Example – Westport Road Wetland

This section details the steps needed to calculate the storm and floodwater storage for an example wetland assessment area.

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Appendix C: Storm and Floodwater Storage Example

USING WDNR'S SURFACE WATER DATA VIEWER

There are several GIS tools available to assist in delineating a watershed and calculating landuse areas. The DNR's Surface Water Data Viewer is a free and user-friendly tool that was used for this example calculation.

Use the Surface Water Data Viewer to delineate the watershed of your wetland assessment area and to calculate the area of each land cover type.

Below is a brief description of the steps needed to perform the necessary calculations in this example.

Step 1: Open the DNR's Surface Water Data Viewer.

Step 2: Find the wetland assessment area. This can be done using the Zoom and Pan buttons found in the "Basic Tools" tab.

Zoom Buttons   **Pan Button**
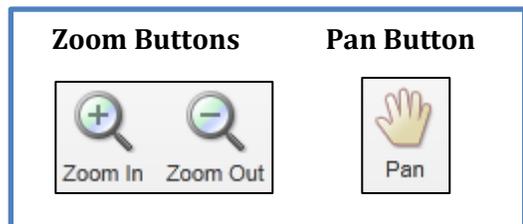
Step 3: Use the Digital Topographic Maps layer to delineate the watershed. This layer can be found by clicking the "Show Layers" button in the "Basic Tools" tab, scrolling down to the Base Maps category and clicking the + box next to the layer to expand, and checking the box next to the "Digital Topographic Maps" layer.

Digital Topographic Maps Layer
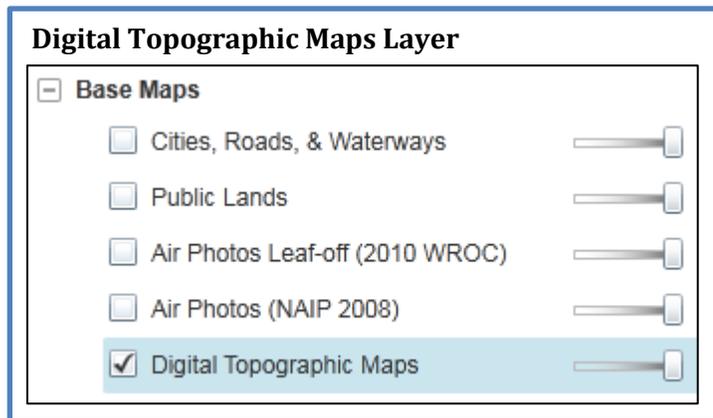
Step 4: Measure the area of the wetland assessment area, as well as the different landuse cover types in the watershed. The "Measure Area" tool can be found under the "Measuring Tools" tab. To Measure an area, click on the "Measure Area" button and click along the outline of the landuse cover type you'd like to measure. Once you are finished outlining the area, double click on the last vertex of the polygon. Look "Area" box under "Measurement Info" and you will find the area of the polygon in Acres.

Measure Area

Measurement Info

Measurement Info		Units
Perimeter:	0.34	Miles (mi)
Area:	4.79	Acres (ac)
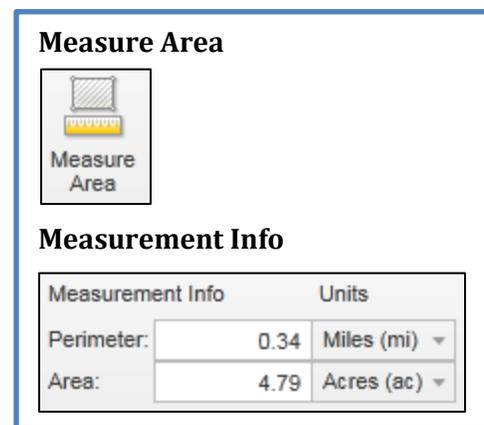
The map on the next page shows the wetland assessment area (light blue shading) and its contributing watershed area (red outline), with land cover/soil type combinations determined. In this case the assessment area is bounded by a railroad embankment and a road, which constrain the watershed on the southwest and northeast. Topography (not shown) defines the northern and southern limits of the contributing area. The map was made using DNR's Surface Water Data Viewer.

Appendix C: Storm and Floodwater Storage Example

EXAMPLE MAP OF WESTPORT ROAD WETLAND AND WATERSHED LAND COVER
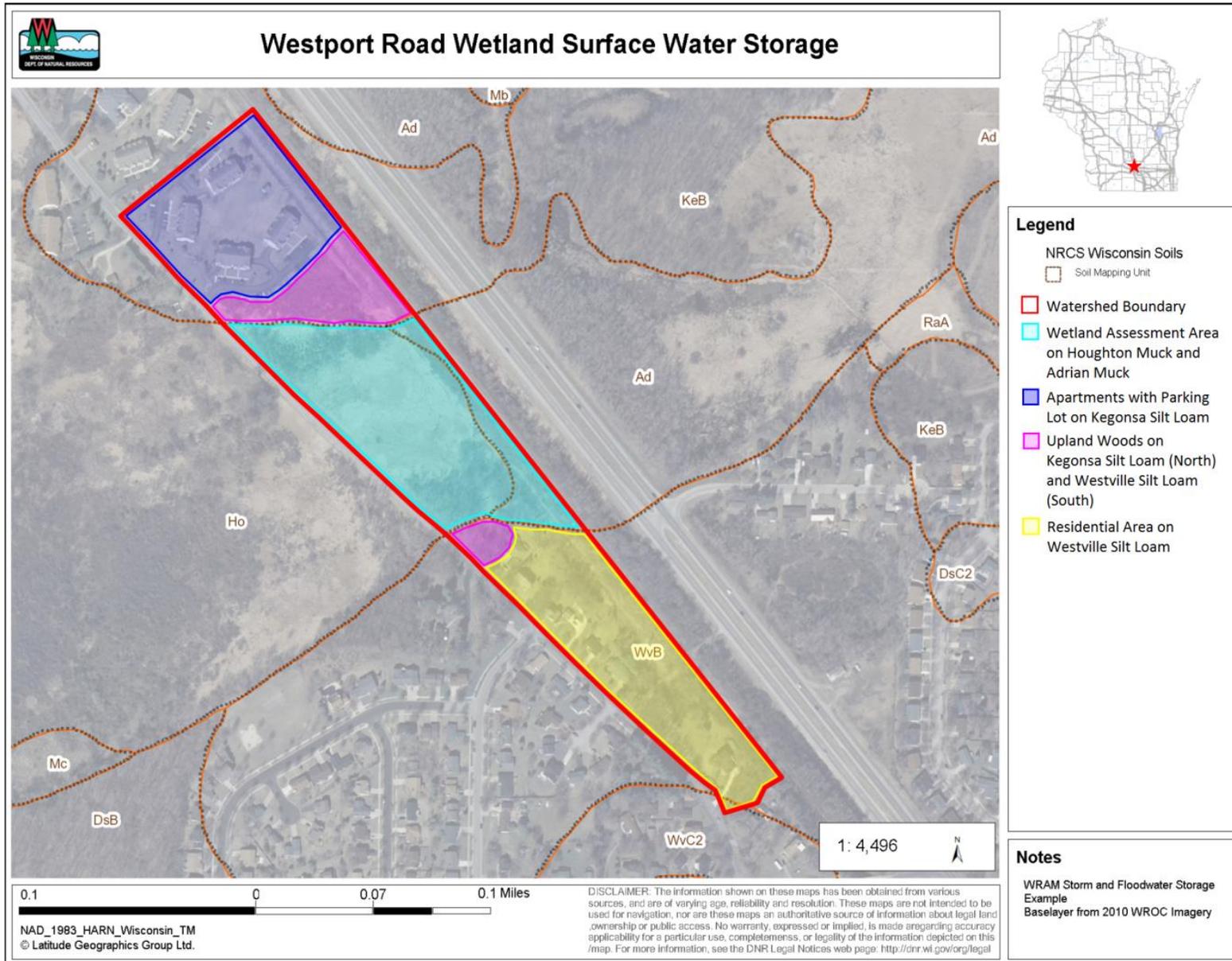
Appendix C: Storm and Floodwater Storage Example

USING USDA'S WEB SOIL SURVEY
The USDA's Web Soil Survey viewer is a free and accessible tool that contains comprehensive information about soils.

**Use the Web Soil Survey to verify soil types and to map each soil type's corresponding Hydrologic Soil Group (HSG).**

Start WSS Button

Below is a brief description of the steps needed to perform the necessary calculations in this example.

Step 1: <u>Open the Web Soil Survey.</u> Go to http://websoilsurvey.nrcs.usda.gov/app/ and click on the green "Start WSS" button.

Zoom and Pan Buttons

Step 2: <u>Find the wetland assessment area.</u> This can be done using the Zoom and Pan buttons at the top of the map.

Watershed delineated as an AOI.
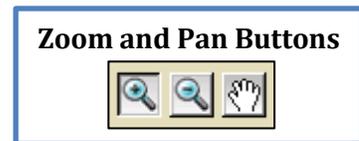
Step 3: <u>Define the area of interest.</u> The area of interest in this example is whichever area you wish to know the soil type and HSG. This example outlines the entire watershed. To define the area of interest, use the AOI (Area of Interest) polygon tool located at the top of the map. Click on the AOI polygon button and outline the watershed. Double-click at the final vertex of the watershed to create the polygon. The watershed should now be shaded with light blue stripes.

AOI Tool
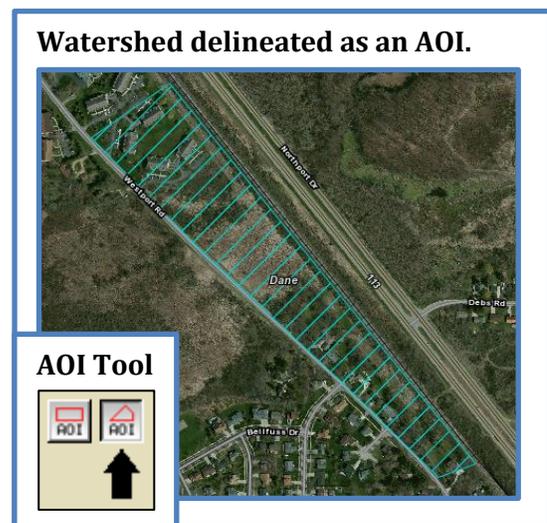
Step 4: <u>Identify the soils in the watershed.</u> Click on the Soil Map tab near the top of the website above the map. The next window will show a map of the watershed with soil types delineated. To the left of the map will be a table listing each soil type and their corresponding acreage in the watershed. A figure depicting the delineated soils for the example watershed and the corresponding soils table is shown at the top of the following page. Note that the acreage of each soil type does not necessarily correspond to the acreage of each land cover type/soil type combination. In order to find the acreage of each land cover type, use the Surface Water Data Viewer (see previous section).
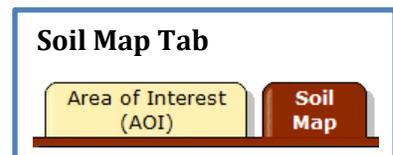
Soil Map Tab

Appendix C: Storm and Floodwater Storage Example

Map and Table Describing Soils in the Watershed

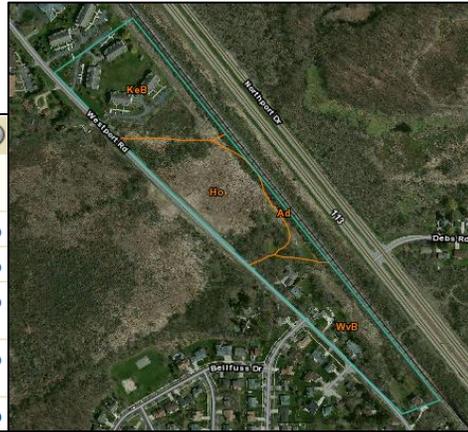| Dane County, Wisconsin (WI025)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Ad	Adrian muck	1.0	5.0%
Ho	Houghton muck	6.4	31.5%
KeB	Kegonsa silt loam, 2 to 6 percent slopes	6.9	33.7%
WvB	Westville silt loam, 2 to 6 percent slopes	6.1	29.8%
Totals for Area of Interest		**20.5**	**100.0%**

Step 5: <u>Define the Hydrologic Soil Group (HSG) for the soils in the watershed.</u> Click on the Soil Data Explorer tab near the top of the website above the map. Then click on the Soil Properties and Qualities sub tab just above the map. To the left of the map will appear a table.

Click on the Soil Qualities and Features row of the table, then click on the Hydrologic Soil Group row. Finally, click on the View Rating button, which is below the red Hydrologic Soil Group banner. Scroll down below the map to see the corresponding HSG ratings for each soil type.

Soil Data Explorer Tab

Area of Interest (AOI)	Soil Map	Soil Data Explorer

Soil Properties and Qualities Tab

Intro to Soils	Suitabilities and Limitations for Use	Soil Properties and Qualities

Soil Properties and Qualities Menu

Soil Chemical Properties	⑦ ⌄
Soil Erosion Factors	⑦ ⌄
Soil Physical Properties	⑦ ⌄
Soil Qualities and Features ⬅	⑦ ⌃
AASHTO Group Classification (Surface)	
Depth to a Selected Soil Restrictive Layer	
Depth to Any Soil Restrictive Layer	
Drainage Class	
Frost Action	
Frost-Free Days	
Hydrologic Soil Group ⬅	
Map Unit Name	
Parent Material Name	
Representative Slope	
Unified Soil Classification (Surface)	
Water Features	⑦ ⌄

Appendix C: Storm and Floodwater Storage Example

DESIGNATING HYDROLOGIC SOIL GROUPS

A critical part of calculating runoff volume is determining the Hydrologic Soil Group (HSG) for each soil type/land cover combination in the watershed. The box below introduces and defines the four Hydrologic Soil Groups.

Hydrologic Soil Group (HSG) refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

❖ **Group A**. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
❖ **Group B**. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
❖ **Group C**. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
❖ **Group D**. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

For soils assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter stands for drained areas and the second stands for undrained areas. Wetland soil HSG depends on presence/absence of drainage. Drained wetland soils are treated as HSG "A" (no ponding or runoff when drainage features are functioning). Undrained wetlands soils are treated as HSG "D" (no infiltration, all precipitation will pond in wetland).

See the Using USDA's Web Soil Survey section (page C-4) for instructions on determining the correct HSG for different soil types.

Appendix C: Storm and Floodwater Storage Example

CHOOSING THE APPROPRIATE RUNOFF DEPTH

Inches of Runoff from the 2-year 24 hour storm event				
Land Cover	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Woodland	0	0.1	0.5	0.9
Grassland	0	0.2	0.6	0.9
Cropland	0.1	0.5	0.9	1.2
Impervious Surface	2.6	2.6	2.6	2.6

Table used to calculate runoff (in inches) by land cover for a 2-year 24 hour storm event.

Runoff depth can be calculated once the Hydrological Soil Group is known for each soil type/land cover combination in the watershed. Inches of runoff in watersheds with multiple land covers should be prorated based on the percentage of each area of land cover within the watershed.

Using the table above, choose the appropriate runoff depth for each land cover type. For wetland soils choose land cover of Woodland or Grassland or Cropland, depending upon the drainage status and dominant vegetation type of the wetland. Most urban and residential areas are Impervious Surface. Major exceptions are homes on large lots in rural areas. Such land covers, although zoned residential, could store an intermediate amount of runoff (somewhere between Impervious Surface and Cropland).

The remaining pages of this Appendix will explain, in detail, the steps and calculations needed to assess the storm and floodwater storage of a wetland assessment area.

The spreadsheet on the next page shows all the necessary calculations for assessing the storm and floodwater storage potential of the example wetland assessment area. Then, the following pages show step-by-step instructions for each calculation. A blank spreadsheet template, like the one shown populated on the next page is available on the Wetland Assessment web page. Go to the WDNR website and search for "Wetland Assessment". Then click on "Assessment Methods and Tools". Scroll down to Level 2 and find the template under Wisconsin Rapid Wetland Assessment Methodology.

Appendix C: Storm and Floodwater Storage Example

EXAMPLE STORM AND FLOODWATER STORAGE CALCULATION SPREADSHEET

Wetland Assessment Area =	7.21	Acres				
Contributing Areas Total =	12.99	Acres				
Total Watershed Area =	20.20	Acres				

Step 1: Calculate Runoff based on Hydrologic Soil Group (HSG) and Land Cover

Land Cover	Soil Type	HSG (from soil survey)	Inches of Runoff (from Table)	Feet of runoff	Area (Acres)	Runoff Volume (Acre Feet)
Apartments (Impervious)	Kegonsa Silt Loam, 2-6% slope	B	2.6	0.22	4.98	1.08
Upland Woods	Kegonsa Silt Loam, 2-6% slope	B	0.1	0.01	1.84	0.02
Wetland (Grassland)	Houghton Muck	D	0.9	0.08	6.14	0.46
Wetland (Grassland)	Adrian Muck	D	0.9	0.08	1.07	0.08
Upland Woods	Westville Silt Loam, 2-6% slope	B	0.1	0.01	0.34	0.00
Residential (Impervious)	Westville Silt Loam, 2-6% slope	B	2.6	0.22	5.83	1.26
Total					20.20	**2.90**

Step 2: Calculate Wetland Storage | **Step 3: Compare Wetland Storage to Runoff Volume (in Acre Feet)**

(area * depth)					
Wetland Area	7.21	Acres			
Average Wetland Depth	1.5	feet		Storage/Runoff (%)	Storage/Runoff >10%?
Wetland Storage	10.815	Acre-feet		373%	YES
Average Wetland Depth	0.5	feet			
Wetland Storage	3.605	Acre-feet		124%	YES

Appendix C: Storm and Floodwater Storage Example

STEP 1: CALCULATE RUNOFF BASED ON HYDROLOGIC SOIL GROUP AND LAND COVER

In this step, the runoff volume in acre-feet is calculated. If, like this example, the watershed of the assessment area has multiple land cover/soil type combinations, each combination must be listed and calculated separately.

A. APARTMENTS WITH PARKING LOT ON KEGONSA SILT LOAM, 2-6% SLOPE

Treat apartments and parking lot as impervious surface regardless of soil type. Runoff is **2.6 inches**, converts to **0.22 ft**. Area is **4.98 Acres**.

$$Runoff = 0.22ft \times 4.98A = 1.08 \ Acre \ Feet$$

Inches of Runoff from the 2-year 24 hour storm event				
Land Cover*	HSG A	HSG B	HSG C	HSG D
Woodland	0	0.1	0.5	0.9
Grassland	0	0.2	0.6	0.9
Cropland	0.1	0.5	0.9	1.2
Impervious Surface	2.6	2.6	2.6	2.6

Land Cover	Soil Type	HSG (from soil survey)	Inches of Runoff (from Table)	Feet of runoff	Area (Acres)	Runoff Volume (Acre Feet)
Apartments (Impervious)	Kegonsa Silt Loam, 2-6% slope	B	2.6	0.22	4.98	1.08

B. UPLAND WOODS ON KEGONSA SILT LOAM, 2-6% SLOPE

Choose Woodland land cover. Soil is Hydrologic Soil Group B. Runoff is **0.1 inches**, converts to **0.01 ft**. Area is **1.84 Acres**.

$$Runoff = 0.01ft \times 1.84A = 0.02 \ Acre \ Feet$$

Inches of Runoff from the 2-year 24 hour storm event				
Land Cover*	HSG A	HSG B	HSG C	HSG D
Woodland	0	0.1	0.5	0.9
Grassland	0	0.2	0.6	0.9
Cropland	0.1	0.5	0.9	1.2
Impervious Surface	2.6	2.6	2.6	2.6

Land Cover	Soil Type	HSG (from soil survey)	Inches of Runoff (from Table)	Feet of runoff	Area (Acres)	Runoff Volume (Acre Feet)
Upland Woods	Kegonsa Silt Loam, 2-6% slope	B	0.1	0.01	1.84	0.02

Appendix C: Storm and Floodwater Storage Example

C. *Wetland Assessment Area – Mostly Emergent Wetland on Houghton Muck*

Choose Grassland. Hydrologic Soil Group for Houghton Muck is A/D. A is for drained soil, <u>undrained</u> condition is D. Note that grassland and woodland have same runoff amount for both A and D. Cropped wetland would be treated as Cropland. Runoff is **0.9 inches**, converts to **0.08 ft**. Area is **6.14 Acres**.

$$Runoff = 0.08 ft \times 6.14 A = 0.46\ Acre\ Feet$$

This is the contribution to runoff from rain falling on the wetland itself.

Inches of Runoff from the 2-year 24 hour storm event				
Land Cover*	HSG A	HSG B	HSG C	HSG D
Woodland	0	0.1	0.5	0.9
Grassland	0	0.2	0.6	0.9
Cropland	0.1	0.5	0.9	1.2
Impervious Surface	2.6	2.6	2.6	2.6

Land Cover	Soil Type	HSG (from soil survey)	Inches of Runoff (from Table)	Feet of runoff	Area (Acres)	Runoff Volume (Acre Feet)
Wetland (Grassland)	Houghton Muck	D	0.9	0.08	6.14	0.46

D. *Wetland Assessment Area – Mostly Emergent Wetland on Adrian Muck*

Choose Grassland. Hydrologic Soil Group for Adrian Muck is A/D. A is for drained soil, <u>undrained</u> condition is D. Note that grassland and woodland have same runoff amount for both A and D. Cropped wetland would be treated as Cropland. Runoff is **0.9 inches**, converts to **0.08 ft**. Area is **1.07 Acres**.

$$Runoff = 0.08 ft \times 1.07 A = 0.08\ Acre\ Feet$$

This is the contribution to runoff from rain falling on the wetland itself.

Inches of Runoff from the 2-year 24 hour storm event				
Land Cover*	HSG A	HSG B	HSG C	HSG D
Woodland	0	0.1	0.5	0.9
Grassland	0	0.2	0.6	0.9
Cropland	0.1	0.5	0.9	1.2
Impervious Surface	2.6	2.6	2.6	2.6

Land Cover	Soil Type	HSG (from soil survey)	Inches of Runoff (from Table)	Feet of runoff	Area (Acres)	Runoff Volume (Acre Feet)
Wetland (Grassland)	Adrian Muck	D	0.9	0.08	1.07	0.08

Appendix C: Storm and Floodwater Storage Example

E. UPLAND WOODS ON WESTVILLE SILT LOAM, 2-6% SLOPE

Choose Woodland land cover. Soil is Hydrologic Soil Group B. Runoff is **0.1 inches**, converts to **0.01 ft**. Area is **0.34 Acres**.

$$Runoff = 0.01ft \times 0.34A = 0.0034\ Acre\ Feet$$

On the spreadsheet, this rounds to 0.00

Inches of Runoff from the 2-year 24 hour storm event				
Land Cover*	HSG A	HSG B	HSG C	HSG D
Woodland	0	0.1	0.5	0.9
Grassland	0	0.2	0.6	0.9
Cropland	0.1	0.5	0.9	1.2
Impervious Surface	2.6	2.6	2.6	2.6

Land Cover	Soil Type	HSG (from soil survey)	Inches of Runoff (from Table)	Feet of runoff	Area (Acres)	Runoff Volume (Acre Feet)
Upland Woods	Westville Silt Loam, 2-6% slope	B	0.1	0.01	0.34	0.00

F. RESIDENTIAL AREA ON WESTVILLE SILT LOAM, 2-6% SLOPE

Choose Impervious Surface for Residential Areas unless you know the area has specific infiltration measures throughout. Even though some rain will infiltrate in lawns, most residential areas have connected impervious surfaces (driveways and sidewalk to streets and storm sewers). Homes on large lots in rural areas could receive an intermediate value between cropland and impervious surface. Note that HSG does not affect impervious surface runoff values. Runoff is **2.6 inches**, converts to **0.22 ft**. Area is **5.83 Acres**.

$$Runoff = 0.22ft \times 5.83A = 1.26\ Acre\ Feet$$

Inches of Runoff from the 2-year 24 hour storm event				
Land Cover*	HSG A	HSG B	HSG C	HSG D
Woodland	0	0.1	0.5	0.9
Grassland	0	0.2	0.6	0.9
Cropland	0.1	0.5	0.9	1.2
Impervious Surface	2.6	2.6	2.6	2.6

Land Cover	Soil Type	HSG (from soil survey)	Inches of Runoff (from Table)	Feet of runoff	Area (Acres)	Runoff Volume (Acre Feet)
Residential (Impervious)	Westville Silt Loam, 2-6% slope	B	2.6	0.22	5.83	1.26

Appendix C: Storm and Floodwater Storage Example

F.   ADD RUNOFF VOLUME OF ALL CONTRIBUTING AREAS AND THE ASSESSMENT AREA

Land Cover	Soil Type	HSG (from soil survey)	Inches of Runoff (from Table)	Feet of runoff	Area (Acres)	Runoff Volume (Acre Feet)
Apartments (Impervious)	Kegonsa Silt Loam, 2-6% slope	B	2.6	0.22	4.98	1.08
Upland Woods	Kegonsa Silt Loam, 2-6% slope	B	0.1	0.01	1.84	0.02
Wetland (Grassland)	Houghton Muck	D	0.9	0.08	6.14	0.46
Wetland (Grassland)	Adrian Muck	D	0.9	0.08	1.07	0.08
Upland Woods	Westville Silt Loam, 2-6% slope	B	0.1	0.01	0.34	0.00
Residential (Impervious)	Westville Silt Loam, 2-6% slope	B	2.6	0.22	5.83	1.26
Total					20.20	**2.90**

This figure is taken directly from the example spreadsheet found on page 8 of this Appendix. The Runoff Volume (Acre Feet) column is highlighted in yellow and shows the total runoff volume, in acre-feet, for each land cover type/soil type combination in the wetland assessment area and the watershed. The runoff volume is calculated by multiplying the runoff (in feet) by the area of the wetland (in acres). The total runoff volume for the watershed is **2.90 acre-feet** and is shown in the bottom row of this table. The total runoff volume will be used in step 3 to compare the wetland storage potential to the runoff volume.

Alternatively, a model or other method such as the TR-55 can be used to calculate runoff volume.

STEP 2: CALCULATE WETLAND STORAGE

Step 2: Calculate Wetland Storage		
(area * depth)		
Wetland Area	7.21	Acres
Average Wetland Depth	1.5	feet
Wetland Storage	10.815	Acre-feet
Average Wetland Depth	0.5	feet
Wetland Storage	3.605	Acre-feet

The figure above shows the portion of the spreadsheet that calculates the storage capacity for the wetland. The storage capacity for this example wetland is the product of the wetland surface area (in acres) and the wetland depth (in feet).

AREA

The wetland area is simple to calculate by using the tools described at the beginning of this Appendix (WDNR's Surface Water Data Viewer and USDA's Web Soil Survey). The value for the wetland area in Step 2 is copied from cell B6 toward the top of the template spreadsheet.

DEPTH

The wetland depth is somewhat tricky to calculate, as it is an average depth over the entire assessment area. It is best to estimate the wetland depth by using a combination of field observations and topographical maps. To estimate wetland depth, first find the outlet of the wetland (the lowest point along the delineated edge of the wetland) and its corresponding elevation. Then estimate the mean depth of the wetland based on the area of the wetland at successive elevations.

The example in this Appendix uses the Digital Topographic Maps layer in the Surface Water Data Viewer to estimate the depth of the wetland. The resolution of the Digital Topographic Maps layer is somewhat coarse, so those with access to finer-resolution elevation data and software with stronger GIS calculation capabilities are encouraged to use those tools to calculate the average wetland depth. If using the Surface Water Data Viewer, it is recommended that a high and low estimate of average wetland depth be used. In this example, the first Average Wetland Depth measure was set at 1.5 feet and represents a lower estimate of average depth. The second Average Wetland Depth measure was set at 0.5 feet and represents a higher estimate of average depth. Using both estimates gives a range of potential Wetland Storage measurements.

Appendix C: Storm and Floodwater Storage Example

STEP 3: COMPARE WETLAND STORAGE TO RUNOFF VOLUME (IN ACRE FEET)

Step 2: Calculate Wetland Storage			Step 3: Compare Wetland Storage to Runoff Volume (in Acre Feet)			
(area * depth)						
Wetland Area	7.21	Acres				
Average Wetland Depth	1.5	feet		Storage/Runoff (%)	Storage/Runoff >10%?	
Wetland Storage	10.815	Acre-feet		373%	YES	
Average Wetland Depth	0.5	feet				
Wetland Storage	3.605	Acre-feet		124%	YES	

Recall that the total runoff volume for the example watershed is **2.90 acre-feet**. Dividing the total wetland storage from Step 2 (page 13 of this Appendix) by the total runoff volume gives the storage capacity, as a percentage of the total runoff, of the wetland for a 2-year 24 hour storm event. For this example, using two average wetland depths and thus two wetland storage calculations, **the wetland can store between 124% and 373% of the runoff from a 2-year 24 hour storm event**.

In this example, the wetland storage capacity percentage range is well above 10%. Therefore, this wetland has the potential to store > 10% of the runoff from its contributing area from a 2-year 24 hour storm event.