STEPL Training August 5, 2014
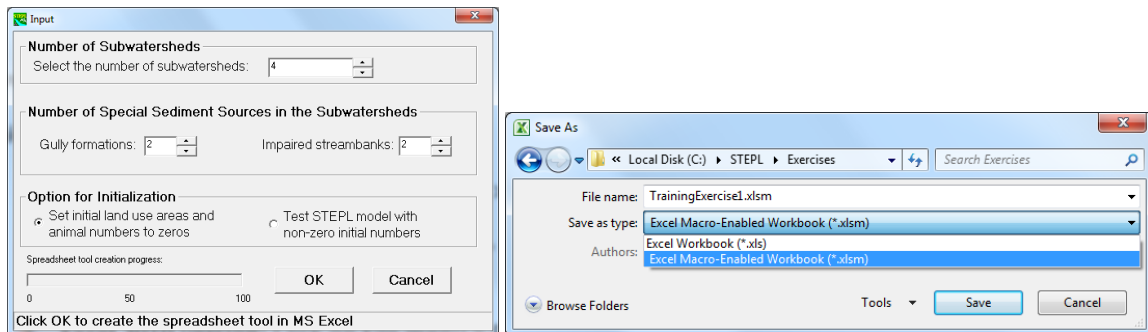
Exercise 1

- Download and install the latest version of STEPL (e.g., STEPL 4.2) model. Make sure to uninstall the older version first before installing the newer version.

    - **http://it.tetratech-ffx.com/steplweb/models$docs.htm**

- Create a STEPL worksheet with 4 watersheds, 2 gullies, and 2 streambanks

- Save as "*TrainingExercise1.xlsm*"

- Make sure macros are enabled

    - **Excel 2003 version:** Click on Tools menu > Macro > Security > Security Level > Medium

    - **Excel 2007 version:** Click on Office icon > Excel Options > Trust Center > Trust Center Settings > Macro Settings

    - **Excel 2010 version:** Click on File menu > Excel Options > Trust Center > Trust Center Settings > Macro Settings

- Set the STEPL installation folder as default file location (e.g., "C:\STEPL\" or "D:\STEPL\").

    - **Excel 2003 version:** Click on Tools menu > Options > General tab

    - **Excel 2007 version:** Click on Office icon > Excel Options > Save

    - **Excel 2010 version:** Click on File menu > Excel Options > Save

> *You need admin rights to install the software.*
>
> *Windows operating system only (not compatible with Mac)*
>
> *Ensure that you have write access to the STEPL installation folder (e.g., C:\STEPL)*
>
> *STEPL is not compatible with the combination of MS Excel 2007 and Windows 7 operating*

Exercise 2

- Save Exercise 1 as Exercise 2 (make sure to save Exercise 1 before saving it as Exercise 2)

  - Select Excel Macro-Enabled Workbook (*.xlsm) save option

- Review primary worksheets

  - Input, BMPs, Total Load, Graphs

- Locate 4 input tables

- Show optional input tables (Click Yes button)

  - How many input tables are there?

- Access STEPL customized menu

  - What is the first option listed? Select it.

  - How many worksheets are there?

  - Select first option again to Hide the additional sheets
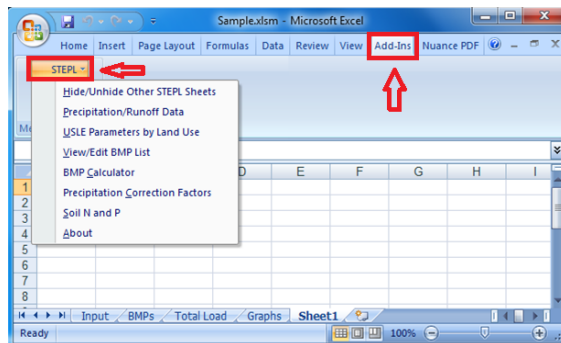
- Unhide the Reference sheet only (click right mouse button on any tab)

- Hide the Reference sheet
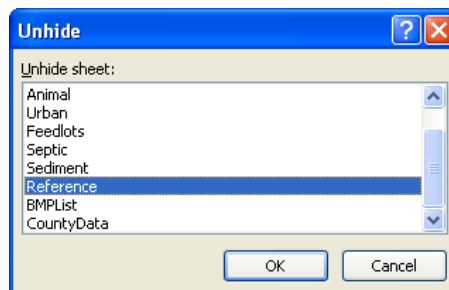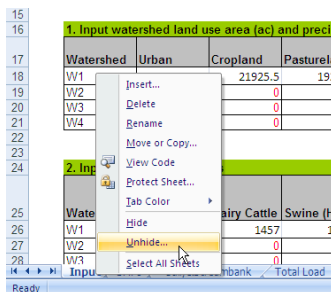
💡**If you do not see the Add-Ins option in the toolbar, make sure you have enabled the macros (see Exercise 1). Save the spreadsheet, close it, and reopen the spreadsheet.**

Exercise 3

Estimate total annual loads for a subwatershed of the Pigeon River:

- Save Exercise 2 as Exercise 3 (make sure to save Exercise 2 before saving it as Exercise 3)

    + Select Excel Macro-Enabled Workbook (*.xlsm) save option

- Select state = Michigan, and county = Huron.

    + Notice that initial values for Annual Rainfall and Number of Rain Days are automatically specified in Table 1 as you select a state or county.

- Select a weather station = MI Flint WSCMO.

    + Notice that rain correction factors change with the selected weather station.

Download data from STEPL Input Data Server

- Select state = Michigan, county = Huron, and watershed = West Branch Extension-Pigeon River.

- Click on table button shown on Step 4 of the above figure.

http://it.tetratech-ffx.com/steplweb/steplweb.html — STEPL Model Input Data Ser... ×

File   Edit   View   Favorites   Tools   Help

Spreadsheet Tool for Estimating Pollutant Load Model Input Data Server
Version 1.0

STEPL Input Data Report

Watershed | Landuse Area | Agricultural Animals Count | Septic System | Hydrologic Soil Group

Watershed Name	HUC12	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Water	Others
West Branch Extension-Pigeon	040801030203	1616.582	22635.702	1742.012	1402.861	0.000	1.074	22.239	1179.800

Watershed | Landuse Area | Agricultural Animals Count | Septic System | Hydrologic Soil Group

Watershed Name	HUC12	Beef Cattle	Dairy Cattle	Swine	Sheep	Horse	Chicken	Turkey	Duck
West Branch Extension-Pige	040801030203	36	742	1005	41	17	0	3	6

Watershed | Landuse Area | Agricultural Animals Count | Septic System | Hydrologic Soil Group

Watershed Name	HUC12	Septic Systems	Population per Septic System	% Septic Failure Rate
West Branch Extension-Pigeon River	040801030203	725	2	1.14

Watershed | Landuse Area | Agricultural Animals Count | Septic System | Hydrologic Soil Group

Watershed Name	HUC12	Hydrologic Soil Group
West Branch Extension-Pigeon River	040801030203	C

Enter data in the Input Worksheet (numbers in red in spreadsheet)

- Enter data in Tables 1, 2, 3, and 5:

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

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots
W1	1616.582	22635.702	1742.012	1402.861	0	1.074
W2	0	0	0	0	0	0
W3	0	0	0	0	0	0
W4	0	0	0	0	0	0

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck
W1	36	742	1005	41	17	0	3	6
W2	0	0	0	0	0	0	0	0
W3	0	0	0	0	0	0	0	0
W4	0	0	0	0	0	0	0	0
Total	36	742	1005	41	17	0	3	6

3. Input septic system and illegal direct wastewater

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %
W1	725	2	1.14
W2	0	0	0
W3	0	0	0
W4	0	0	0

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected
W1	○	○	◉	○	C
W2	○	◉	○	○	B
W3	○	◉	○	○	B
W4	○	◉	○	○	B

- Examine estimated load in Total Load worksheet and compare the results below:

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	105540.6	17827.4	246734.9	2587.9	0.0	0.0	0.0	0.0
W2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	105540.6	17827.4	246734.9	2587.9	0.0	0.0	0.0	0.0

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	8810.39	1360.50	34239.01	202.29
Cropland	84953.78	15128.10	178055.46	2358.96
Pastureland	9349.81	726.20	30286.21	25.17
Forest	291.14	145.01	725.41	1.52
Feedlots	1923.96	384.79	2565.28	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	211.48	82.83	863.53	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	105540.55	17827.43	246734.90	2587.93

💡 If you cannot select the SHG controls in Table 5, make sure you have enabled the macros (see Exercise 1). Save the spreadsheet, close it, and reopen the spreadsheet.

- Which land use has the highest annual load contributions?

    - Cropland

Total N Load by Land Uses (with BMP) (lb/yr)	Total P Load by Land Uses (with BMP) (lb/yr)
■ Urban ■ Cropland ■ Pastureland ■ Forest ■ Feedlots ■ User Defined ■ Septic	■ Urban ■ Cropland ■ Pastureland ■ Forest ■ Feedlots ■ User Defined ■ Septic
Total BOD Load by Land Uses (with BMP) (lb/yr)	**Total Sediment Load by Land Uses (with BMP) (t/yr)**
■ Urban ■ Cropland ■ Pastureland ■ Forest ■ Feedlots ■ User Defined ■ Septic	■ Urban ■ Cropland ■ Pastureland ■ Forest ■ Feedlots ■ User Defined ■ Septic

- Review the Input Data parameters. Which required value did we leave out?

    - # of months manure applied

- Set the number of months manure applied to 8.

    - Note the difference in total loads.

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied
W1	36	742	1005	41	17	0	3	6	8
W2	0	0	0	0	0	0	0	0	0
W3	0	0	0	0	0	0	0	0	0
W4	0	0	0	0	0	0	0	0	0
Total	36	742	1005	41	17	0	3	6	

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	273930.6	63998.9	472160.3	2587.9	0.0	0.0	0.0	0.0
W2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	273930.6	63998.9	472160.3	2587.9	0.0	0.0	0.0	0.0

- Which pollutant load value did not change?

    - Sediment

Exercise 4

For the same farm area, estimate total annual load reduction assuming reduced tillage is adopted on <u>all </u>cropland

- Save Exercise 3 as Exercise 4 (make sure to save Exercise 3 before saving it as Exercise 4)

  - Select Excel Macro-Enabled Workbook (*.xlsm) save option

- Enter BMP data in BMPs worksheet

  - In Table 1 which is for cropland areas, select Reduced Tillage System under BMP column and enter 100 for % area BMP applied. Note that initial values of BMP efficiencies are automatically specified with the selected BMP.

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data						
Watershed	Cropland					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0.55	0.45	ND	0.75	🔴 Reduced Tillage Systems	100

- Examine estimated load reduction in Total Load worksheet and compare with the results below:

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	273930.6	63998.9	472160.3	2587.9	140848.8	28456.7	11323.0	1769.2
W2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	273930.6	63998.9	472160.3	2587.9	140848.8	28456.7	11323.0	1769.2

1. Total load by subwatershed(s)

- How many acres were treated by Reduced Tillage? Is this realistic?

- Calculate the load reductions assuming Reduced Tillage is applied on 550 cropland acres

  - Hint: 550 out of 22635.702 is 2.43%

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data						
Watershed	Cropland					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0.013365	0.010935	ND	0.018225	🔴 Reduced Tillage Systems	2.43

- Examine estimated load reduction in Total Load worksheet and compare with the results below:

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	273930.6	63998.9	472160.3	2587.9	3422.6	691.5	275.1	43.0
W2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	273930.6	63998.9	472160.3	2587.9	3422.6	691.5	275.1	43.0

1. Total load by subwatershed(s)

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	8810.39	1360.50	34239.01	202.29
Cropland	249921.19	60608.06	403205.69	2315.97
Pastureland	9349.81	726.20	30286.21	25.17
Forest	291.14	145.01	725.41	1.52
Feedlots	1923.96	384.79	2565.28	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	211.48	82.83	863.53	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	270507.97	63307.39	471885.13	2544.94

A waste management system is installed to treat the entire 1.074 acres of runoff from Feedlots.

- Add the BMP and calculate the new total load reductions for the watershed.

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

Watershed	Feedlots					
	N	P	BOD	Sediment	BMPs	%Area BMP Applied
W1	0.8	0.9	ND	ND	🔴 Waste Mgmt System	100

- Examine estimated load reduction in Total Load worksheet and compare with the results below:

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	273930.6	63998.9	472160.3	2587.9	4961.8	1037.8	275.1	43.0
W2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	273930.6	63998.9	472160.3	2587.9	4961.8	1037.8	275.1	43.0

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	8810.39	1360.50	34239.01	202.29
Cropland	249921.19	60608.06	403205.69	2315.97
Pastureland	9349.81	726.20	30286.21	25.17
Forest	291.14	145.01	725.41	1.52
Feedlots	384.79	38.48	2565.28	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	211.48	82.83	863.53	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	268968.80	62961.08	471885.13	2544.94

Gullies & Streambanks

- Let's say the project also restores 2,000 feet of severely eroding streambank

- From the BMP worksheet, click the button to view the Gully and Streambank erosion worksheet

- Add the BMP and calculate the new total load reductions for the watershed.

    – Assume bank is 2 ft high and soil class is Fine Sandy Loam

2. Impaired streambank dimensions in the different watersheds

Watershed	Strm Bank	Length (ft)	Height (ft)	Lateral Recession	Rate Range (ft/yr)	Rate (ft/yr)	BMP Efficiency (0-1)	Soil Textural Class
⊙ W1	Bank1	2000	2 ⊙ 3. Severe		0.3 - 0.5	0.4	0.95 ⊙	Fine Sandy loam

✦ Note this is just one bank, whereas you will normally model them in pairs

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	274039.4	64040.8	472377.9	2667.9	5065.2	1077.6	481.9	119.0
W2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	274039.4	64040.8	472377.9	2667.9	5065.2	1077.6	481.9	119.0

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	8810.39	1360.50	34239.01	202.29
Cropland	249921.19	60608.06	403205.69	2315.97
Pastureland	9349.81	726.20	30286.21	25.17
Forest	291.14	145.01	725.41	1.52
Feedlots	384.79	38.48	2565.28	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	211.48	82.83	863.53	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	5.44	2.09	10.88	4.00
Groundwater	0.00	0.00	0.00	0.00
Total	268974.24	62963.18	471896.01	2548.94

Exercise 5

Apply Urban BMPs/LIDs.

- Save Exercise 4 as Exercise 5 (make sure to save Exercise 4 before saving it as Exercise 5)

  ⬥ Select Excel Macro-Enabled Workbook (*.xlsm) save option

- In the example watershed, what % of urban land use is open space?

  ⬥ 5%

- Next we will apply LID/Bioretention to 5 acres of Open Space

- Click Urban BMP Tool

  - Select Open Space under urban land use options->Select LID/Bioretention under Available LID/BMP -> Click Apply LID/BMP

- Note that the LID/BMP Area is the area treated by the practice

- Review results on Urban worksheet

4. Pollutant loads from urban in lb/year								
Watershed	Pre-BMP Load				Load Reduction			
	N	P	BOD	TSS	N	P	BOD	TSS
W1	8810.39	1360.4991	34239.012	404571.87	4.2907646	0.8082603	0	0
W2	0	0	0	0	0	0	0	0
W3	0	0	0	0	0	0	0	0
W4	0	0	0	0	0	0	0	0

Note: The LID practices with an * require runoff volume input (Cisterns and Rain Barrels)

5B) Residential BMPs Project

- The project aims to install rain barrels in 20 single family homes

- The average size of each home's total rooftop area is ~4,000 sq ft (0.1 acres)

- The total runoff volume from the rooftops is 43,560 cubic ft (1 ac-ft) per year

Set Urban LID/BMP

Select a Watershed: 1 ▼

Select an Urban Land Use

○ Commercial ○ Industrial ○ Institutional ○ Transportation ○ Multi Family

● Single Family ○ Urban-Cultivated ○ Vacant-Developed ○ Open Space

Select LID/BMP

Available LID/BMP: | LID/BMP Area (ac): | Total Available Area (ac):

LID*/Rain Barrel ▼ | 2.00 | 484.97

☑ Simple form | **Reset All** | **Apply LID/BMP** | **Exit**

LID*/Rain Barrel

Input the runoff volume (ac-ft/yr) reduced by the practice (Baseline Runoff = 261.29 ac-ft/yr) :

OK

Cancel

1

- Review results on Urban worksheet

3. Selected urban BMPs

| Landuse	Commercial	Industrial	Institutiona	Transporta	Multi-Fami	Single-Family	Urban-Cult	Vacant (de	Open Space
W1	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	LID*/Rain Barrel	0 No BMP	0 No BMP	LID/Bioretention

4. Pollutant loads from urban in lb/year

Watershed	Pre-BMP Load				Load Reduction			
	N	P	BOD	TSS	N	P	BOD	TSS
W1	8810.390028	1360.4991	34239.012	404571.87	4.2907646	0.808260304	0	0
W2	0	0	0	0	0	0	0	0
W3	0	0	0	0	0	0	0	0
W4	0	0	0	0	0	0	0	0

💡 **To clear/delete the existing urban BMPs/LIDs in the urban worksheet, click on "Reset All" button available on the Urban BMP Tool.**

Exercise 6

- Save Exercise 5 as Exercise 6 (make sure to save Exercise 5 before saving it as Exercise 6)

    - Select Excel Macro-Enabled Workbook (*.xlsm) save option

- Download data for all 4 subwatersheds making up the Pigeon River drainage in Huron County, MI
    - West Branch Extension-Pigeon River
    - Dr Blair Drain-Pigeon River
    - Campau Drain-Pigeon River
    - Little Pigeon River
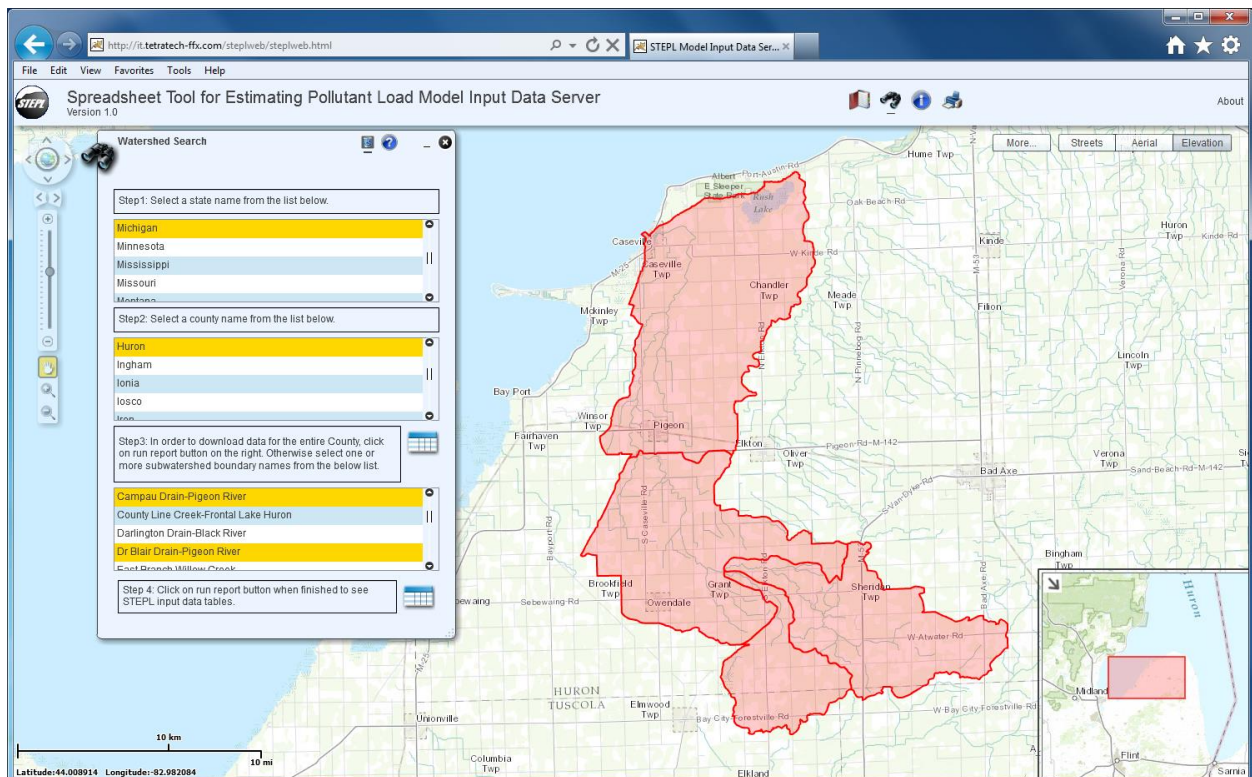
- Save and open data file in Excel

- Copy and paste input data into your STEPL workbook

    - Enter data for the selected watersheds in the same order as shown below

        - West Branch Extension-Pigeon River
        - Dr Blair Drain-Pigeon River
        - Campau Drain-Pigeon River
        - Little Pigeon River

- Land cover, agricultural animals, septics

- Change Hydrologic Soils Groups if necessary (Optional Input Table #5)

- What required piece of information was not provided?

    - # of months manure applied

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

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots
W1	1616.582	22635.702	1742.012	1402.861	0	1.074
W2	1131.095	13391.452	2864.212	2300.666	0	1.741
W3	2764.358	29911.543	3369.491	492.157	0	2.077
W4	558.209	6807.034	1609.243	906.033	0	0.77

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck
W1	36	742	1005	41	17	0	3	6
W2	60	1206	1616	67	28	2	6	9
W3	70	1436	1944	80	32	0	7	11
W4	40	495	755	32	25	0	4	6
Total	206	3879	5320	220	102	2	20	32

3. Input septic system and illegal direct wastewater

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %
W1	725	2	1.14
W2	366	2	1.14
W3	1213	2	1.14
W4	130	2	1.14

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration an

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected
W1	○	○	●	○	C
W2	○	●	○	○	B
W3	○	○	●	○	C
W4	○	●	○	○	B

- Review results on Total Load worksheet

## 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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	274039.4	64040.8	472377.9	2667.9	5069.4	1078.4	481.9	119.0
W2	55897.8	9378.0	135292.5	1689.7	0.0	0.0	0.0	0.0
W3	148807.5	24355.0	357517.3	3268.4	0.0	0.0	0.0	0.0
W4	29105.0	4920.2	70765.7	1010.5	0.0	0.0	0.0	0.0
Total	507849.6	102694.0	1035953.4	8636.5	5069.4	1078.4	481.9	119.0

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	31517.66	4862.69	122126.29	723.85
Cropland	417979.78	91011.51	755220.48	7638.22
Pastureland	43164.59	3381.65	139703.01	145.47
Forest	799.02	397.30	1987.94	6.01
Feedlots	8603.73	1682.27	13523.86	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	709.98	278.07	2899.08	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	5.44	2.09	10.88	4.00
Groundwater	0.00	0.00	0.00	0.00
Total	502780.20	101615.59	1035471.55	8517.55

To preserve the table format of Input worksheet, paste special and select Text option or Values option.
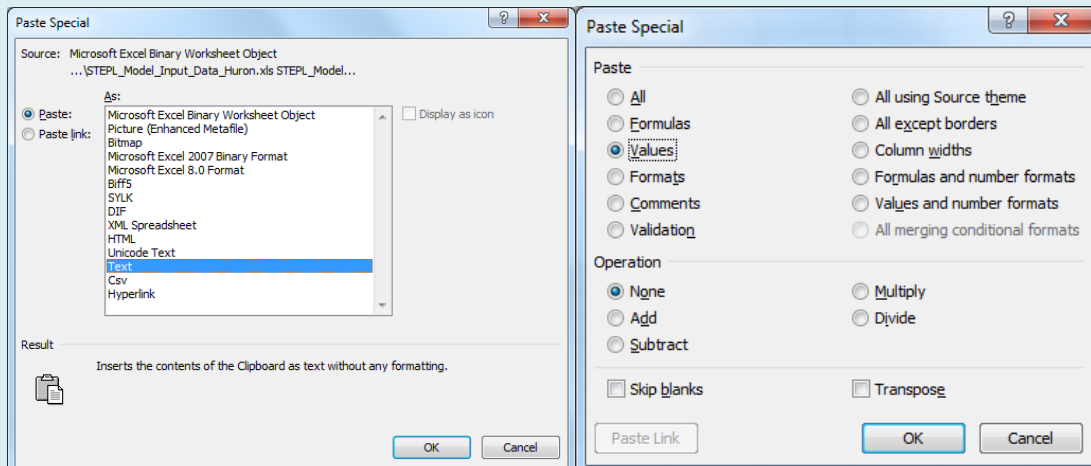
Exercise 7

- Save Exercise 6 as Exercise 7 (make sure to save Exercise 6 before saving it as Exercise 7)

    ⁜ Select Excel Macro-Enabled Workbook (*.xlsm) save option

- From STEPL customized menu, select View/Edit BMP List option

    ⁜ You can also unhide **BMPList** worksheet (see Exercise 2 to unhide a worksheet)

- Insert a new row after the Cropland Contour Farming BMP on the BMPList worksheet

- Enter **Cropland** under Landuse column and **Cover Crop** BMP with the following efficiencies: Nitrogen 0.3, Phosphorus 0.25, Sediment 0.35

- Click on **Update BMP Data** and view in Cropland BMP dropdown list on BMP worksheet

- Click on **Save Updates** to update the BMP list for BMP calculator (for next exercise)


💡 **Ensure you have set the STEPL installation folder as default file location (see Exercise 1) before you click "Save Updates" button otherwise the newly added BMPs will not appear in the BMP list of BMP calculator.**

Exercise 8

Use of BMP Calculator

- Save Exercise 7 as Exercise 8 (make sure to save Exercise 7 before saving it as Exercise 8)

    ⬦ Select Excel Macro-Enabled Workbook (*.xlsm) save option

- Estimate total annual load and load reduction with reduced tillage and filter strips (shown below) applied to 550 acres cropland and cover crops applied to another 550 acres.
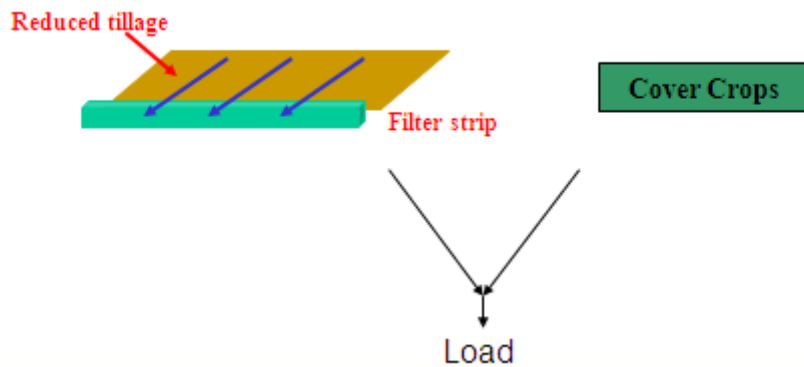
- Enter BMP data in BMP worksheet

    – In Table 1, which is for cropland areas, select "Combined-BMP calculated" under BMP column to indicate that we have multiple BMPs applied to cropland.

    – Note that the N, P, BOD, and Sediment BMP efficiencies remained zero.

    – If you had the combined efficiency values for this particular BMP train, you would enter them in Table 7 (number in red).

    – We do not have the values, so we will use the BMP calculator (next step)

- Run the BMP Calculator by selecting the STEPL/BMP Calculator menu of the STEPL spreadsheet.

    – If the system cannot find the BMP Calculator program, navigate to /STEPL folder and select BMPCalculator.exe

- Using the BMP Calculator interface, do the following

    – Add 4 BMP boxes (one for each BMP plus the Combined total)

    – Enter BMP information (type, area, etc.) for each BMP box by double-clicking the box

    – Left click and hold to draw a connection between boxes. You may move the boxes around.

    – Click the Run button to calculate the Combine efficiency

16
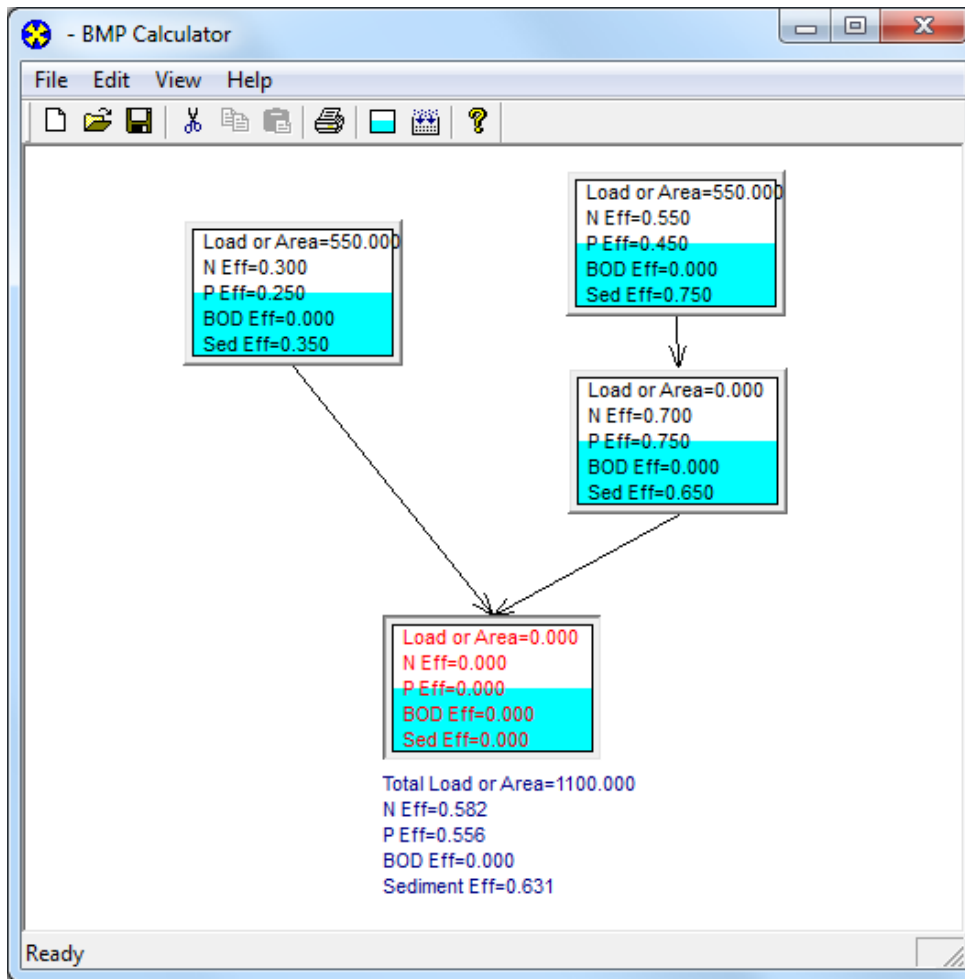
– Enter the combined efficiencies in Table 7 of STEPL spreadsheet.

7. Combined watershed BMP efficiencies from the BMP calculator

Watershed	Watershed Combined BMP Efficiencies				
	N	P	BOD	Sediment	BMPs
W1-Crop	0.582	0.556	0	0.631	Combined BMPs

– Also note the Total Area treated. Calculate the new % Area BMP Applied

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

Watershed	Cropland					% Area BMP Applied
	N	P	BOD	Sediment	BMPs	
W1	0.0282852	0.0270216	0	0.0306666	Combined BMPs-Calculated	4.86

💡 **To copy the combined efficiency value from the BMP calculator click right mouse button on the combined efficiency number and select the copy option. You have to copy those values one at a time.**
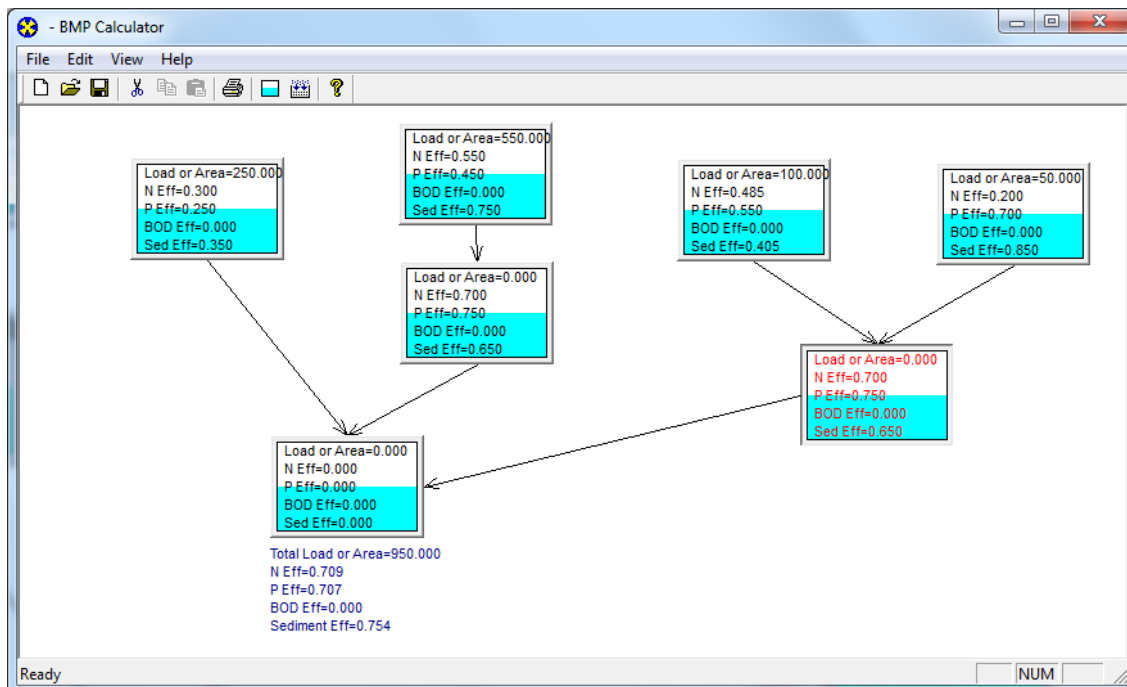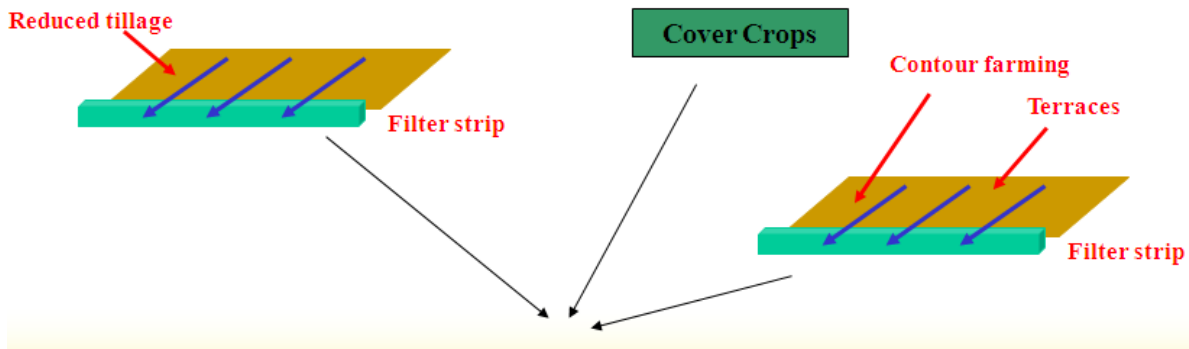
- Review results on Total Load worksheet

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	274039.4	64040.8	472377.9	2667.9	8830.7	2053.9	669.7	148.3
W2	55897.8	9378.0	135292.5	1689.7	0.0	0.0	0.0	0.0
W3	148807.5	24355.0	357517.3	3268.4	0.0	0.0	0.0	0.0
W4	29105.0	4920.2	70765.7	1010.5	0.0	0.0	0.0	0.0
Total	507849.6	102694.0	1035953.4	8636.5	8830.7	2053.9	669.7	148.3

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	31517.66	4862.69	122126.29	723.85
Cropland	414218.55	90036.00	755032.65	7608.87
Pastureland	43164.59	3381.65	139703.01	145.47
Forest	799.02	397.30	1987.94	6.01
Feedlots	8603.73	1682.27	13523.86	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	709.98	278.07	2899.08	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	5.44	2.09	10.88	4.00
Groundwater	0.00	0.00	0.00	0.00
Total	499018.96	100640.08	1035283.71	8488.20

Exercise 9

- Save Exercise 8 as Exercise 9 (make sure to save Exercise 8 before saving it as Exercise 9)

    ↓ Select Excel Macro-Enabled Workbook (*.xlsm) save option

- Multiple cropland practices are applied in W2

- Estimate total annual load and load reduction with reduced tillage and filter strips applied to 550 acres, cover crops applied to another 250 acres, contour farming on 100 acres, and terraces on 50 acres

- Filter strips are in place to treat runoff from the upland terraces and contoured fields

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

Watershed	Cropland						
	N	P	BOD	Sediment	BMPs		% Area BMP Applied
W1	0.0282852	0.0270216	0	0.0306666	⊙ Combined BMPs-Calculated	⇕	4.86
W2	0.050339	0.050197	0	0.053534	⊙ Combined BMPs-Calculated	⇕	7.1

7. Combined watershed BMP efficiencies from the BMP calculator

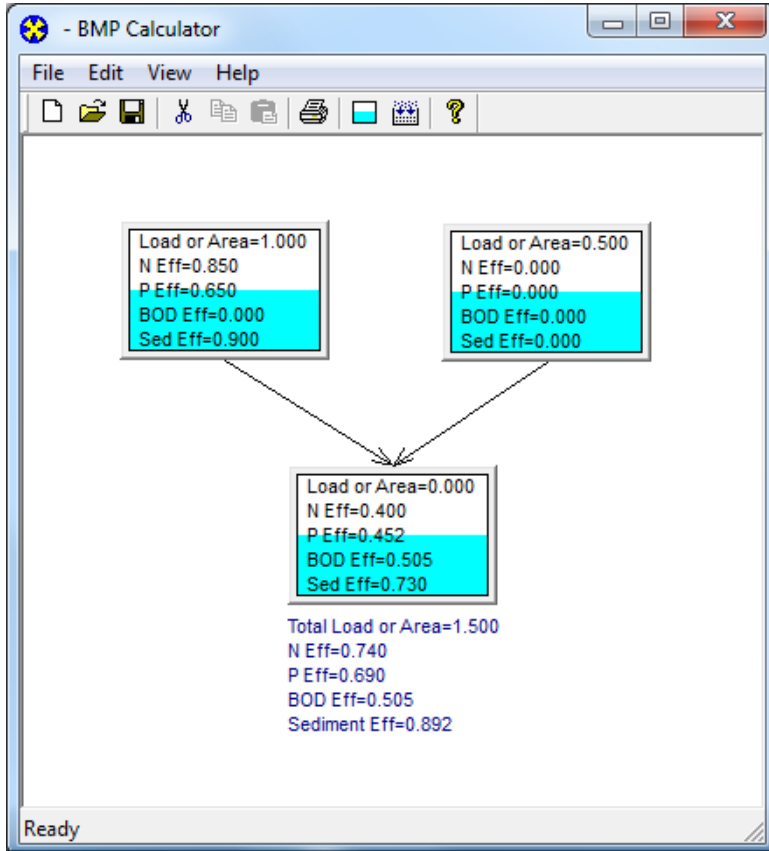| Watershed	Watershed Combined BMP Efficiencies				
	N	P	BOD	Sediment	BMPs
W1-Crop	0.582	0.556	0	0.631	Combined BMPs
W2-Crop	0.709	0.707	0	0.754	Combined BMPs

- Review results on Total Load worksheet

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	274039.4	64040.8	472377.9	2667.9	8830.7	2053.9	669.7	148.3
W2	55897.8	9378.0	135292.5	1689.7	1887.8	356.7	522.2	81.6
W3	148807.5	24355.0	357517.3	3268.4	0.0	0.0	0.0	0.0
W4	29105.0	4920.2	70765.7	1010.5	0.0	0.0	0.0	0.0
Total	507849.6	102694.0	1035953.4	8636.5	10718.5	2410.6	1191.9	229.9

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	31517.66	4862.69	122126.29	723.85
Cropland	412330.71	89679.34	754510.43	7527.27
Pastureland	43164.59	3381.65	139703.01	145.47
Forest	799.02	397.30	1987.94	6.01
Feedlots	8603.73	1682.27	13523.86	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	709.98	278.07	2899.08	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	5.44	2.09	10.88	4.00
Groundwater	0.00	0.00	0.00	0.00
Total	497131.13	100283.43	1034761.49	8406.60

Exercise 10

- Save Exercise 9 as Exercise 10 (make sure to save Exercise 9 before saving it as Exercise 10)

    - Select Excel Macro-Enabled Workbook (*.xlsm) save option

- Congratulations, you secured grant funding to retrofit a 1.5-acre industrial parking lot. The project will replace 1 acre of concrete with porous pavement. The entire parking lot will be bordered by vegetated filter strips to capture runoff. Add these BMPs to watershed 1.

    - Hint: you will need to use the BMP Calculator

- Review results on Urban worksheet

2a. Effective BMP application area (ac)

Landuse	Commercial	Industrial	Institution:	Transporta	Multi-Fami	Single-Family	Urban-Cul	Vacant (de	Open Space
W1	242.4873	1.5	161.6582	161.6582	161.6582	2	80.8291	80.8291	5
W2	0	0	0	0	0	0	0	0	0
W3	0	0	0	0	0	0	0	0	0
W4	0	0	0	0	0	0	0	0	0

3. Selected urban BMPs

Landuse	Commercial	Industrial	Institution:	Transporta	Multi-Fami	Single-Family	Urban-Cul	Vacant (de	Open Space
W1	0 No BMP	Combined	0 No BMP	0 No BMP	0 No BMP	LID*/Rain Barrel	0 No BMP	0 No BMP	LID/Bioretention
W2	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP
W3	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP
W4	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP

4. Pollutant loads from urban in lb/year

Watershed	Pre-BMP Load				Load Reduction			
	N	P	BOD	TSS	N	P	BOD	TSS
W1	8810.390028	1360.4991	34239.012	404571.87	11.492883	1.88273858	17.693854	416.71071
W2	5119.32894	787.77169	19643.972	235220	0	0	0	0
W3	15065.7821	2326.4558	58548.77	691818.59	0	0	0	0
W4	2526.450465	388.77481	9694.5365	116083.9	0	0	0	0

- Review results on Total Load worksheet

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	274039.4	64040.8	472377.9	2667.9	8837.9	2055.0	687.4	148.5
W2	55897.8	9378.0	135292.5	1689.7	1887.8	356.7	522.2	81.6
W3	148807.5	24355.0	357517.3	3268.4	0.0	0.0	0.0	0.0
W4	29105.0	4920.2	70765.7	1010.5	0.0	0.0	0.0	0.0
Total	507849.6	102694.0	1035953.4	8636.5	10725.7	2411.6	1209.6	230.1

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	31510.46	4861.62	122108.60	723.64
Cropland	412330.71	89679.34	754510.43	7527.27
Pastureland	43164.59	3381.65	139703.01	145.47
Forest	799.02	397.30	1987.94	6.01
Feedlots	8603.73	1682.27	13523.86	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	709.98	278.07	2899.08	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	5.44	2.09	10.88	4.00
Groundwater	0.00	0.00	0.00	0.00
Total	497123.92	100282.35	1034743.80	8406.40