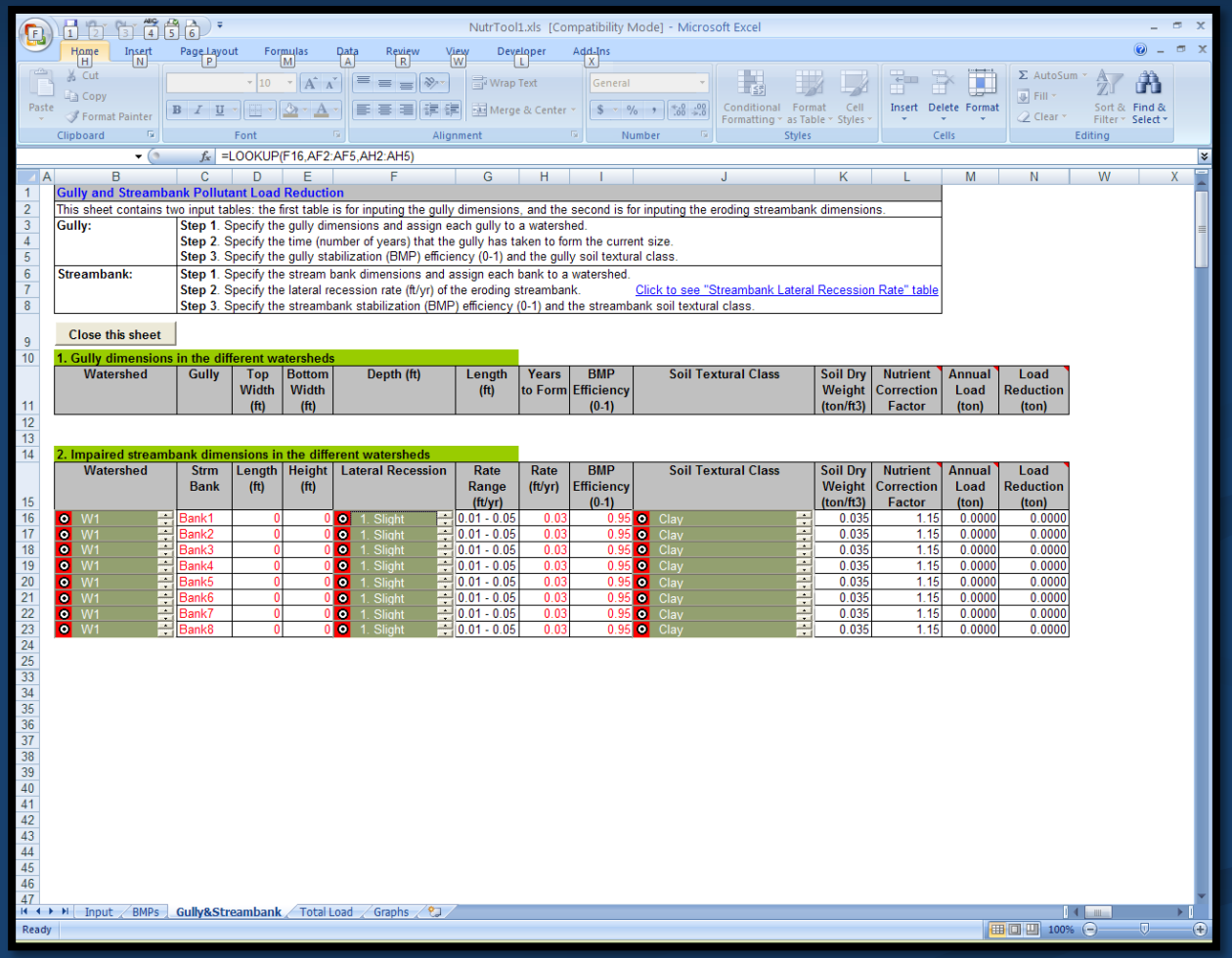
- Indicate the corresponding watershed/HUC (W1, W2, etc.) where the project occurred. It should correspond with the appropriate watershed from the Input tab.
- You can change the default name of the project (from Bank1, Bank 2, etc) if you want.
- Input the length and height of the stream bank.

Running The STEPL Program

14. Using the Stream bank and Gully Tool

- Select the appropriate description of the amount of lateral recession. At the top you can click on the link that defines the lateral recession rates. The recession rate will then be automatically filled in for you.
- You may adjust the BMP efficiency rate if it is known.
- Indicate the type of soils that compose the stream bank.
- This information will be reflected in the load reduction estimate when you are finished.

Example of Gully and Stream bank Tool



Using the STEPL Results

1. Now all the steps are complete and you've run the model.

2. Click the "Total Load" worksheet tab to get the results for the load reduction estimates. These were calculated based on what you entered in the Input and BMPs tabs.

Purple shaded boxes are the estimated load reductions based on selected BMPs, land use areas, and associated statistics.

The numbers in the red bounded area are the numbers needed for reporting purposes.

NutrTool1.xls

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	3808345.0	663187.2	11866773.8	46860.0	561692.4	129475.0	3687.0	576.1	3246652.6	533712.2	11863086.8	46283.9	14.7	19.5	0.0	1.2
Total	3808345.0	663187.2	11866773.8	46860.0	561692.4	129475.0	3687.0	576.1	3246652.6	533712.2	11863086.8	46283.9	14.7	19.5	0.0	1.2

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	1993252.48	307006.71	7718711.03	45716.30
Cropland	187230.79	43158.33	1217967.18	192.03
Pastureland	668305.66	50364.99	2171017.31	244.02
Forest	173617.62	86760.40	433833.57	131.55
Feedlots	216041.39	43208.28	288055.19	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	8204.69	3213.50	33502.50	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	3246652.63	533712.21	11863086.78	46283.90

Using the STEPL Results

3. The numbers in the middle purple section (noted on the previous page) are the load reduction estimates for the project.
4. Enter these numbers onto the Load Reduction Reporting Form due to Ecology on January 15th.

Relax-It's over.