

Water Quality Models to Support Watershed Planning

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Wisconsin Department of Natural Resources

WI Lakes Partnership Convention
April 6, 2017

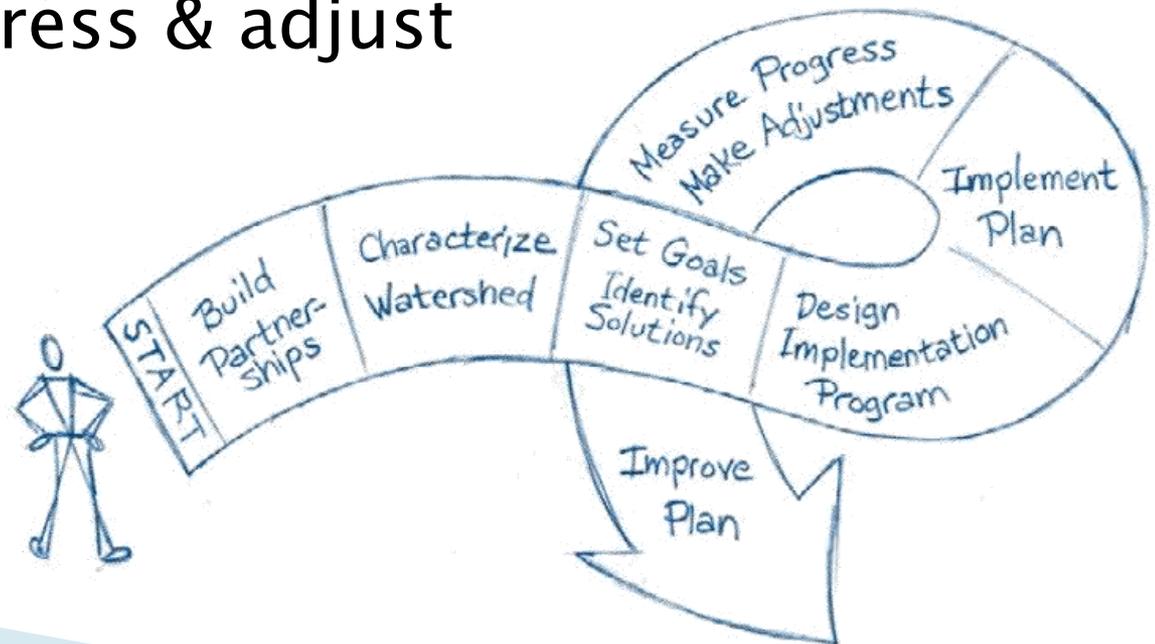


Overview

- ▶ Planning process
- ▶ PRESTO
- ▶ EVAAL
- ▶ STEPL
- ▶ More information

Planning Process

1. Build partnerships
2. Characterize watershed
3. Finalize goals & identify solutions
4. Design an implementation program
5. Implement the watershed plan
6. Measure progress & adjust



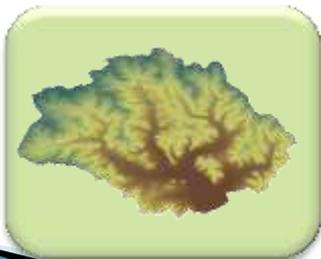
Planning Process

- ▶ Characterize watershed
 - Watershed boundaries
 - Land use
 - Pollutant sources & loads
- ▶ Finalize goals & identify solutions
 - Best management practices
 - Load reductions
- ▶ Design an implementation program
 - Where to work?



- ▶ Statewide GIS-based tool that calculates average annual phosphorus loads from point and nonpoint sources
- ▶ Combines three concepts:

**Watershed
Delineation**



**Effluent
Aggregation**



**Pollutant
Runoff**



PRESTO – Data



SWAMP Outfall Locations
And Effluent Point Loads

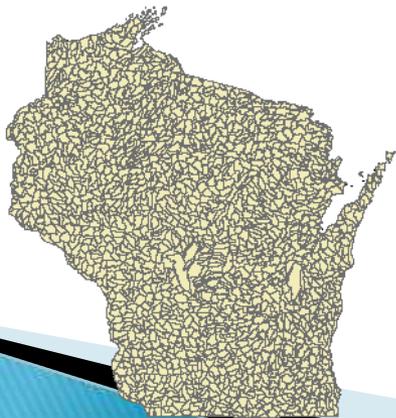


Elevation



Hydrography

Point Source : Nonpoint Source
Load Ratio



Sub-basin Boundaries

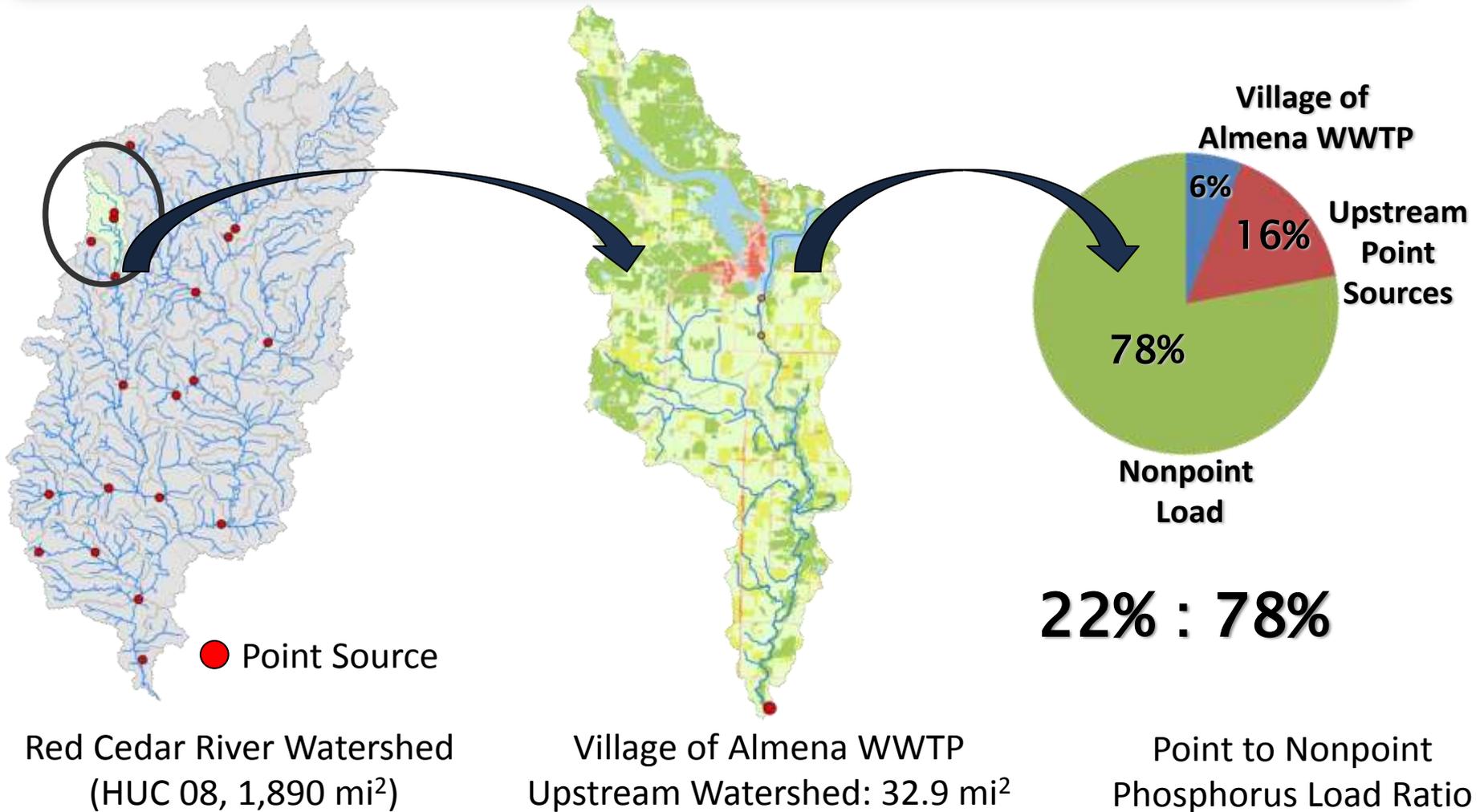


Land cover



Tabular Model Parameters

PRESTO – Results



PRESTO-Lite

Web-based Application for Watershed Delineation and Characterization

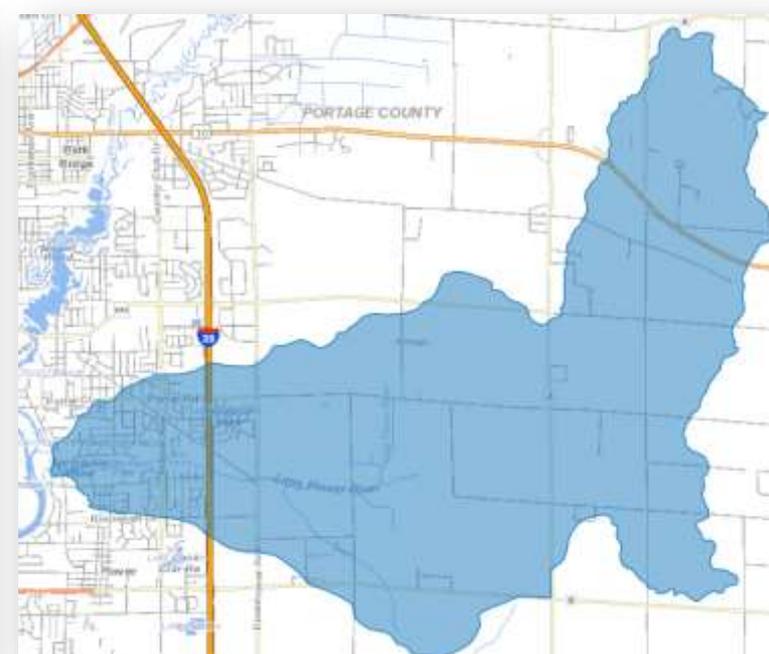
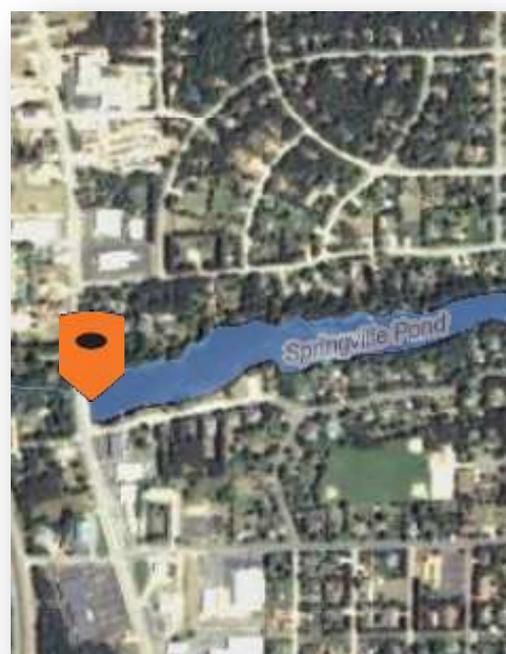
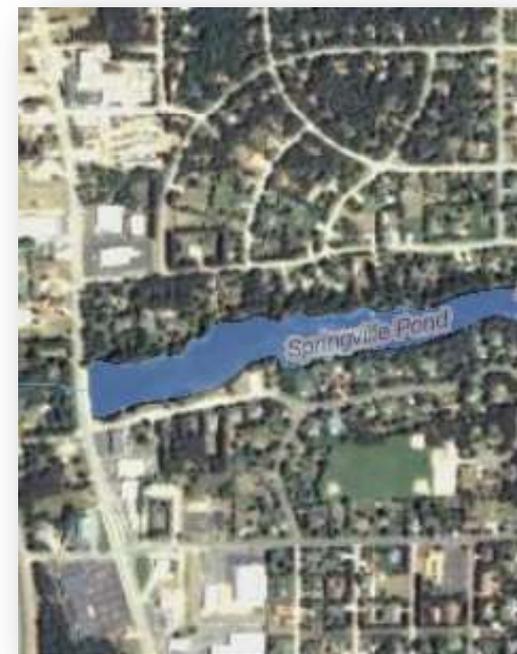
Locate



Click

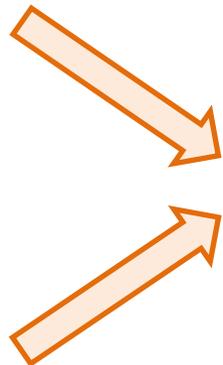


Delineate



PRESTO-Lite

Web-based Application for Watershed Delineation and Characterization



Watershed Delineation



Effluent Aggregation



Pollutant Runoff



Watershed Characteristics



Web Interface



Wisconsin Hydrography Dataset Plus

Watershed		
REACHID	ATTR1	ATTR2
13624141	A	0.1234
13624143	B	5.6789



PRESTO-Lite

Web-based Application for Watershed Delineation and Characterization

Visit PRESTO Website to launch app : <http://dnr.wi.gov/topic/surfacewater/presto.html>

The screenshot displays the 'Wisconsin DNR Watershed Restoration Viewer' web application. The interface includes a navigation menu with options like 'File', 'Home', 'Tools', and 'PRESTO-Lite Tool'. A toolbar contains icons for 'Pan', 'Zoom In', 'Zoom Out', 'Full Extent', 'PRESTO-Lite', 'PRESTO Help', 'PRESTO Shapefile Export', 'PRESTO Shapefile Edit', and 'PRESTO Fact Sheet'. The 'PRESTO-Lite' icon is highlighted with an orange box. Below the toolbar is a 'Layers' panel with a search bar containing 'I want to...'. The layers are categorized into 'Operational Layers' and 'Base Maps'. Under 'Operational Layers', 'Wisconsin River TMDL' is selected. Under 'Base Maps', 'Detailed Basemap' is selected. The main map area shows a detailed view of a watershed in Wisconsin, with various rivers, roads, and land use patterns. The map includes labels for cities like St. Paul, Eau Claire, and Wausau, and counties like Barron, Eau Claire, and Waushara.

PRESTO-Lite

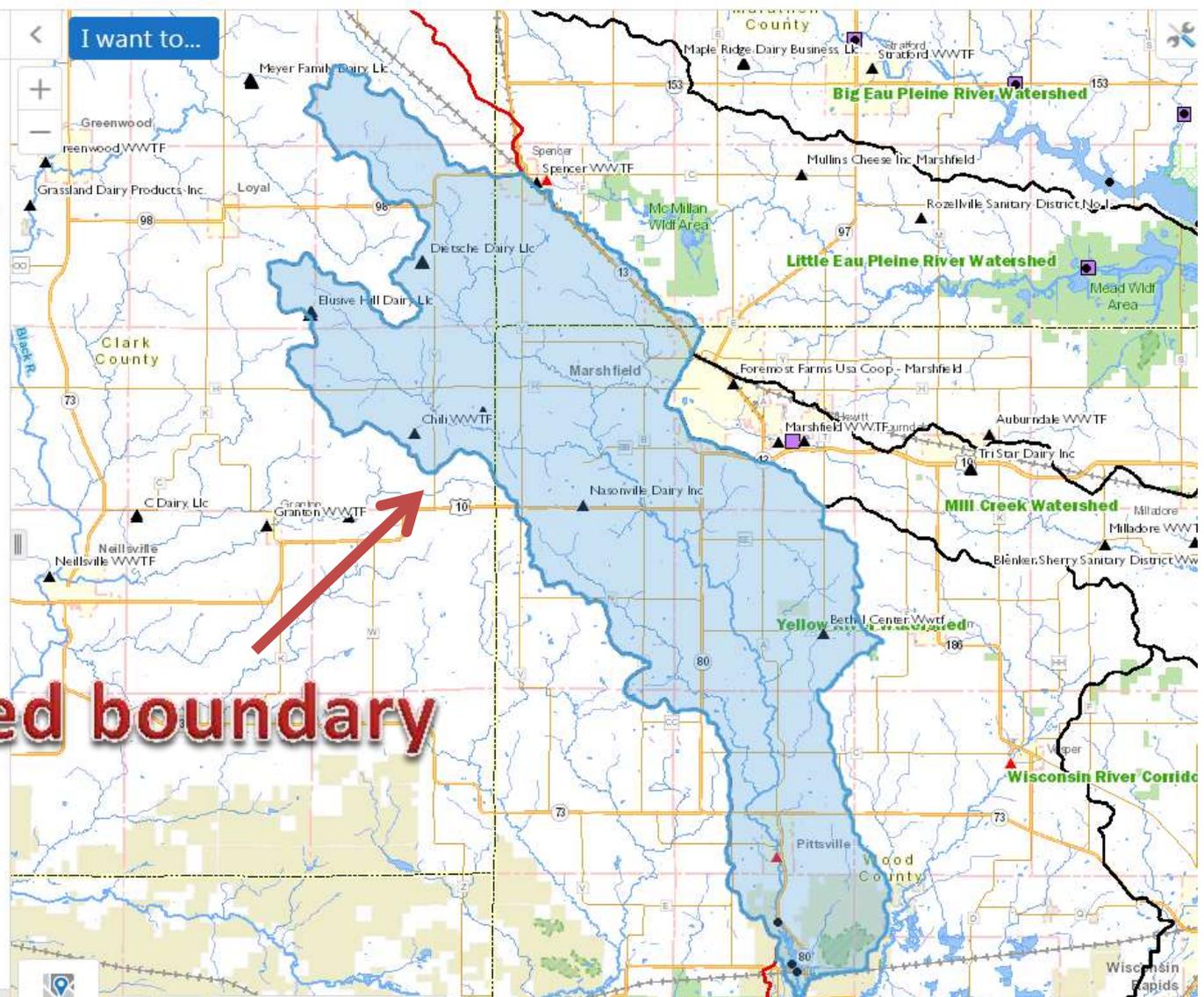
What's in the Results?

PRESTO-Lite Delineation Tool 

Your PRESTO-Lite watershed delineation report is ready.
Click the link below to download the report.

[PRESTO-Lite report](#)

Close

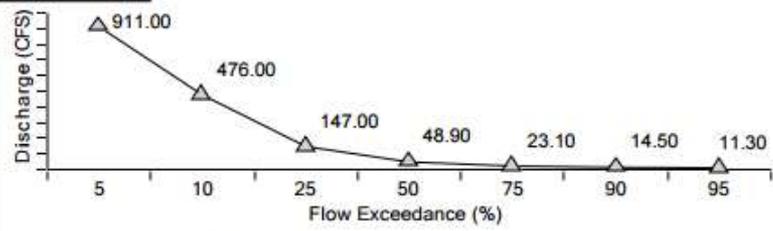


Watershed boundary

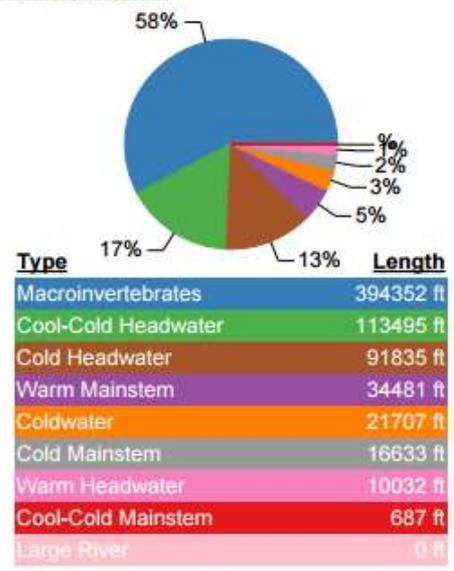
Reach ID: 200088244
Watershed Name: Owl Creek-Yellow River
Waterbody Name: Yellow River
HUC08: Castle-Rock
Watershed Area: 215.03 mi ²
Average Annual Precipitation: 32.40in



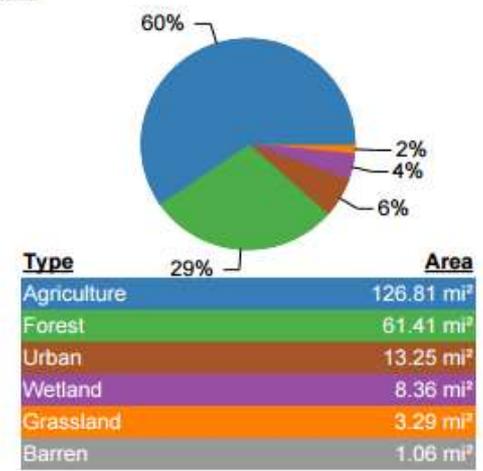
Stream Flow



Tributary Stream Type



Landcover



PRESTO Phosphorus Load Estimate

Avg. Annual Nonpoint Phosphorous Load (80% Confidence Interval)	81,301 (40,238 - 164,269) lb
Number of Facilities (Individual Facility Information below)	
Avg. Annual Point-source Phosphorous Load (2010 - 2012 total of all facilities)	1,697 lb
Most Likely Point : Nonpoint Phosphorous Ratio	2% : 98%

PRESTO-Lite Demo

What's in the Results?

Reach ID: 200088244

Watershed Name: Owl Creek-Yellow River

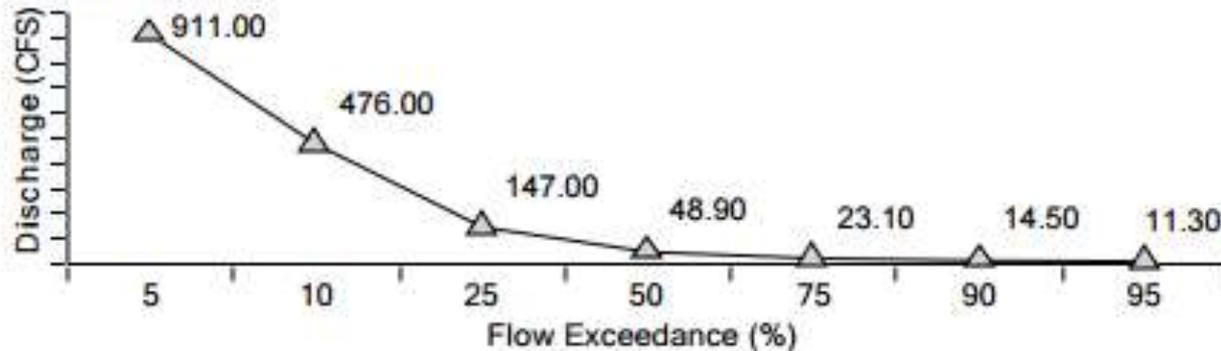
Waterbody Name: Yellow River

HUC08: Castle-Rock

Watershed Area: 215.03 mi²

Average Annual Precipitation: 32.40in

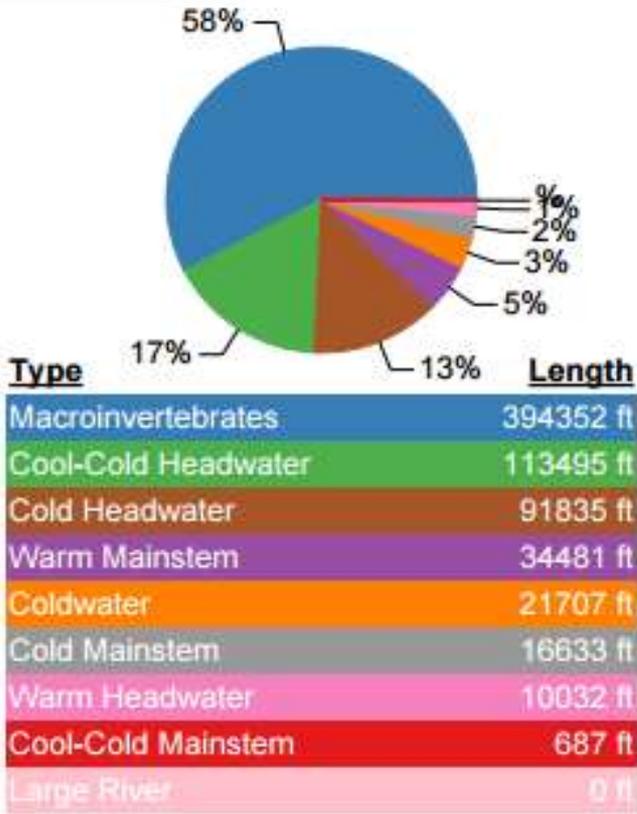
Stream Flow



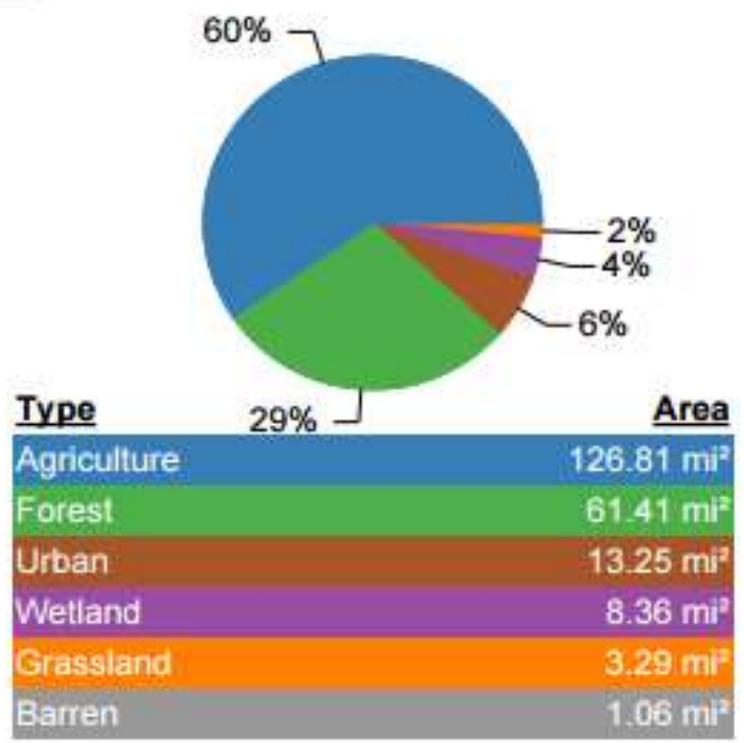
PRESTO-Lite Demo

What's in the Results?

Tributary Stream Type



Landcover



Landuse

PRESTO-Lite Demo

What's in the Results?

Sources & Loads



PRESTO Phosphorus Load Estimate

Avg. Annual Nonpoint Phosphorous Load (80% Confidence Interval)	81,301 (40,238 - 164,269) lbs
Number of Facilities (Individual Facility Information below)	4
Avg. Annual Point-source Phosphorous Load (2010 - 2012 total of all facilities)	1,697lbs
Most Likely Point : Nonpoint Phosphorous Ratio	2% : 98%
Low Estimate Point : Nonpoint Phosphorous Ratio (Adaptive Management)	1% : 99%

Adaptive Management Results

Facilities Discharging to the Owl Creek-Yellow River Watershed:

Facility Name	Permit #	Outfall #	Waste Type	Receiving Water	Avg. Phosphorus Load (lbs.) (2010 - 2012)
PITTSVILLE WATER AND SEWER DEPT WWTF	0020494	002	Municipal	Yellow River	938
NASONVILLE DAIRY INC	0040312	006	Industrial	Unnamed	294
CHILI WASTEWATER TREATMENT FACILITY	0030961	001	Municipal	Unnamed	281
BETHEL CENTER WWTF	0031313	002	Municipal	Unnamed	184

Planning Process

- ▶ Characterize watershed
 - Watershed boundaries
 - Land use
 - Pollutant sources & loads

- ▶ Finalize goals & identify solutions
 - Best management practices
 - Load reductions



- ▶ Spreadsheet Tool for Estimating Pollutant Load
- ▶ Simple model – MS Excel spreadsheet
- ▶ Calculates
 - Pollutant loads by land use type and watershed
 - Load reductions from implementation of BMPs
 - Runoff, nitrogen, phosphorus, BOD, sediment



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 change.

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 parameters in Table 2.

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.

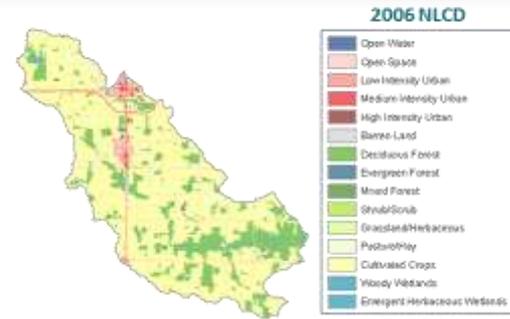
Show optional input tables? Yes No Treat all the subwatersheds as parts of a single watershed Groundwater load calculation

State: Wisconsin County: Brown Weather Station (for rain correction factors): WI GREEN BAY WSO

1. Input watershed land use area (ac) and precipitation (in)								Rain correction factors			
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
WV1		0	0	0	0	0	75-100%	0.25	20.25	101.2	0.674

Input Data

- ▶ User defined:
 - Land use distribution
 - Agricultural animal population
 - Septic system information
- ▶ These data are derived from user inputs, but can be modified:
 - Soil information (based on county)
 - Curve Numbers (land use/soil group)
 - Urban land use distribution
- ▶ Other optional input data
 - BMP type and % area applied
 - Special sediment sources from gullies and eroding streambanks



BMPs Available

BMPs



▶ Cropland

- Contour farming
- Diversion
- Filter strip
- Reduced tillage
- Streambank stabilization
- Terrace



▶ Feedlots

- Diversion
- Filter strip
- Runoff management system
- Solids separation basin
- Waste storage facility



▶ Urban

- Alum treatment
- Bioretention
- Dry/wet detention
- Grass swales
- Porous pavement
- Sand filter
- Settling basin
- Street sweeping
- Wetland detention
- Rain barrel/cistern
- Infiltration Trench
- Filter strips
- Oil/Grid separator

STEPL Output

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	t/year
W1	8140.2	1778.8	12165.4	262.5
Total	8140.2	1778.8	12165.4	262.5

N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)
lb/year	lb/year	lb/year	t/year
7927.4	1696.8	11739.8	129.5
7927.4	1696.8	11739.8	129.5

N Reduction	P Reduction	BOD Reduction	Sediment Reduction
lb/year	lb/year	lb/year	t/year
212.8	81.9	425.6	133.0
212.8	81.9	425.6	133.0

Load Reductions



%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
%	%	%	%
2.6	4.6	3.5	50.7
2.6	4.6	3.5	50.7

Planning Process

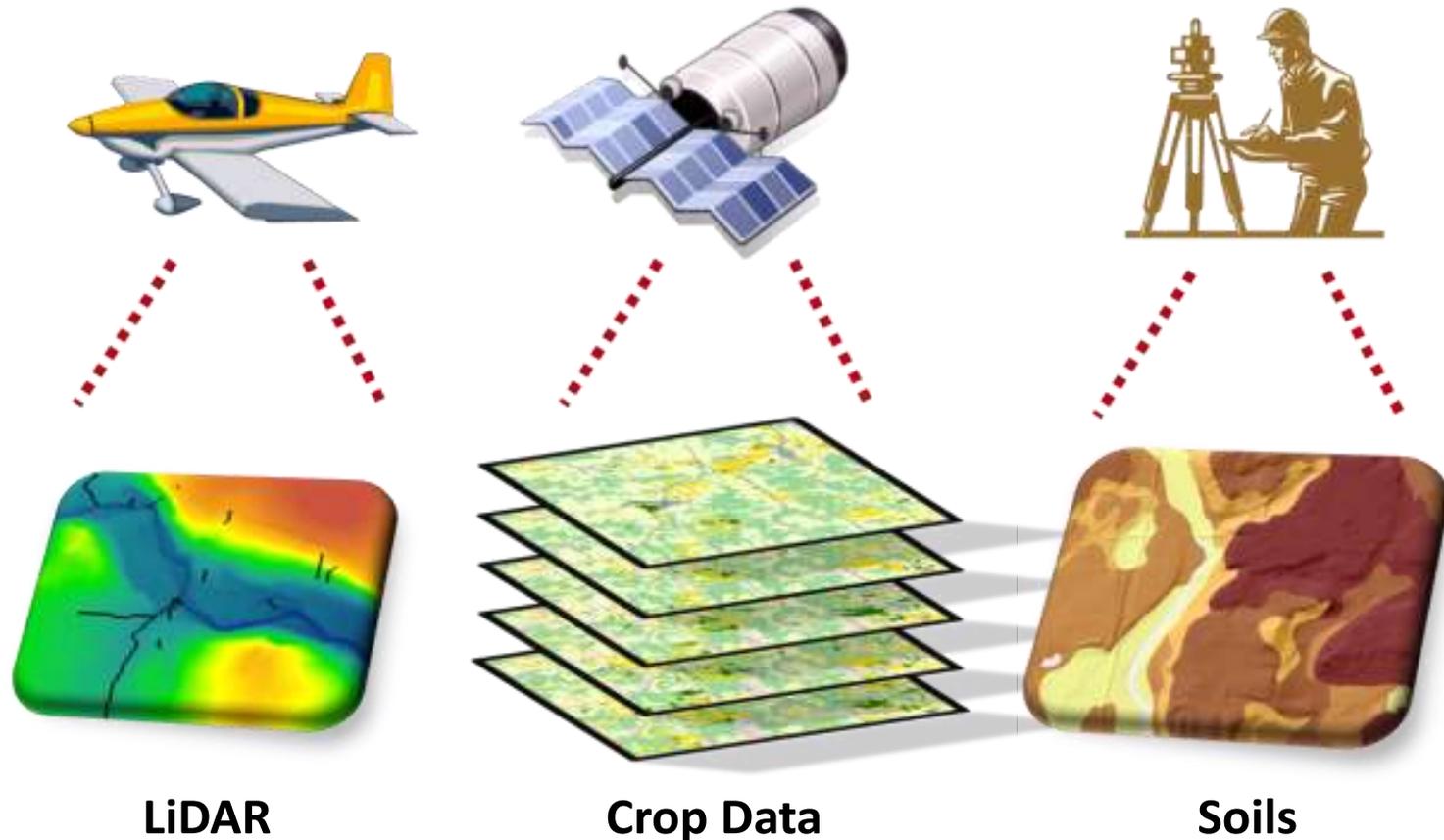
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- ▶ Design an implementation program
 - Where to work?



- ▶ Erosion Vulnerability Assessment for Agricultural Lands
- ▶ GIS-based model
- ▶ Vulnerability to erosion and nutrient export
- ▶ Deprioritizes internally draining areas



Available Datasets

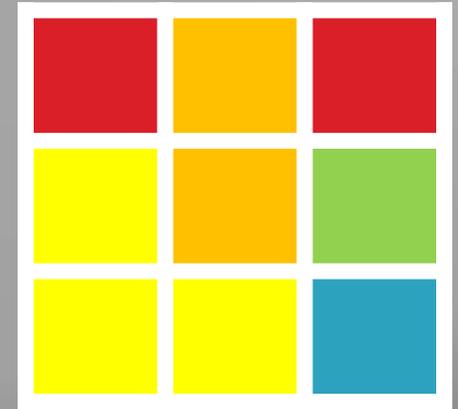
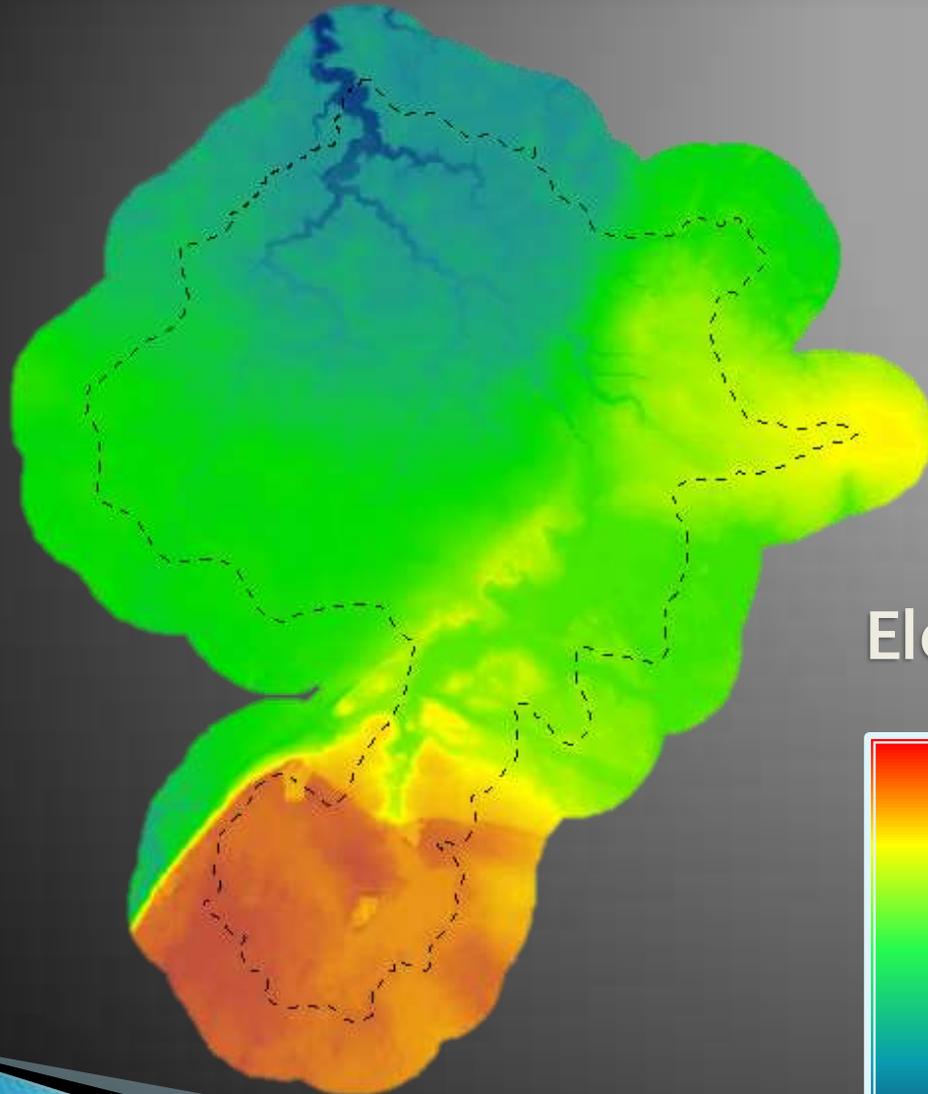


LiDAR

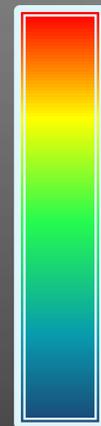
Crop Data

Soils

LiDAR Data



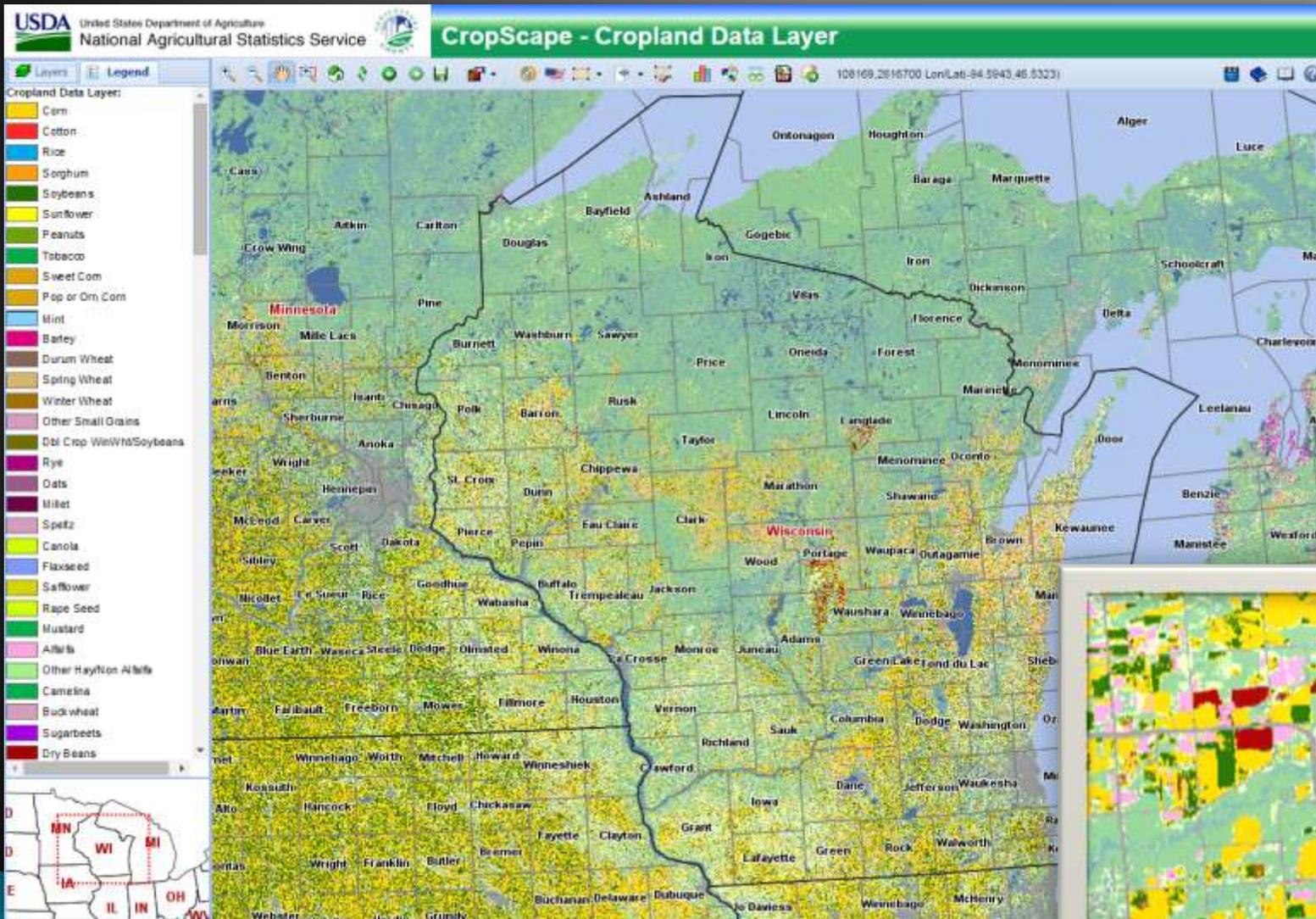
Elevation (feet)



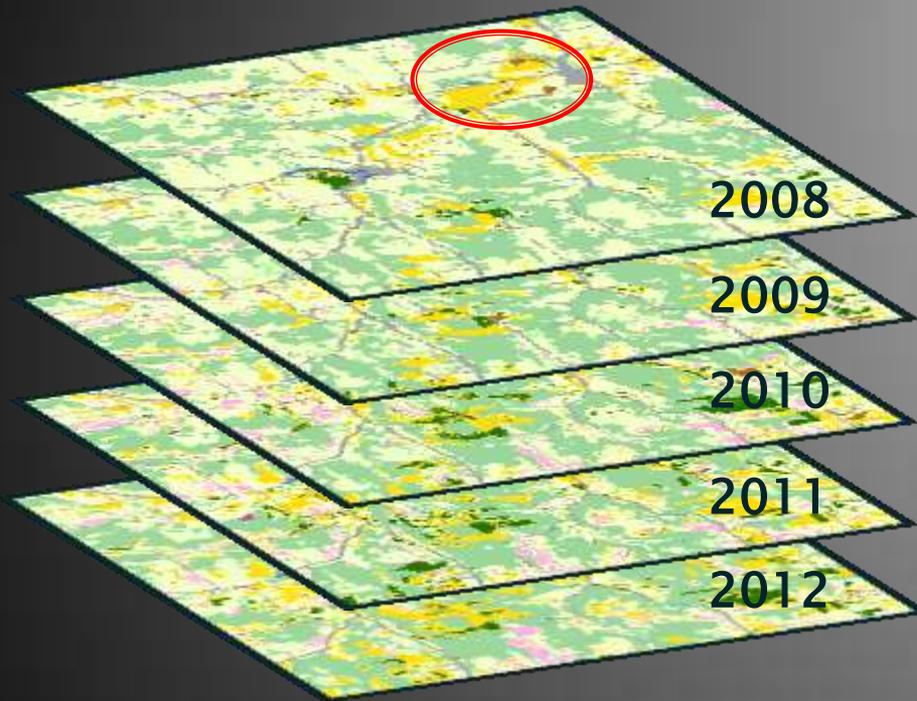
1000

650

Crop Data



Crop Rotations



Corn

Soybean

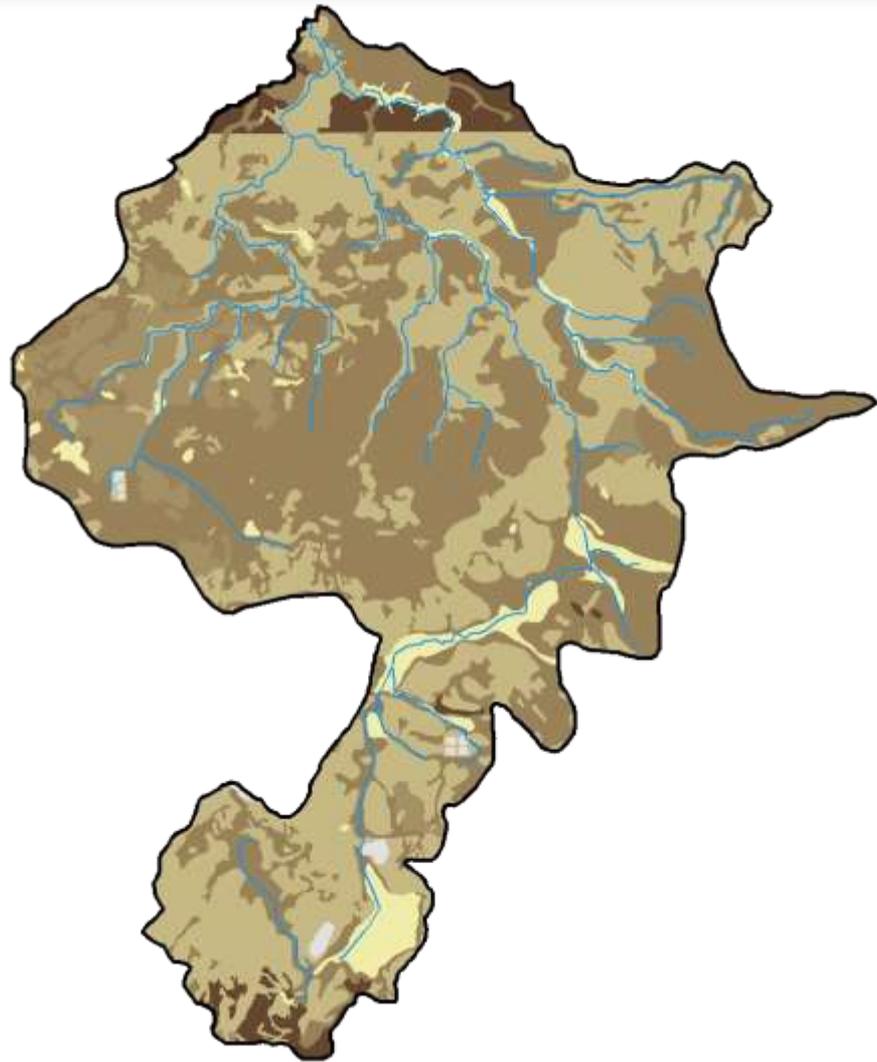
Corn

Corn

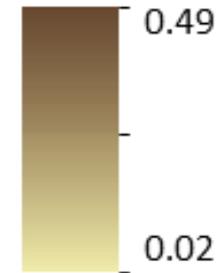
Soybean

C-C-S-C-C, C-S-C-S-C, S-C-C-S-C, C-C-C-C-S, S-S-S-S-C
= Cash Grain Rotation

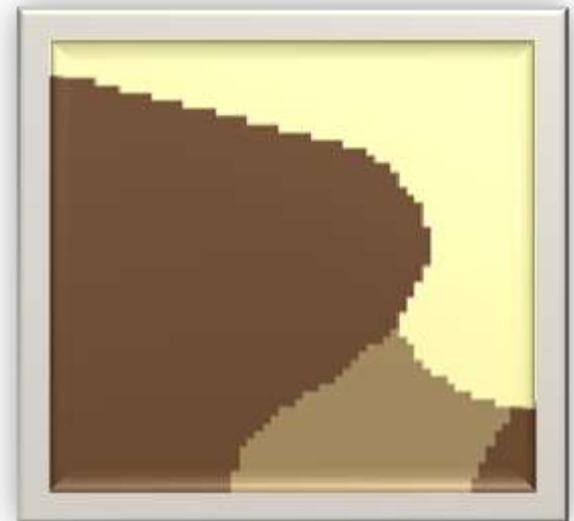
Soils



Soil Erodibility



10 meter resolution



Erosion Vulnerability Analysis

USLE + SPI - IDA

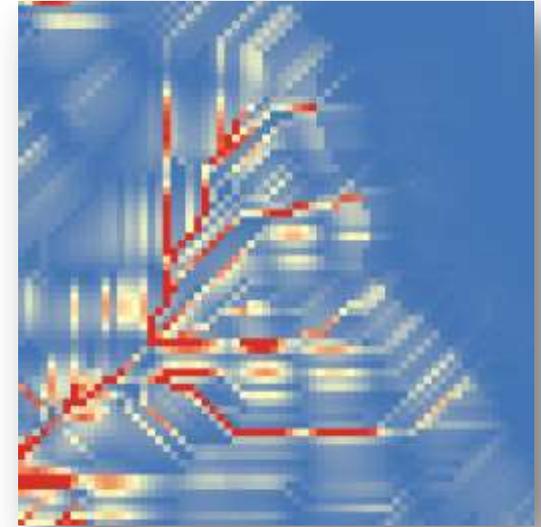
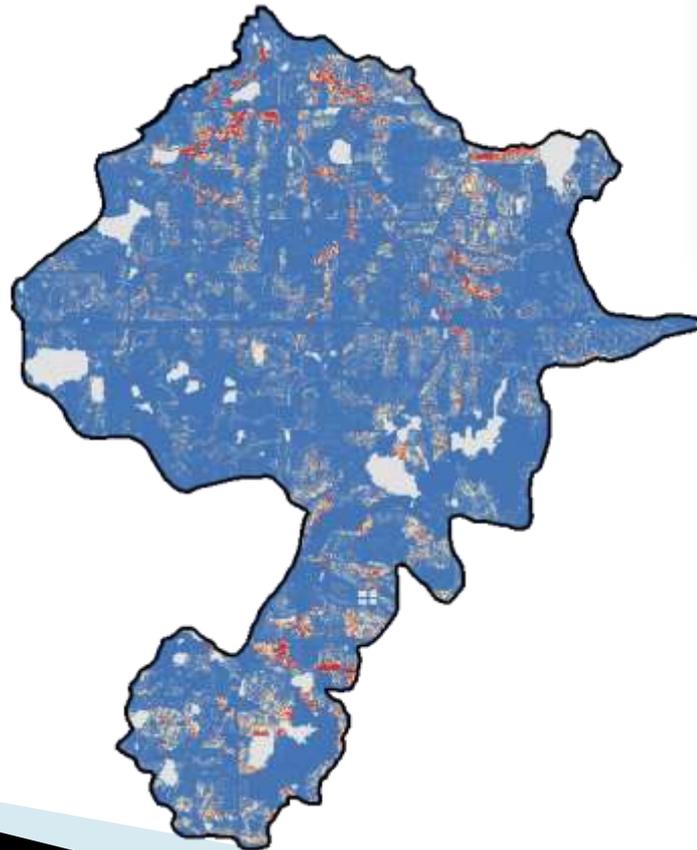


= **E**  **AAL**

**Erosion Vulnerability Assessment
for Agricultural Lands**

Universal Soil Loss Equation

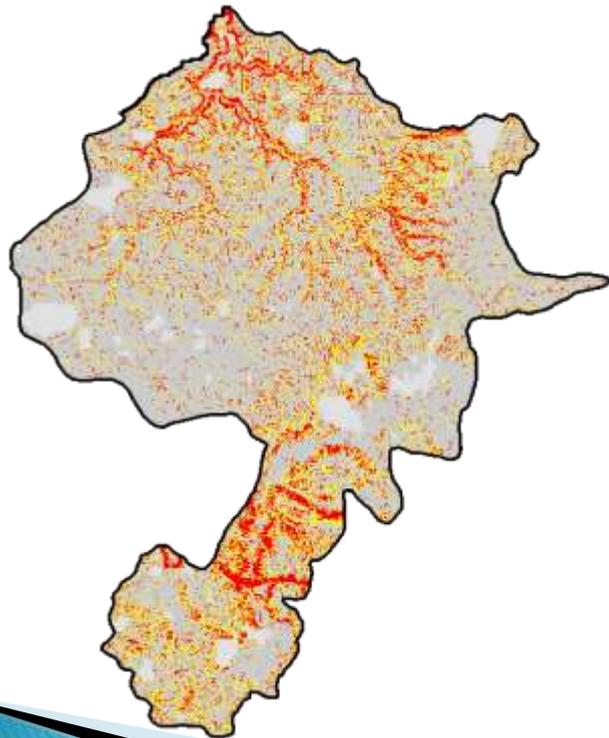
- ▶ Sheet and rill erosion
 - Soil erodibility
 - Slope/slope length
 - Crop cover



Stream Power Index

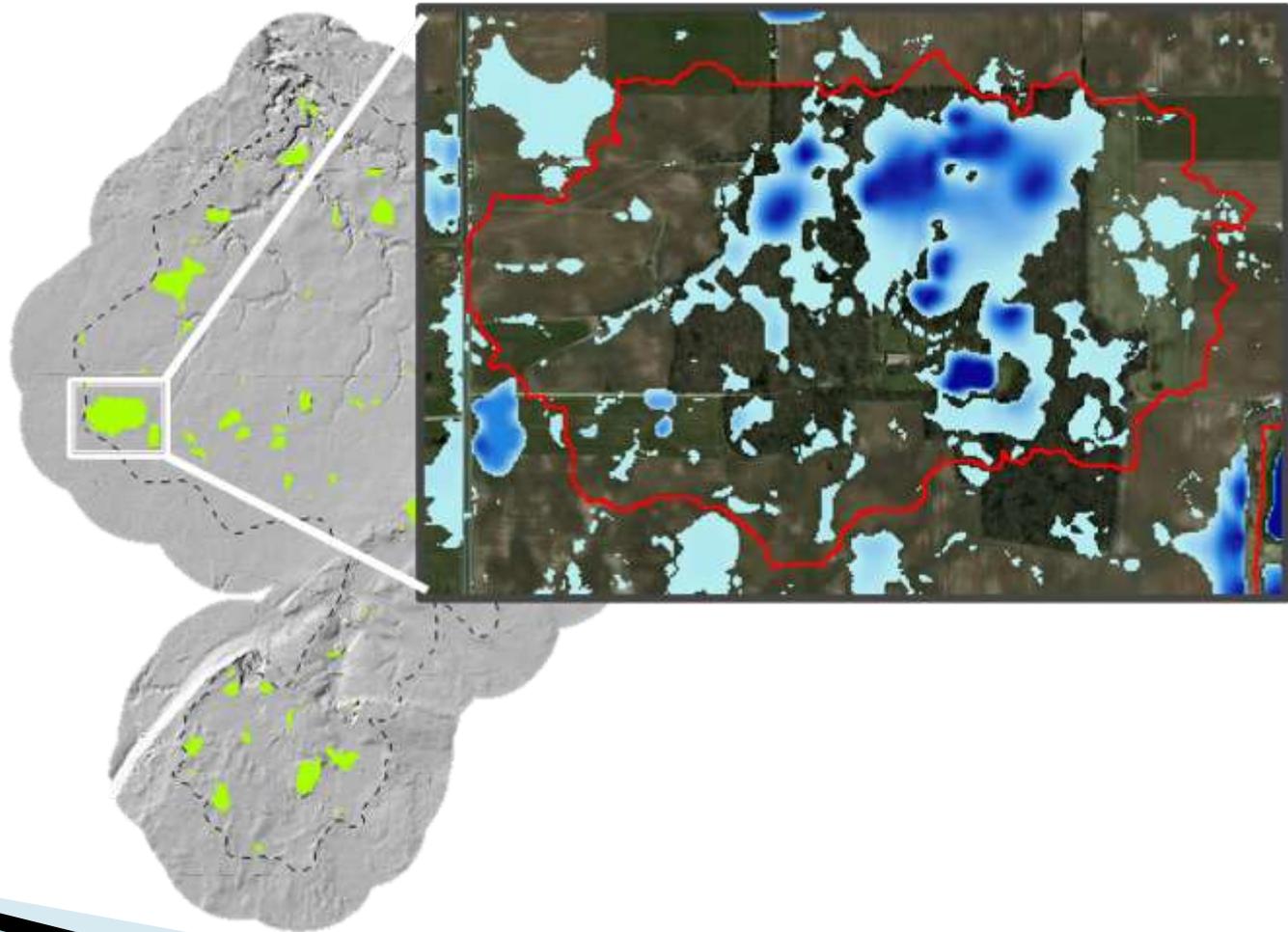
- ▶ Potential for gully erosion

$$\text{SPI} = f(\text{slope, catchment area})$$



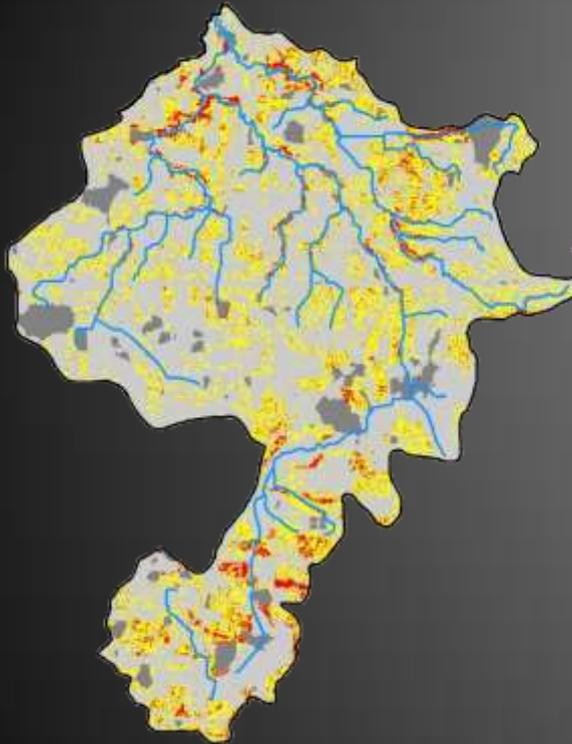
Internally Draining Areas

- ▶ Areas that do not contribute to surface waters

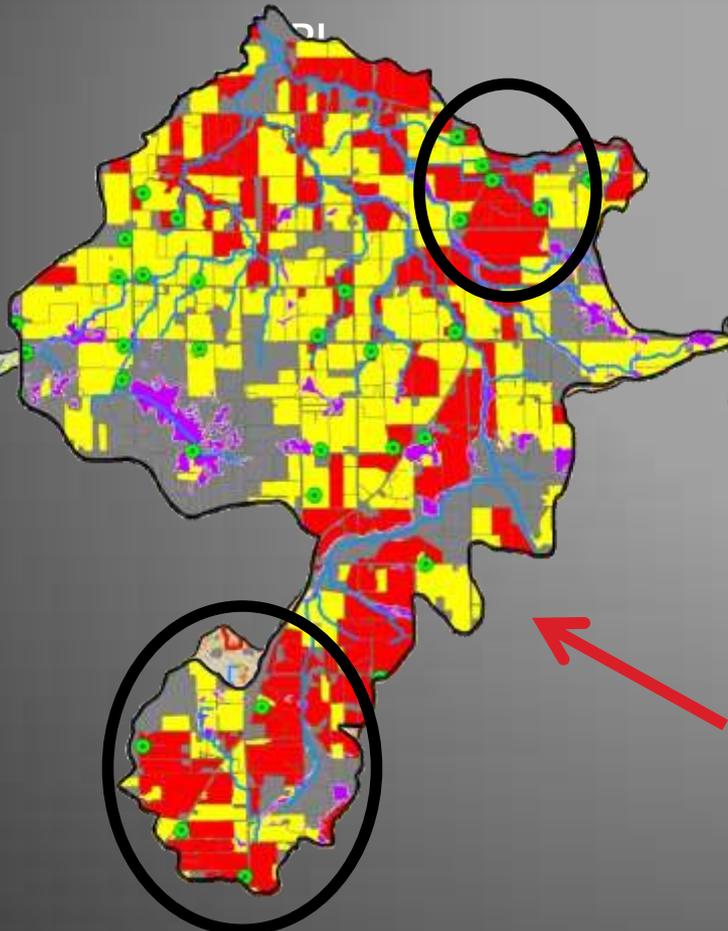


Results

USLE

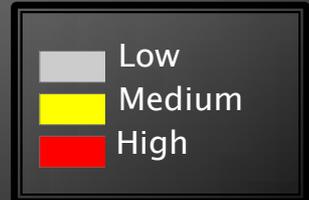


NC Areas



Where to work

Erosion Potential



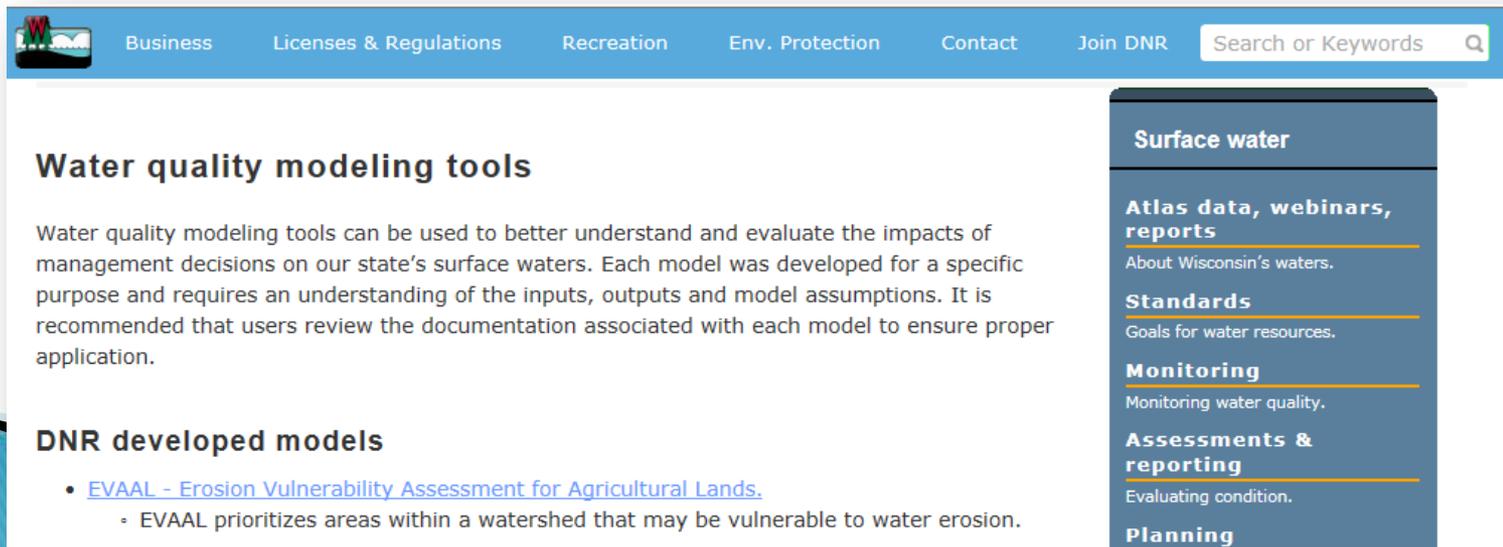
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More Information

- ▶ DNR Water Quality Modeling Tools
 - <http://dnr.wi.gov/topic/surfacewater/models.html>
 - DNR models
 - Other water quality models
 - Training
 - Contact Information



The screenshot shows the DNR website's navigation bar with links for Business, Licenses & Regulations, Recreation, Env. Protection, Contact, and Join DNR. A search bar is located on the right. The main content area features a heading "Water quality modeling tools" followed by a paragraph explaining the purpose of these tools. Below this is a section titled "DNR developed models" with a bullet point linking to "EVAAL - Erosion Vulnerability Assessment for Agricultural Lands." and a sub-bullet explaining that EVAAL prioritizes vulnerable areas. On the right side, there is a vertical sidebar with a dark blue background and white text, listing categories: "Surface water", "Atlas data, webinars, reports", "Standards", "Monitoring", "Assessments & reporting", and "Planning".

Water quality modeling tools

Water quality modeling tools can be used to better understand and evaluate the impacts of management decisions on our state's surface waters. Each model was developed for a specific purpose and requires an understanding of the inputs, outputs and model assumptions. It is recommended that users review the documentation associated with each model to ensure proper application.

DNR developed models

- [EVAAL - Erosion Vulnerability Assessment for Agricultural Lands.](#)
 - EVAAL prioritizes areas within a watershed that may be vulnerable to water erosion.

Surface water

Atlas data, webinars, reports
About Wisconsin's waters.

Standards
Goals for water resources.

Monitoring
Monitoring water quality.

Assessments & reporting
Evaluating condition.

Planning





Acknowledgements

- Aaron Ruesch
- Adam Freihoefer

Questions?

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