

EVAAL Training

Theresa M. Possley Nelson, PE
Michelle Hu
Wisconsin Department of Natural Resources

July 21, 2016



Acknowledgements

- ▶ Aaron Ruesch
- ▶ Dave Evans
- ▶ Michelle Hu



Overview

- ▶ Introductions
- ▶ EVAAL Overview
- ▶ EVAAL – How To
- ▶ Exercises



EVAAL

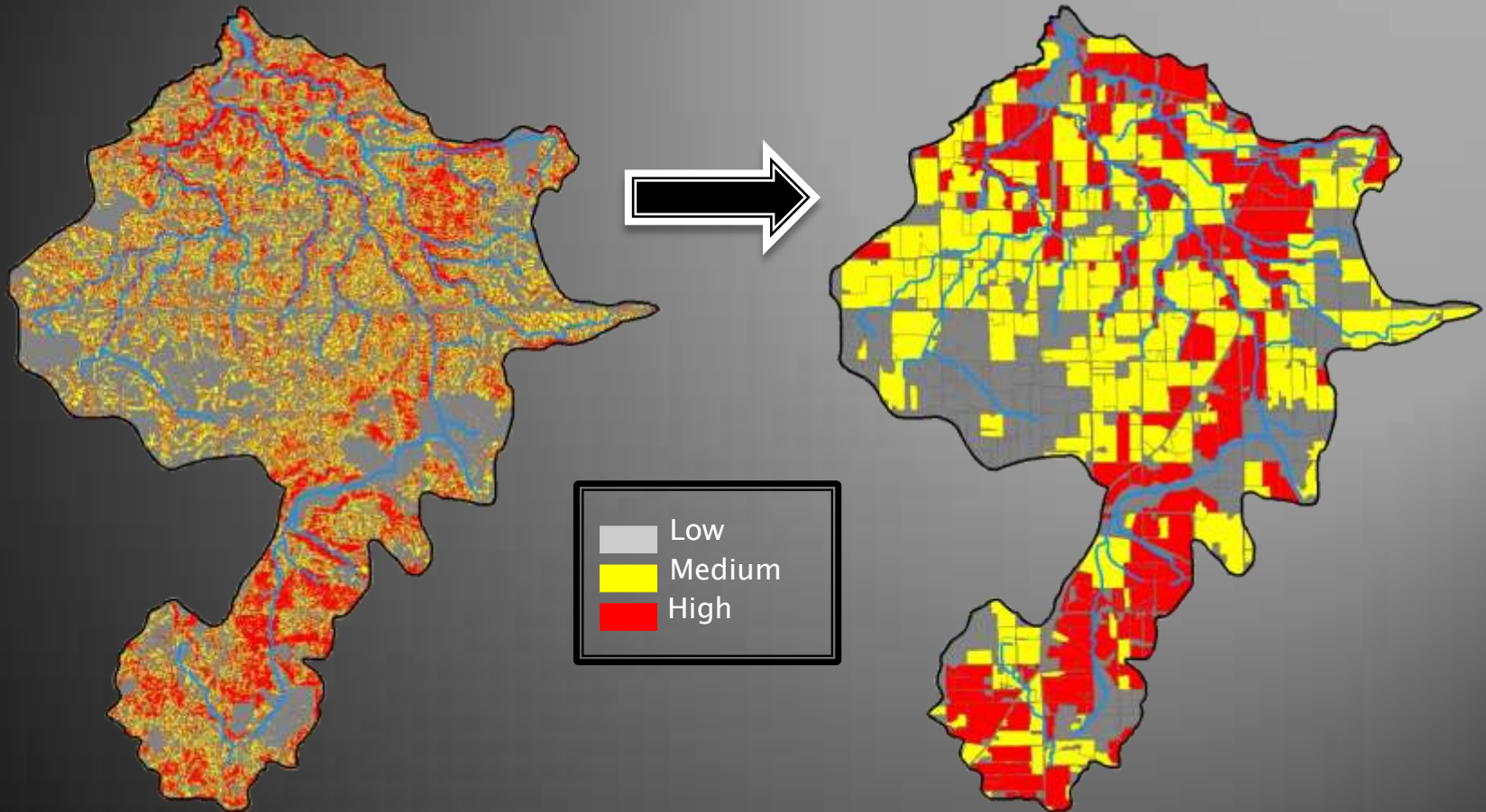
»» Overview

EVAAL

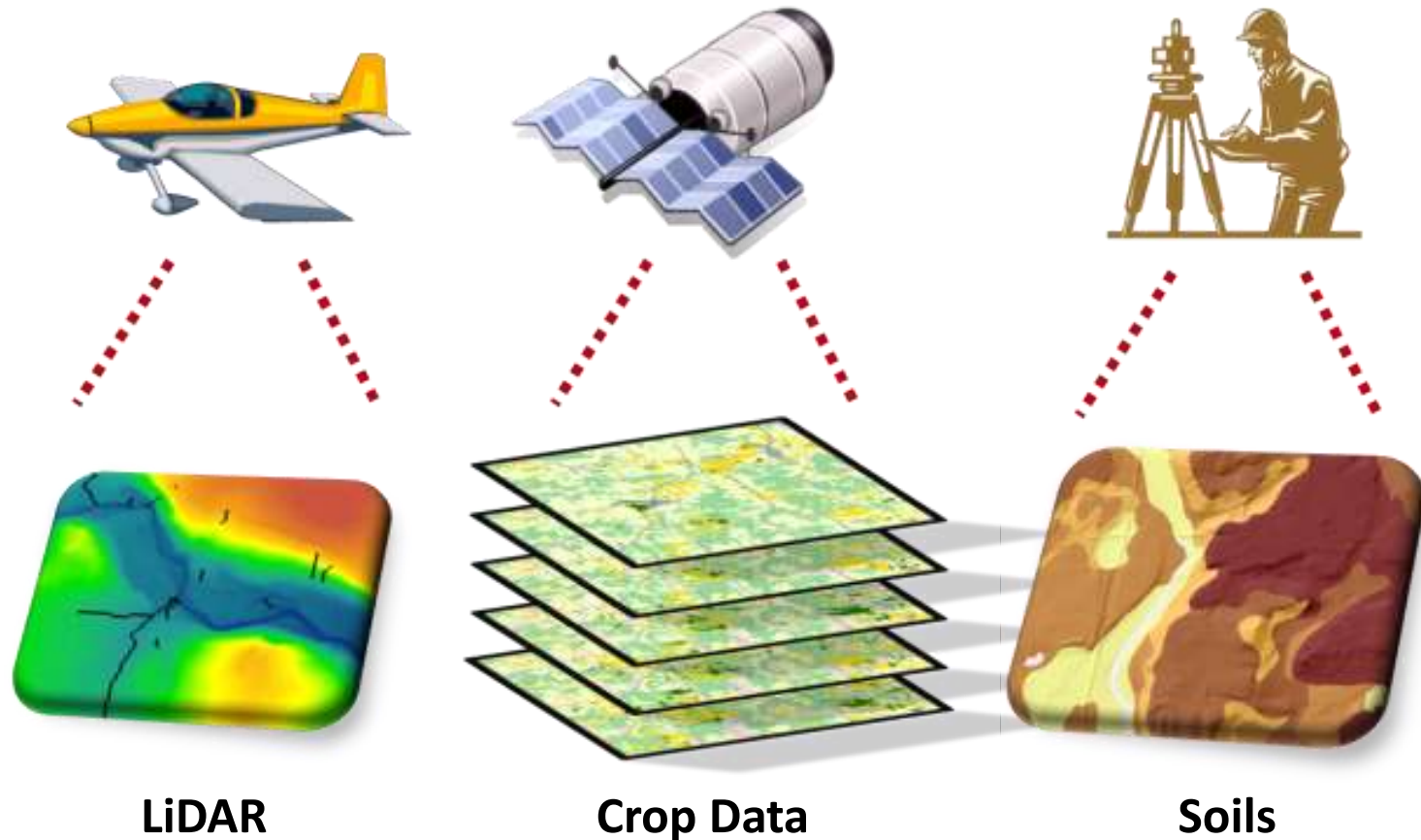
- ▶ **Erosion Vulnerability Assessment for Agricultural Lands**
- ▶ Developed by WDNR
- ▶ GIS-based model
- ▶ Vulnerability to erosion and nutrient export
- ▶ Deprioritizes internally draining areas



Erosion Vulnerability



Available Datasets

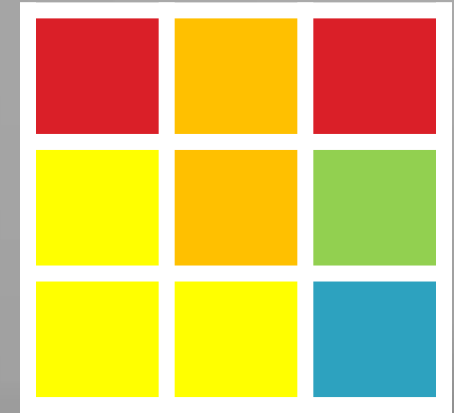
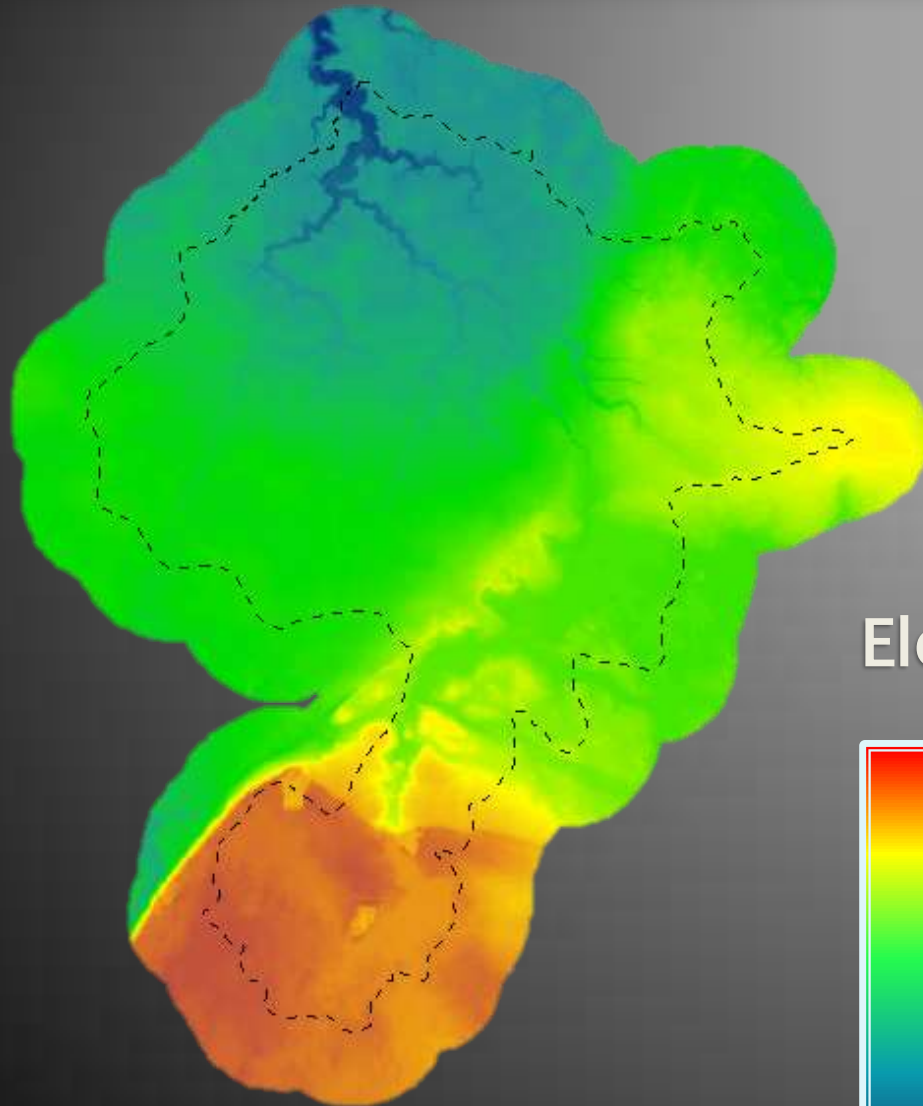


LiDAR

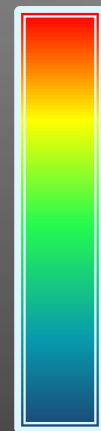
Crop Data

Soils

LiDAR Data



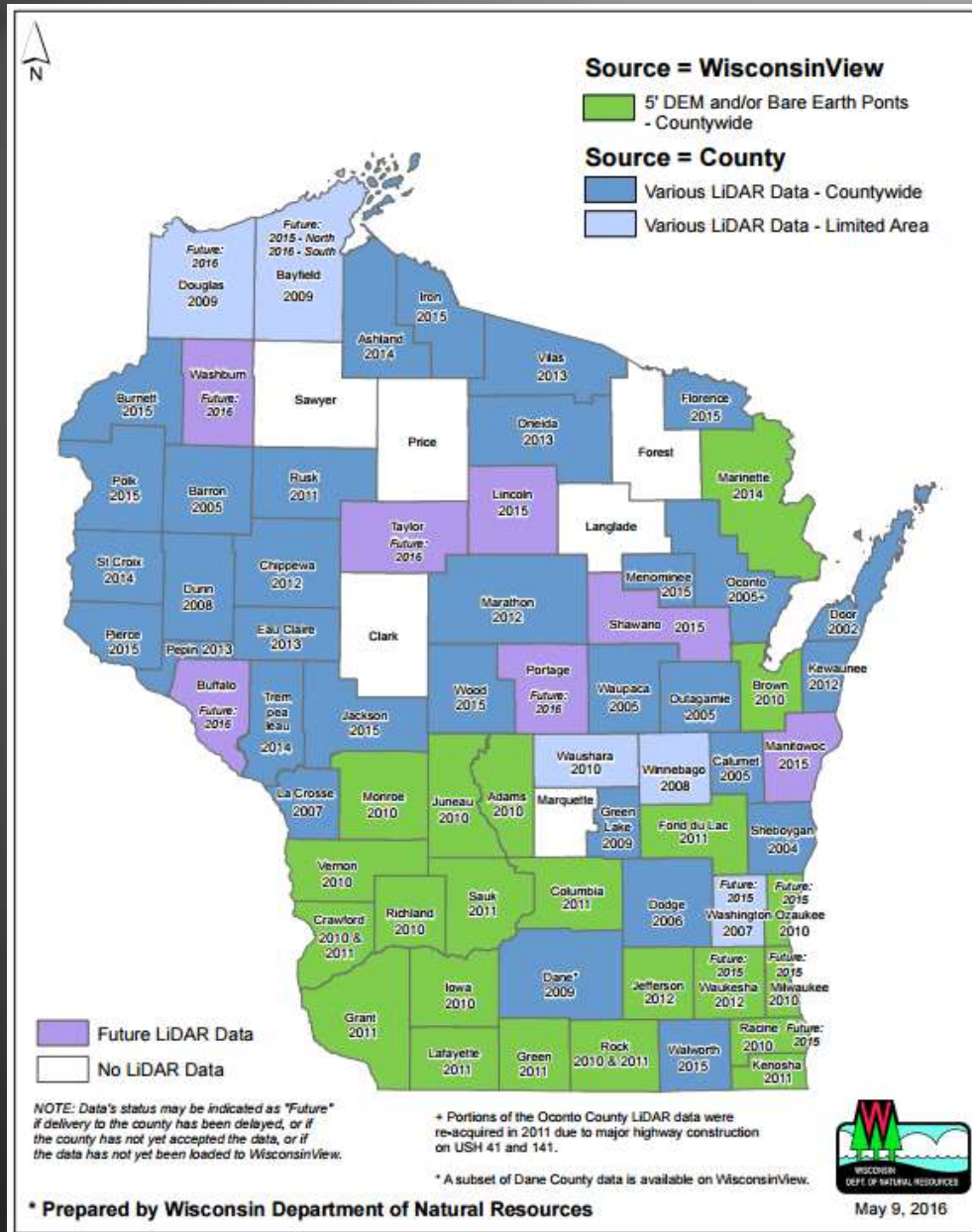
Elevation (feet)



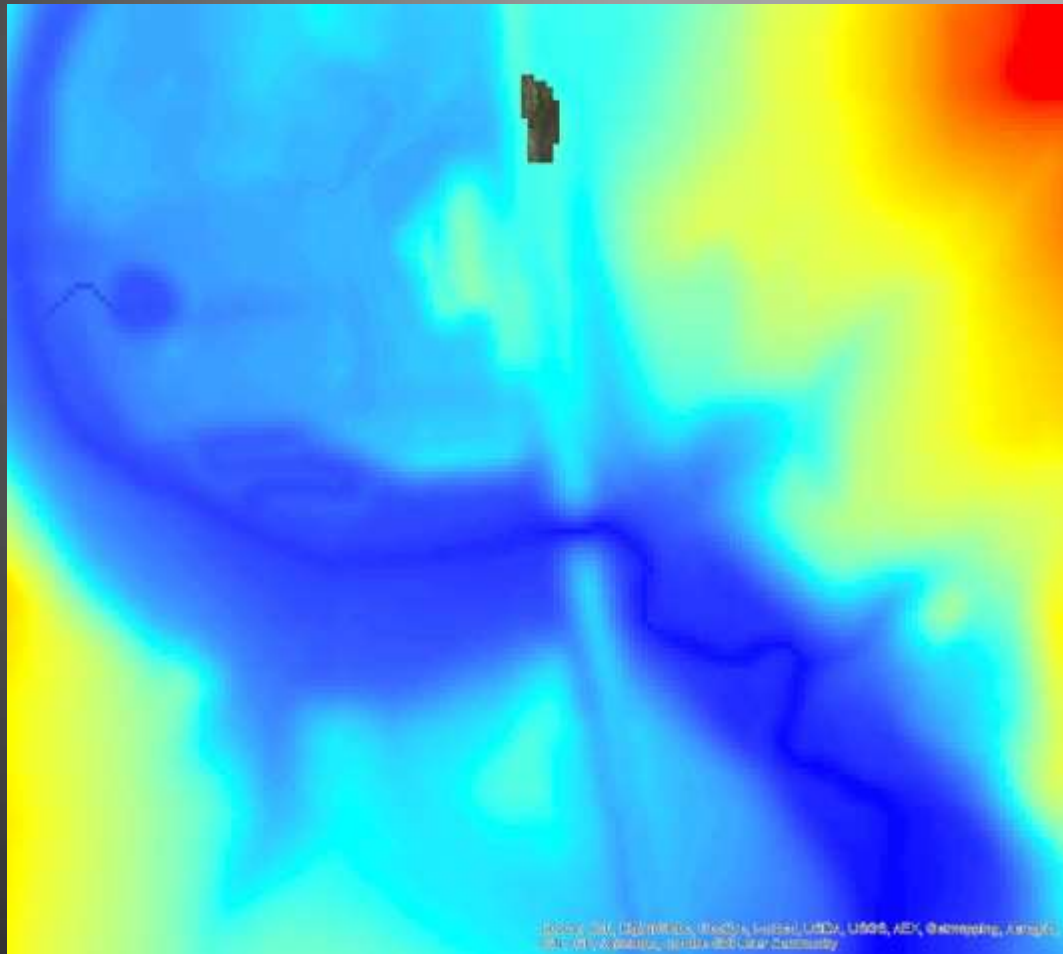
1000

650

LiDAR Availability

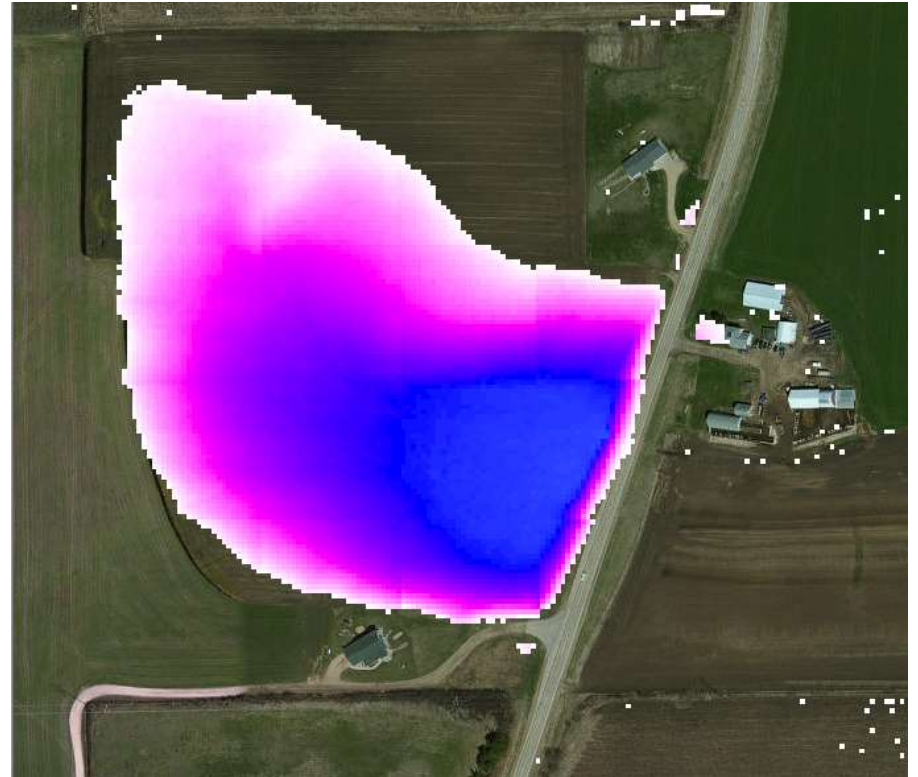


Digital Dams



Locate Depressions

- ▶ Differentiate between real and “fake” depressions



Classic case

- Completely round...
- Don't bother trying to cut these



Create Culverts

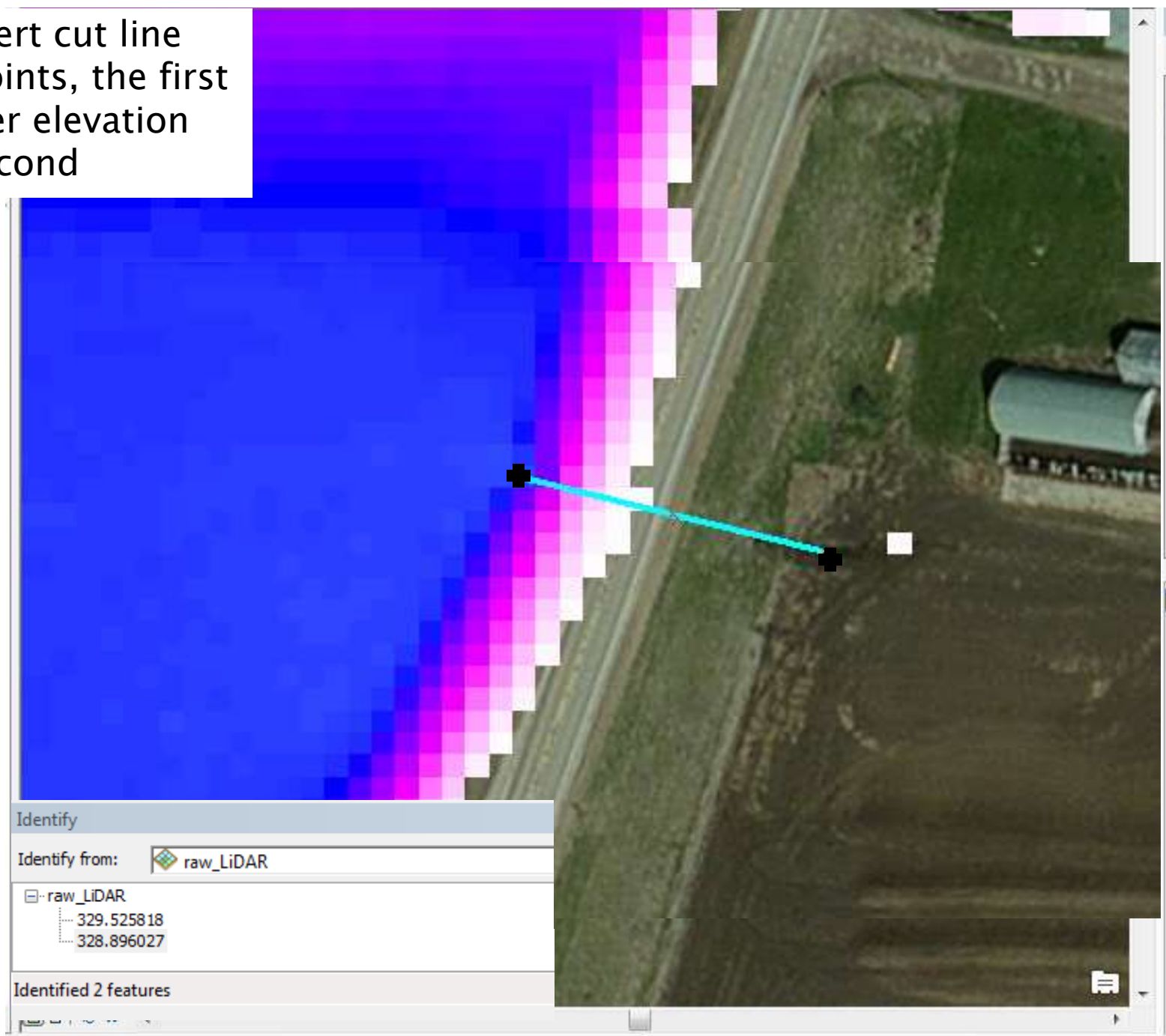
- ▶ Different approaches:
 - Geolocate culverts in your area of interest in the field, prior to digitizing
 - View aerial photos and base maps while creating the culvert layer
 - After creating a culverts layer, field verify questionable areas



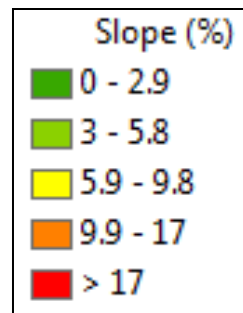
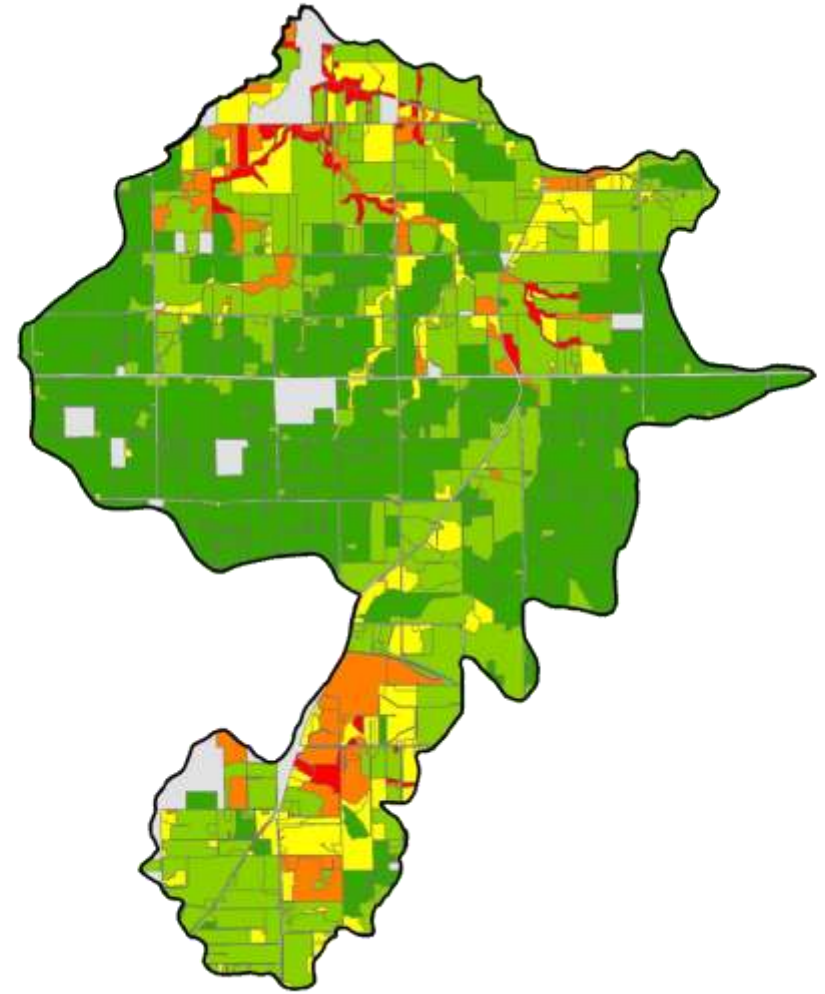
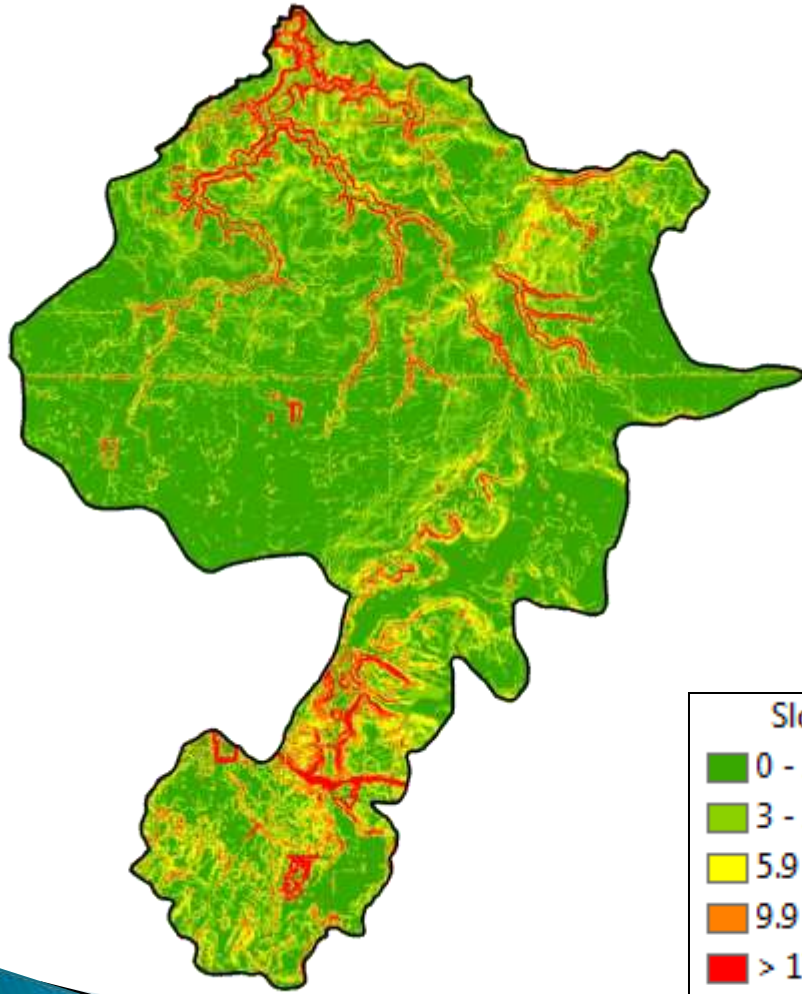
Google Street View



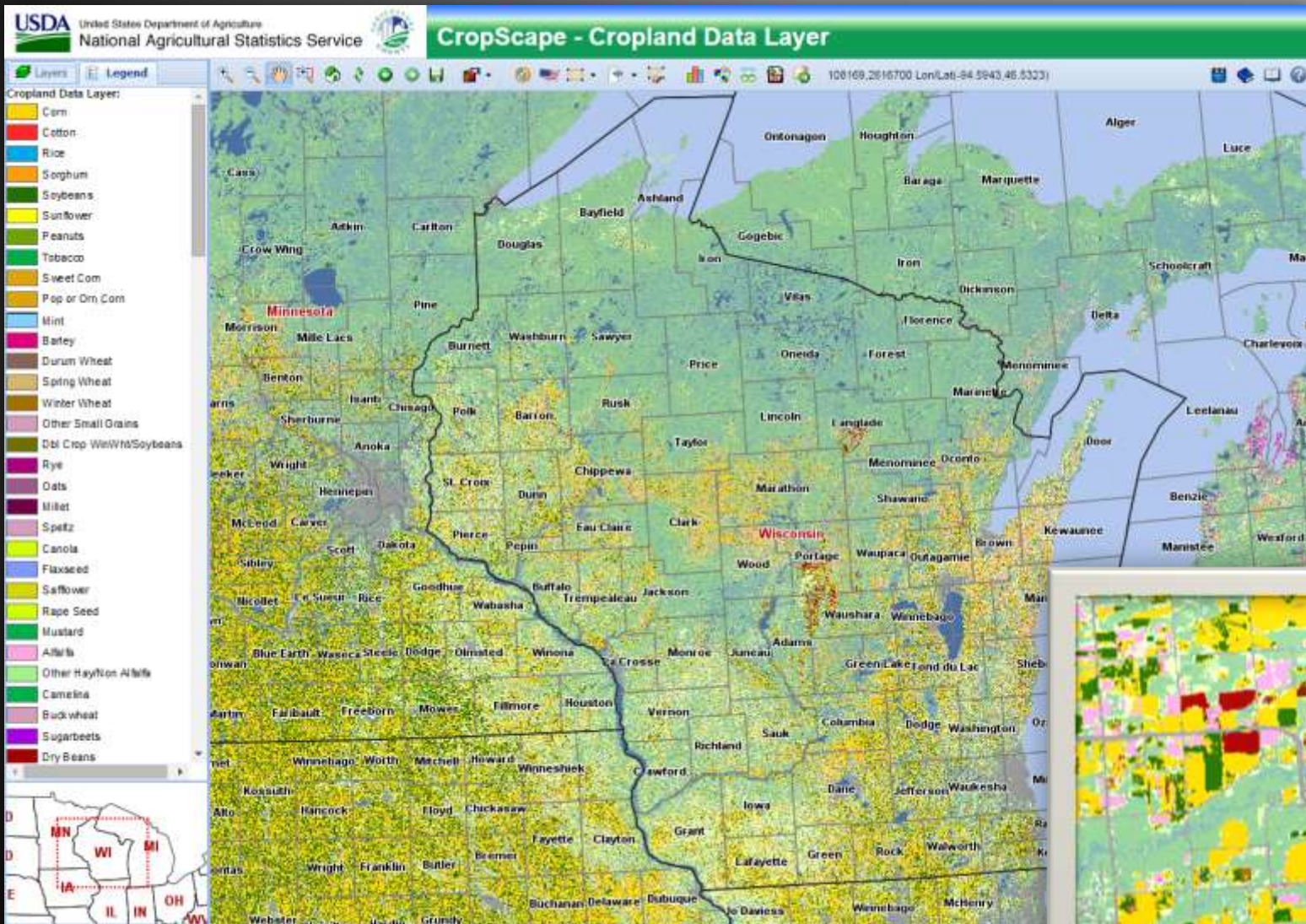
Create culvert cut line with two points, the first being higher elevation than the second



Slope

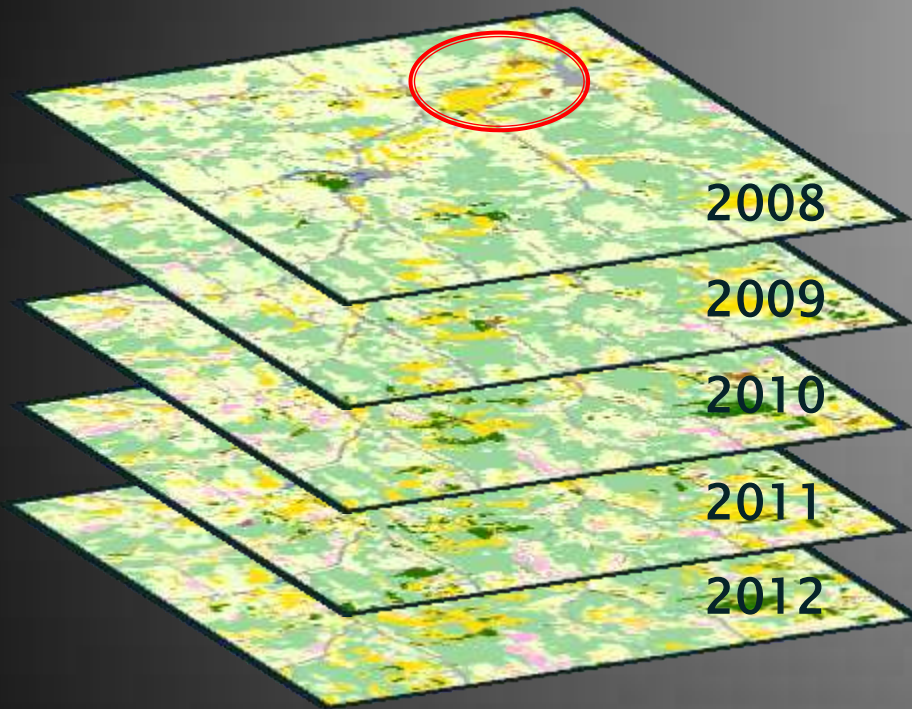


Crop Data



<http://nassgeodata.gmu.edu/CropScape/>

Crop Rotations



Corn

Soybean

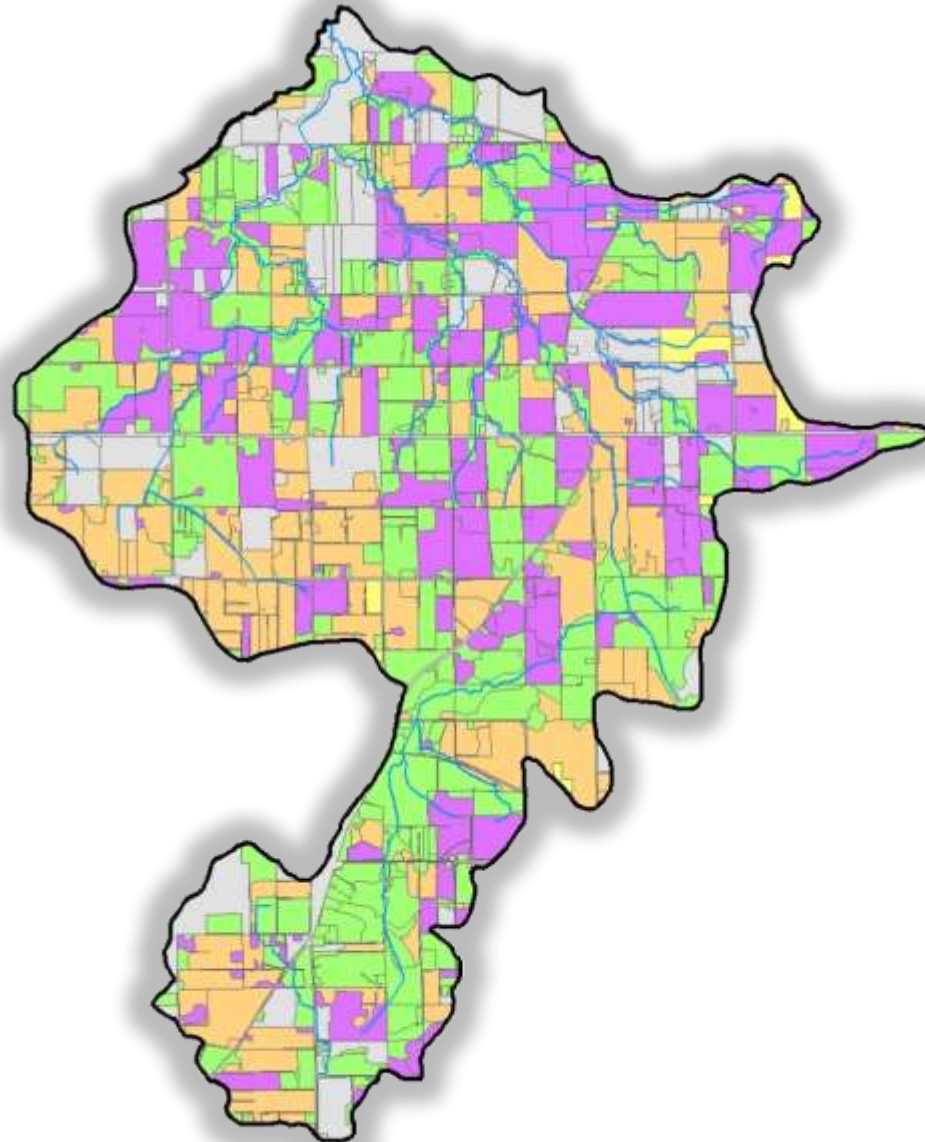
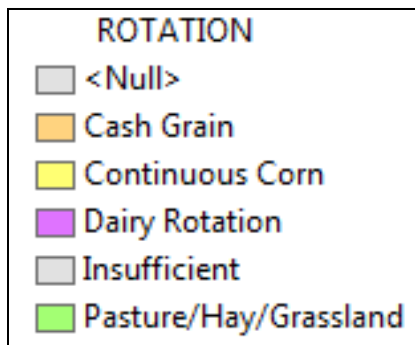
Corn

Corn

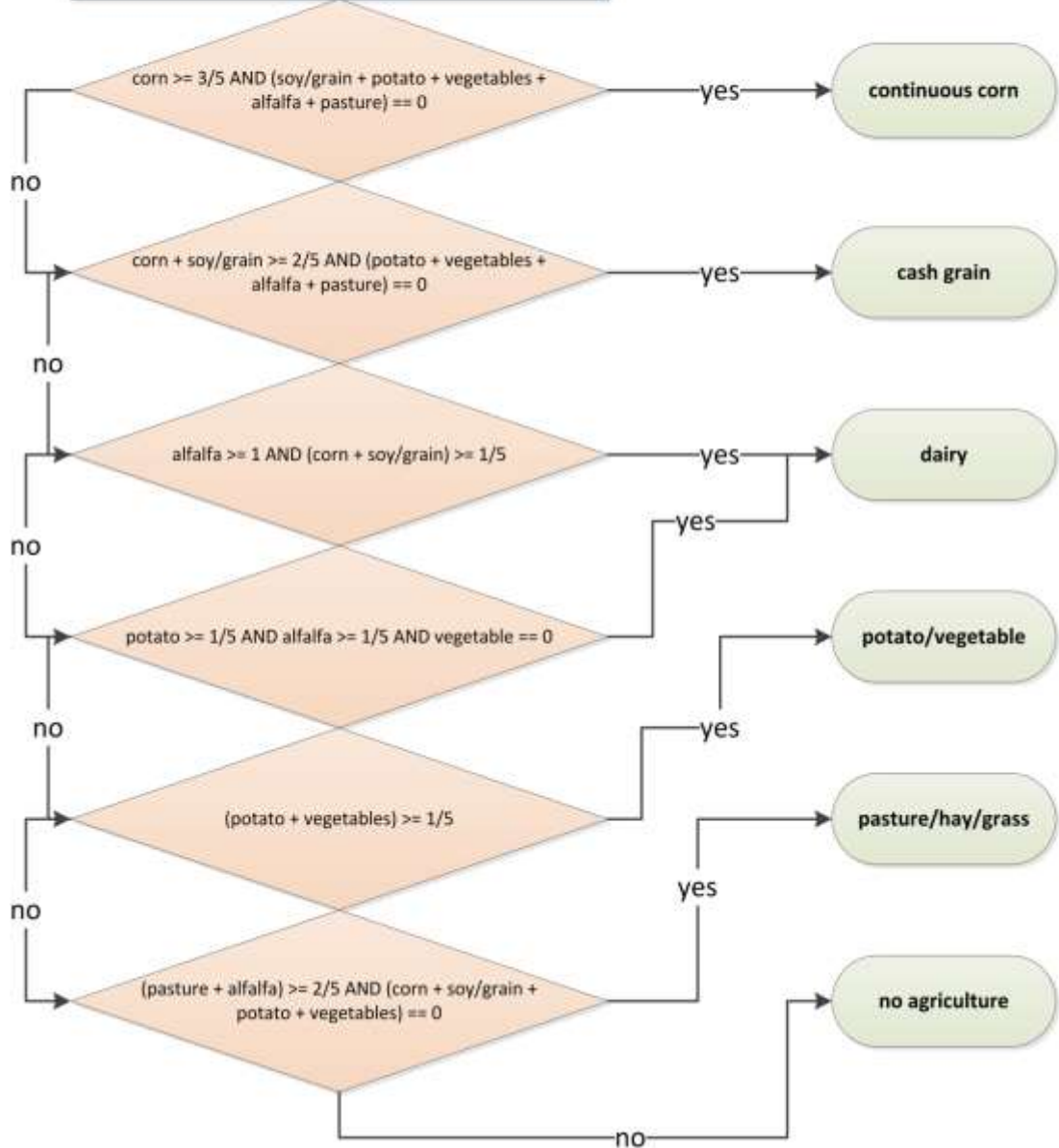
Soybean

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

Generalized Crop Rotations



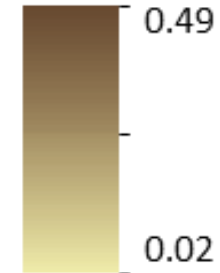
Time series of crop types by CDL code
 corn: [1]
 soy/grain: [4,5,21,22,23,24,25,27,28,29,30,39,205]
 potato: [43]
 vegetables: [12,42,47,49,50,53,206,216]
 alfalfa: [28, 36, 37, 58]
 pasture: [62, 181, 176]



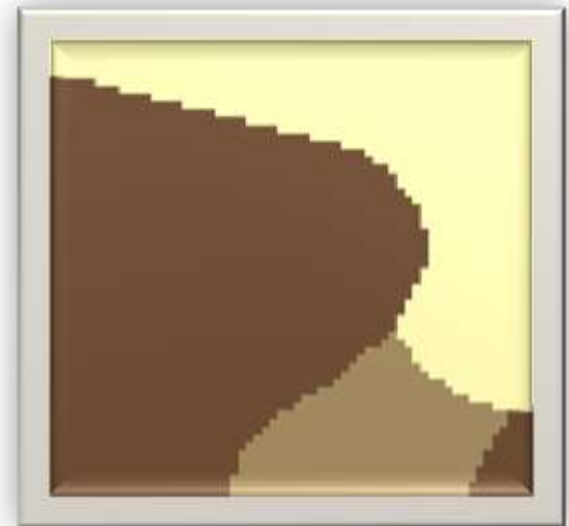
Soils – gSSURGO



Soil Erodibility



10 meter resolution

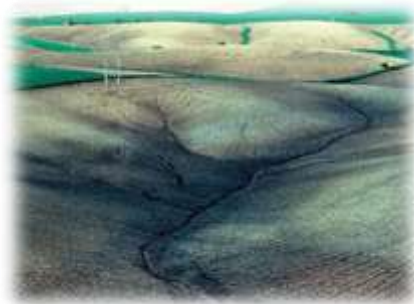


<http://datagateway.nrcs.usda.gov/>



Erosion Vulnerability Analysis

USLE + SPI - IDA



= **E**  **AAL**

**Erosion Vulnerability Assessment
for Agricultural Lands**

Universal Soil Loss Equation

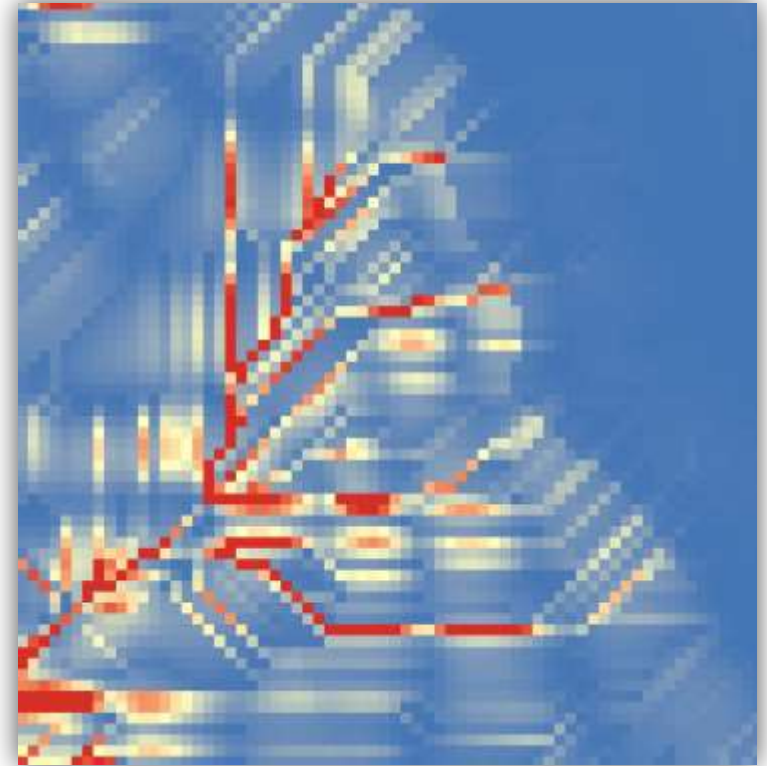
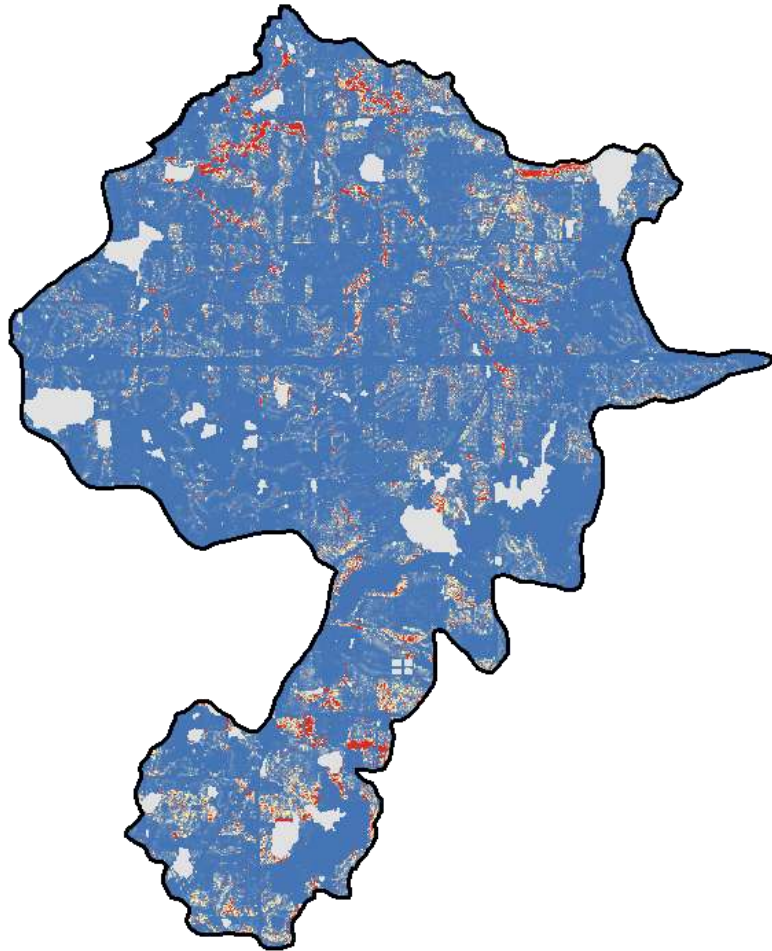
▶ Sheet and rill erosion

$$A = RK(LS)CP$$

- Rainfall erosivity
- Soil erodibility
- Slope/Slope–Length
- Cover factor
- Practice Factor



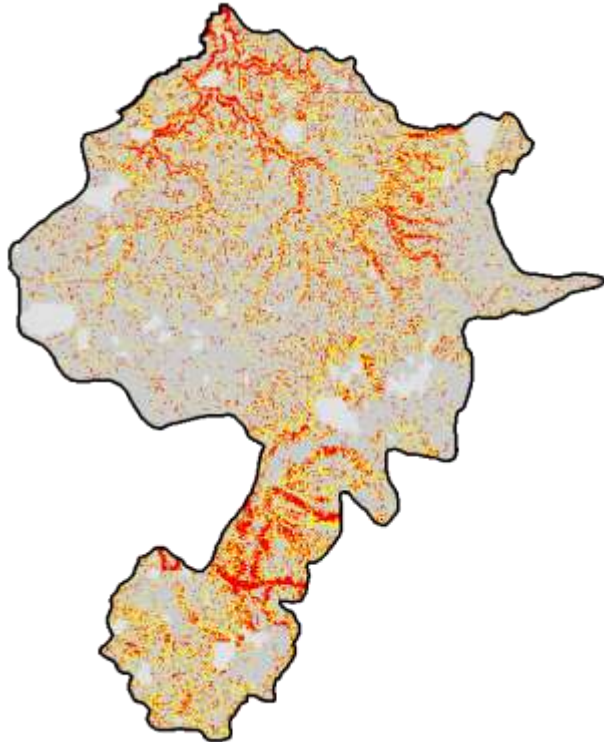
Universal Soil Loss Equation



Stream Power Index

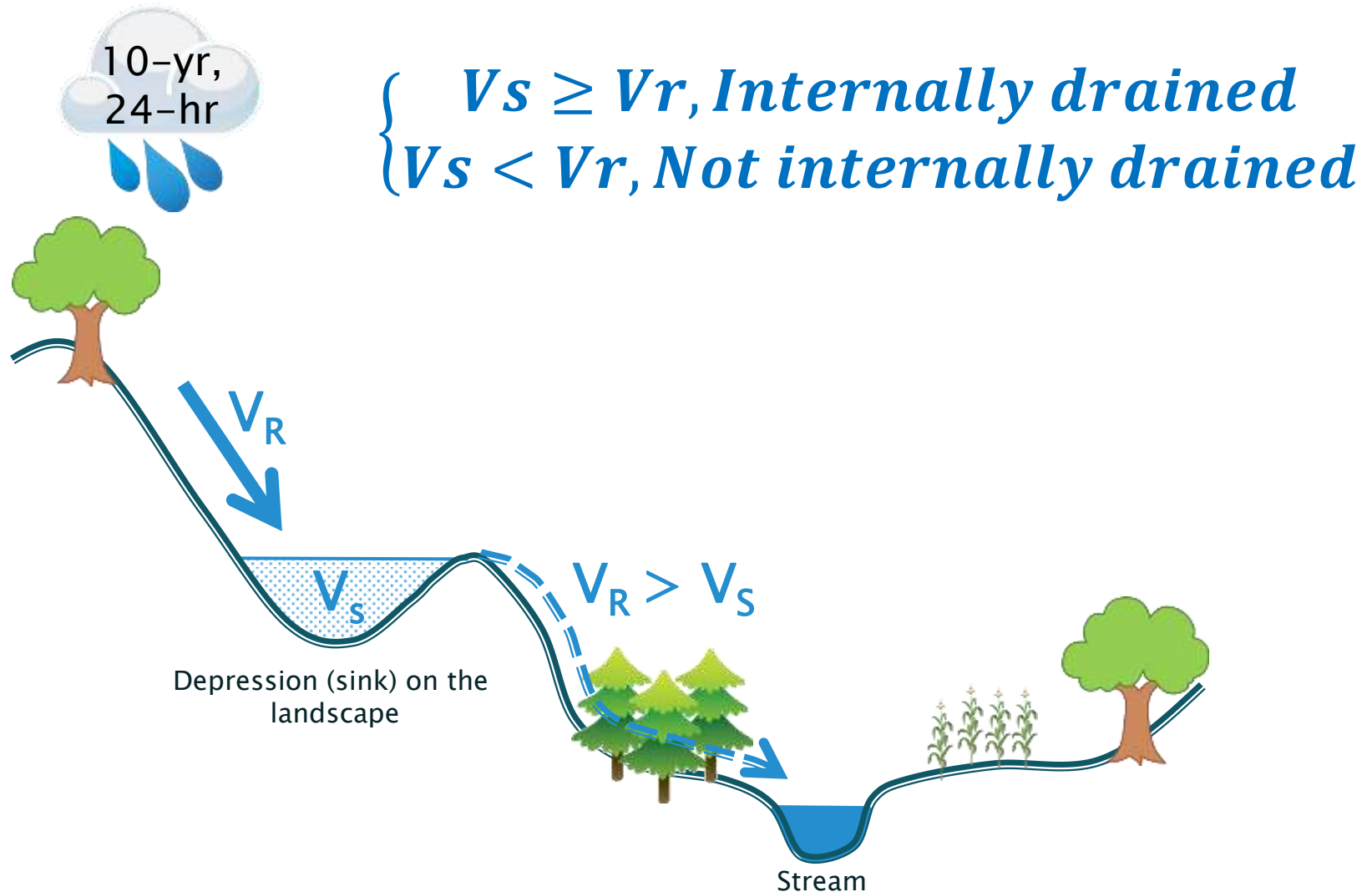
- ▶ Potential for gully erosion

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

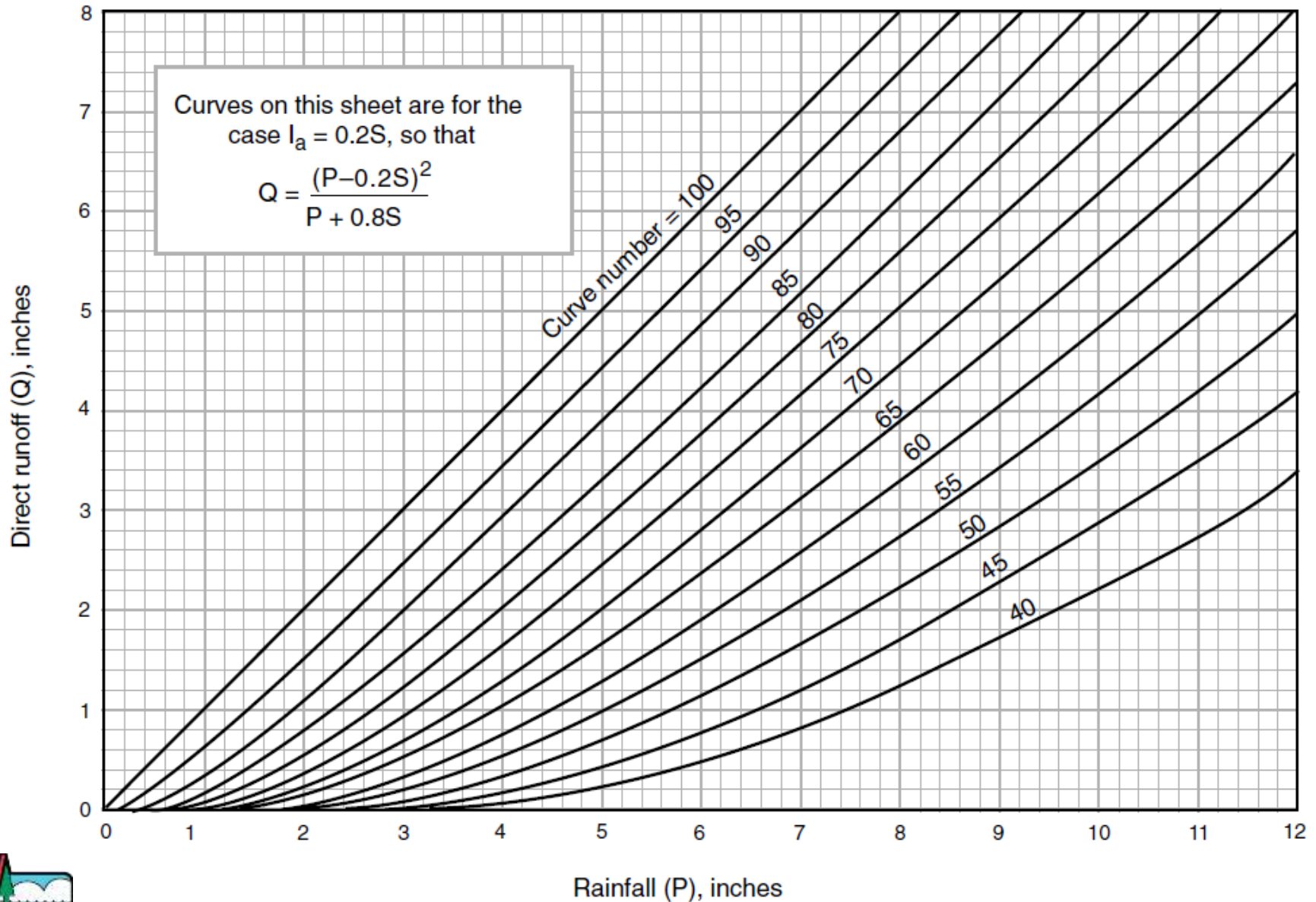


Internally Draining Areas

- ▶ Areas that do not contribute to surface waters



Runoff Calculation



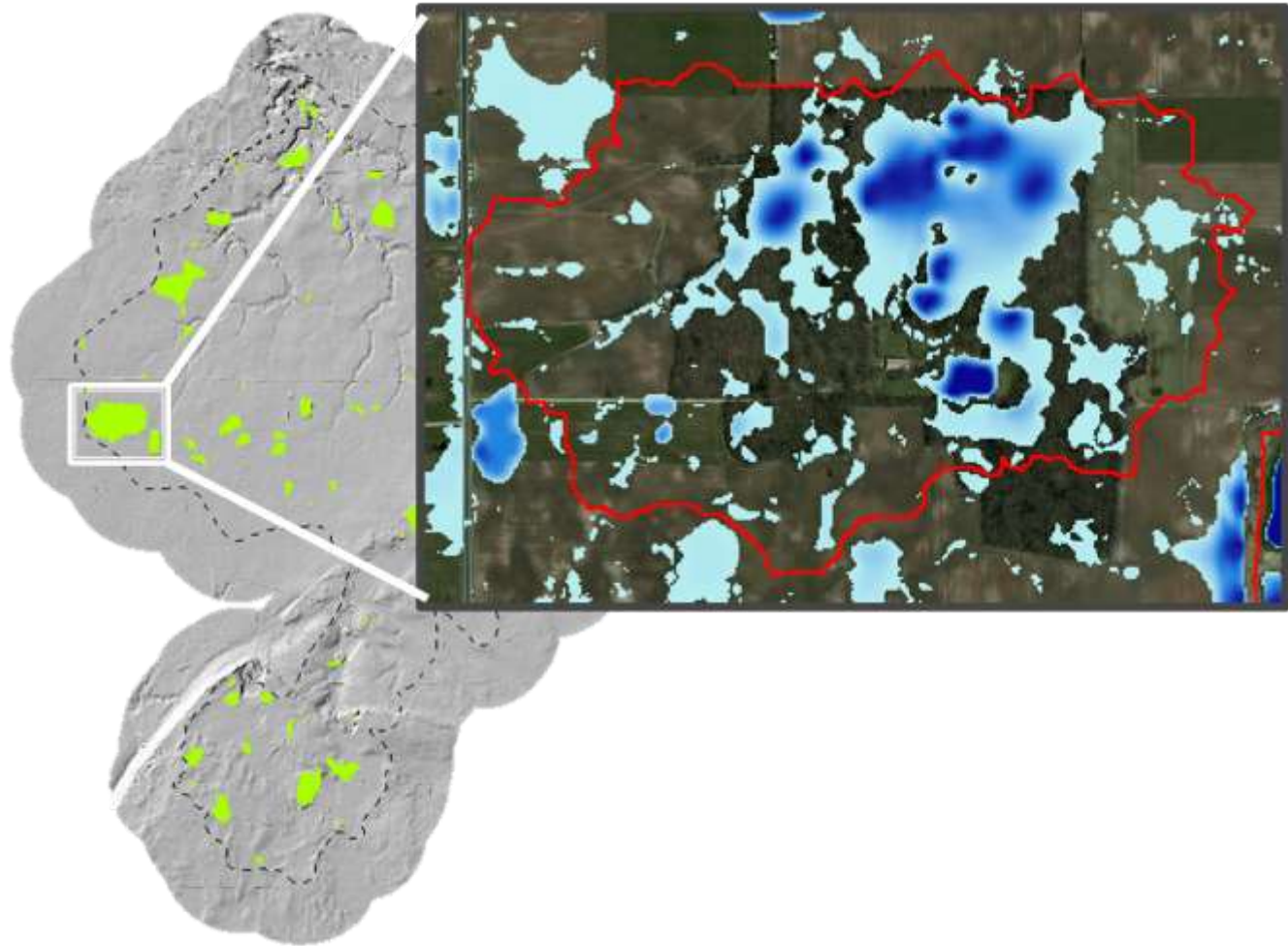
Curve Numbers

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment ^{2/}	Hydrologic condition ^{3/}	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
C&T+ CR	Poor	65	73	79	81	
	Good	61	70	77	80	
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
C&T+ CR	Poor	60	71	78	81	
	Good	58	69	77	80	
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
Good	51	67	76	80		



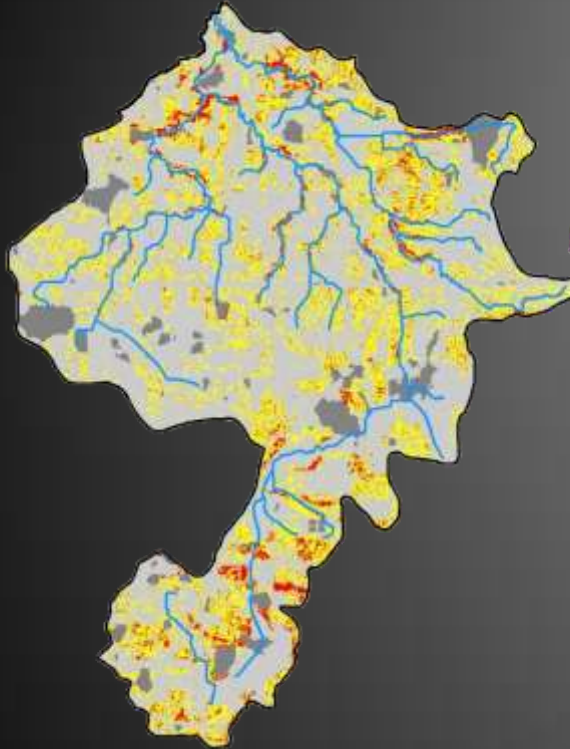
Internally Draining Areas

- ▶ Areas that do not contribute to surface waters



Results

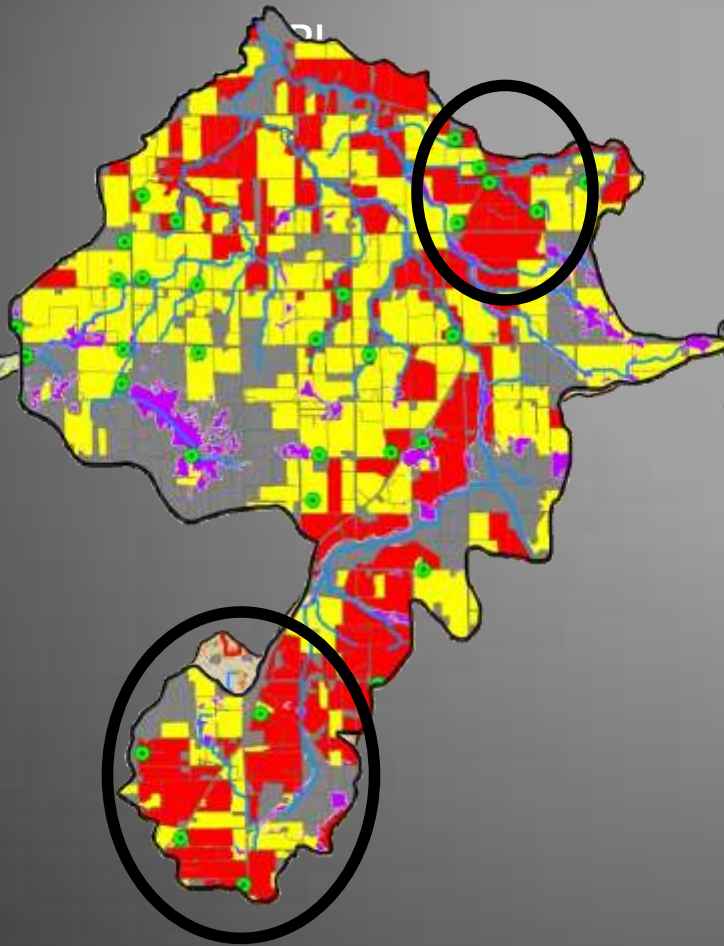
USLE



NC Areas



Positional Vulnerability



- Low
- Medium
- High

Mitigation Opportunity

$$A = K(LS)C$$


Cropland data layer



Crop Rotations



SNAP-Plus -> Rotation C Factor



Poor



Good

C Factor Adjustments

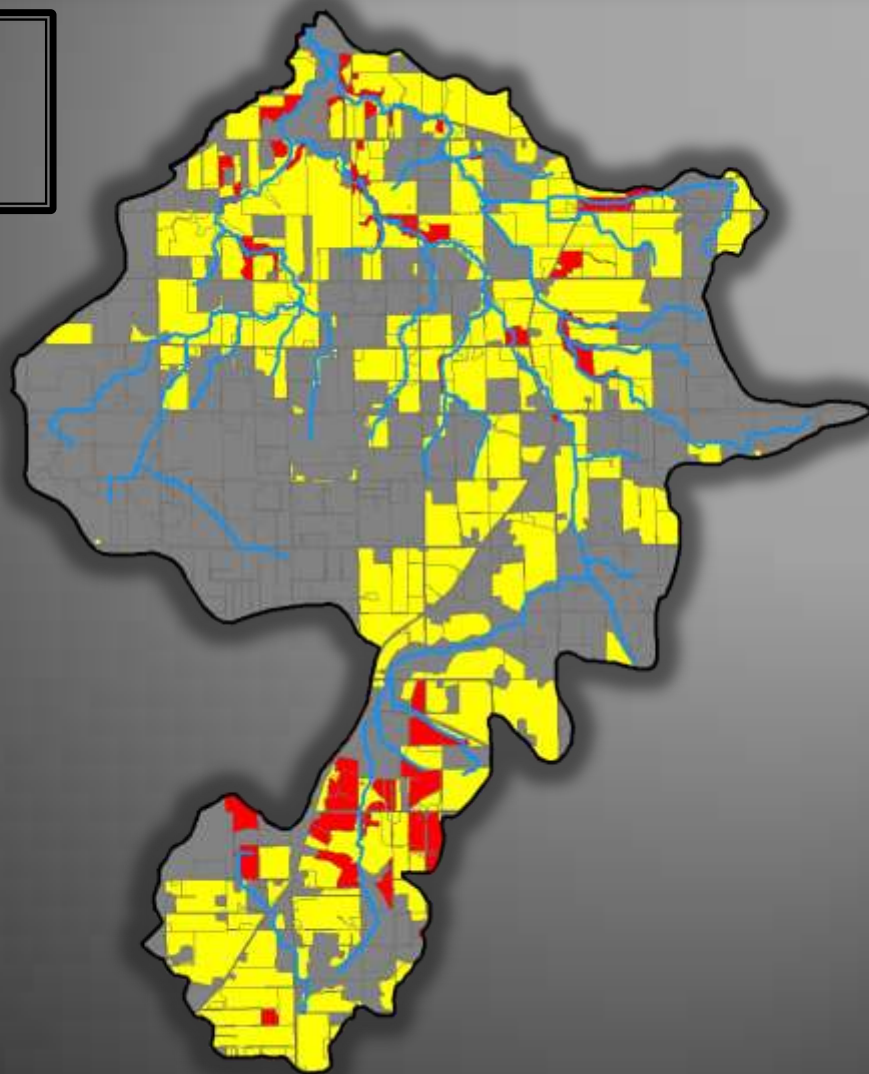
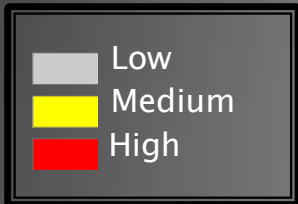


USLE w/ Low C Factor



USLE w/ High C Factor

Mitigation Opportunity



EVAAL Outputs

- ▶ Relative erosion vulnerability across watershed
 - Normalizes USLE & SPI prior to calculating vulnerability index
- ▶ What does this mean?
 - Cannot compare values from different watersheds
 - Look at relative values for one run
- ▶ How to compare across watersheds?
 - Merge USLE and SPI layers prior to running erosion vulnerability



EVAAL System Requirements

- ▶ Windows operating system
 - ▶ ArcGIS Desktop 10.x
 - ▶ ArcGIS Spatial Analyst 10.x
 - ▶ 1.5 GB RAM minimum
-
- ▶ Does not require any installation, but does need write access to file folder



Limitations

- ▶ We can't model what we don't know
 - Tillage
 - Manure application
 - BMPs
- ▶ Erosion must be driving factor
- ▶ Does not account for delivery factors or tile drainage
- ▶ Cannot “target”, rather “prioritize”



EVAAL Website

- ▶ Documents
- ▶ Tutorial Data
- ▶ ArcToolbox

ArcToolbox

ArcToolbox

▣ EVAAL_

1. Condition the LiDAR DEM
- 2a. Download precipitation data
- 2b. Create curve number raster
- 2c. Identify internally draining areas
3. Recondition DEM for internally draining areas
4. Calculate Stream Power Index
- 5a. Rasterize K-factor for USLE
- 5b. Rasterize C-factor for USLE
- 5c. Calculate soil loss index using USLE
6. Calculate erosion vulnerability index

Business Licenses & Regulations Recreation Education Topics Contact Join DNR Search or Keywords

EVAAL

Erosion Vulnerability Assessment for Agricultural Lands

Agricultural NPS pollution

Erosion Vulnerability Assessment for Agricultural Lands (EVAAL)

The Wisconsin Department of Natural Resources (WDNR) Bureau of Water Quality has developed the Erosion Vulnerability Assessment for Agricultural Lands (EVAAL) toolset to assist watershed managers in prioritizing areas within a watershed which may be vulnerable to water erosion (and thus increased nutrient export) and thus may contribute to downstream surface water quality problems. It evaluates locations of relative vulnerability to sheet, rill and gully erosion using information about topography, soils, rainfall and land cover. This tool enables watershed managers to prioritize and focus field-scale data collection efforts, thus saving time and money while increasing the probability of locating fields with high sediment and nutrient export for implementation of best management practices (BMPs).

Erosion Vulnerability Index

EVAAL was designed to quickly identify areas vulnerable to erosion, and thus more likely to export nutrients like phosphorus, using readily available data and a user-friendly interface. This tool estimates vulnerability by separately assessing the risk for sheet and rill erosion (using the Universal Soil Loss Equation, USLE), and gully erosion (using the Stream Power index, SPI), while deprioritizing those areas that are not hydrologically connected to surface waters (also known as internally drained areas, IDA). These three pieces are combined to produce an erosion vulnerability index value that can be assessed at the grid scale or aggregated to areas, such as field boundaries.

EVAAL, Version 1.0 (August 2014)

- [Fact Sheet \(PDF\)](#)
- [Tutorial \(PDF\)](#)
(Includes installation instructions to be read prior to downloading EVAAL model files)
- [Methods Documentation \(PDF\)](#)
- [EVAAL Model Files \(zipped\)](#)
- [EVAAL Tutorial Data \(PDF\) \(zipped\)](#)

Contact information

For questions or information about this model, please contact:

[Theresa M. Possley Nelson, P.E.](#)
TMDL modeling engineer
Project manager

Last revised: Friday September 26 2014

Nonpoint source pollution

Agricultural nonpoint source pollution

Learn more about agricultural nonpoint source pollution

Urban nonpoint source pollution

Learn more about urban nonpoint source pollution

What you can do

Learn more about controlling nonpoint source pollution in your area

TMDL implementation

Learn more about what the DNR is doing to control nonpoint source pollution

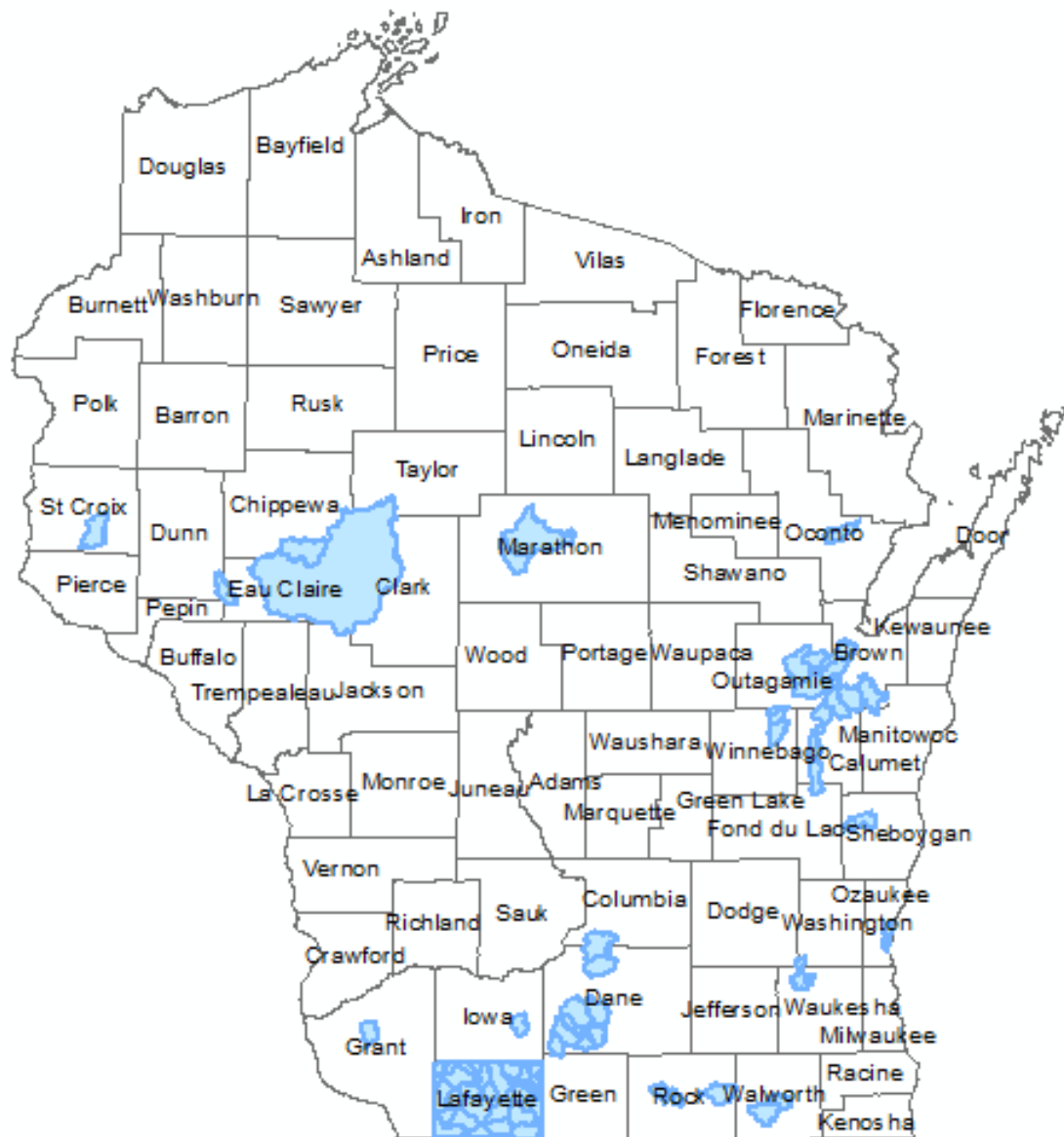
Related links

- [Environmental impacts](#)
- [Wisconsin Runoff Rules: What Farmers Need to Know \(PDF\)](#)
- [NR 151 implementation strategy](#)
- [Agricultural technical standards & assistance](#)
- [Financial assistance](#)
- [Discharges, complaints & assistance](#)
- [Notices of discharge](#)
- [Nonpoint program contacts](#)

<http://dnr.wi.gov/topic/nonpoint/evaal.html>



EVAAL Applications



EVAAL

»» How to use the model

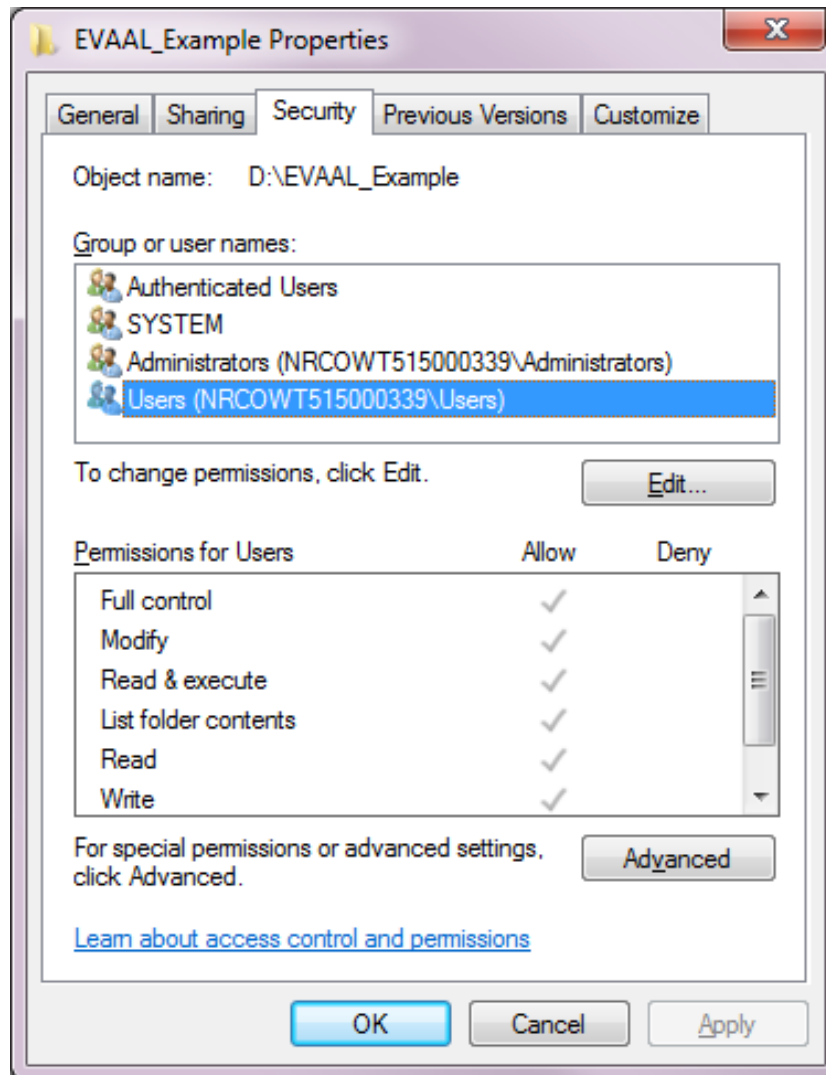
Model Setup

- ▶ Check folder permissions
- ▶ Check ArcMap versions
- ▶ Where to download EVAAL
- ▶ Load EVAAL toolbox and Spatial Analyst Extension in ArcMap

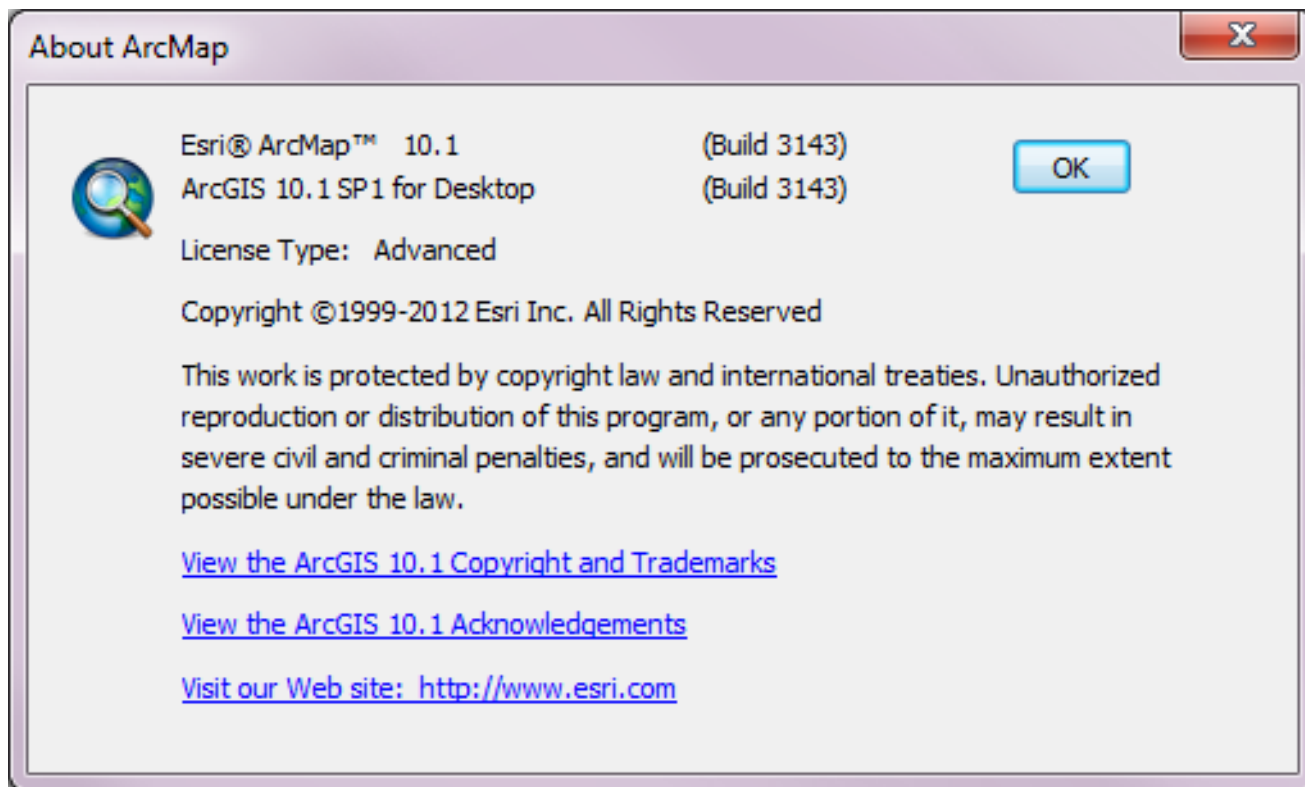
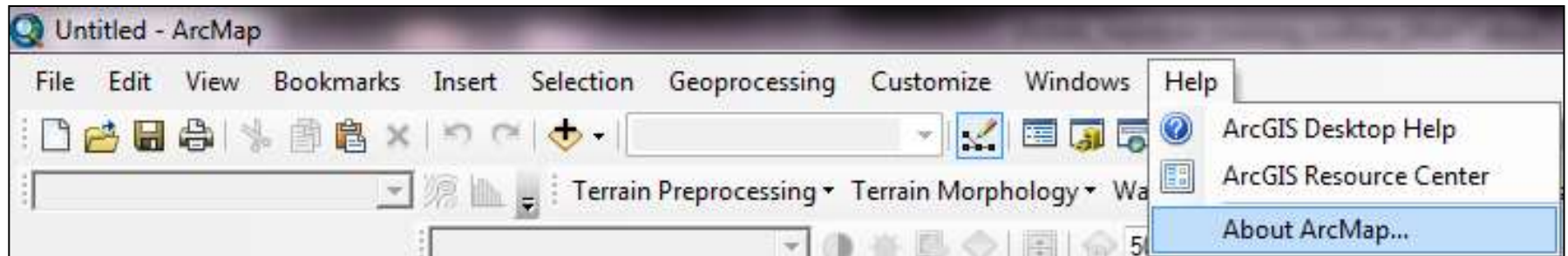


Check Folder Permissions

- ▶ Need permission to Read & Write



Check ArcMap Version



Download EVAAL

<http://dnr.wi.gov/>



WISCONSIN DNR Department of Natural Resources

May is Clean Air

It all adds up to clean

Business Licenses & Regulations Recreation Education Contact

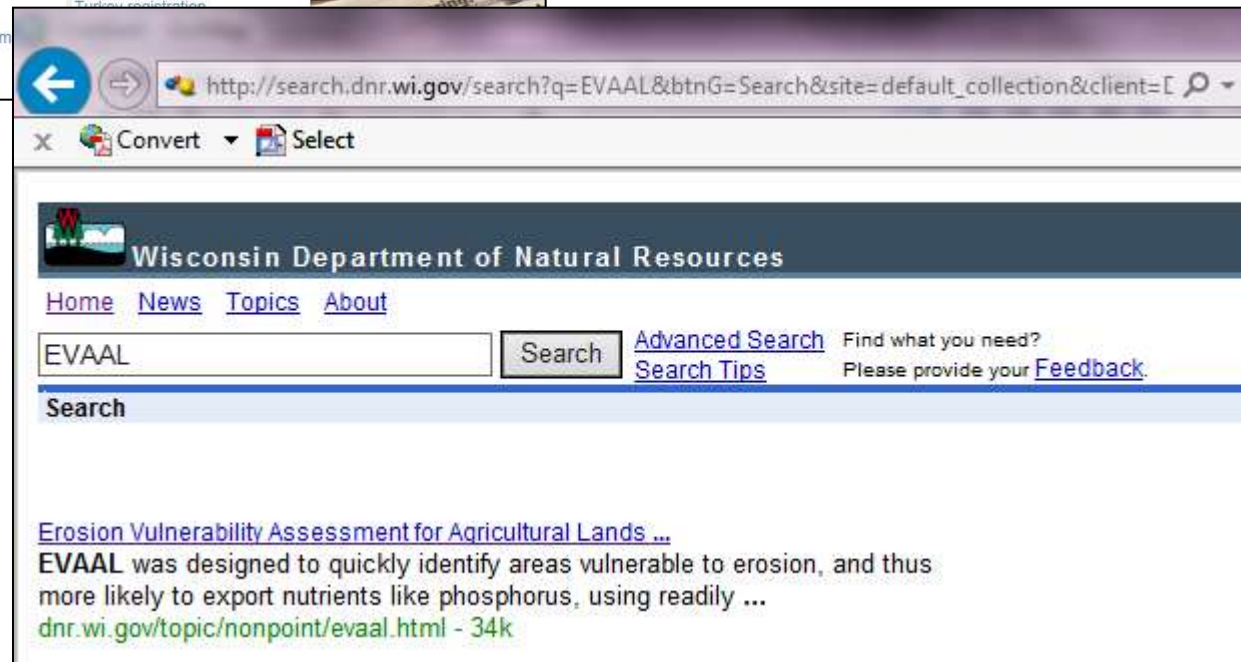
EVAAL HELP

Quick tasks

- Reserve a campsite
- Burn permits
- Online license center
- Emergency & enforcement

Popular links

Fishing Season 2015 is now



Wisconsin Department of Natural Resources

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EVAAL [Advanced Search](#) Find what you need?
[Search Tips](#) Please provide your [Feedback](#).

Search

[Erosion Vulnerability Assessment for Agricultural Lands ...](#)
EVAAL was designed to quickly identify areas vulnerable to erosion, and thus more likely to export nutrients like phosphorus, using readily ...
dnr.wi.gov/topic/nonpoint/evaal.html - 34k



Download EVAAL

Agricultural NPS pollution

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The Wisconsin Department of Natural Resources (WDNR) Bureau of Water Quality has developed the Erosion Vulnerability Assessment for Agricultural Lands (EVAAL) toolset to assist watershed managers in prioritizing areas within a watershed which may be vulnerable to water erosion (and thus increased nutrient export) and thus may contribute to downstream surface water quality problems. It evaluates locations of relative vulnerability to sheet, rill and gully erosion using information about topography, soils, rainfall and land cover. This tool enables watershed managers to prioritize and focus field-scale data collection efforts, thus saving time and money while increasing the probability of locating fields with high sediment and nutrient export for implementation of best management practices (BMPs).

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USLE + SPI + IDA

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Related links

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- [Wisconsin Runoff Rules](#)

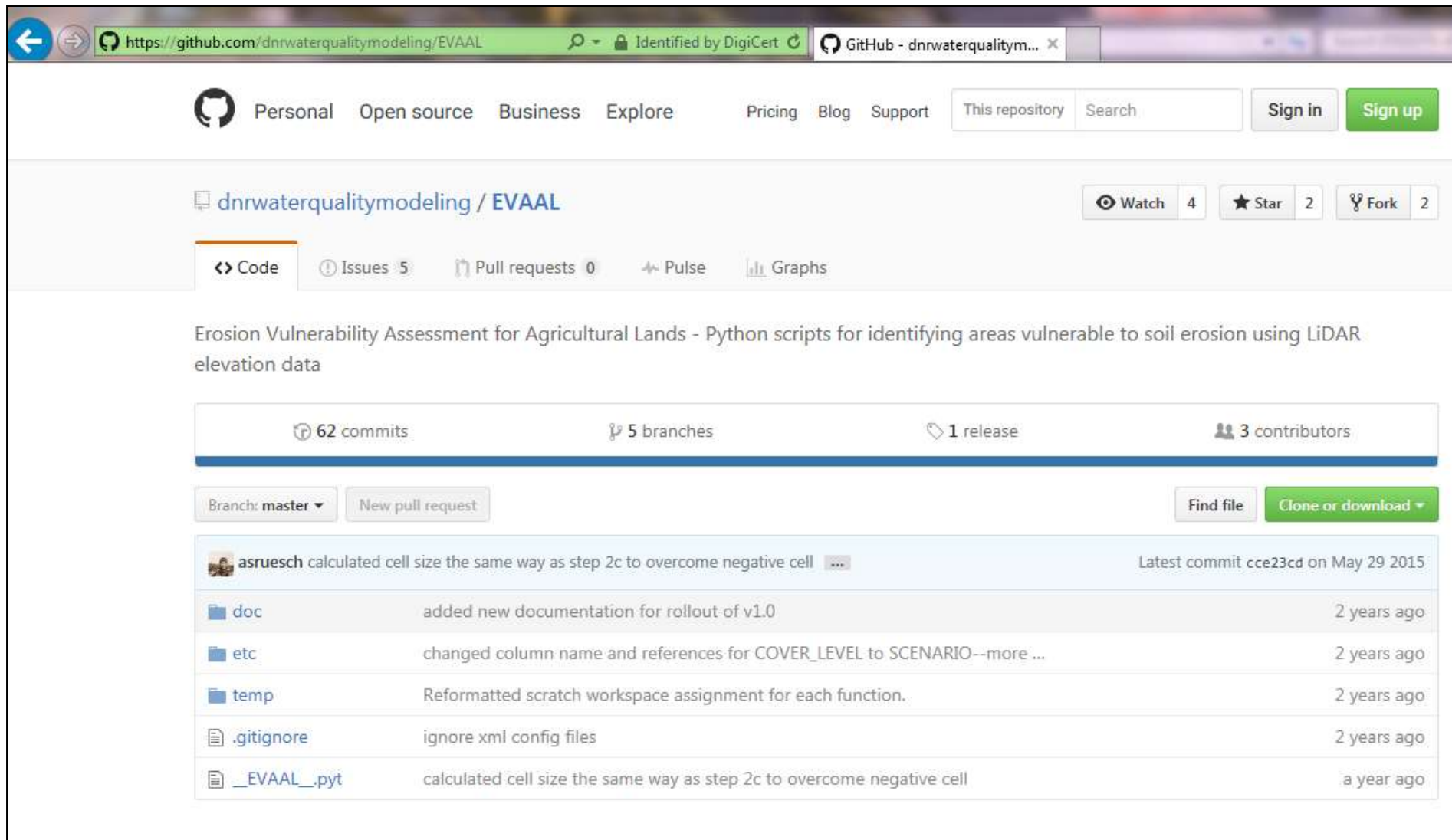
EVAAL, Version 1.0.1 (December 2015)

(Although updates to the model files were made in December, documentation remains the same.)

- [Fact Sheet \[PDF\]](#)
- [Tutorial \[PDF\]](#)
(Includes installation instructions to be read prior to downloading EVAAL model files)
- [Methods Documentation \[PDF\]](#)
- [EVAAL Model Files \[exit DNR\]](#)
- [EVAAL Tutorial Data \[FTP site, ZIP file format\]](#) (~~includes 2014 gSSURGO geodatabase~~)



Download EVAAL

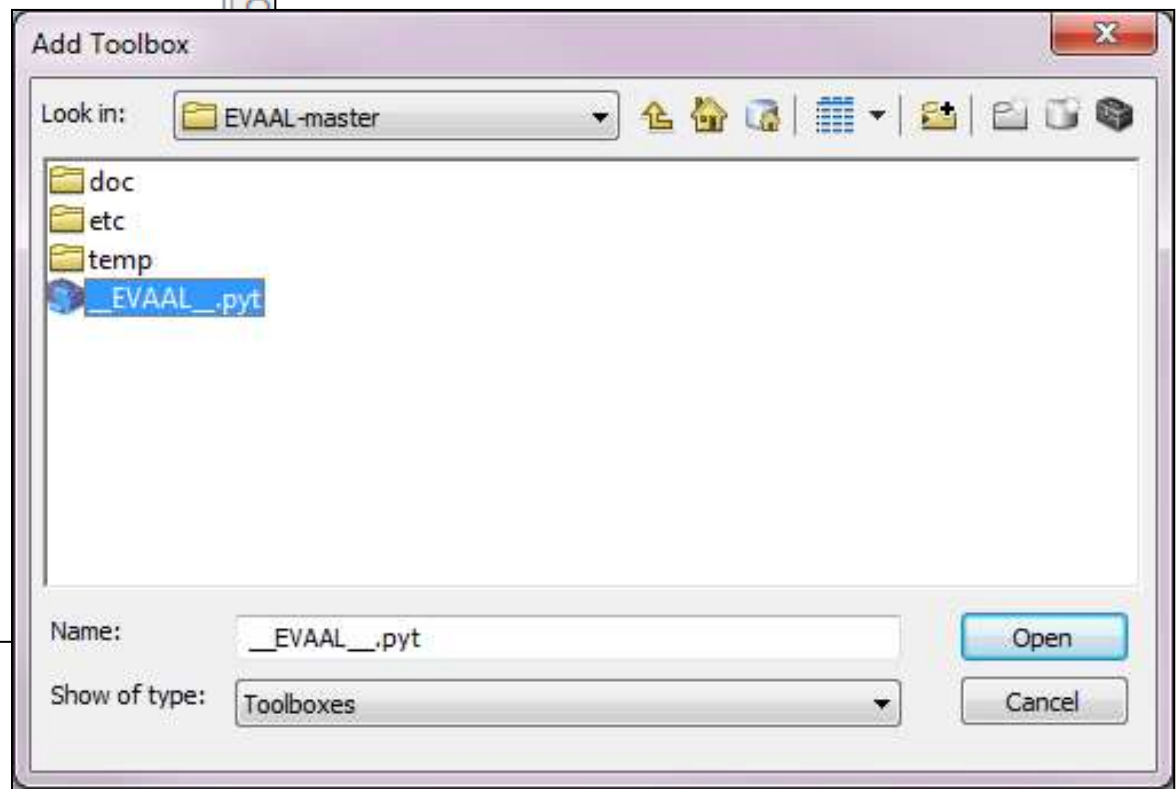
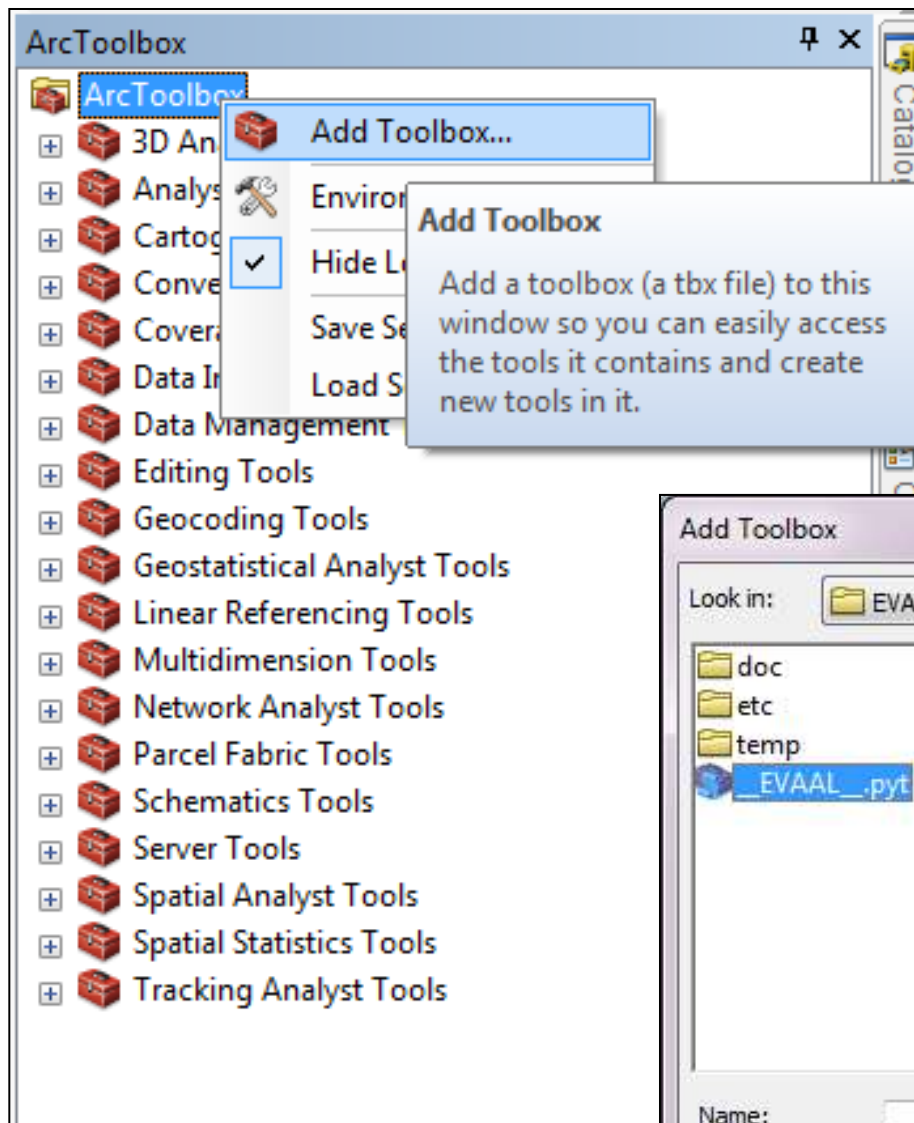


The screenshot shows the GitHub repository page for `dnrwaterqualitymodeling/EVAAL`. The browser address bar shows the URL `https://github.com/dnrwaterqualitymodeling/EVAAL`. The repository name is `dnrwaterqualitymodeling / EVAAL`. The repository has 62 commits, 5 branches, 1 release, and 3 contributors. The latest commit is by `asruesch` on May 29, 2015, with the message "calculated cell size the same way as step 2c to overcome negative cell". The commit history table is as follows:

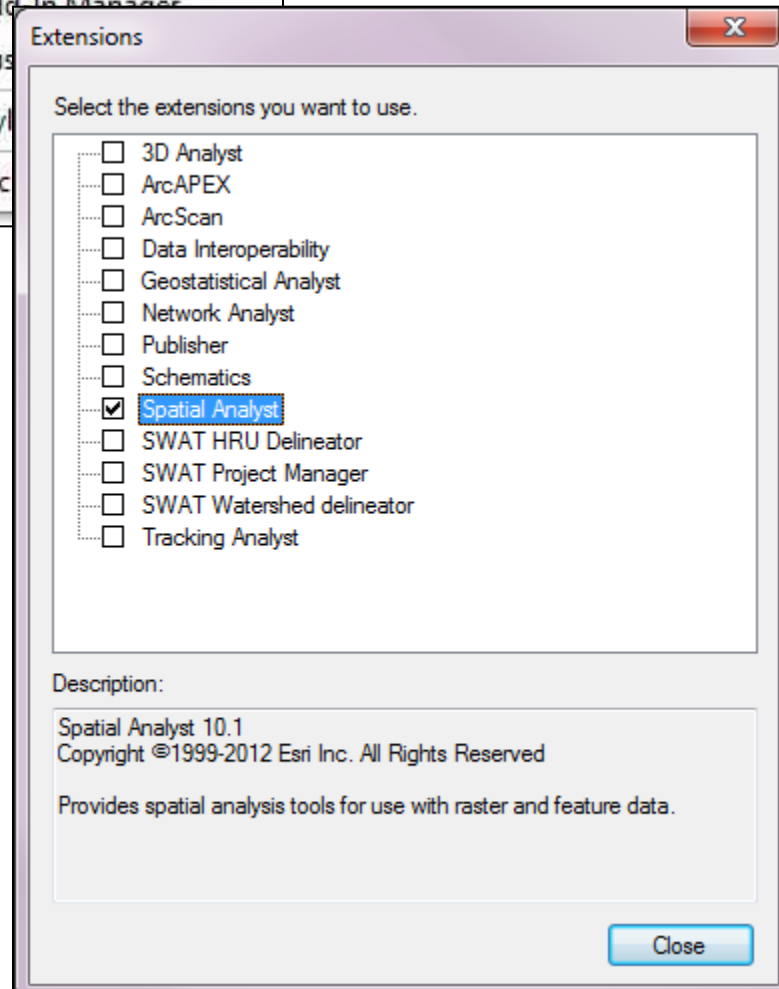
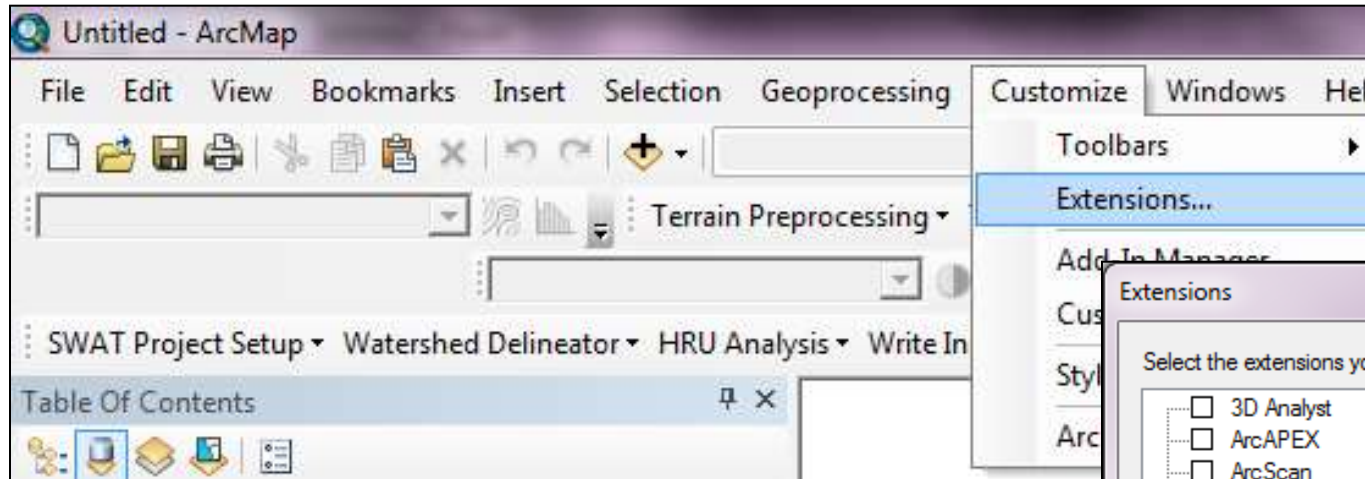
File	Commit Message	Time
<code>doc</code>	added new documentation for rollout of v1.0	2 years ago
<code>etc</code>	changed column name and references for COVER_LEVEL to SCENARIO--more ...	2 years ago
<code>temp</code>	Reformatted scratch workspace assignment for each function.	2 years ago
<code>.gitignore</code>	ignore xml config files	2 years ago
<code>__EVAAL__.pyt</code>	calculated cell size the same way as step 2c to overcome negative cell	a year ago



Load Toolbox



Load Spatial Analyst Extension



Inputs

- ▶ Coordinate projection
- ▶ Watershed & buffered watershed
- ▶ DEM
- ▶ gSSURGO
- ▶ Culverts



Coordinate Projection

- ▶ EVAAL requires all datasets to be in Wisconsin Transverse Mercator projection (meters)
 - EPSG: 3071
 - NAD_1983_HARN_Wisconsin_TM
 - NAD_1983_HARN_Transverse_Mercator
 - ftp://dnrftp01.wi.gov/geodata/projection_file/



Watershed boundary

The screenshot shows the ArcMap interface with a watershed boundary displayed in the map view. The 'Layers' panel on the left shows a layer named 'watershed'. A 'Layer Properties' dialog box is open in the foreground, displaying the 'Source' tab with coordinate system information.

Layer Properties - Source Tab

Extent	
Top:	426659.009000 m
Left:	660664.390800 m
Right:	664028.679000 m
Bottom:	422679.009000 m

Data Source	
Projected Coordinate System:	NAD_1983_HARN_Wisconsin_TM
Projection:	Transverse_Mercator
False_Easting:	520000.00000000
False_Northing:	-4480000.00000000
Central_Meridian:	-90.00000000
Scale_Factor:	0.99960000
Latitude_Of_Origin:	0.00000000
Linear Unit:	Meter
Geographic Coordinate System:	GCS_North_American_1983_HARN

Buttons: Set Data Source..., OK, Cancel, Apply

Where to get watershed boundaries?

- ▶ HUCs:

ftp://dnrftp01.wi.gov/geodata/WI_WBD_HUCs/

- ▶ WHD-plus:

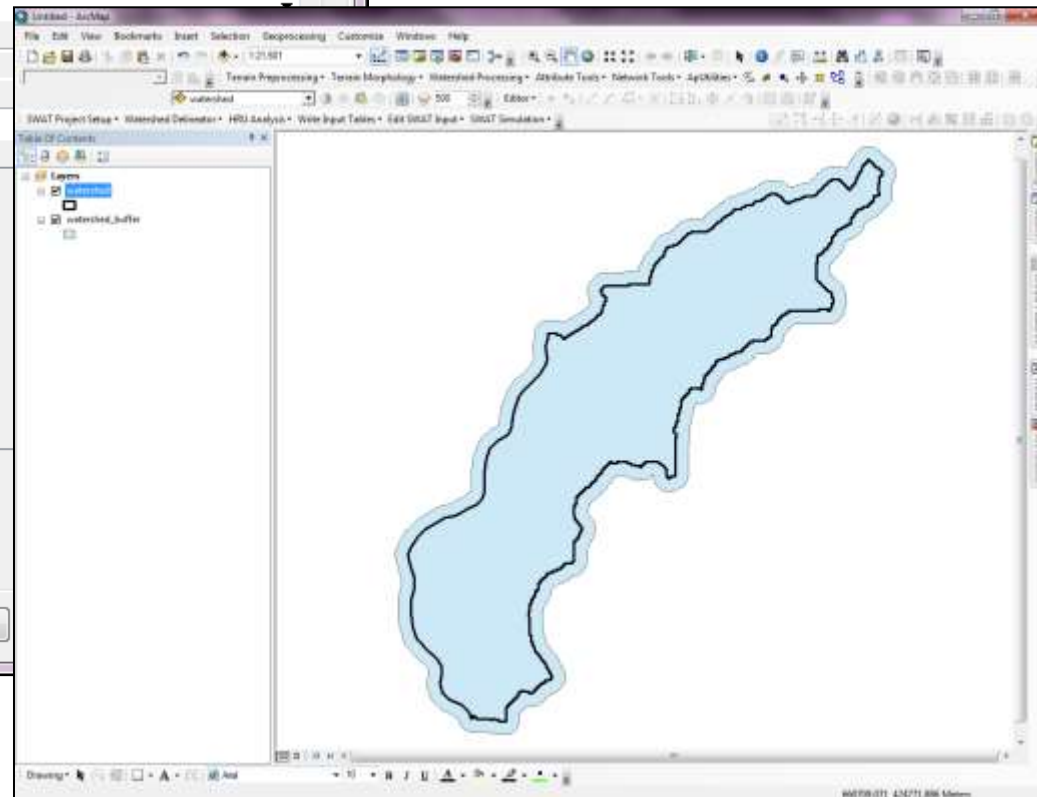
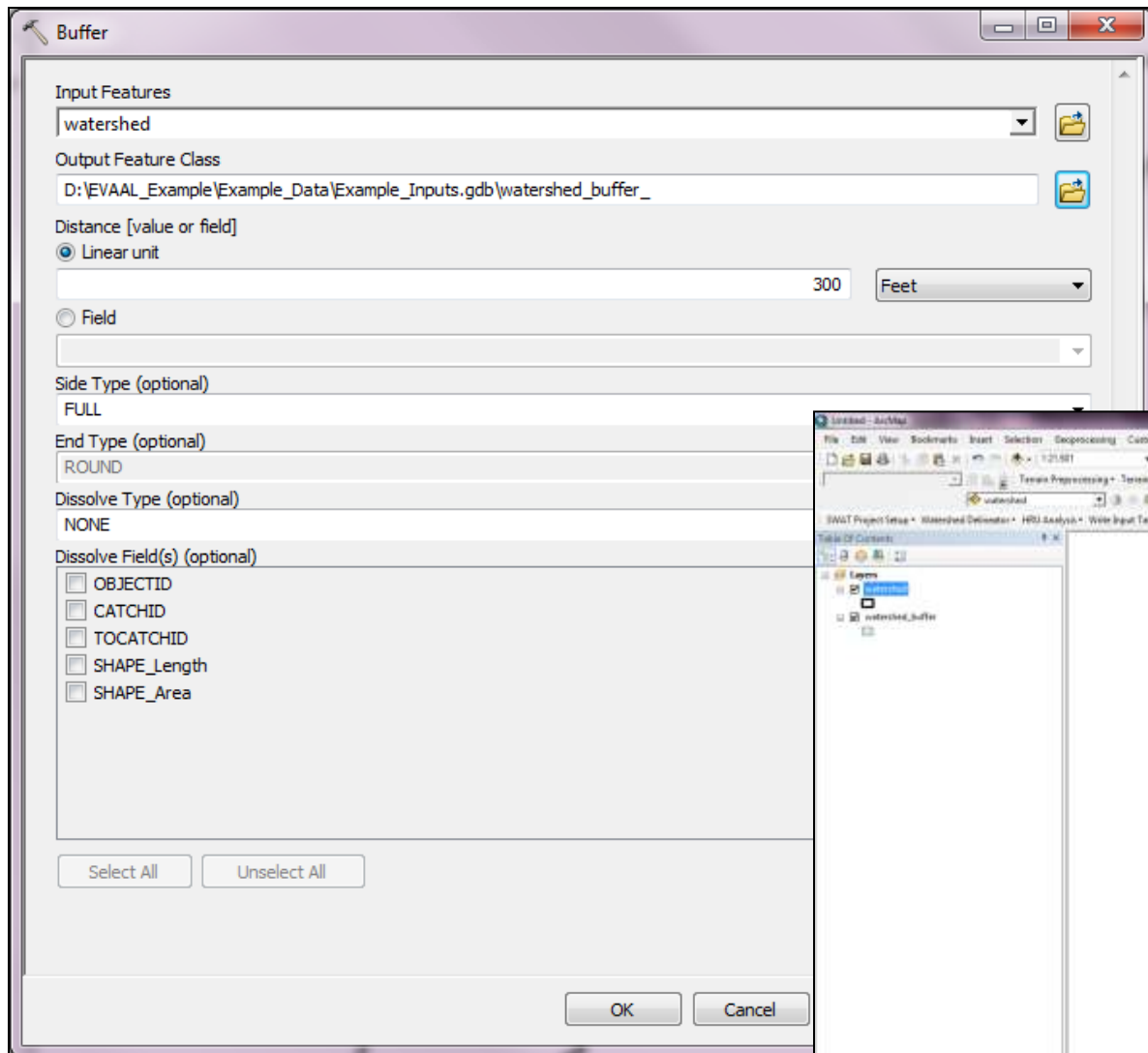
ftp://dnrftp01.wi.gov/geodata/hydro_va_24k/

- ▶ USGS: <http://viewer.nationalmap.gov/viewer/>

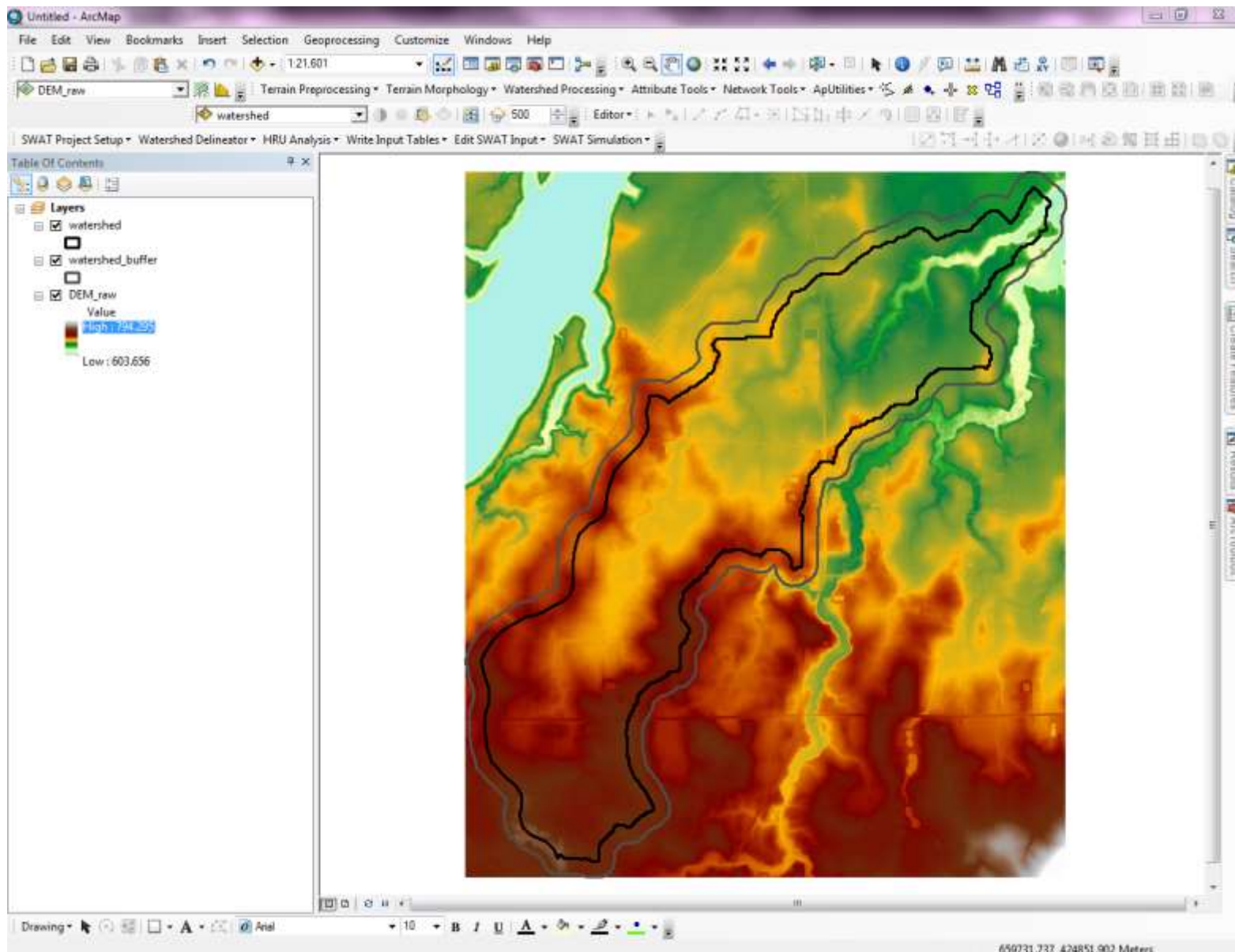
- ▶ USDA: <https://gdg.sc.egov.usda.gov/>



Buffered Watershed

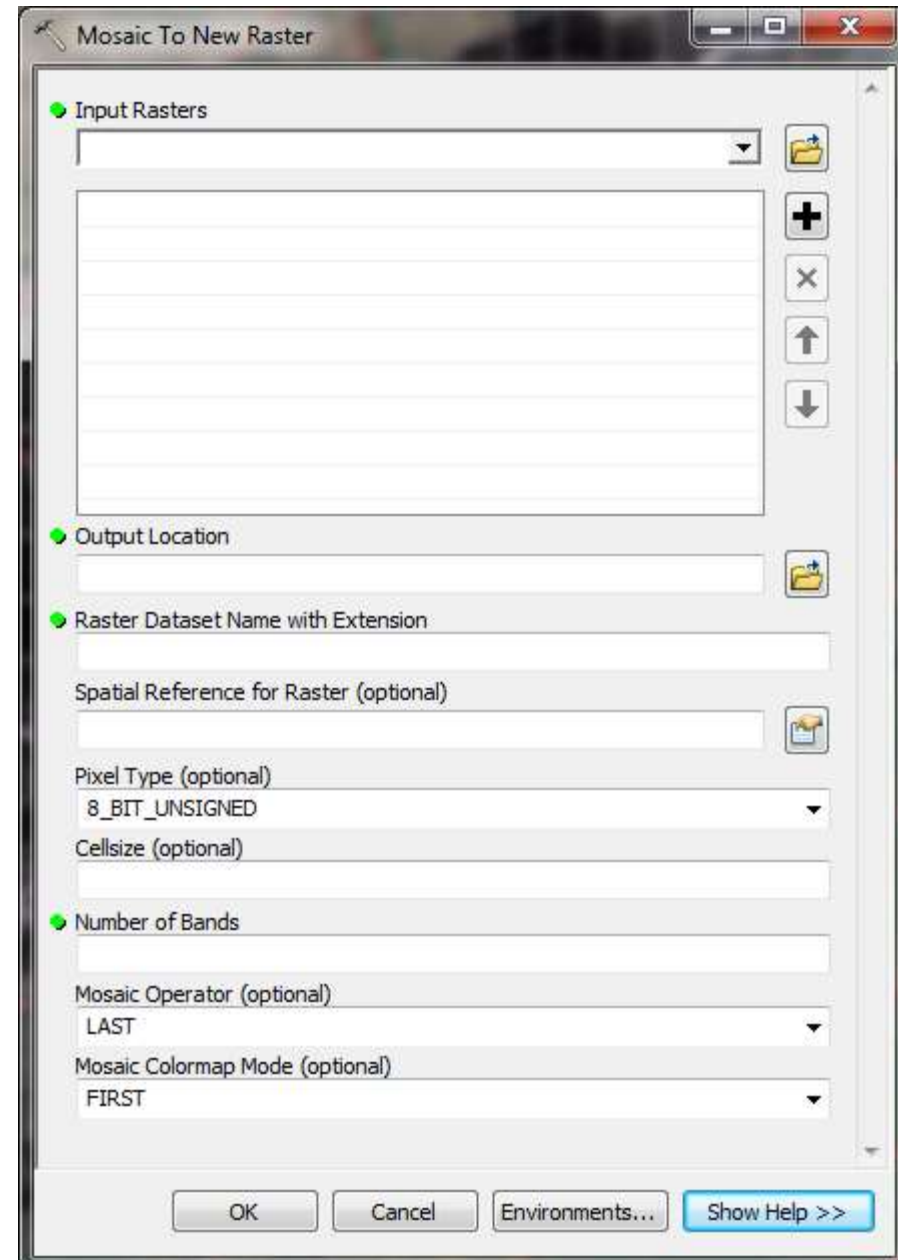


DEM



Combine multiple rasters

- ▶ Mosaic to New Raster Tool
 - Specify Pixel Type the same as input rasters



The screenshot shows the homepage of the Geospatial Data Gateway. At the top, there is a navigation bar with links: Home, Login, Check Order, Status Maps, News, Data Policy, FAQ, Help, Admin, and Contact Us. Below this is a search bar with a 'Go' button. To the left is a 'Browse by Subject' menu with links to various services like Natural Resources, Farm Services Agency, and Rural Development. The main content area features a 'Welcome to GDG' section with a large image of a natural rock arch and the text 'the one stop source for environmental and natural resource data'. Below this is a 'System Status' section with a 'Please Note' dated 4/29/2015 12:32:14 PM MST, stating that the gateway is running normally with a new version. To the right of the main content is a 'GET DATA' button and a 'Place a Data Order GDG' button. At the bottom right, there is an 'I Want To...' section with a list of options: Order by County/Countries, Order by State, Order by Place, Order by Bounding Rectangle (Center Latitude and Longitude), Order by Interactive Map - Custom Area Of Interest (AOI), Find Available Data for the U.S., and Check Status of an Existing Order. The footer contains 'NRCS Home | USDA | My USDA | FOIA | Accessibility Statement | Privacy Policy | Non-Discrimination Statement | Information Quality | FirstGov | White House' and a 'Last Modified' timestamp of 9/12/2014 12:40:34 PM.



gSSURGO

The screenshot shows a web browser window with the URL <https://gdg.sc.egov.usda.gov/GDGOrder.aspx>. The page header includes the USDA logo and text: "United States Department of Agriculture Natural Resources Conservation Service" and "GeoSpatial Data". A navigation bar contains links for "Home", "Status Maps", "Help", "FAQ", and "Contact Us". The main content area is titled "WHERE" and contains the instruction: "If you wish to change the method for selecting the order area, click [HERE](#)." Below this is a section titled "Order by County/Countries" with a dropdown menu labeled "Select State for order:" and "Select State". A tooltip "Change WHERE option" is visible over the dropdown. On the left, a sidebar titled "1-WHERE" contains the heading "Order by County/Countries" and a paragraph: "Using the panel in the middle select the state for your order. A list of available counties for that state will then be displayed. Select one or more items from the **Available Counties**. The *shift* and *ctrl* keys are...". On the right, a sidebar titled "YOU" contains links for "Order Map La" and "Order Format".



WHERE

If you wish to change the method for selecting the order area, click [HERE](#).

Order by State

Select entire state for order:

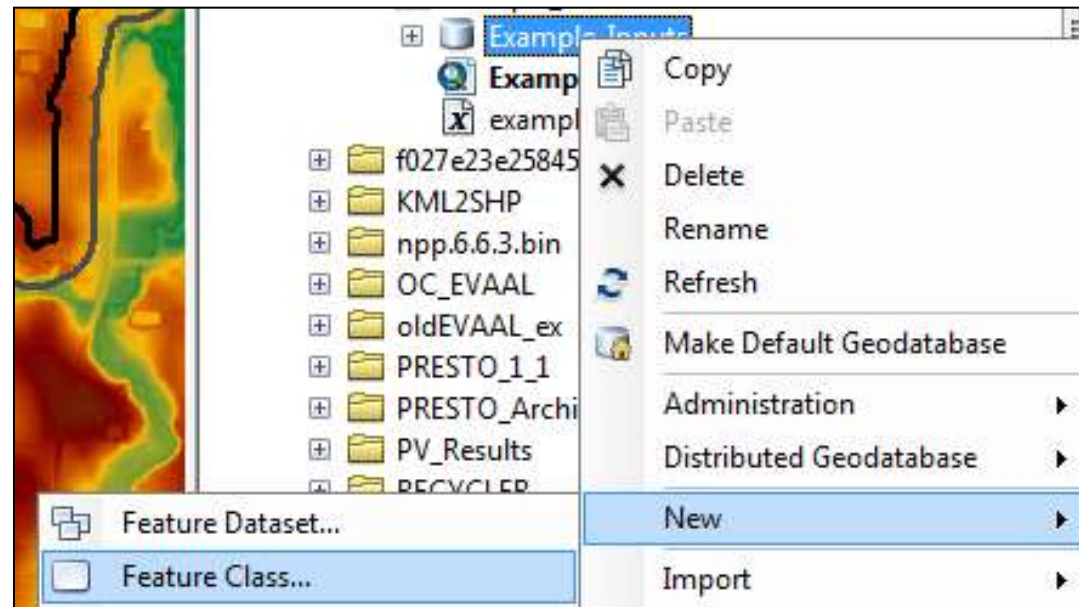
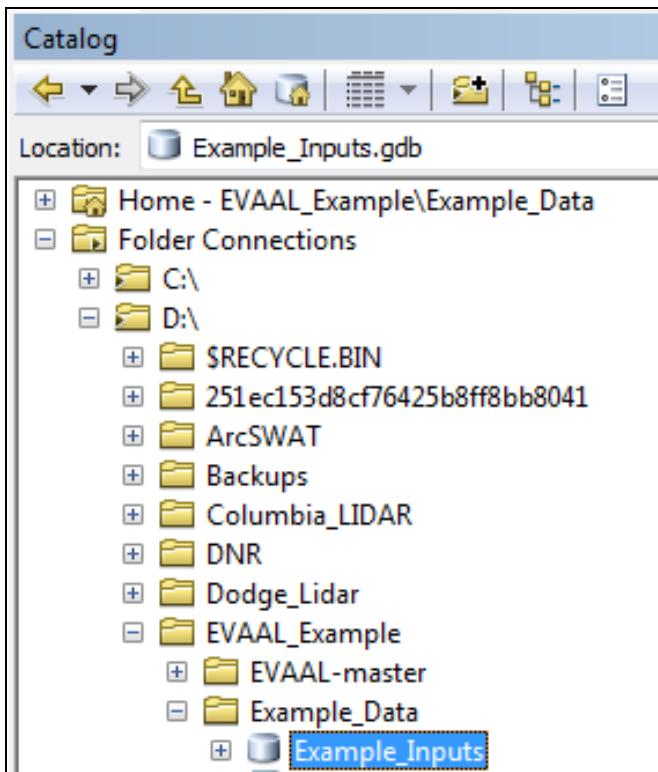
Nevada
New York
Ohio
Oklahoma
Oregon
Pennsylvania
Puerto Rico
Palau
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Baker Island
Howland Island
Jarvis Island
Johnston Atoll
Kingman Reef
Midway Islands
Navassa Island
Palmyra Atoll
Wake Island
Utah
Virginia
Virgin Islands of the U.S.
Vermont
Washington
Wisconsin
West Virginia
Wyoming

Soils

- Major Land Resource Areas by State, 1 map 2.616 MB  
- Common Resource Areas by State, 1 map 2.500 MB  
- Soil Survey Spatial and Tabular Data (SSURGO 2.2), 69 maps 2177.970 MB  
- U.S. General Soil Map (STATSGO2) by State, 1 map 5.363 MB  
- Gridded Soil Survey Geographic (gSSURGO) by State **or Conterminous U.S.**, 1 map 1360.892 MB  

Culverts

- ▶ Create empty feature class



Culverts

New Feature Class

Name:

Alias:

Type
Type of features stored in this feature class:

Geometry Properties

Coordinates include M values. Used to store route data.

Coordinates include Z values. Used to store 3D data.

< Back Next > Cancel

New Feature Class

Choose the coordinate system that will be used for XY coordinates in this data.

Geographic coordinate systems use latitude and longitude coordinates on a spherical model of the earth's surface. Projected coordinate systems use a mathematical conversion to transform latitude and longitude coordinates to a two-dimensional linear system.

Type here to search

- NAD 1983 HARN Texas Centric Mapping System Albers (Me
- NAD 1983 HARN Texas Centric Mapping System Lambert (M
- NAD 1983 HARN Virginia Lambert (Meters)
- NAD 1983 HARN Wisconsin TM (Meters)**
- NAD 1983 HARN Wisconsin TM (US Feet)
- NAD 1983 Idaho TM (Meters)
- NAD 1983 Michigan GeoRef (Meters)
- NAD 1983 Michigan GeoRef (US Feet)
- NAD 1983 Michigan TM (Meters)

Current coordinate system:

NAD_1983_HARN_Wisconsin_TM
WKID: 3071 Authority: EPSG

Projection: Transverse_Mercator
False_Easting: 520000.0
False_Northing: -4480000.0
Central_Meridian: -90.0
Scale_Factor: 0.9996
Latitude_Of_Origin: 0.0
Linear Unit: Meter (1.0)

< Back Next > Cancel



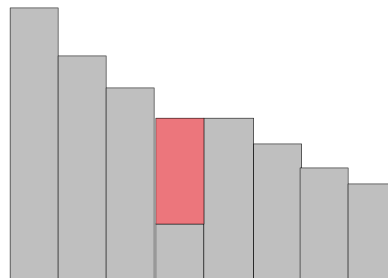
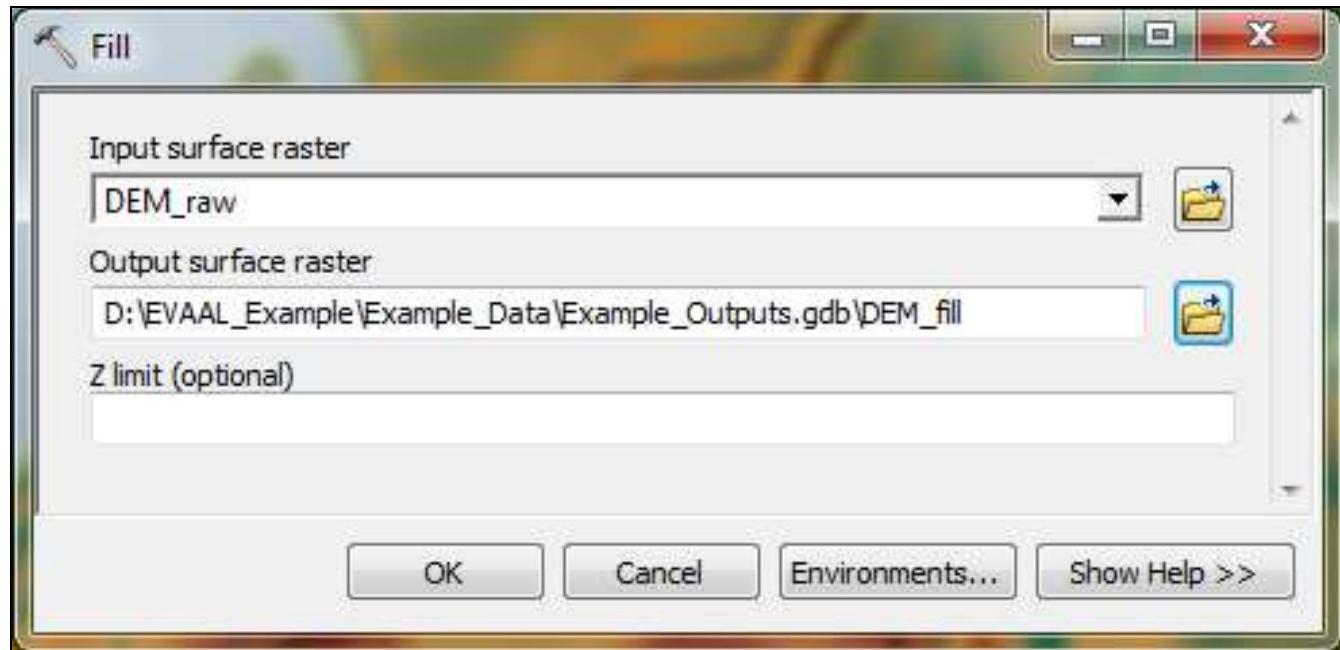
Where to place culvert cut lines

- ▶ Create depression raster
- ▶ Add additional layers
- ▶ Draw culverts
- ▶ Run steps 1 thru 2c
 - Review internally draining areas
 - Add more culverts if necessary
 - Repeat steps 1 & 2c



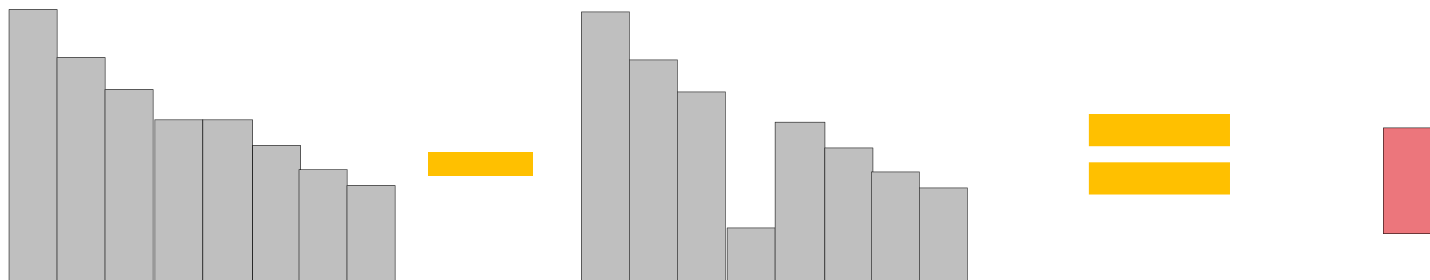
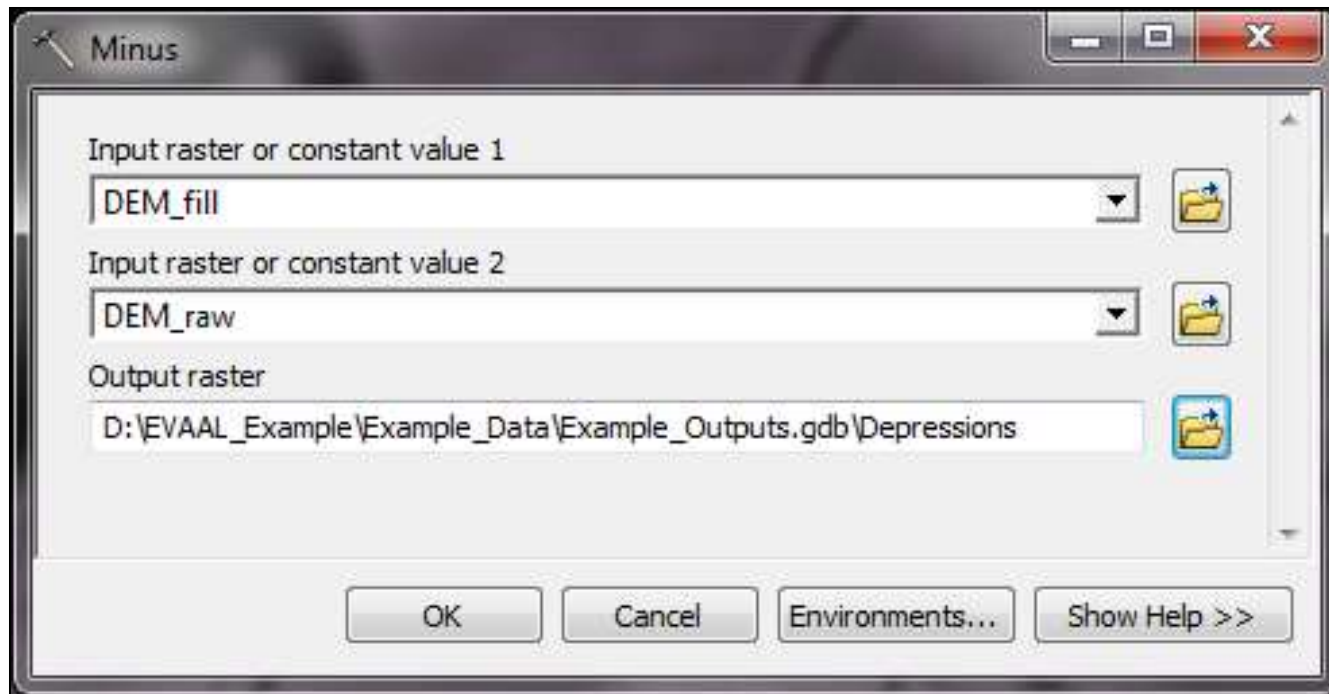
Create Depression Raster

► Fill DEM



Create Depression Raster

- ▶ Subtract filled DEM from raw DEM



Add additional layers

- ▶ Aerial photo basemap
- ▶ Streams
- ▶ Roads

- ▶ Others
 - Wetlands
 - Lakes



Create Culverts

- ▶ **Main idea:** input culverts to areas that are drained by culverts, bridges, etc.
 - Find sinks that are likely drained by culverts
 - Create a line that represents a culvert
 - Repeat
- **NOTE:** this can be a difficult and iterative process. It will take some time to get right and will involve a number of judgment calls.



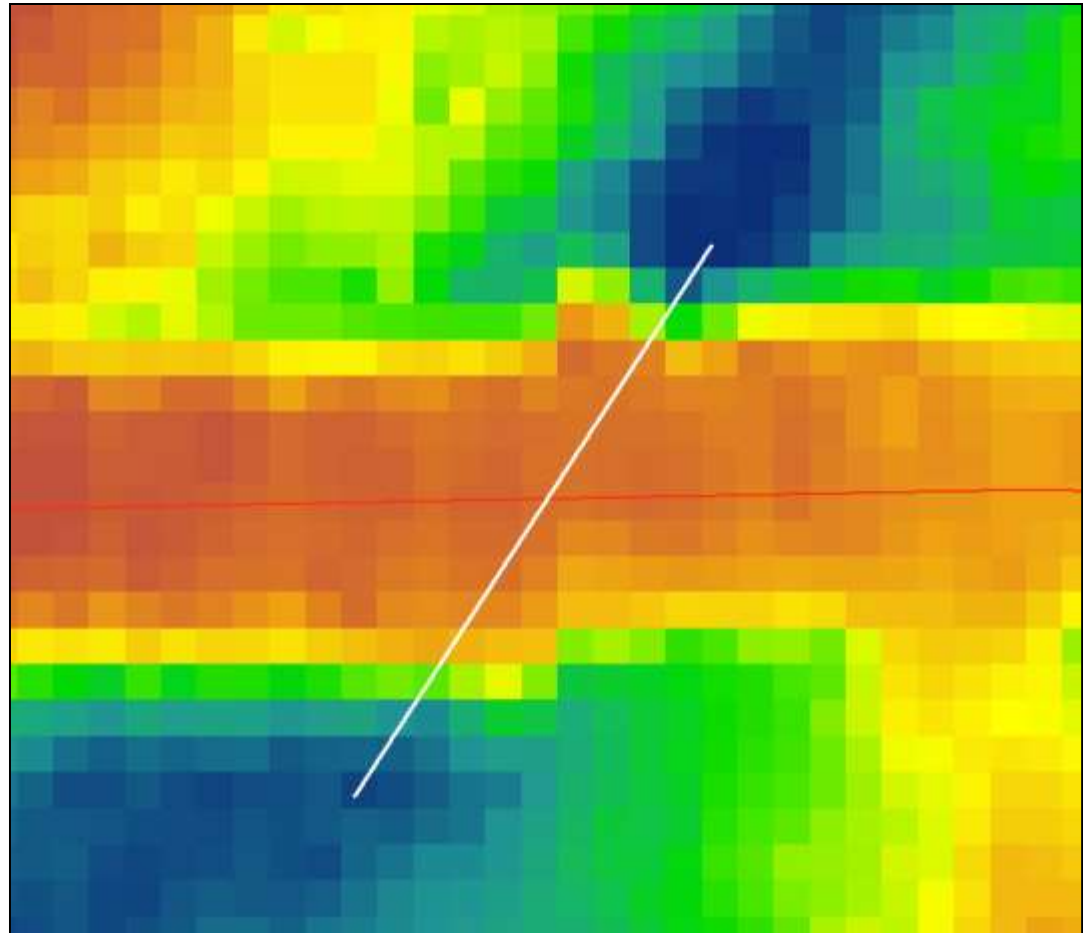
Create Culverts

- ▶ Zoom in to depression area
- ▶ Look for evidence of channel/culvert

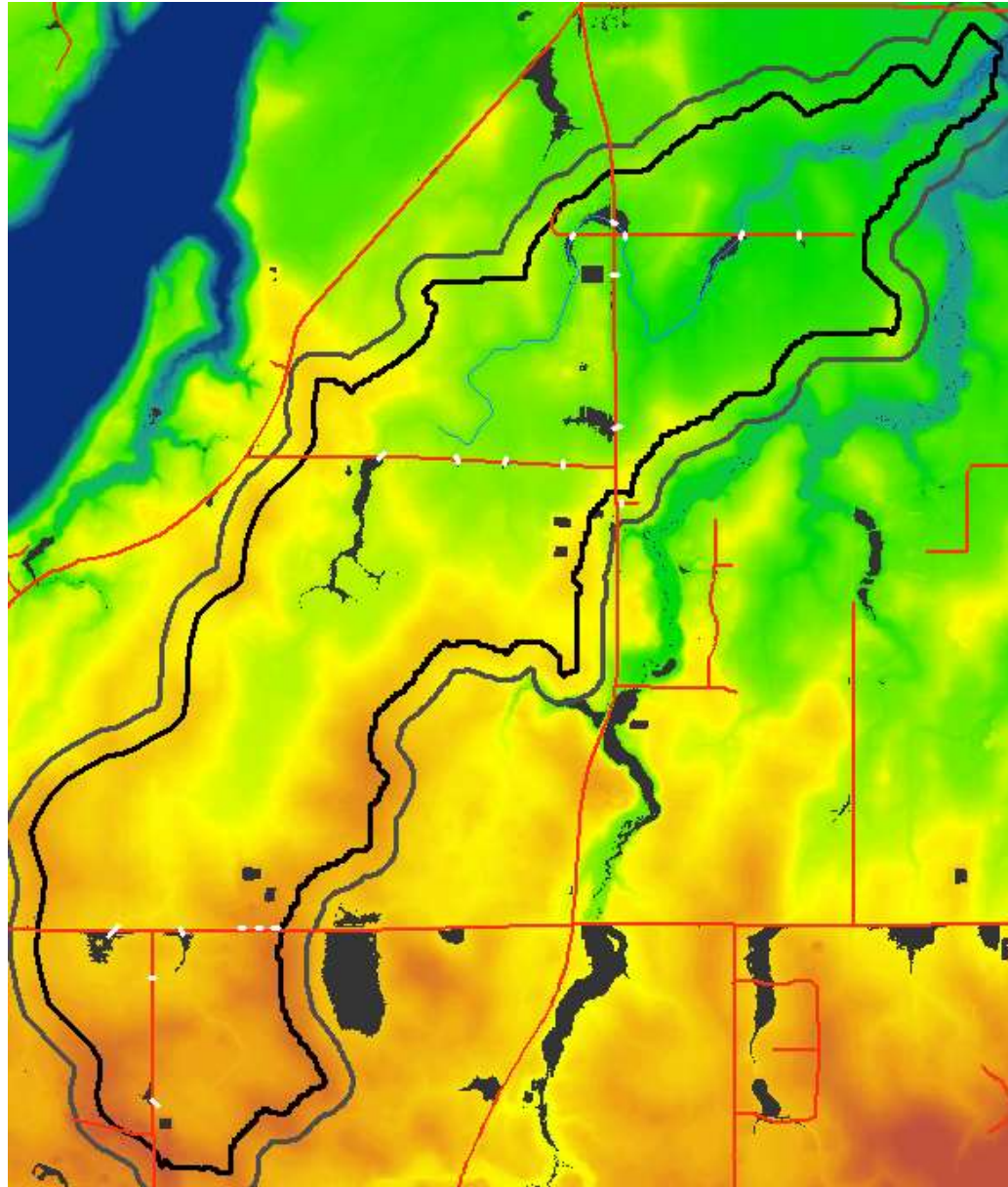


Create Culverts

- ▶ Turn on raw DEM
- ▶ Draw culvert line
 - Upstream to downstream
 - First point of line must be higher elevation than second point



Create Culverts



Step 1: Condition DEM

1. Condition the LiDAR DEM

Culverts
Culverts

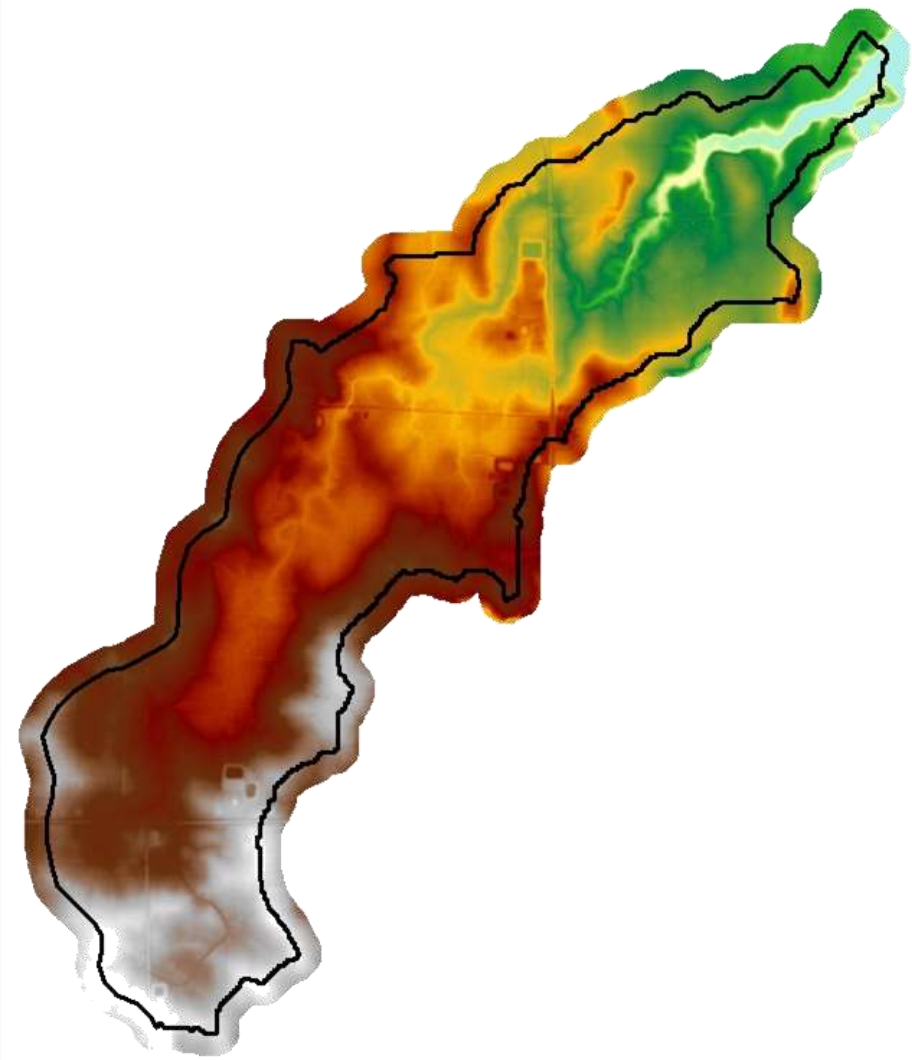
Watershed area (unbuffered)
watershed

Raw LIDAR DEM
DEM_raw

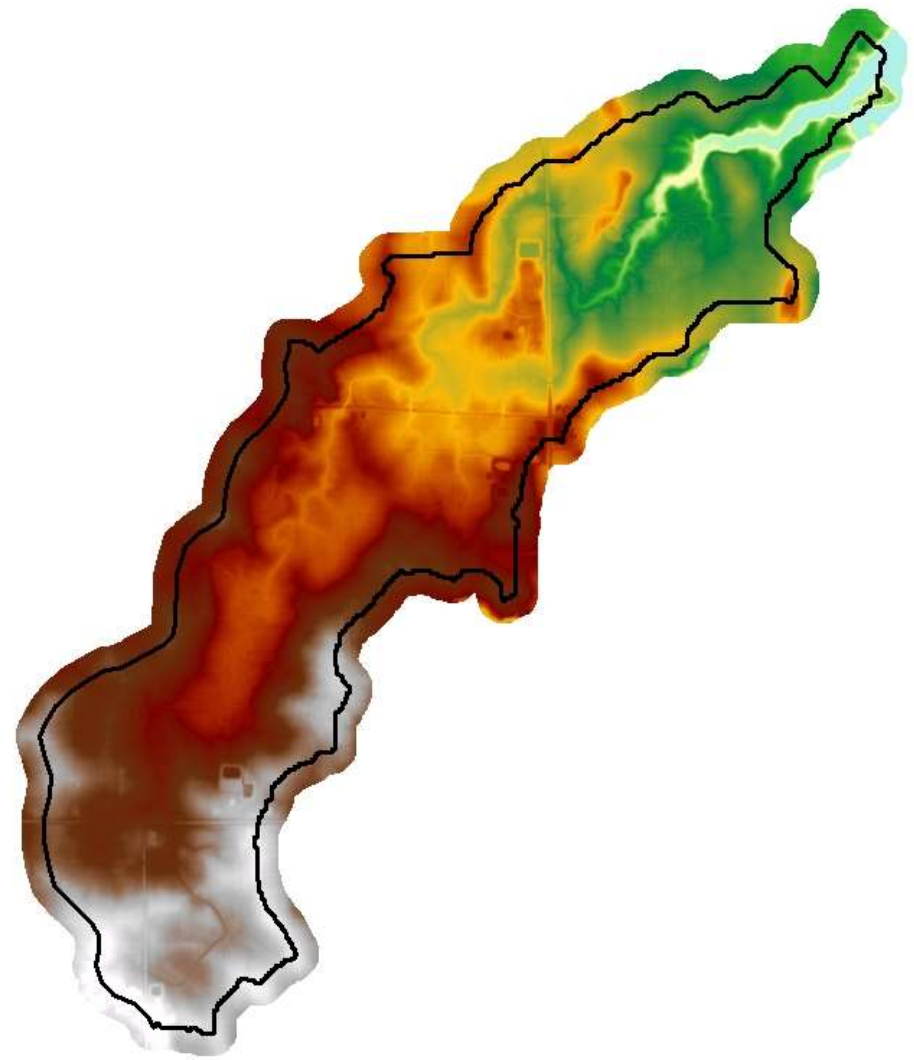
Output conditioned DEM, select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\DEM_cond

Output optimized fill, select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\DEM_opfill

OK Cancel Environments... Show Help >>



Conditioned DEM
"DEM_cond"



Optimized Filled DEM
"DEM_opfill"

Step 2a: Download precip data

2a. Download precipitation data

Download frequency-duration data? If yes, define frequency and duration below.

Frequency (years) (optional)
10

Duration (hours) (optional)
24

Locally stored frequency-duration data (zip file) (optional)

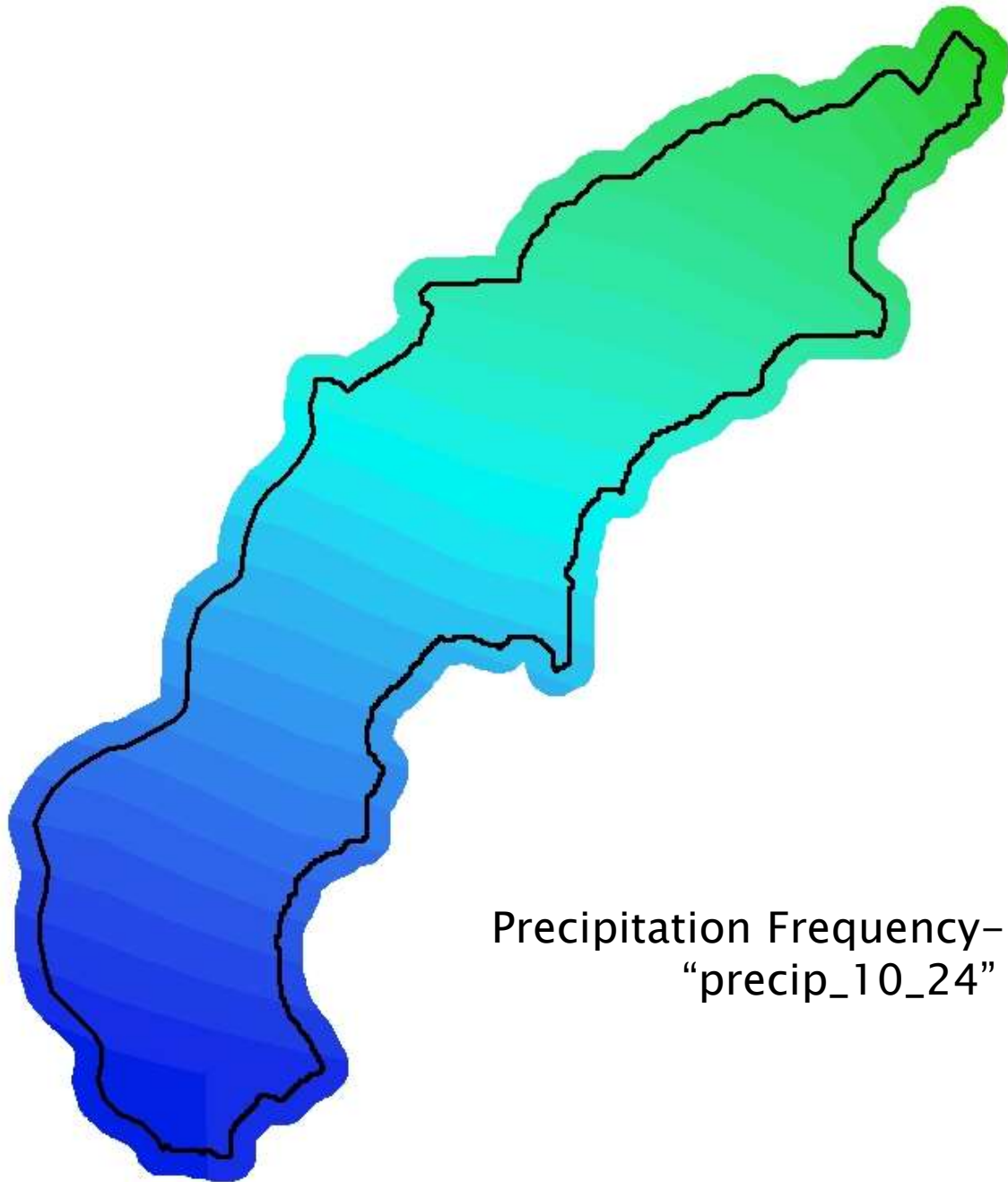
Conditioned DEM (for template)
DEM_cond

Output precipitation frequency-duration raster, select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\precip_10_24

OK Cancel Environments... Show Help >>

<ftp://hdsc.nws.noaa.gov/pub/hdsc/data/mw/>





Precipitation Frequency-Duration
"precip_10_24"

Step 2b: Create curve number raster

2b. Create curve number raster

Download Cropland Data Layers? If yes, define years below. If no, define locally stored layers

Start year (2008 is recommended) (optional)
2009

End year (2012 is recommended) (optional)
2013

Use locally stored Cropland Data Layers? (optional)

gSSURGO geodatabase
D:\EVAAL_Example\gSSURGO_WI.gdb

Watershed area (buffered)
watershed_buffer

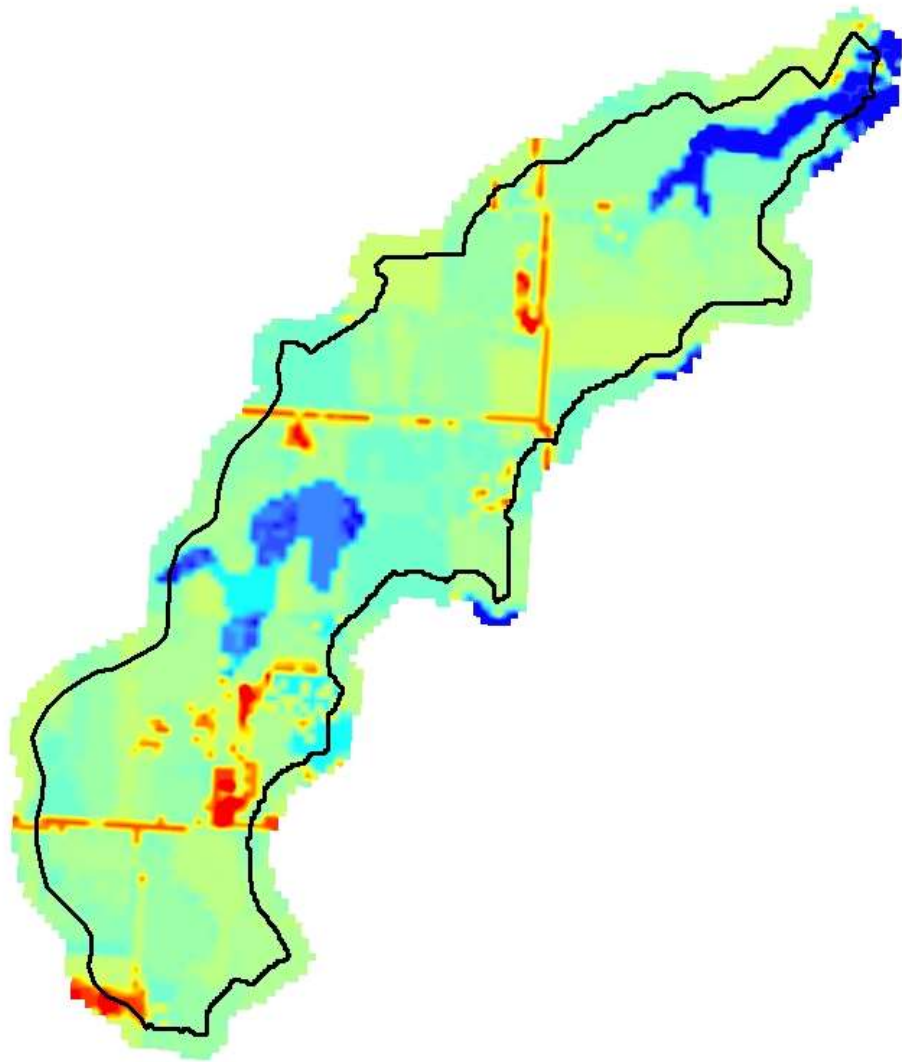
Conditioned DEM for raster template
DEM_cond

Output curve number raster (high estimate), select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\CN_high

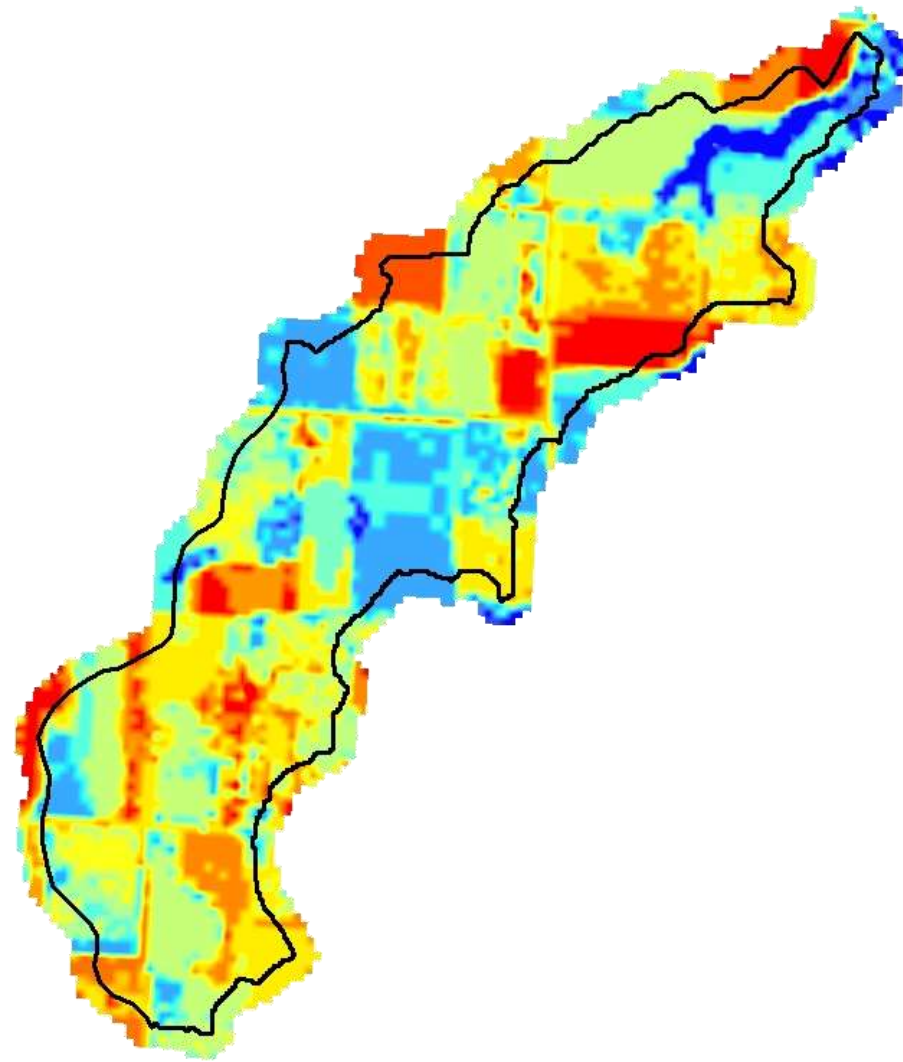
Output curve number raster (low estimate), select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\CN_low

OK Cancel Environments... Show Help >>





Curve Number (low estimate)
"CN_low"



Curve Number (high estimate)
"CN_high"

Step 2c: Identify internally draining areas

2c. Identify internally draining areas

Conditioned DEM
DEM_cond

Optimized fill raster
DEM_opfill

Precipitation frequency-duration raster
precip_10_24

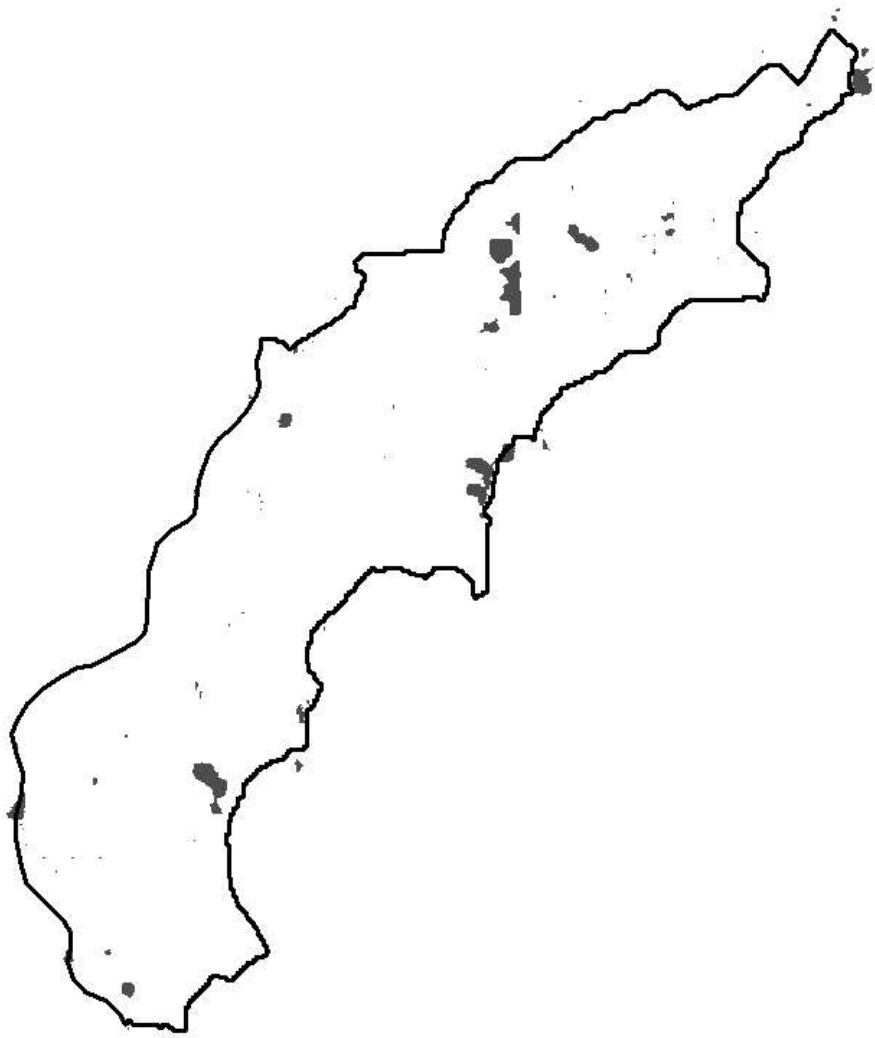
Curve number raster
CN_high

Watershed area (buffered)
watershed_buffer

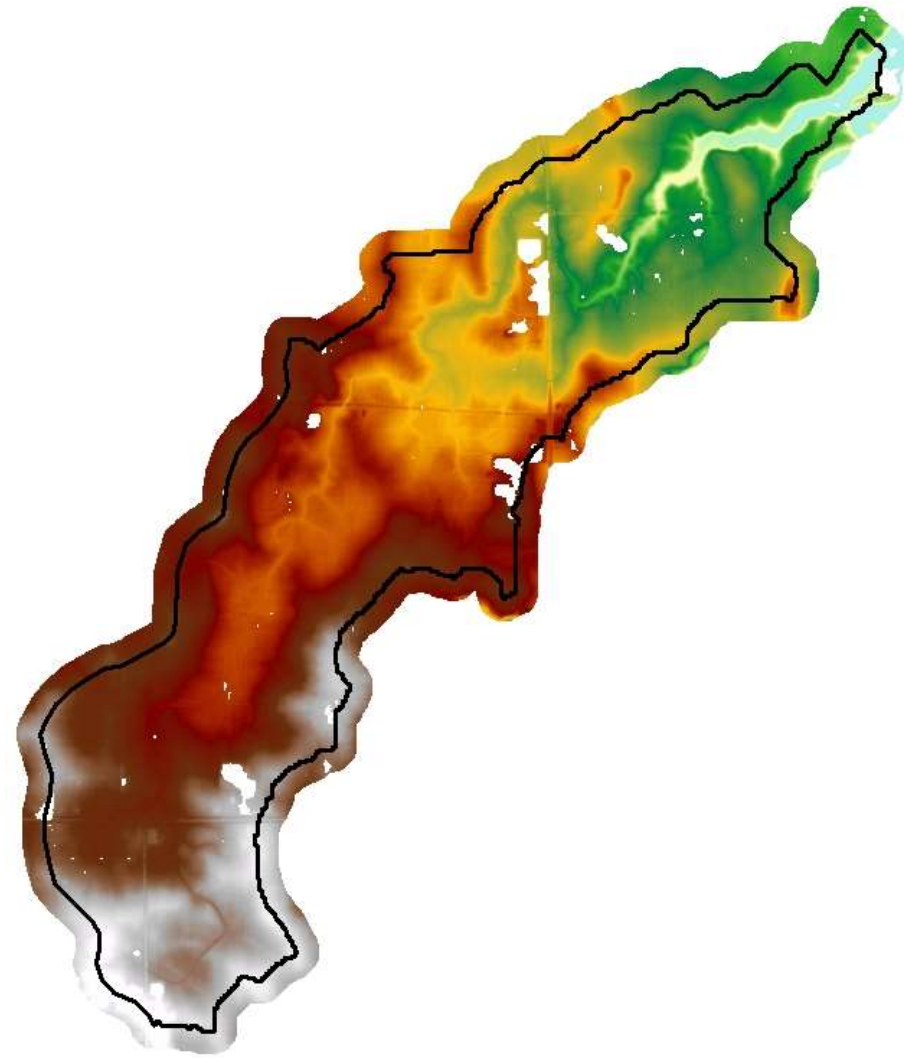
Output internally draining areas, select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\IDA

Output DEM excluding internally draining areas, select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\DEM_exIDA

OK Cancel Environments... Show Help >>

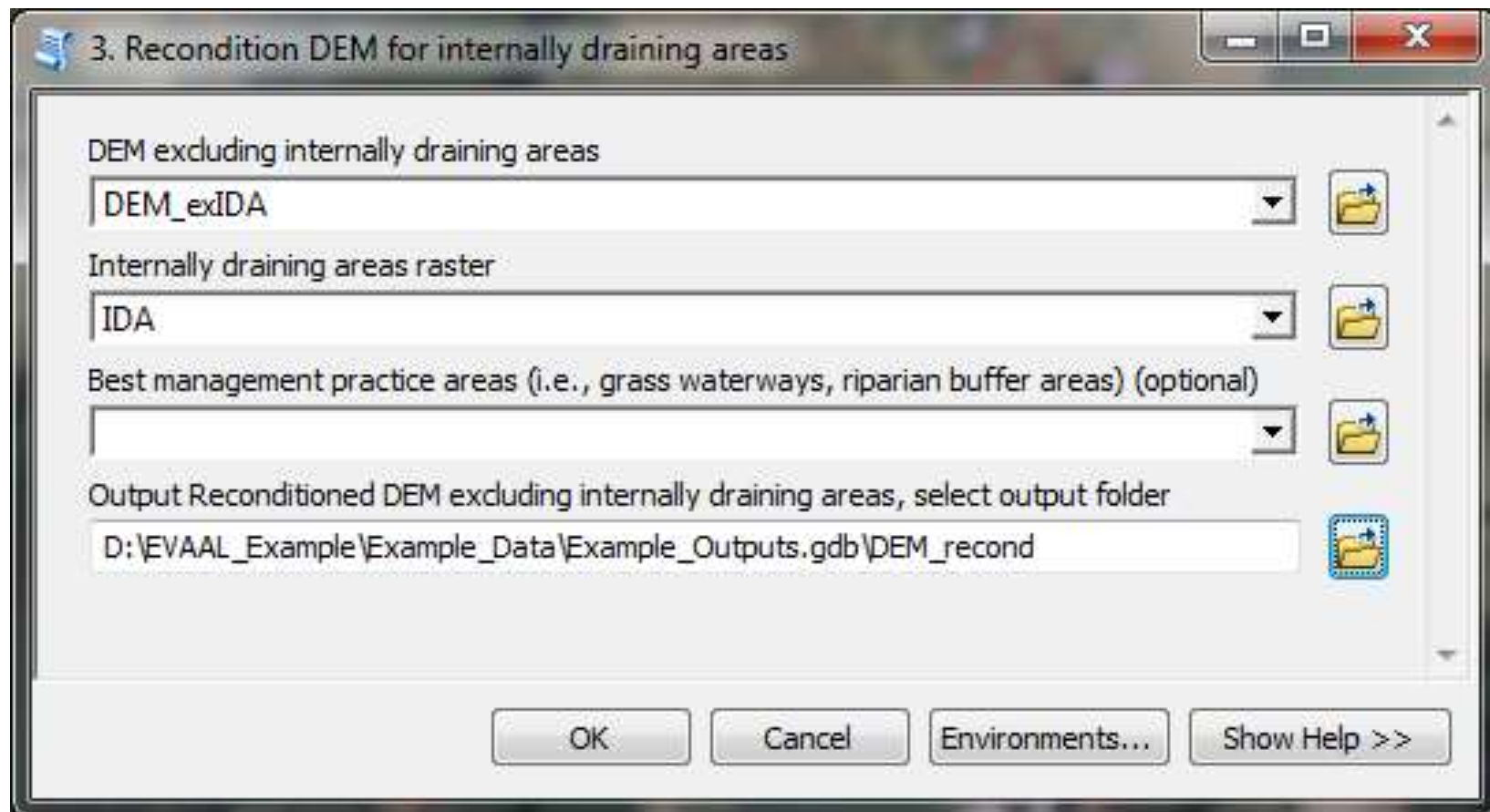


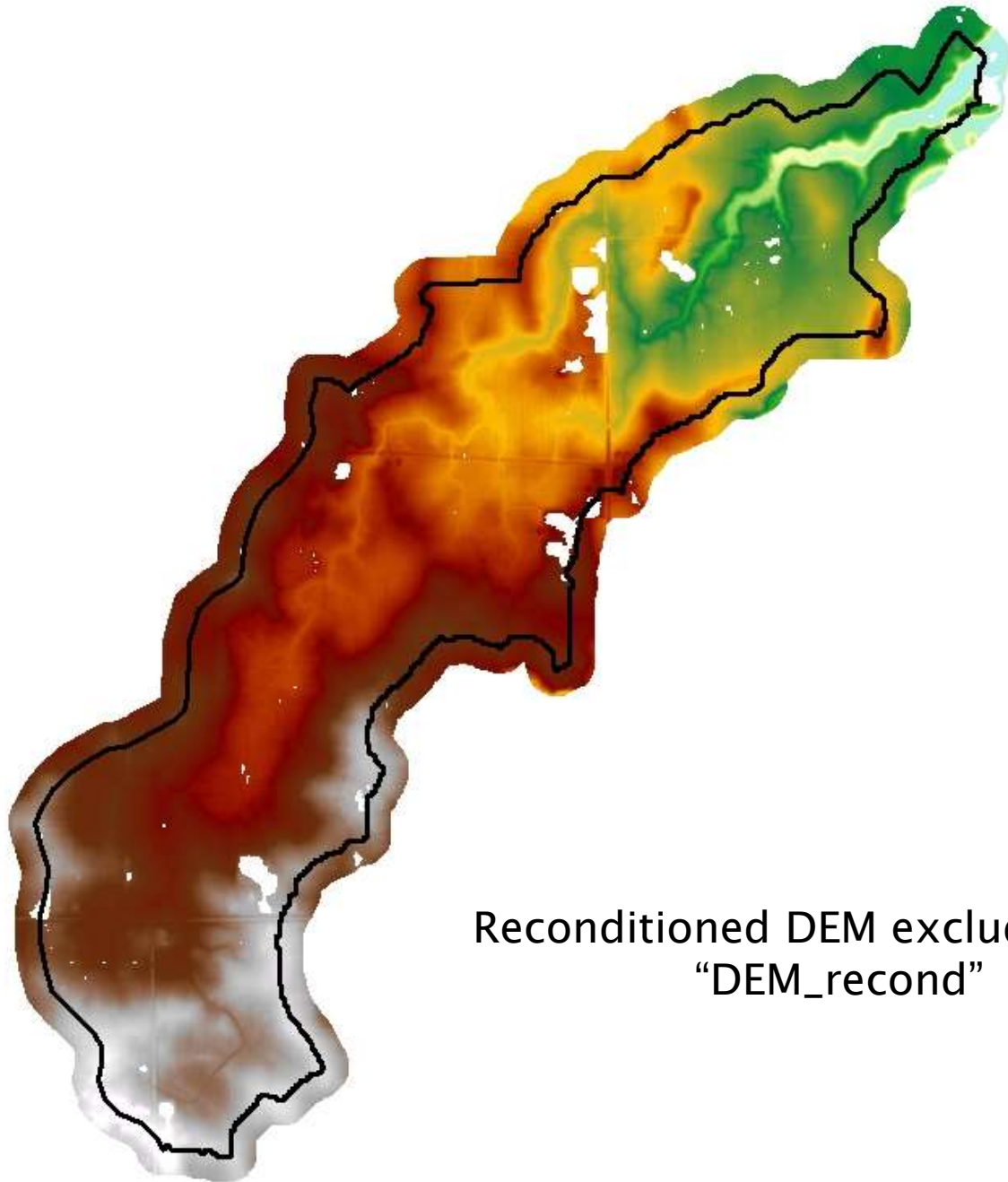
Internally Draining Areas
"IDA"



DEM excluding internally draining areas
"DEM_exIDA"

Step 3: Recondition DEM





Reconditioned DEM excluding IDAs
"DEM_recond"

Step 4: Calculate Stream Power Index

4. Calculate Stream Power Index

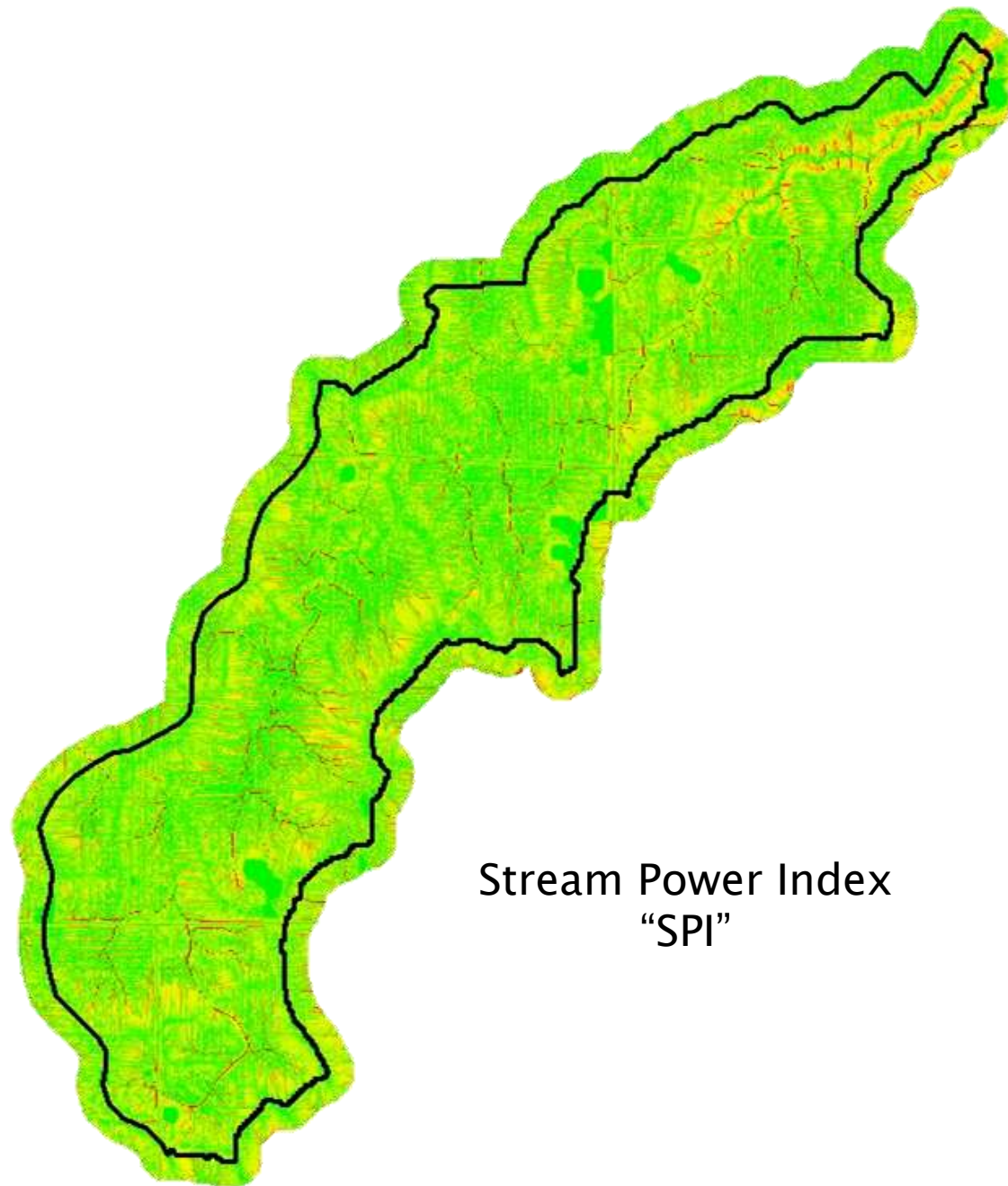
Conditioned DEM
DEM_cond

Reconditioned DEM excluding non-contributing areas
DEM_recond

Flow accumulation threshold (for a 3-meter resolution grid)
50000

Output stream power index raster, select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\SPI

OK Cancel Environments... Show Help >>



Stream Power Index
"SPI"

Calculate Statistics

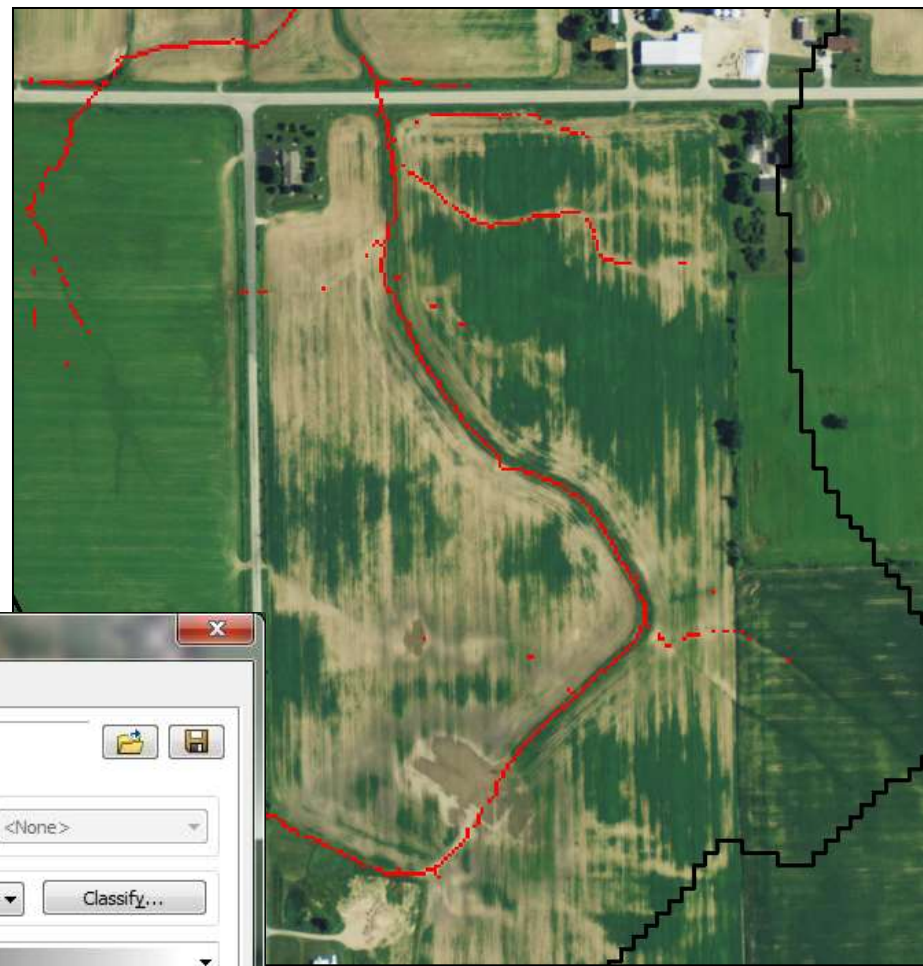
Input Raster Dataset
 D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\SPI

Number of Columns to Skip (optional)
 1

Number of Rows to Skip (optional)
 1

Ignore Values (optional)

Skip Existing
 Area of Interest
 Calculate Statistics
 area_of_interest



Layer Properties

General | Source | Extent | Display | Symbology

Show:
 Unique Values
 Classified
 Stretched
 Discrete Color

Draw raster grouping values into classes

Fields
 Value: <VALUE> Normalization: <None>

Classification
 Manual Classes: 2 Classify...

Color Ramp: [Color Ramp]

Symbol	Range	Label
[White]	0 - 7	0 - 7
[Red]	7 - 11.56090355	7,000000001 - 11.56090355

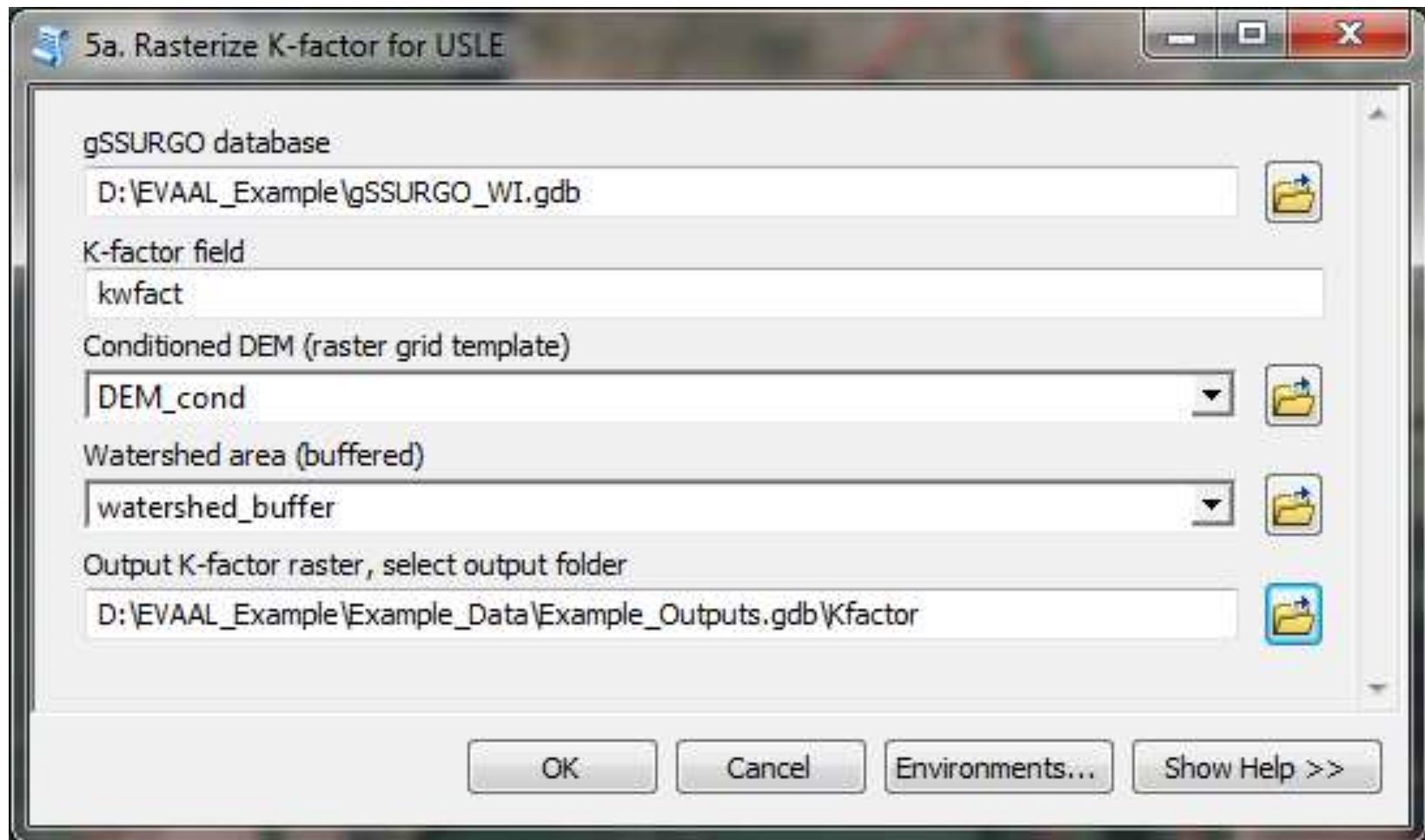
Show class breaks using cell values
 Use hillshade effect z: 1
 Display NoData as: [NoData]

[About symbology](#)

OK Cancel Apply



Step 5a: Rasterize K-factor



5a. Rasterize K-factor for USLE

gSSURGO database
D:\EVAAL_Example\gSSURGO_WI.gdb

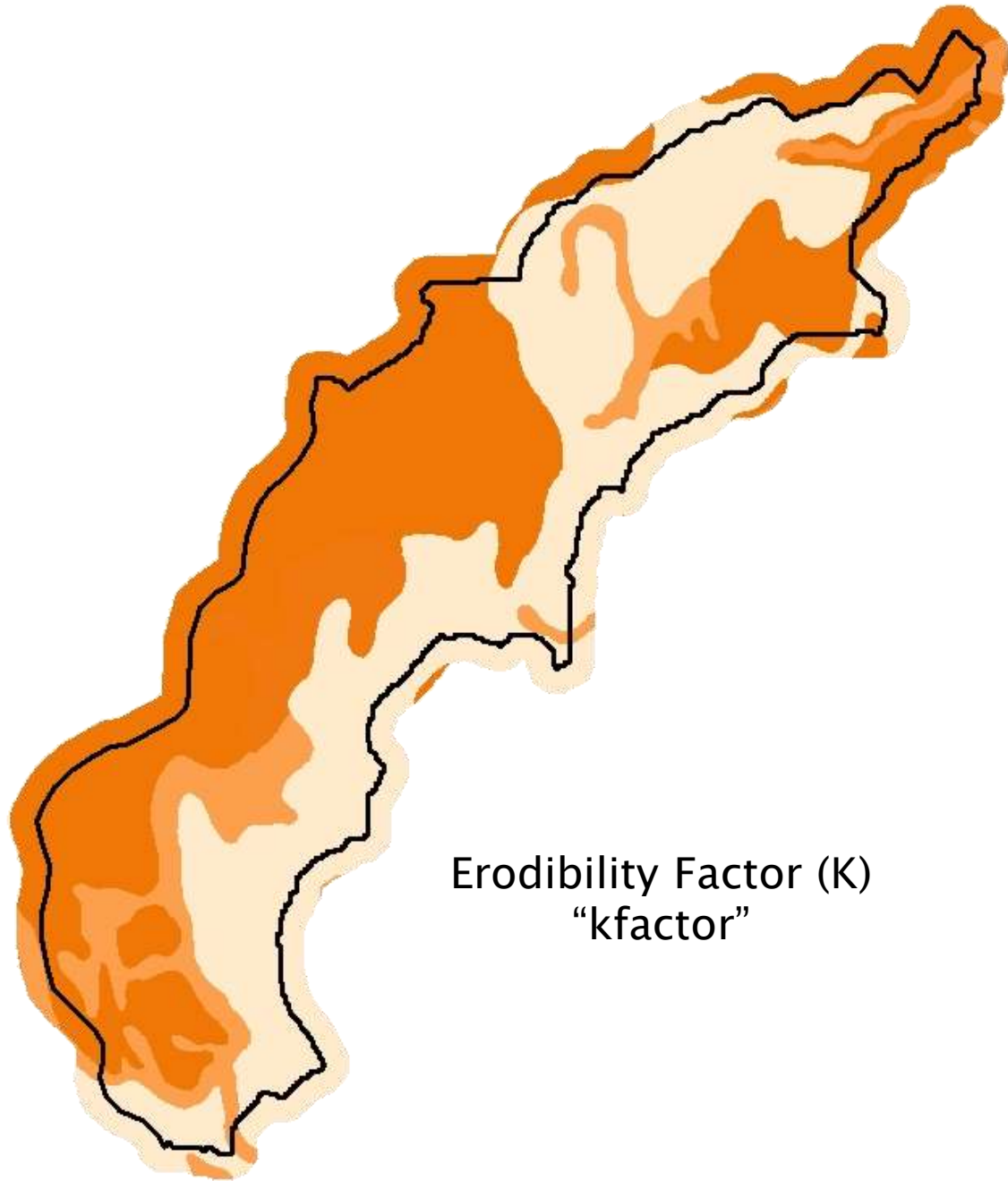
K-factor field
kwfact

Conditioned DEM (raster grid template)
DEM_cond

Watershed area (buffered)
watershed_buffer

Output K-factor raster, select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\Kfactor

OK Cancel Environments... Show Help >>



Erodibility Factor (K)
"kfactor"

Step 5b: Rasterize C-factor

5b. Rasterize C-factor for USLE

Download Cropland Data Layers? If yes, define years below. If no, define locally stored layers

Start year (2008 is recommended) (optional)
2009

End year (2012 is recommended) (optional)
2013

Use locally stored Cropland Data Layers? (optional)

Watershed area (buffered)
watershed_buffer

Conditioned DEM, for template
DEM_cond

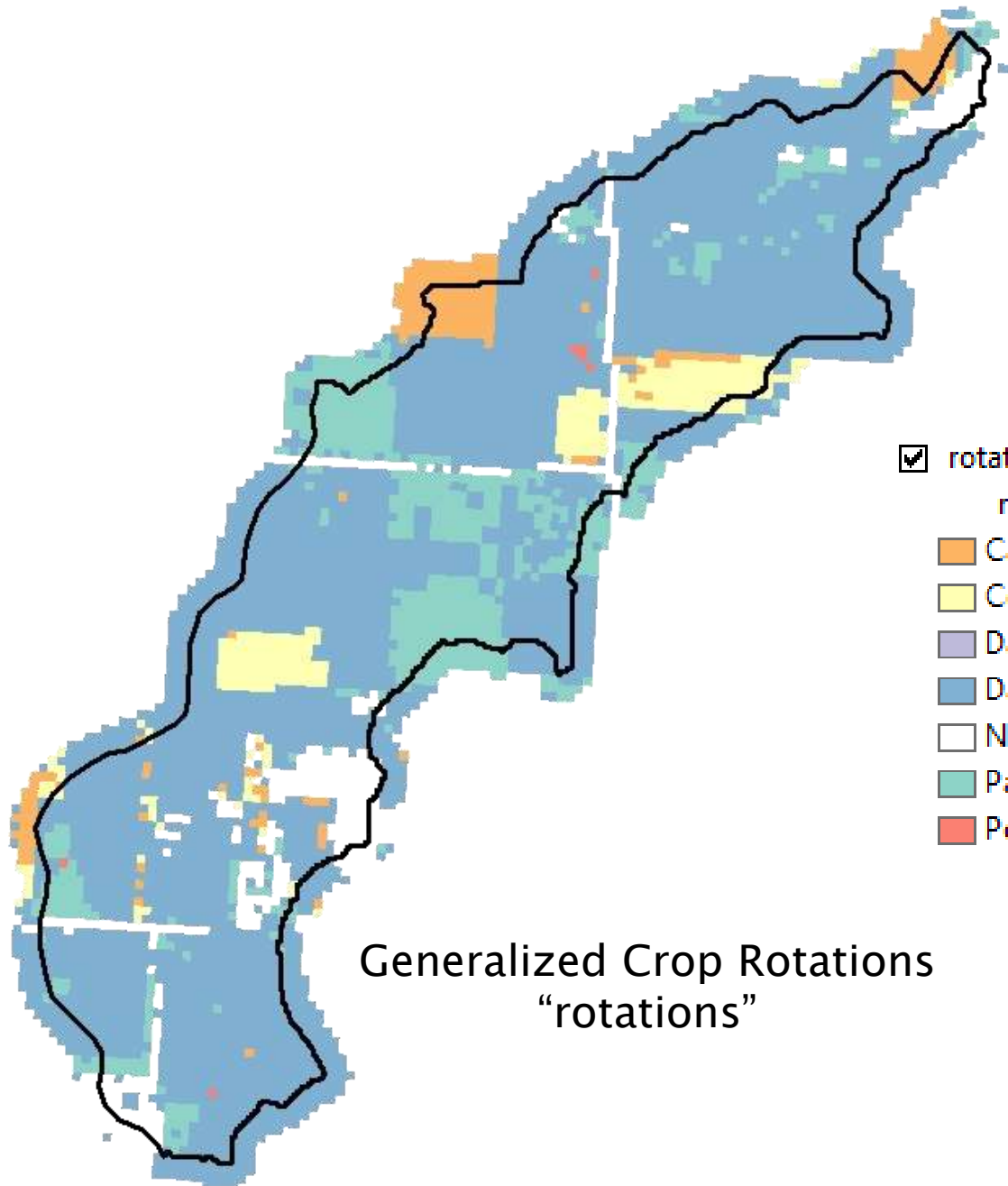
Output crop rotation raster, select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\rotations

Output C-factor raster (high estimate), select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\C_high

Output C-factor raster (low estimate), select output folder
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\C_low

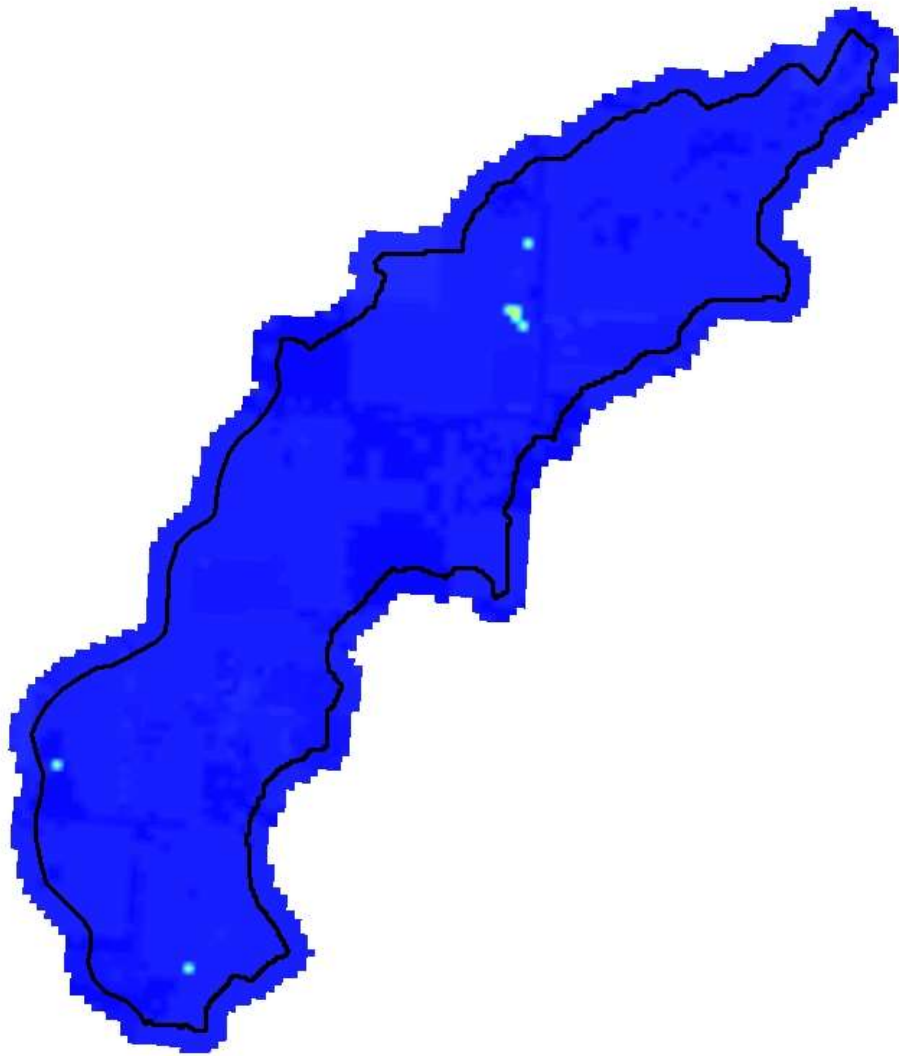
OK Cancel Environments... Show Help >>



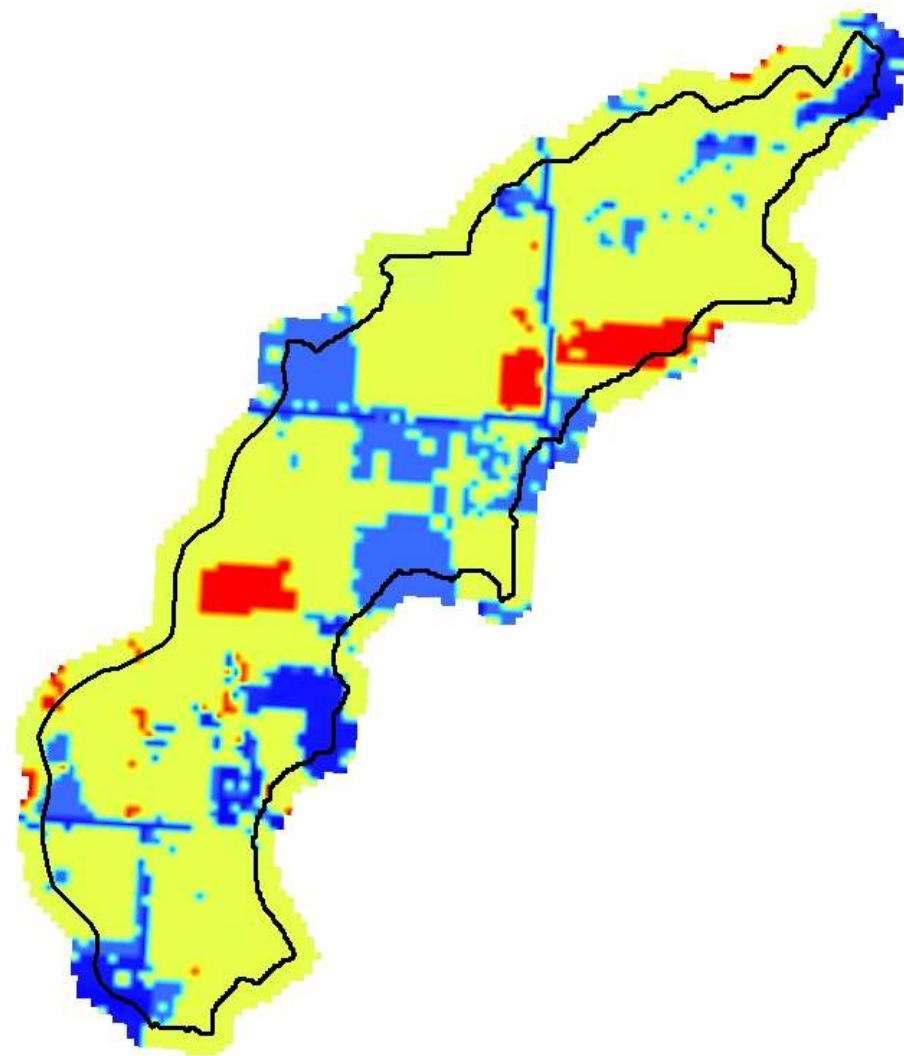


- rotations
- rotation
- Cash Grain
- Continuous Corn
- Dairy Potato Year
- Dairy Rotation
- No agriculture
- Pasture/Hay/Grassland
- Potato/Grain/Veggie Rotation

Generalized Crop Rotations
“rotations”



Cover Factor (C) – low estimate
“C_low”



Cover Factor (C) – high estimate
“C_high”

Step 5c: Calculate soil loss index

5c. Calculate soil loss index using USLE

Conditioned DEM
DEM_cond

Reconditioned DEM excluding non-contributing areas
DEM_recond

Erosivity raster (SI units) (optional)

Erosivity constant (optional)

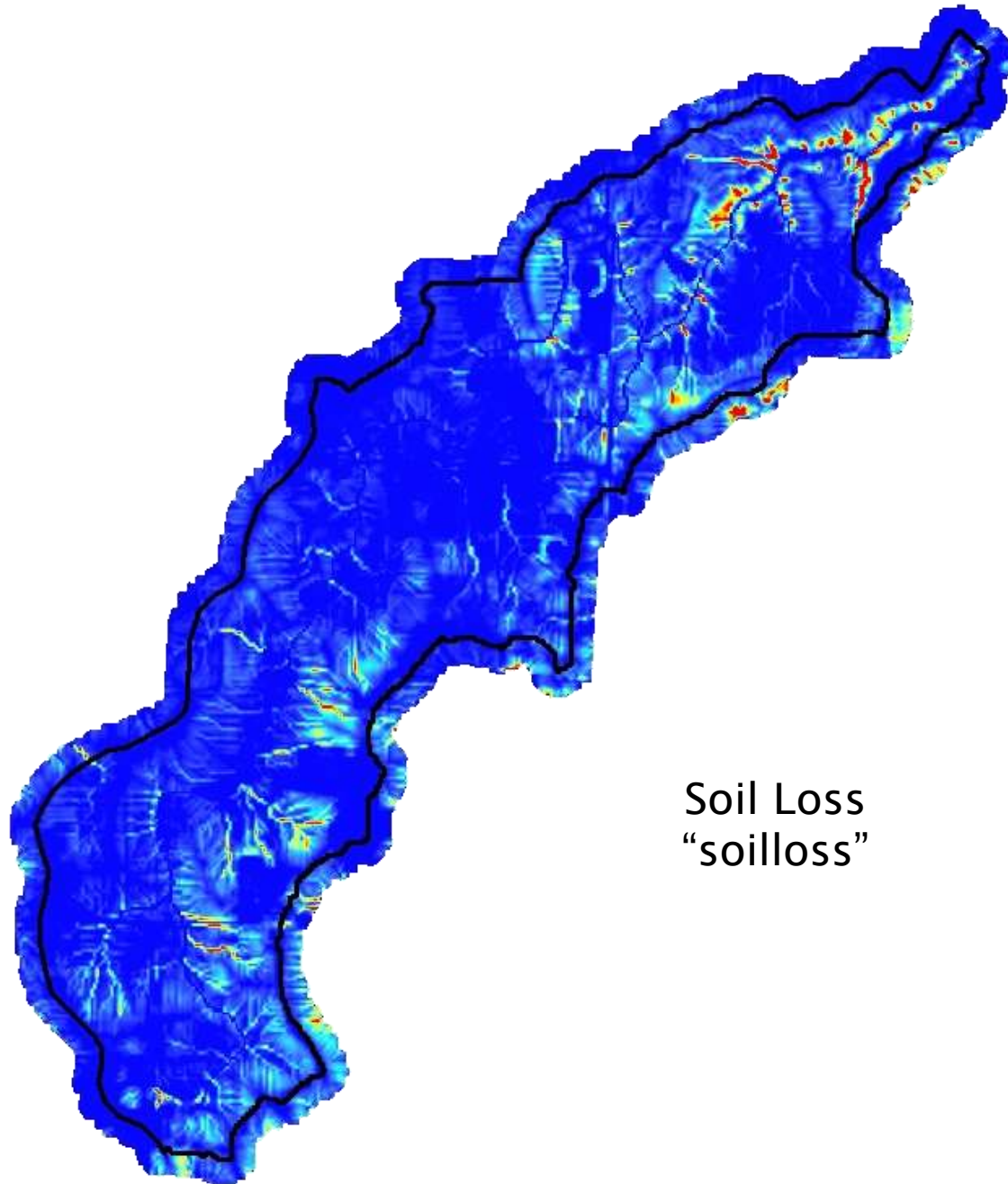
K-factor raster
kfactor

C-factor raster
C_high

Flow Accumulation threshold (for a 10-meter resolution grid)
1000

Output soil loss raster
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\soilloss

OK Cancel Environments... Show Help >>



Soil Loss
"soilloss"

Step 6: Calculate erosion vulnerability

6. Calculate erosion vulnerability index

Soil loss raster
soilloss

Stream power index raster
SPI

Zonal statistic boundary feature class (optional)

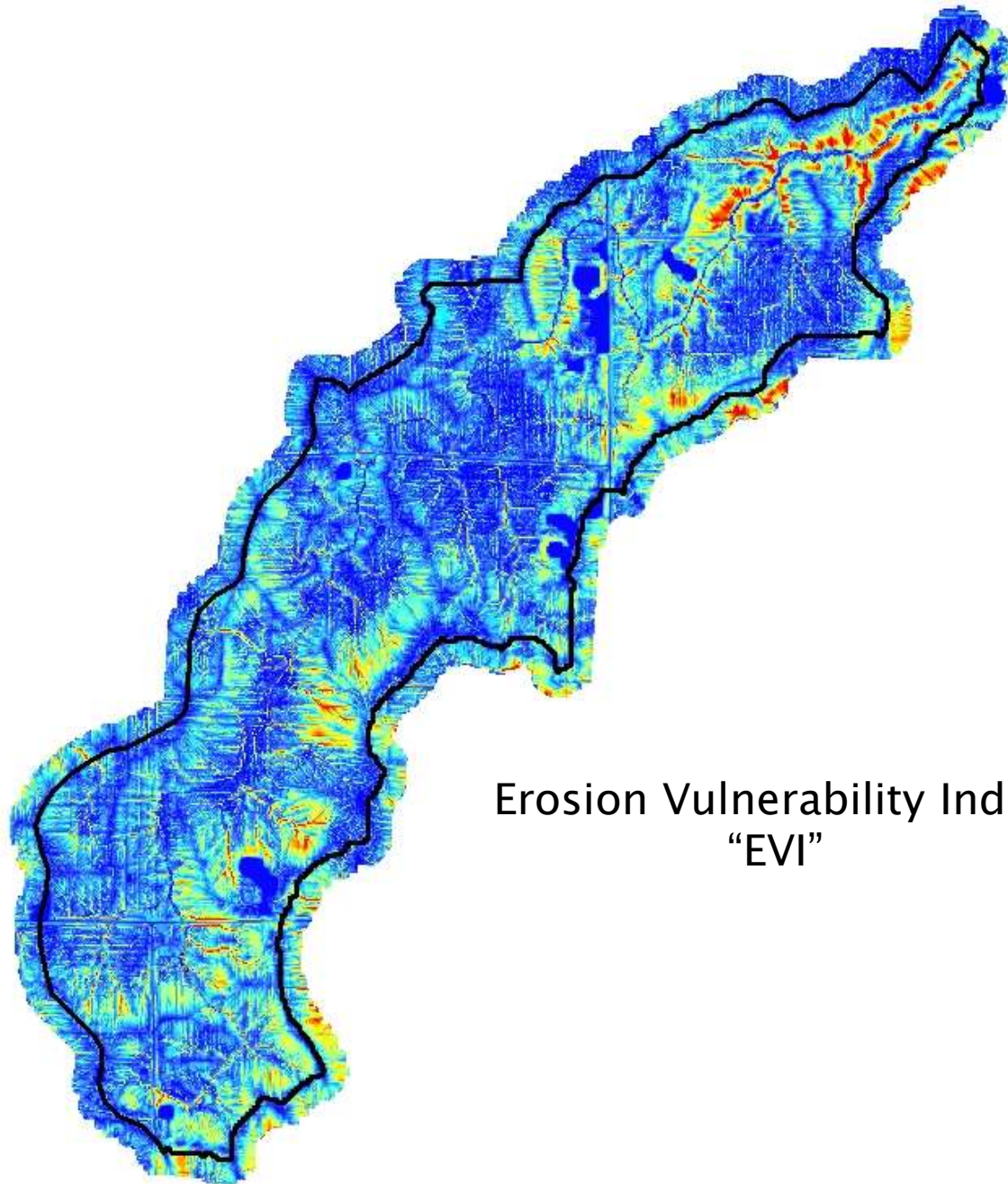
Zonal statistic field (optional)

Conditioned DEM (for raster template)
DEM_cond

Output erosion vulnerability index raster, select output folder (optional)
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\EVI

Output summary table, select output folder (optional)

OK Cancel Environments... Show Help >>



Erosion Vulnerability Index
“EVI”

Step 6: Calculate erosion vulnerability

6. Calculate erosion vulnerability index

Soil loss raster
soilloss

Stream power index raster
SPI

Zonal statistic boundary feature class (optional)
fields

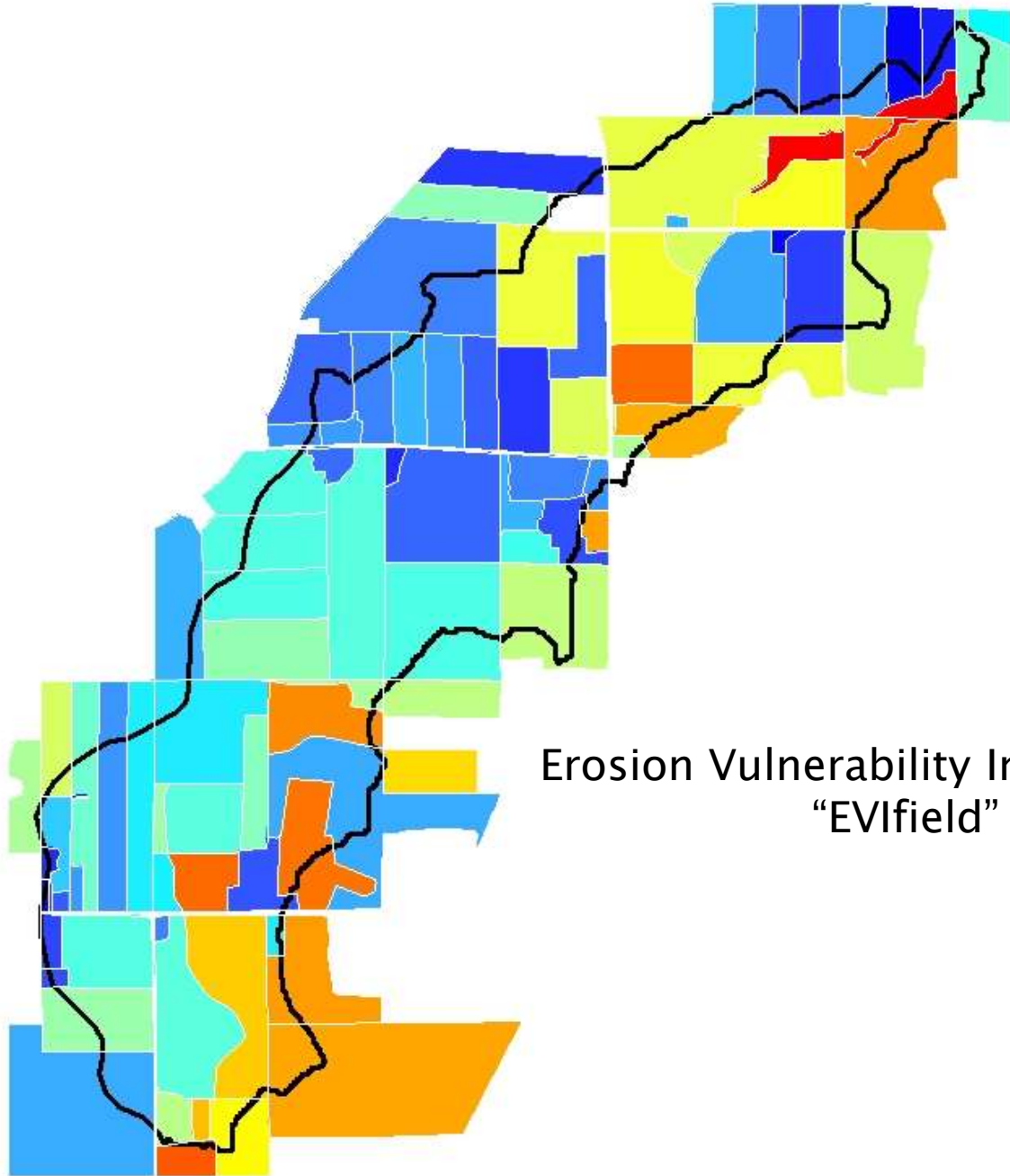
Zonal statistic field (optional)
OBJECTID

Conditioned DEM (for raster template)
DEM_cond

Output erosion vulnerability index raster, select output folder (optional)
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\EVIfields

Output summary table, select output folder (optional)
D:\EVAAL_Example\Example_Data\Example_Outputs.gdb\EVI_fields_tbl

OK Cancel Environments... Show Help >>



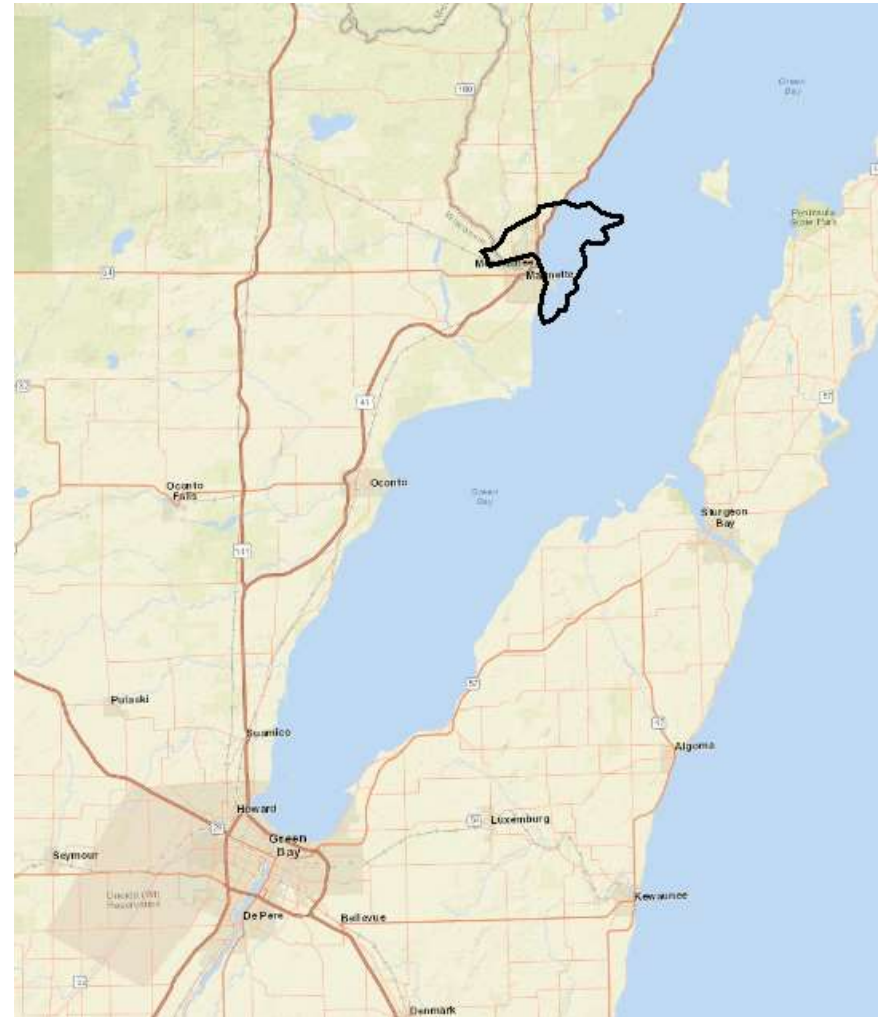
Erosion Vulnerability Index by field
“EVIField”

Common Problems



Projection Issues

- ▶ Input data incorrectly projected



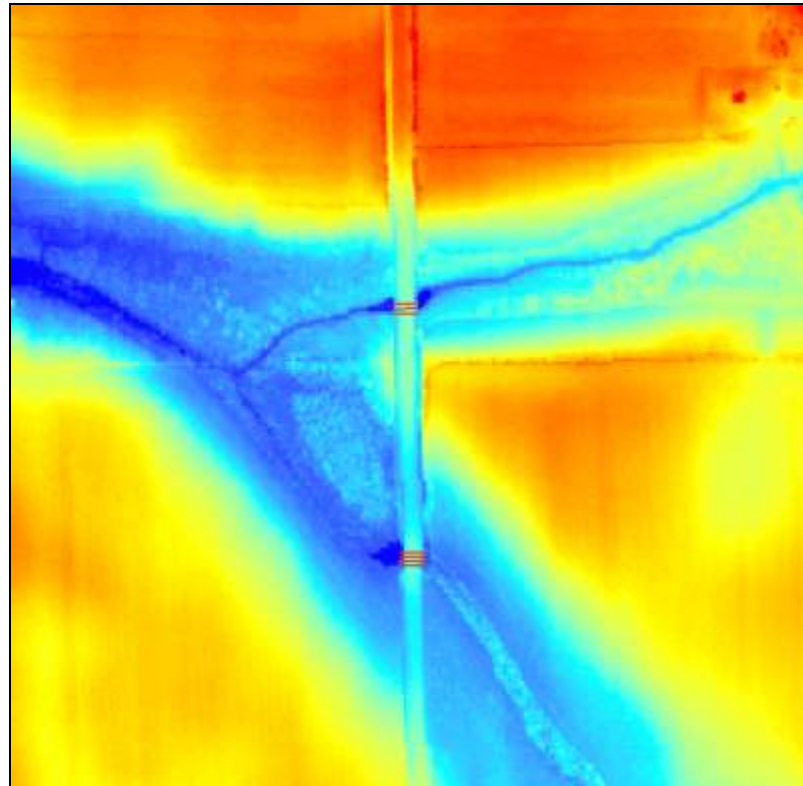
Folder Permissions & Pathnames

- ▶ Must have “write” permission to EVAAL-master folder
 - Temp files are stored in scratch.gdb
- ▶ No special characters in path name (., &, /, etc.)
 - Better to also have no spaces



Culverts!

- ▶ Unnecessary culverts
- ▶ Wrong orientation
- ▶ Need to have at least one in the watershed
- ▶ No culvert lines outside the watershed



Watershed Too Big

- ▶ Limit is approximately 75 km² or 30 mi²
 - Actual limit is number of grid cells in raster, so can run into problems with long narrow watershed, or irregular shaped watershed



Watershed Boundaries

- ▶ Clipping upper parts of watershed at county line
- ▶ Not providing an actual watershed

Missing soils data

- ▶ “holes” in outputs that are not internally draining areas
 - Kwfact is blank in soils database tables
 - Often “udorthents”



Bugs

- ▶ If you get an error, try downloading and using the Development version
 - Bugs are fixed there first

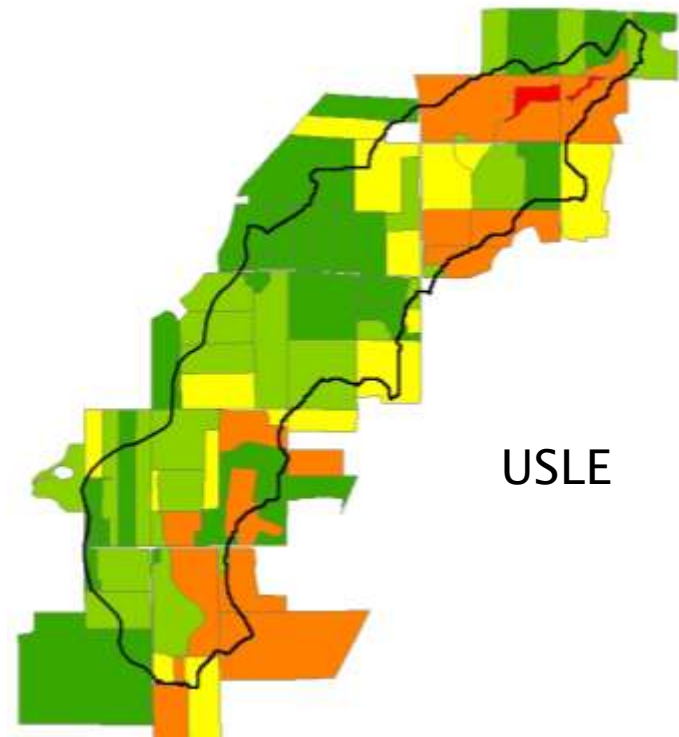
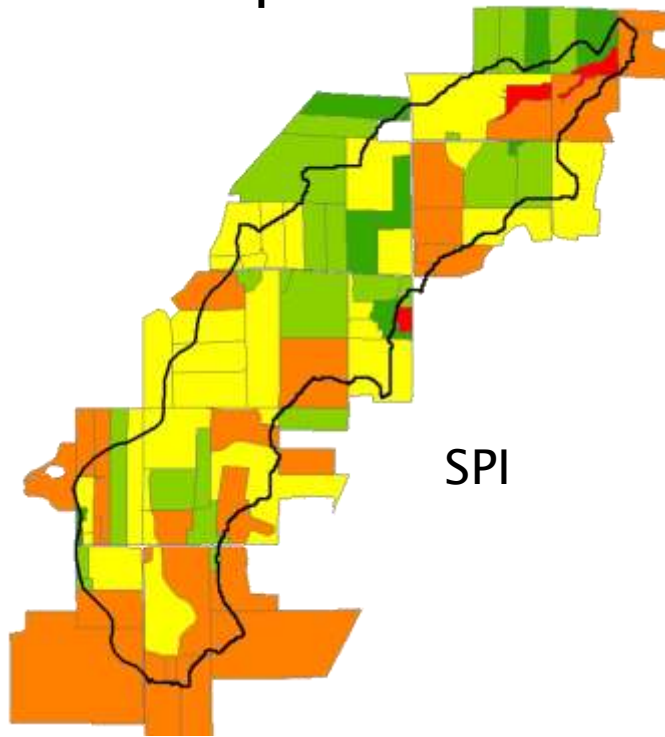
Branch: dev ▼

Exercises

»» On your own

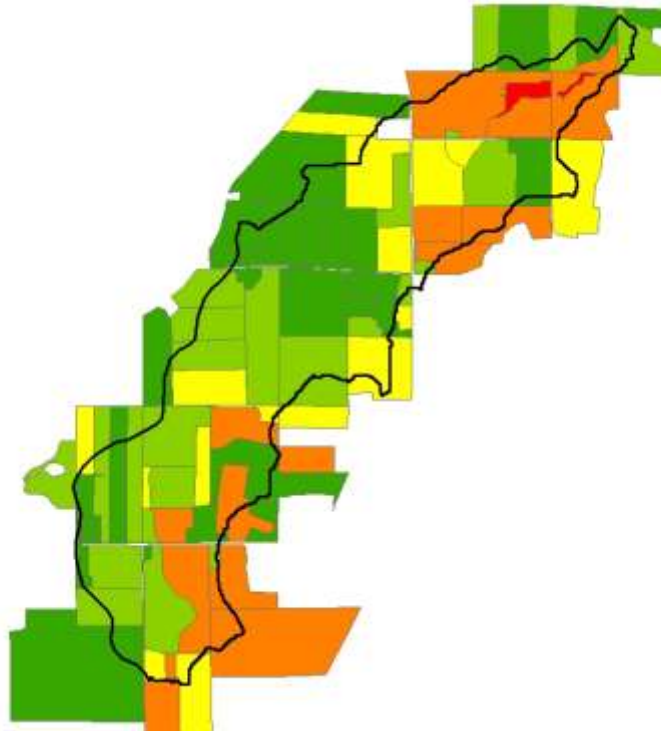
Exercise 1: Visualize by Field Boundaries

- ▶ Visualize results by field boundaries
 - Run Zonal Statistics on SPI and soil loss rasters using field boundaries as zones
 - Join resulting tables with field layer
 - Symbolize by mean value
 - Select top 10% of fields



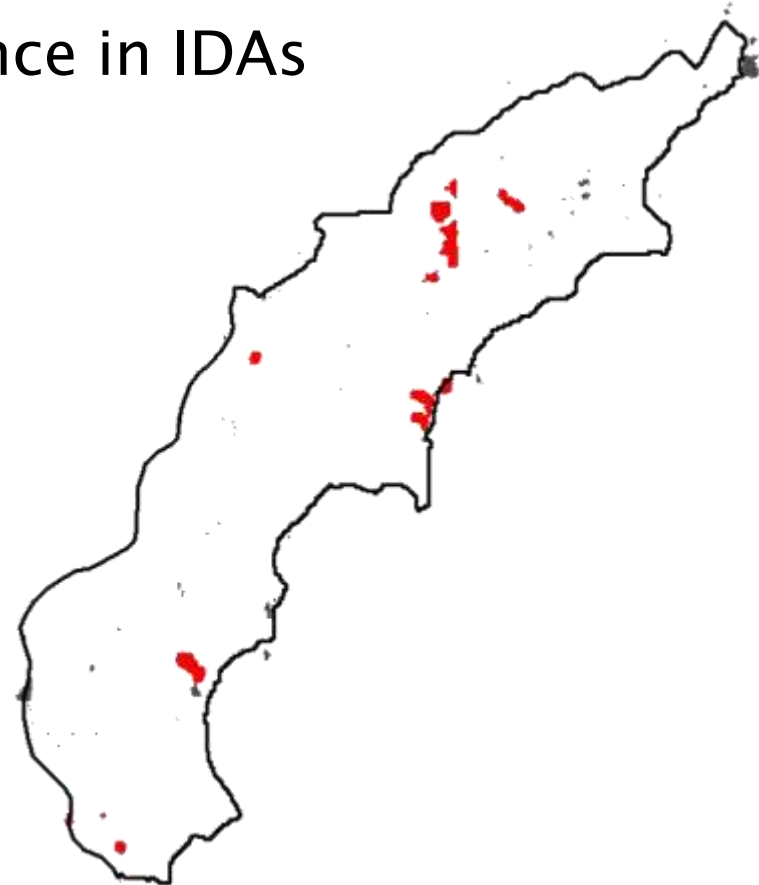
Exercise 2: Mitigation Opportunity

- ▶ Mitigation Opportunity
 - Re-run soil loss with low C factor
 - Subtract soil loss (low) from soil loss (high)
 - Run Zonal statistics and join to field table to visualize by fields



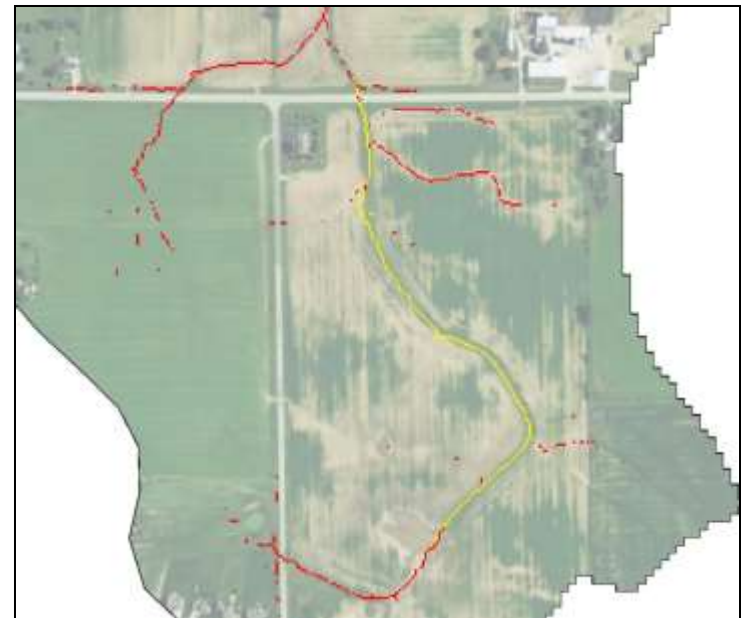
Exercise 3: IDA sensitivity to precip

- ▶ Sensitivity of IDAs to precipitation
 - Re-run Step 2a using a different frequency and duration
 - How different is the precipitation amount?
 - Re-run Step 2c to see difference in IDAs
 - Do results make sense?



Exercise 4: Create BMP layer

- ▶ Use BMP layer to deprioritize areas where practices are already in place
 - Create BMP layer (new polygon feature class)
 - Re-run Step 3 with BMP input
 - See how this changes SPI, soil loss, EVI results





Contact Info

Theresa M. Possley Nelson, PE
(608) 266-7037

Theresa.Nelson@wisconsin.gov
dnrwaterqualitymodeling@wisconsin.gov