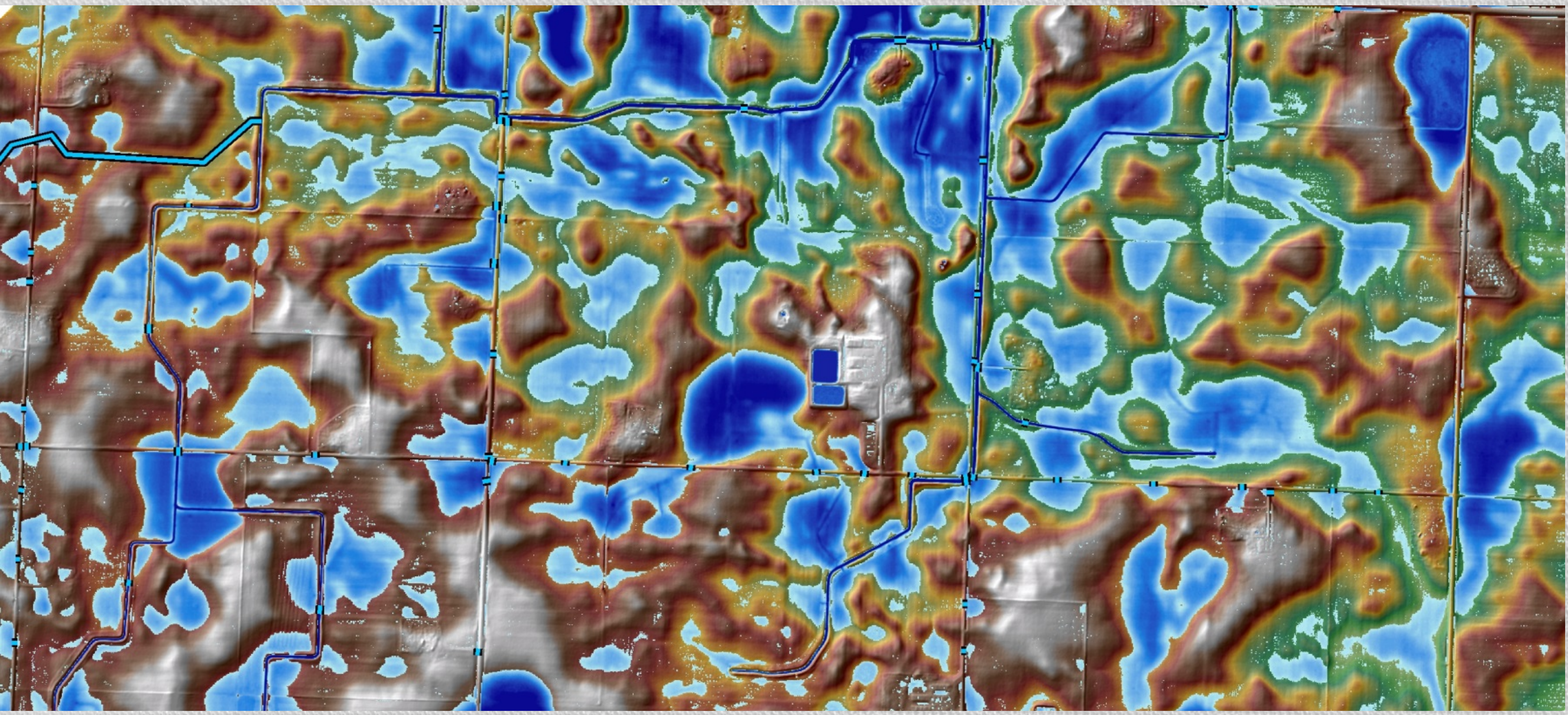
Terrain Analysis

Watson Creek – Root River

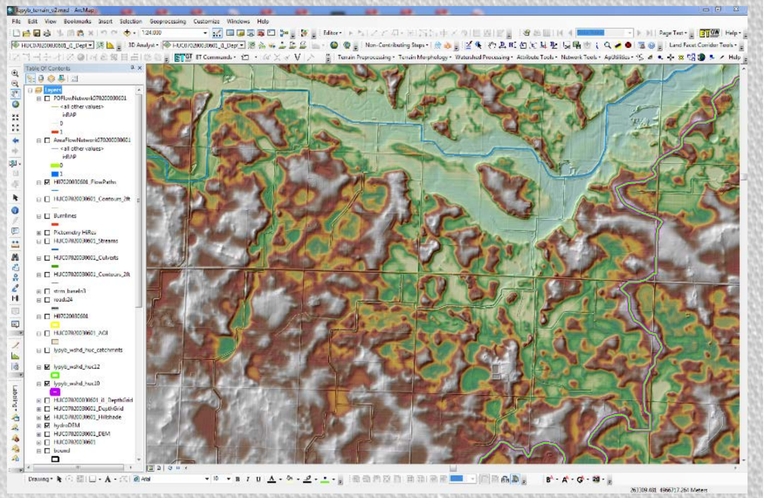


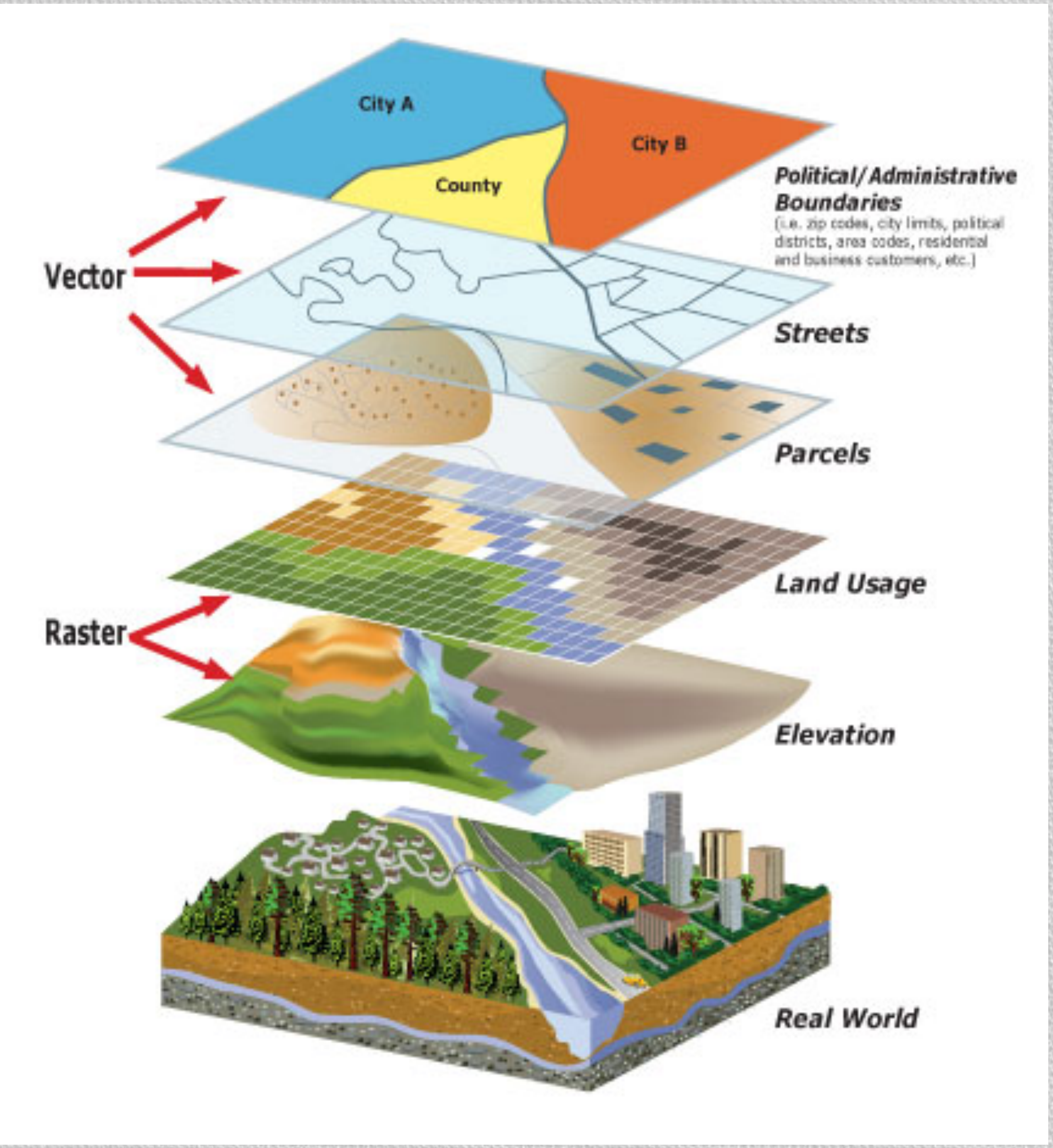
Water Resources Center Minnesota State University, Mankato
Jessica Nelson, Rick Moore, Andrew Meyer

Agricultural Conservation Planning Framework

National Laboratory for Agriculture and the Environment
U.S. Department of Agriculture, Agriculture Research Service
Mark Tomer, Sarah Porter, David James, and Kathy Boomer (TNC)

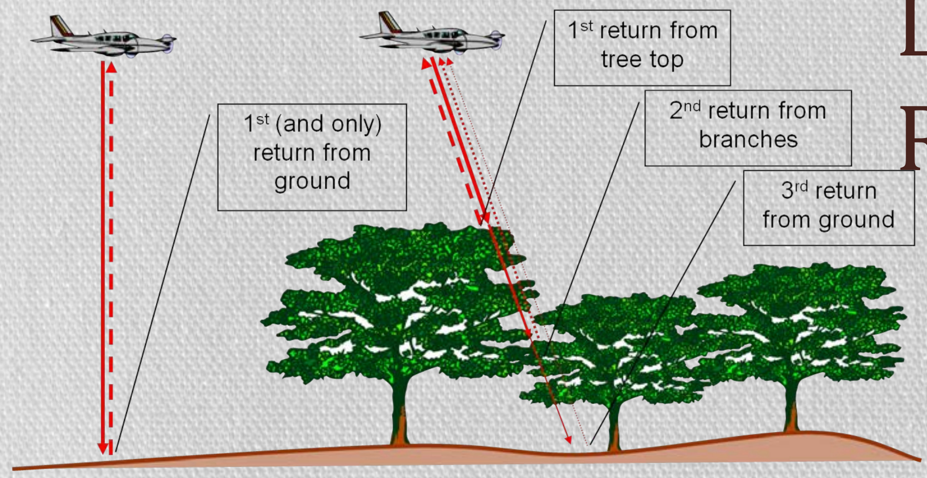
Geographic Information Systems (GIS)

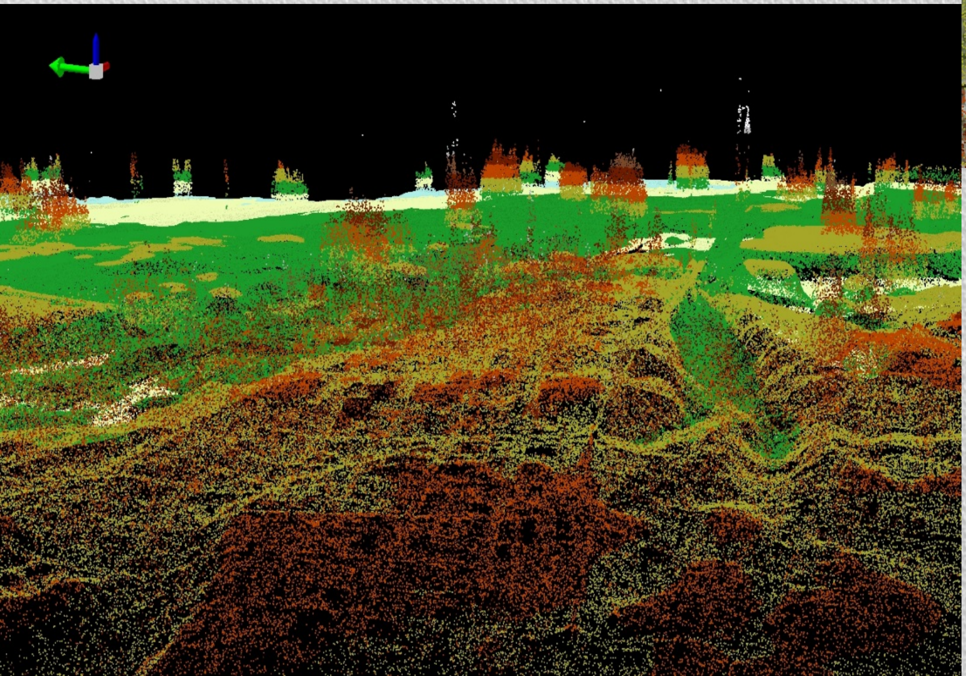




A GIS combines layers of information about a place to give you a better understanding of that place.

Light Detection and Ranging (LiDAR)



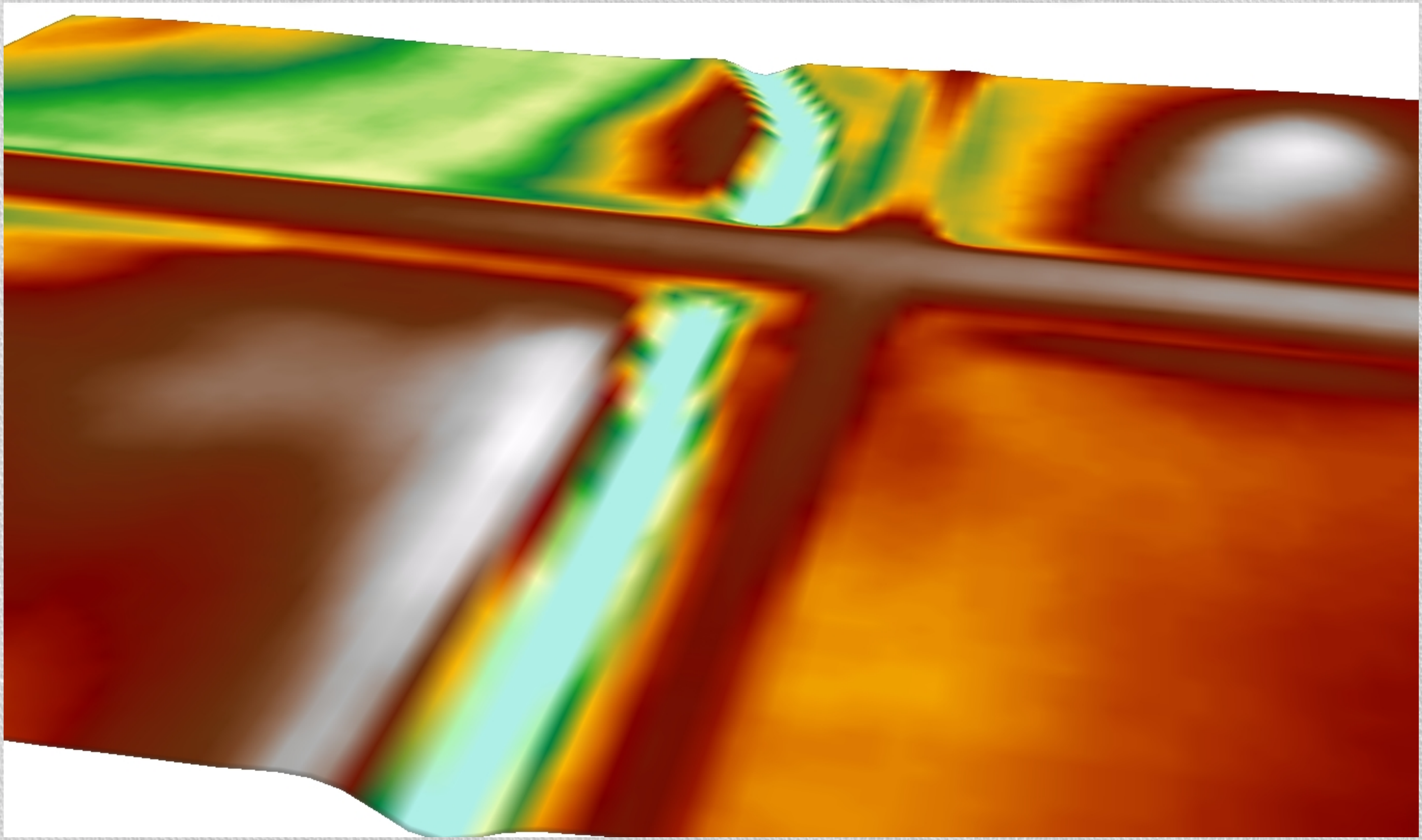


- Lidar: pulsed laser used to measure ranges (distance)
- Lidar data can be used to vegetation intensity through series of algorithms

Terrain Analysis

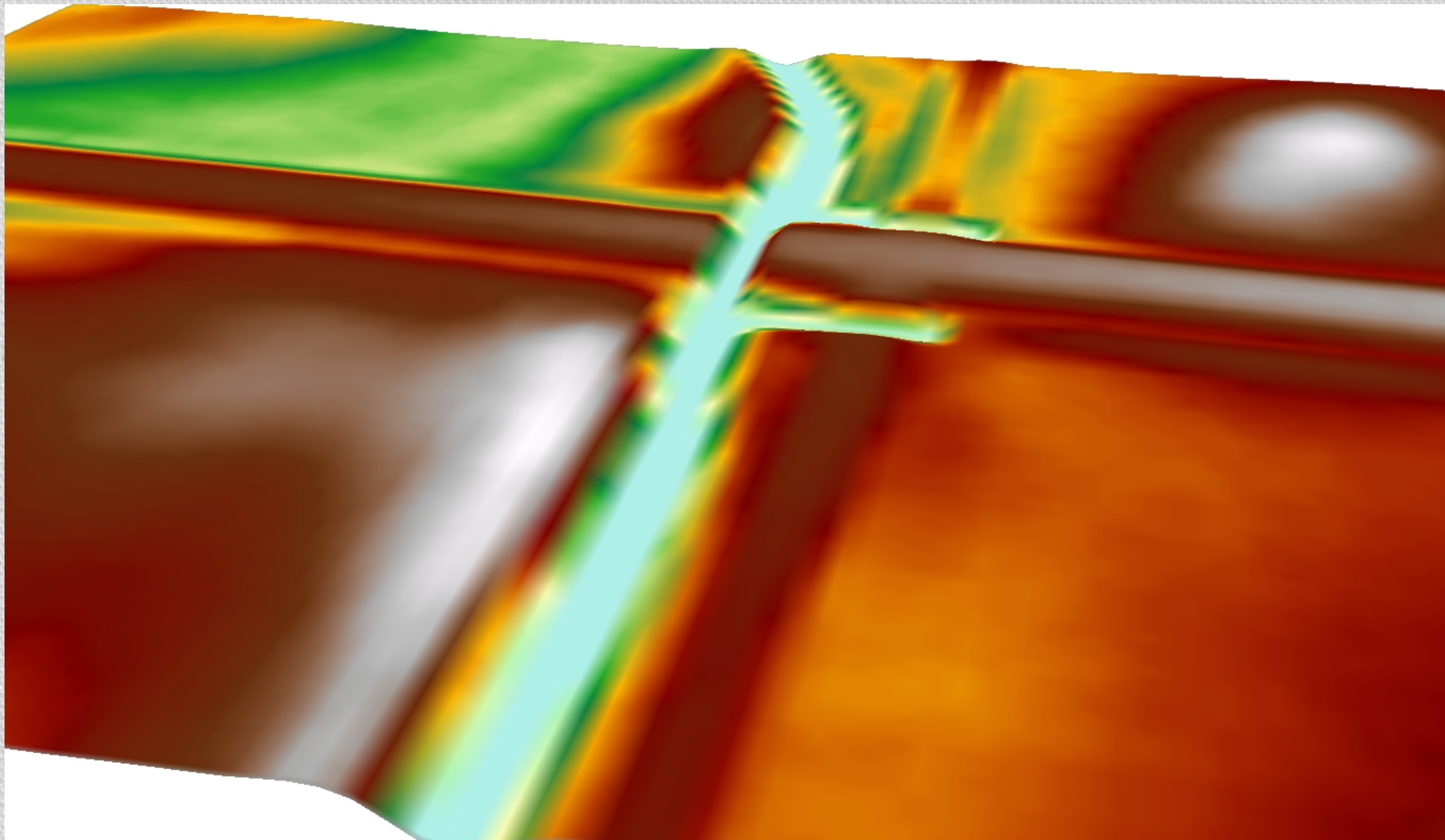
Terrain Analysis – Hydrologic Conditioning

Hydrologic Conditioning Digital Dams



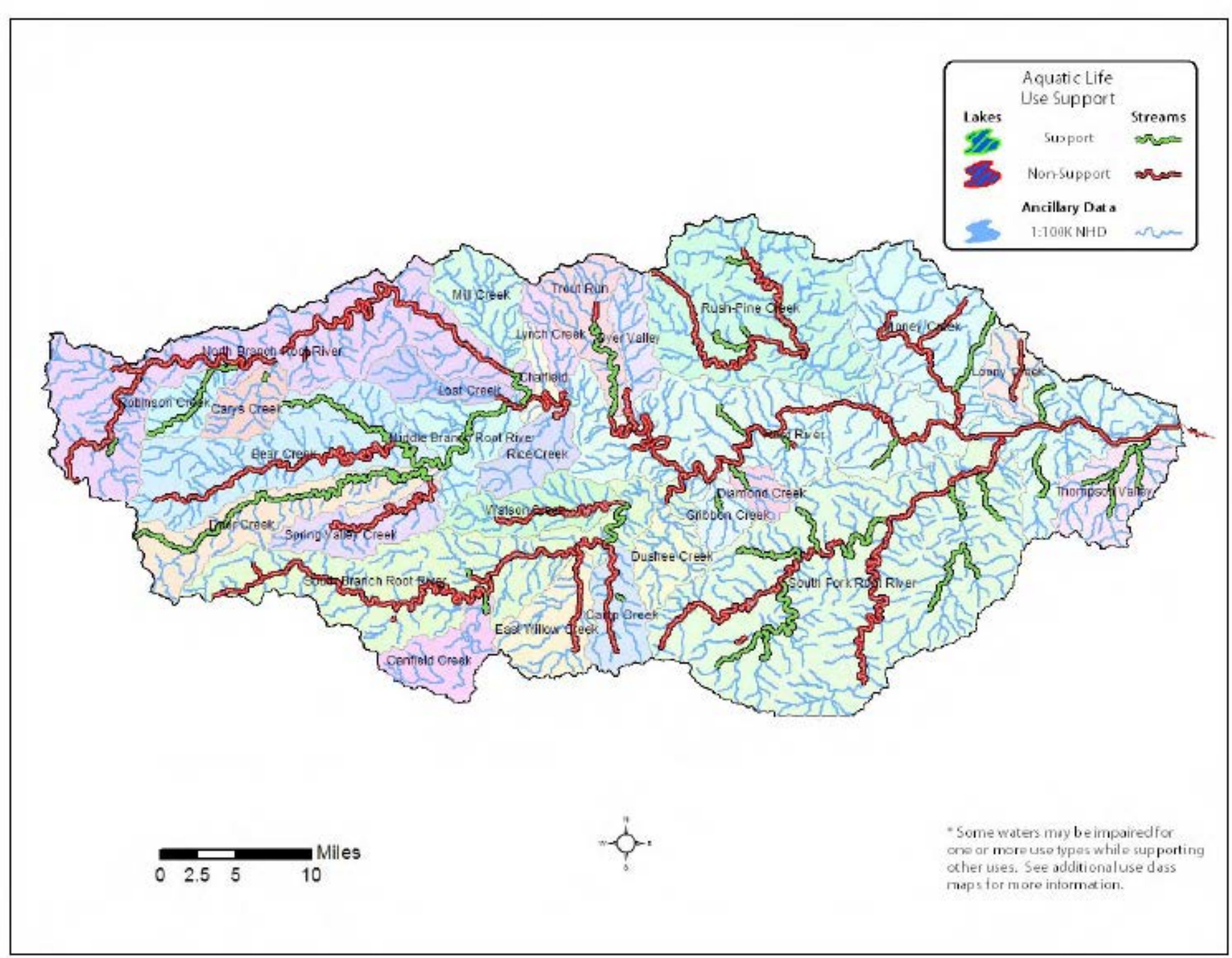
- "Digital Dams"
  - Culverts, bridges, any subsurface drainage alterations
  - Creates errors in subwatershed areas at points downstream

Hydrologic Conditioning Digital Dams

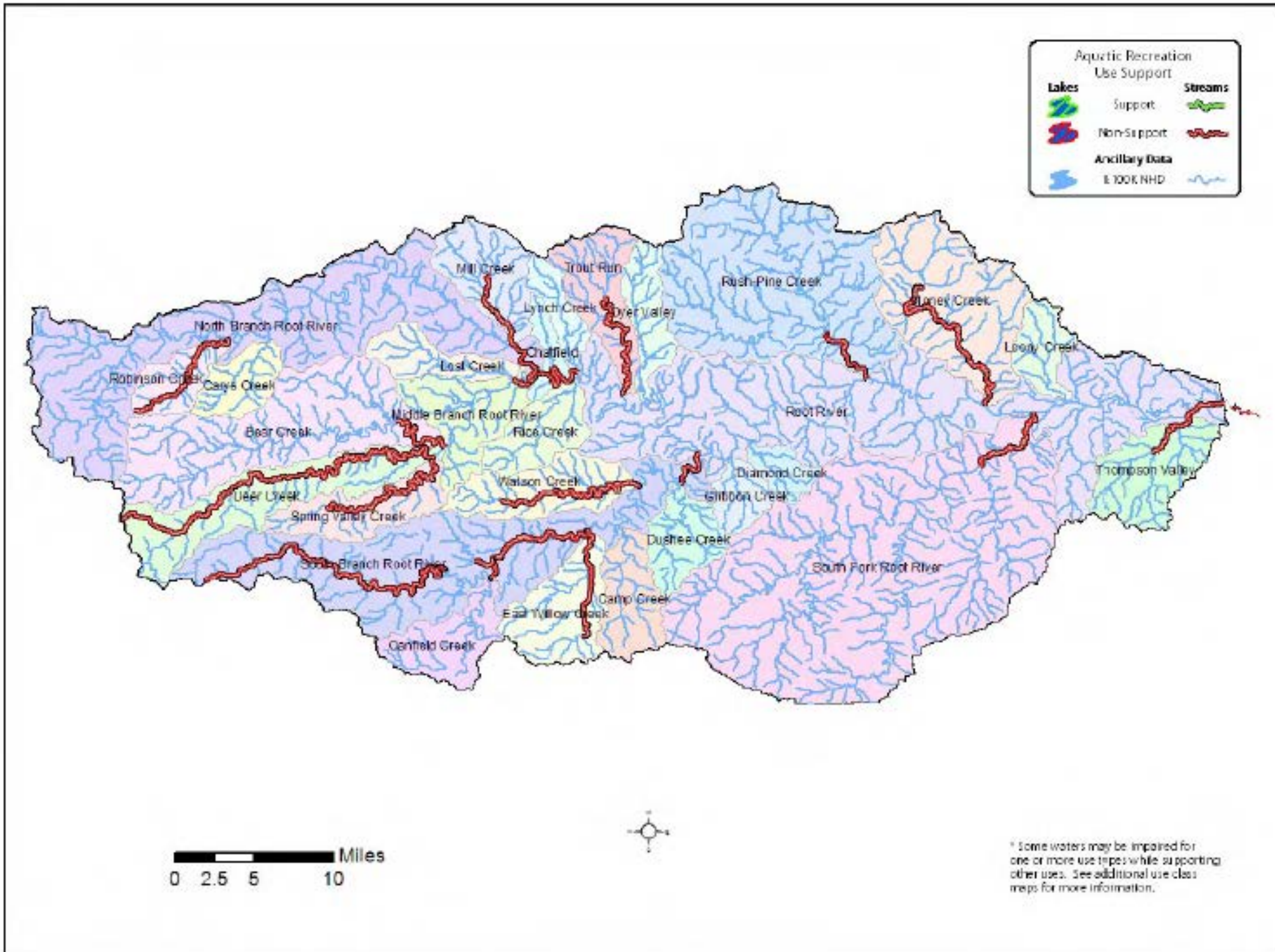


- "Digital Dams"
  - Culverts, bridges, any subsurface drainage alterations
  - Creates errors in subwatershed areas at points downstream

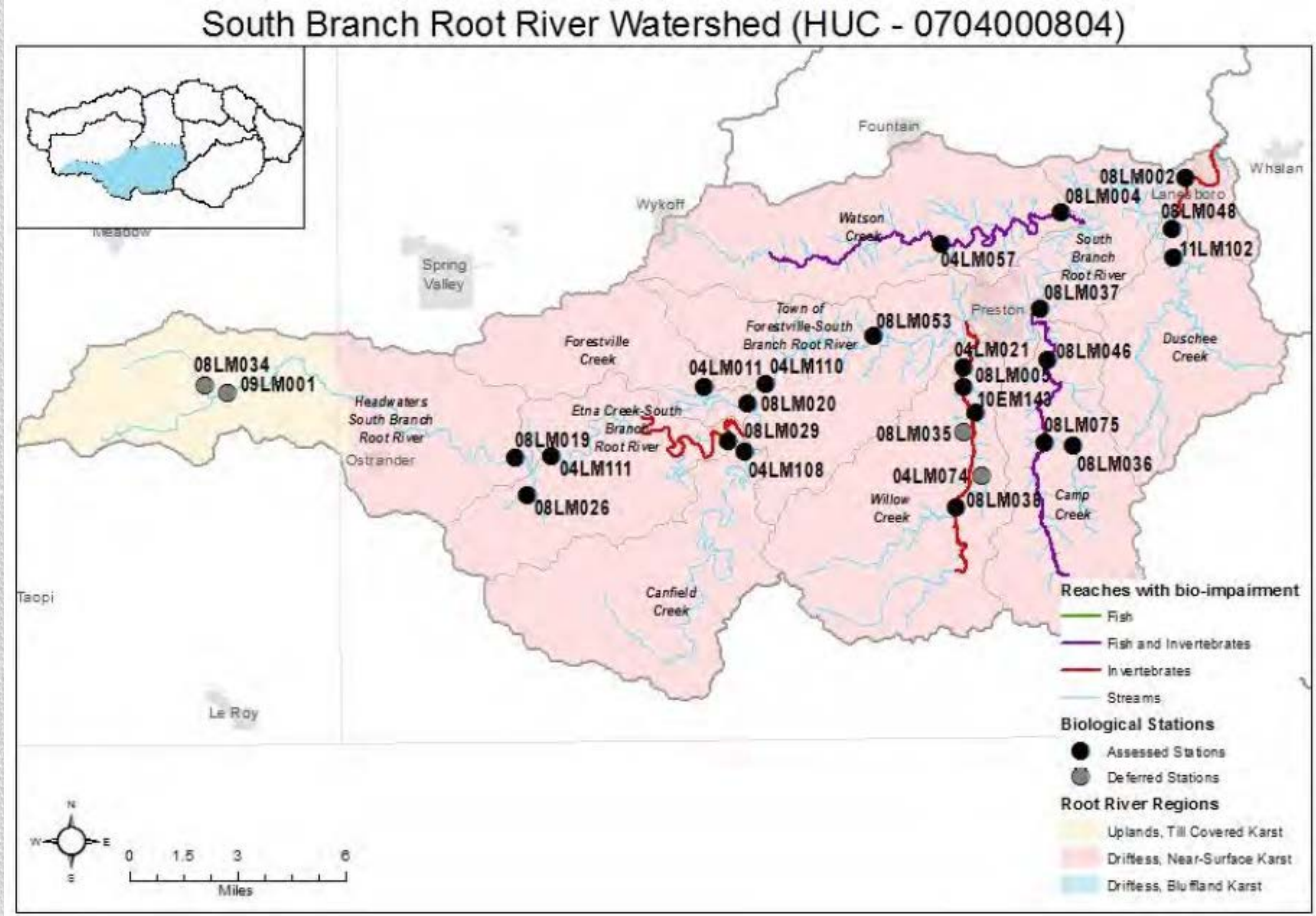
HUC12 Targeting



HUC12 Targeting

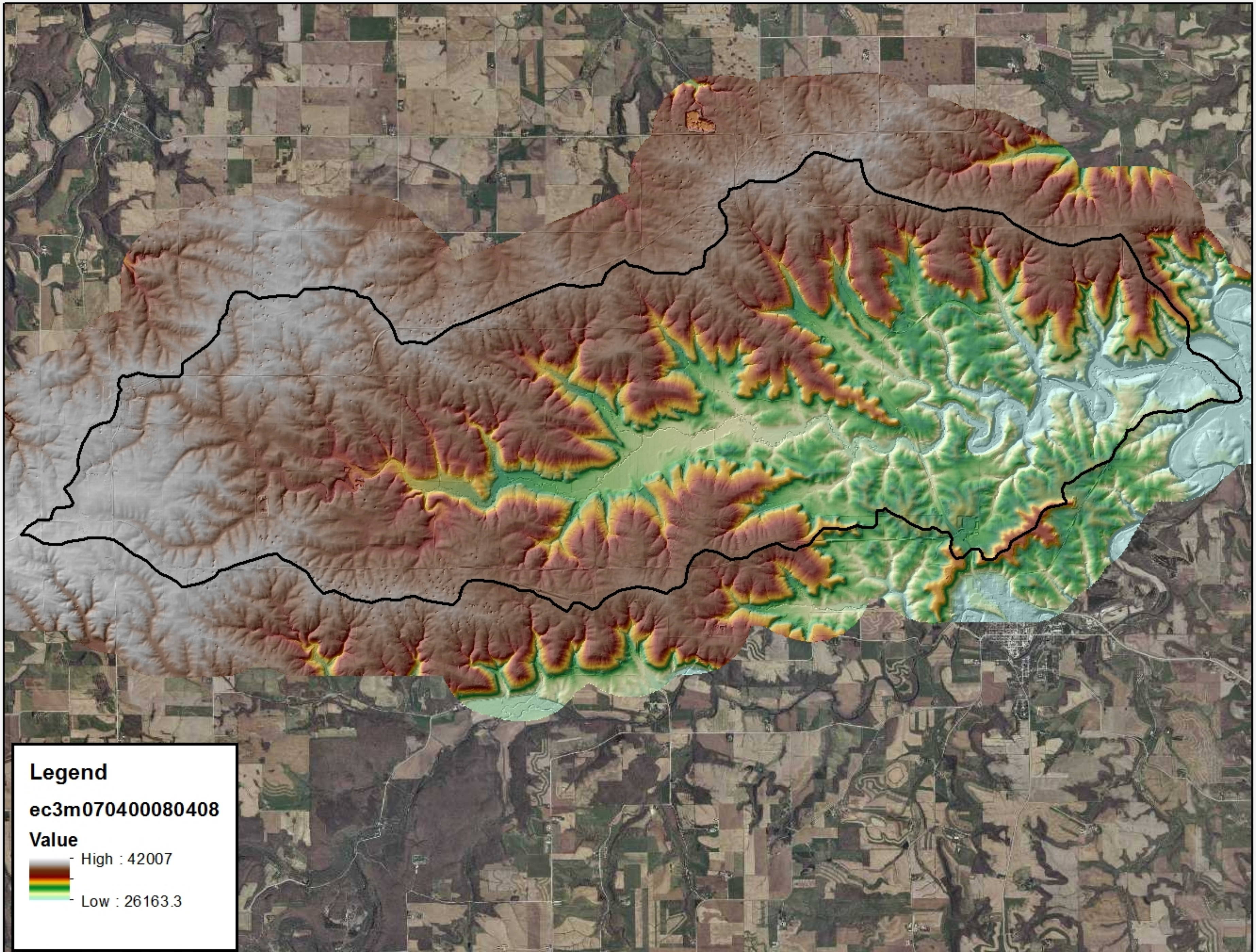


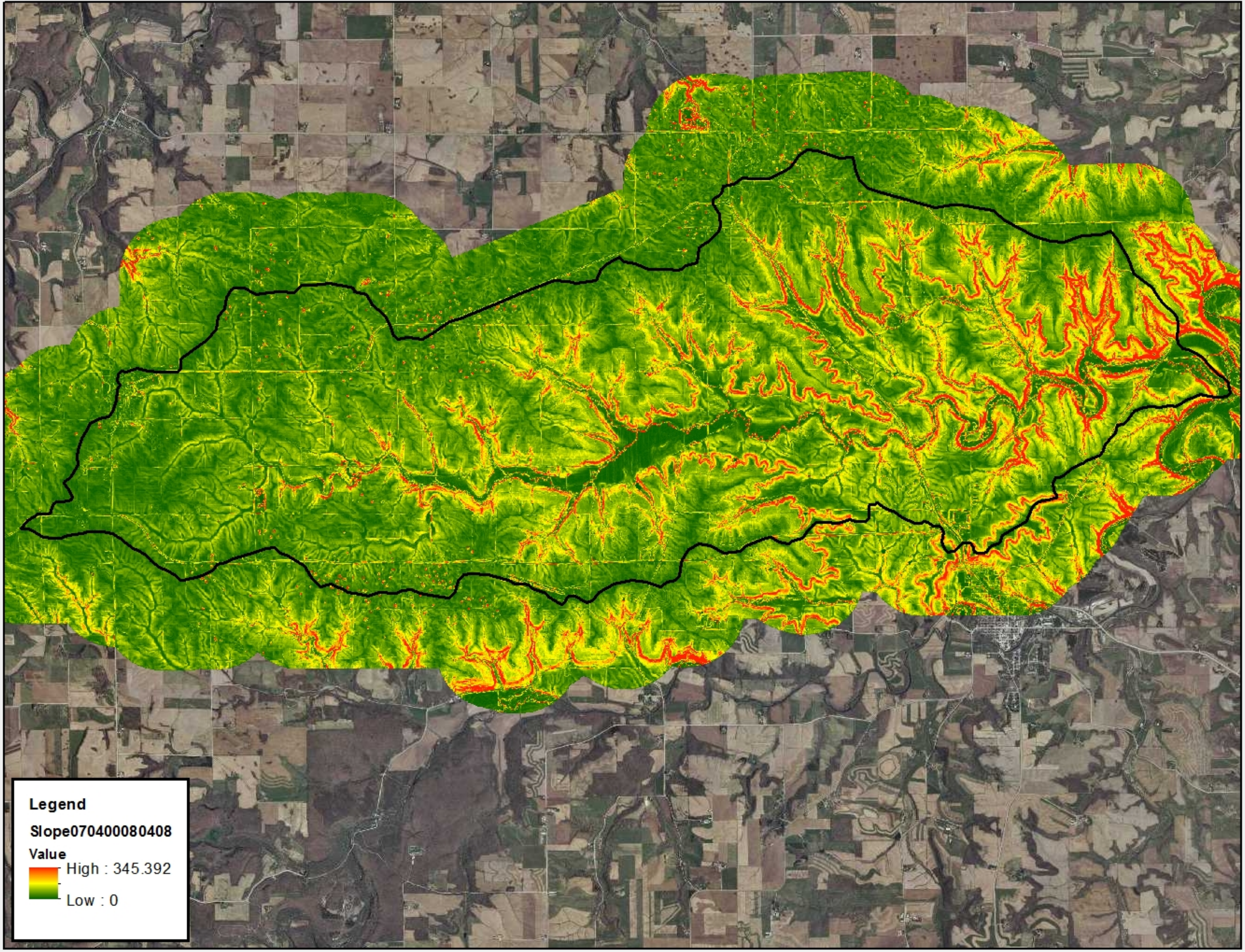
HUC12 Targeting

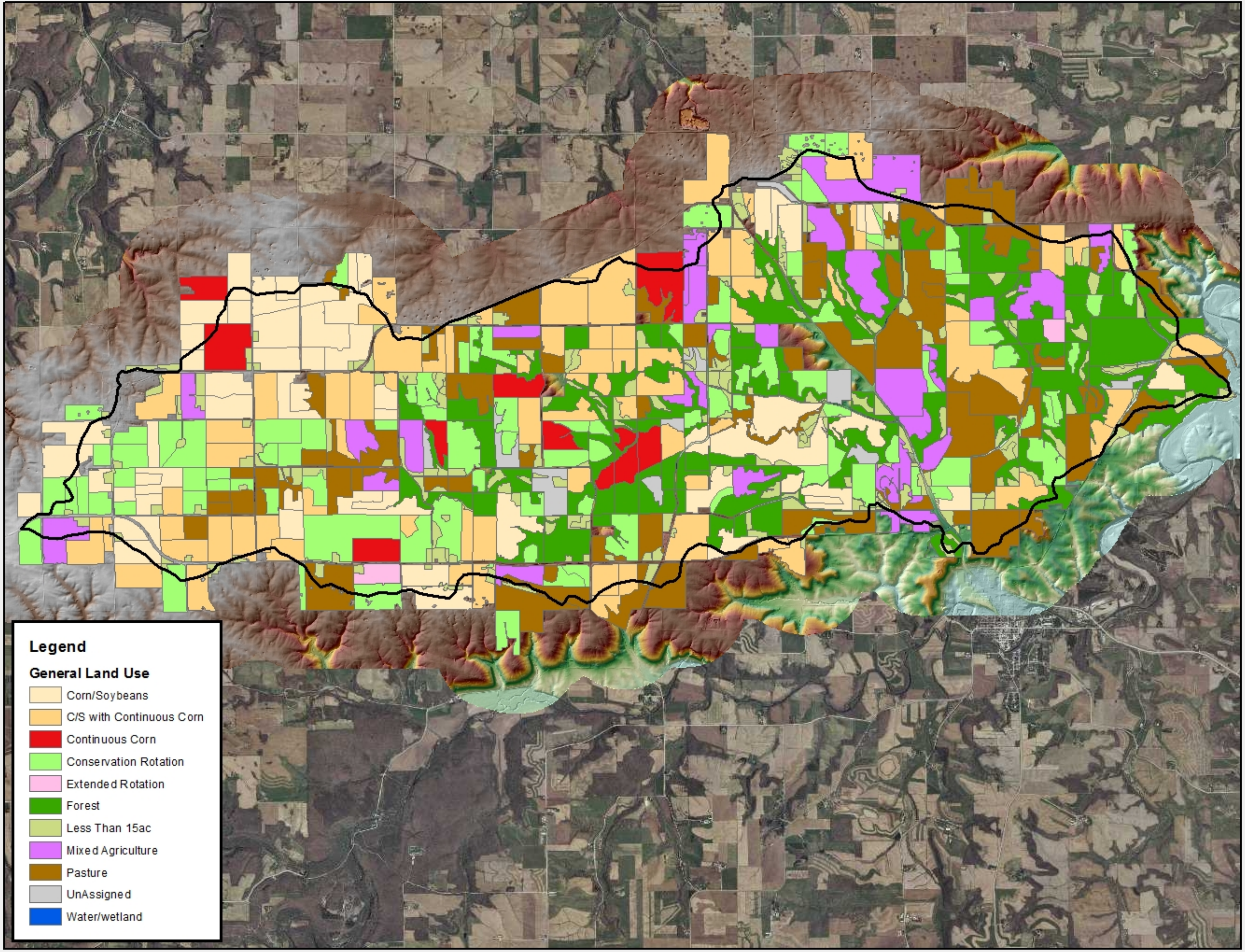


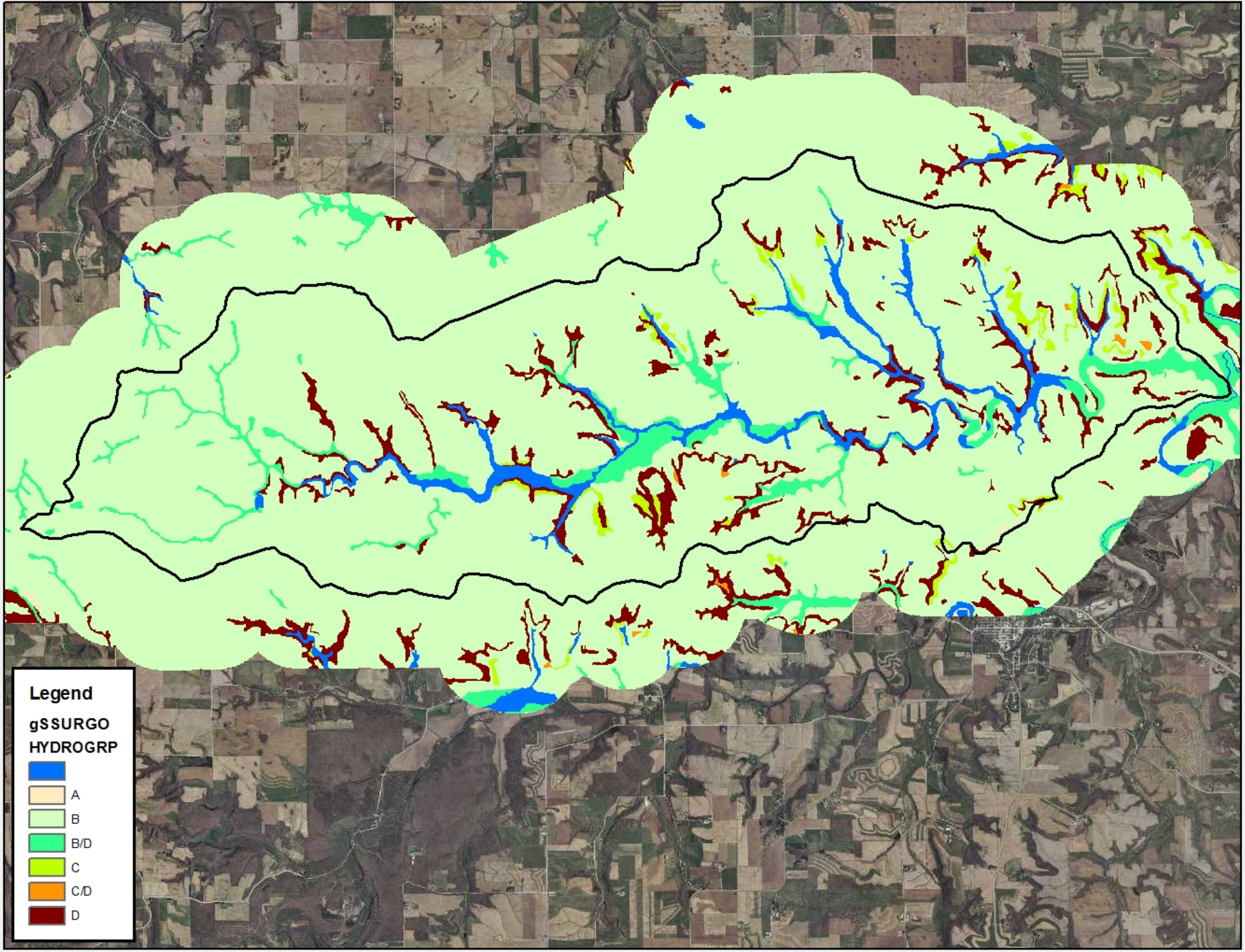
Data Sets

Input data include a LiDAR-derived digital elevation model (DEM), agricultural field boundaries with land use information, and SSURGO soil survey data.


Legend
ec3m070400080408
Value
High : 42007
Low : 26163.3


Legend
Slope070400080408
Value
High : 345.392
Low : 0


Legend
General Land Use
Corn/Soybeans
C/S with Continuous Corn
Continuous Corn
Conservation Rotation
Extended Rotation
Forest
Less Than 15ac
Mixed Agriculture
Pasture
UnAssigned
Water/wetland


Legend
gSSURGO
HYDROGRP
A
B
B/D
C
C/D
D

SPI -
Stream Power Index

Stream Power Index

Measurement of potential energy of water as it flows over bare ground

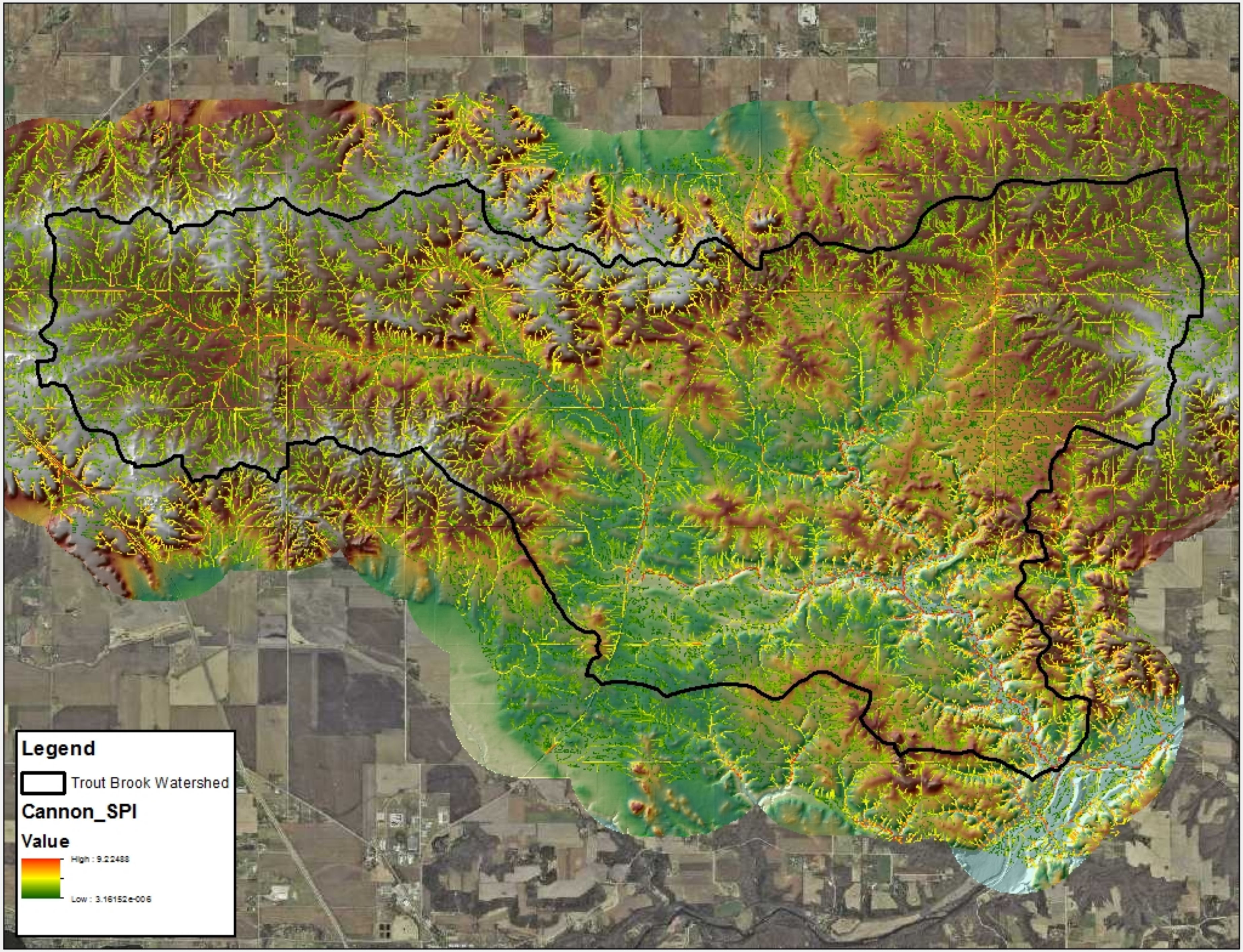
SPI = ln[(flow accumulation) x (slope)]

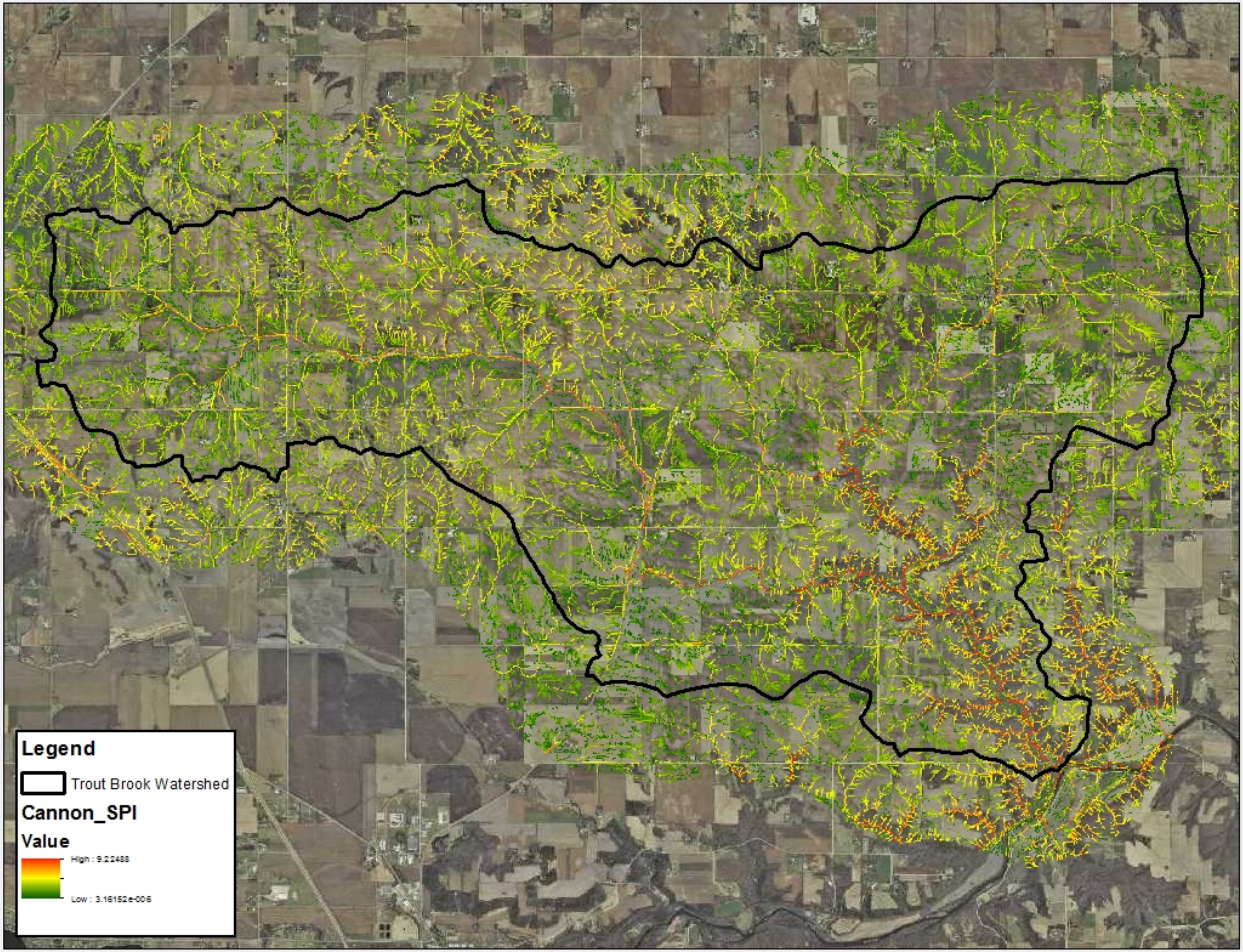
Amount of water expected

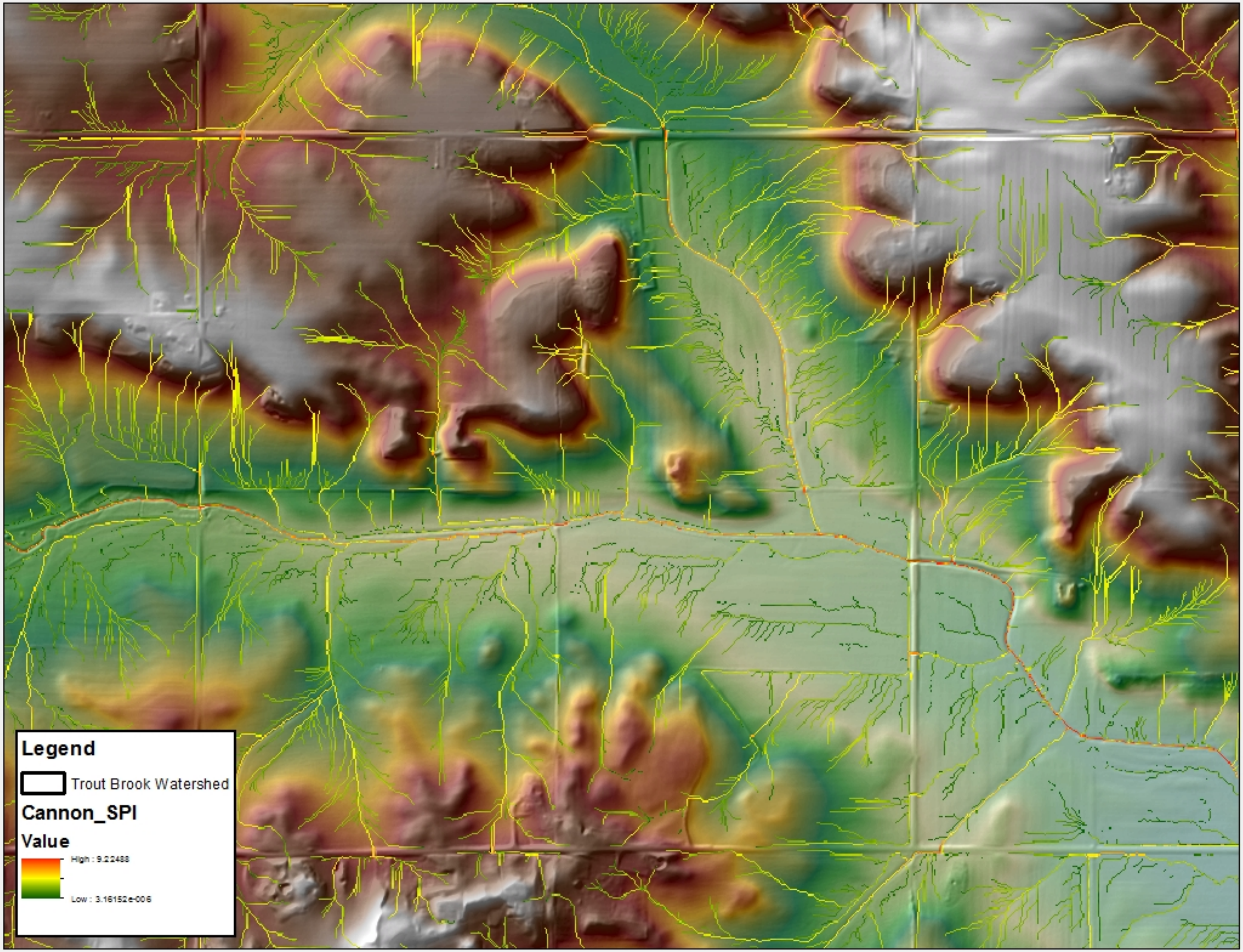
Slope of flow path

Purpose: Identify locations with high potential for gully erosion

Photo credit: http://www.mngeo.state.mn.us/chouse/elevation/uses/lidar_uses_waterquality.html


Legend
Trout Brook Watershed
Cannon_SPI
Value
High : 9.22488
Low : 3.16152e-006


Legend
Trout Brook Watershed
Cannon_SPI
Value
High : 9.22488
Low : 3.16152e-006


Legend
Trout Brook Watershed
Cannon_SPI
Value
High : 9.22488
Low : 3.16152e-006


Legend
Trout Brook Watershed
Cannon_SPI
Value
High : 9.22488
Low : 3.16152e-006

Precision Conservation Framework

By Mark Tomer, ARS, Ames, IA

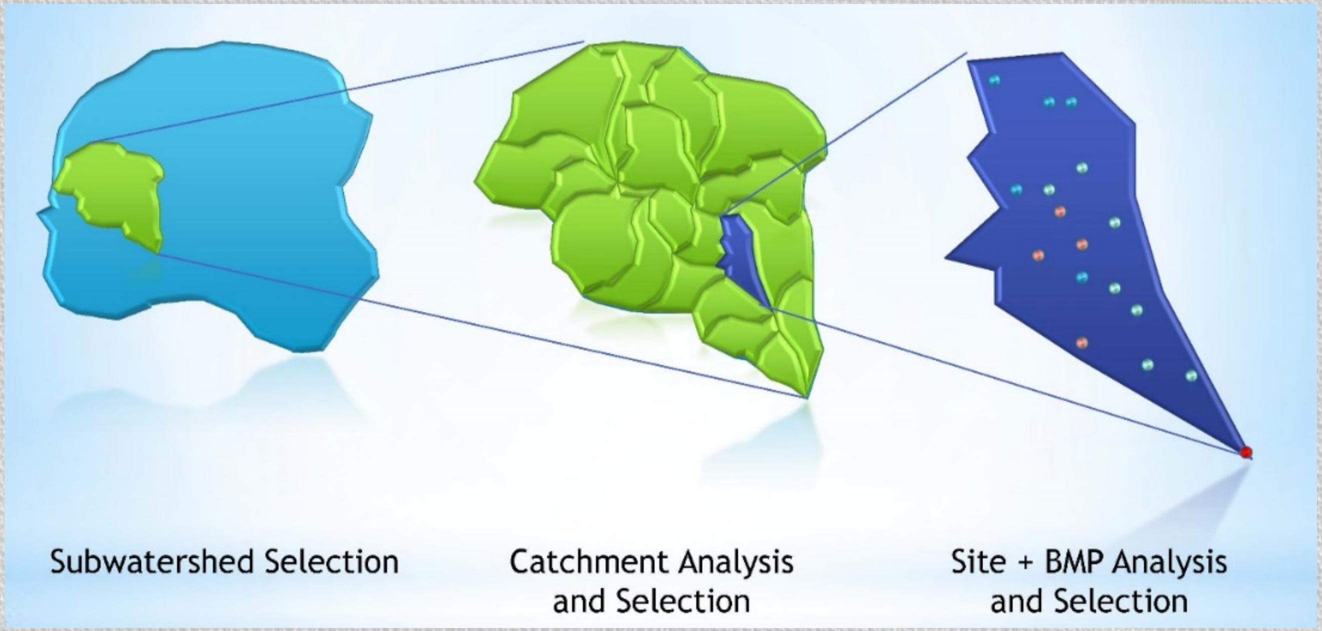
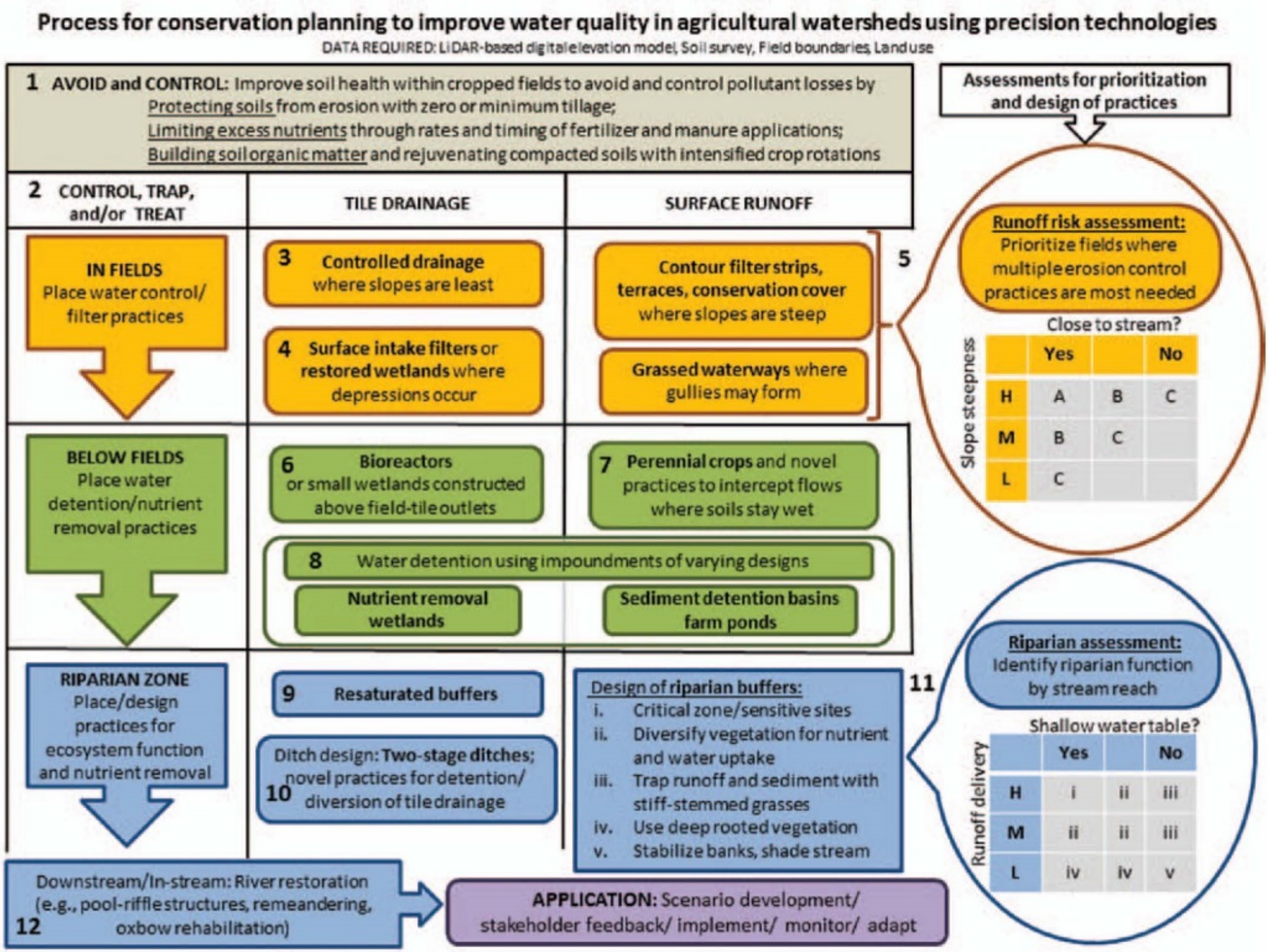


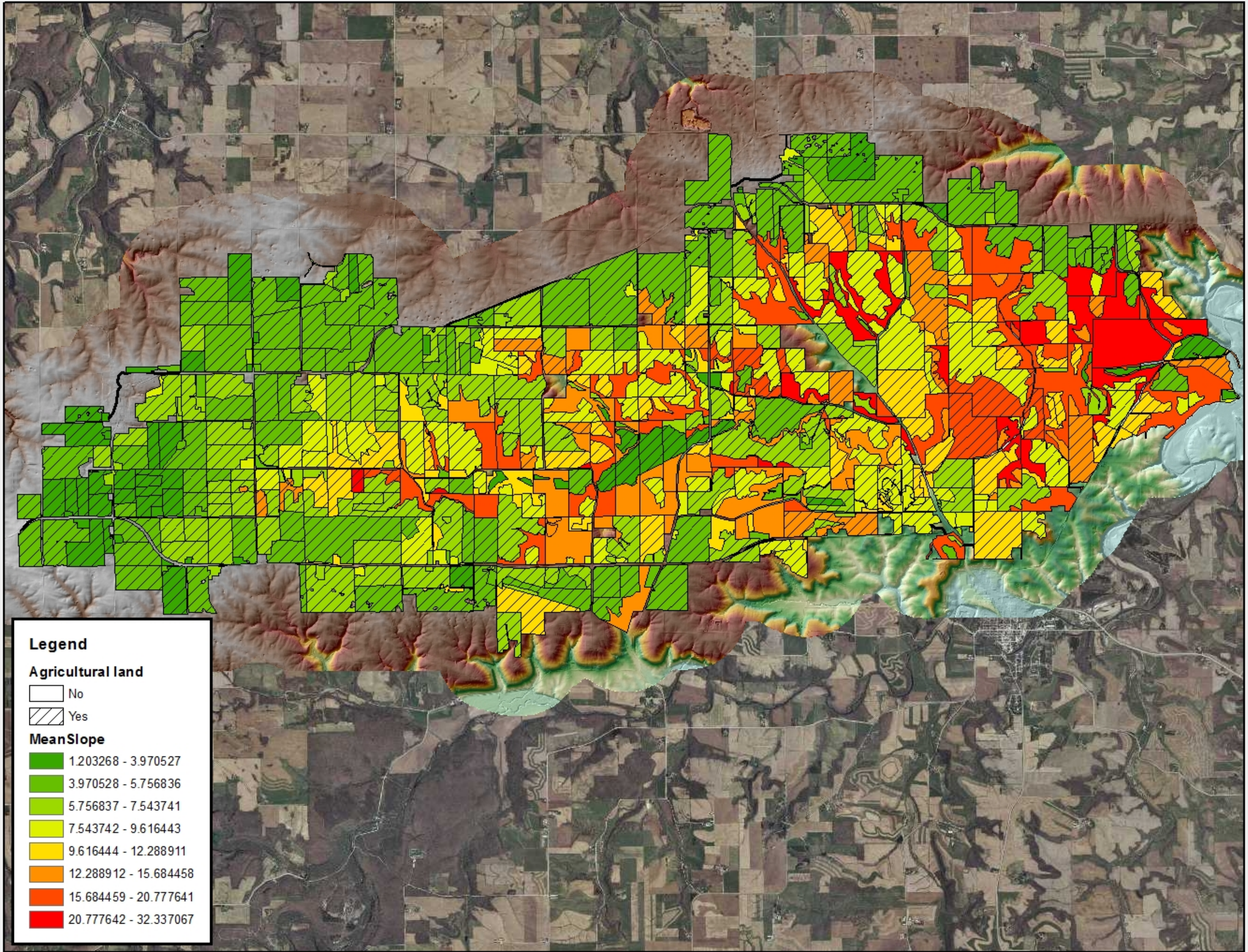
Figure 2

A framework for watershed-scale conservation planning using precision technologies.



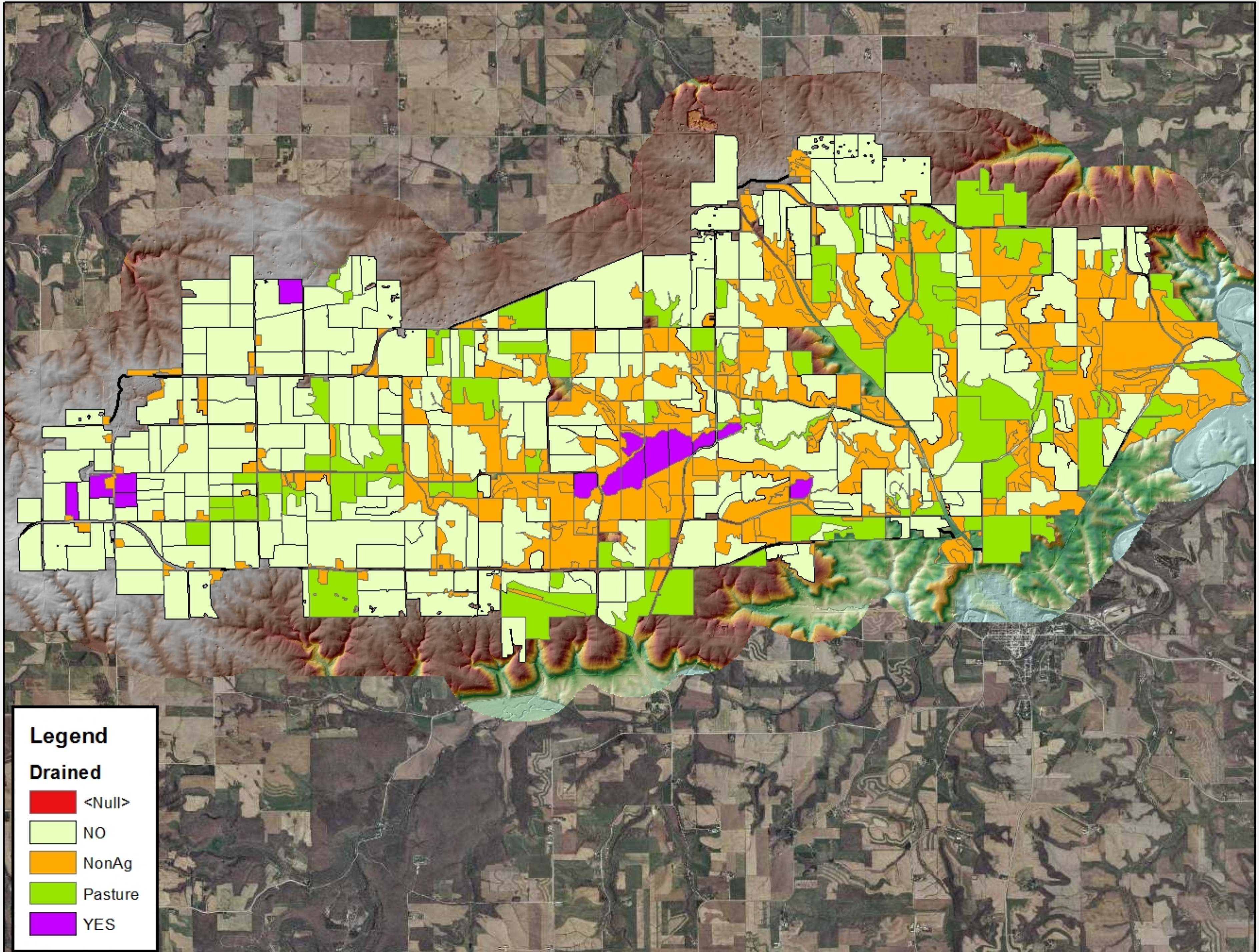
By-Field Slope Statistics

Field Characterization


Legend
Agricultural land
No
Yes
MeanSlope
1.203268 - 3.970527
3.970528 - 5.756836
5.756837 - 7.543741
7.543742 - 9.616443
9.616444 - 12.288911
12.288912 - 15.684458
15.684459 - 20.777641
20.777642 - 32.337067

Tile Drainage Determination

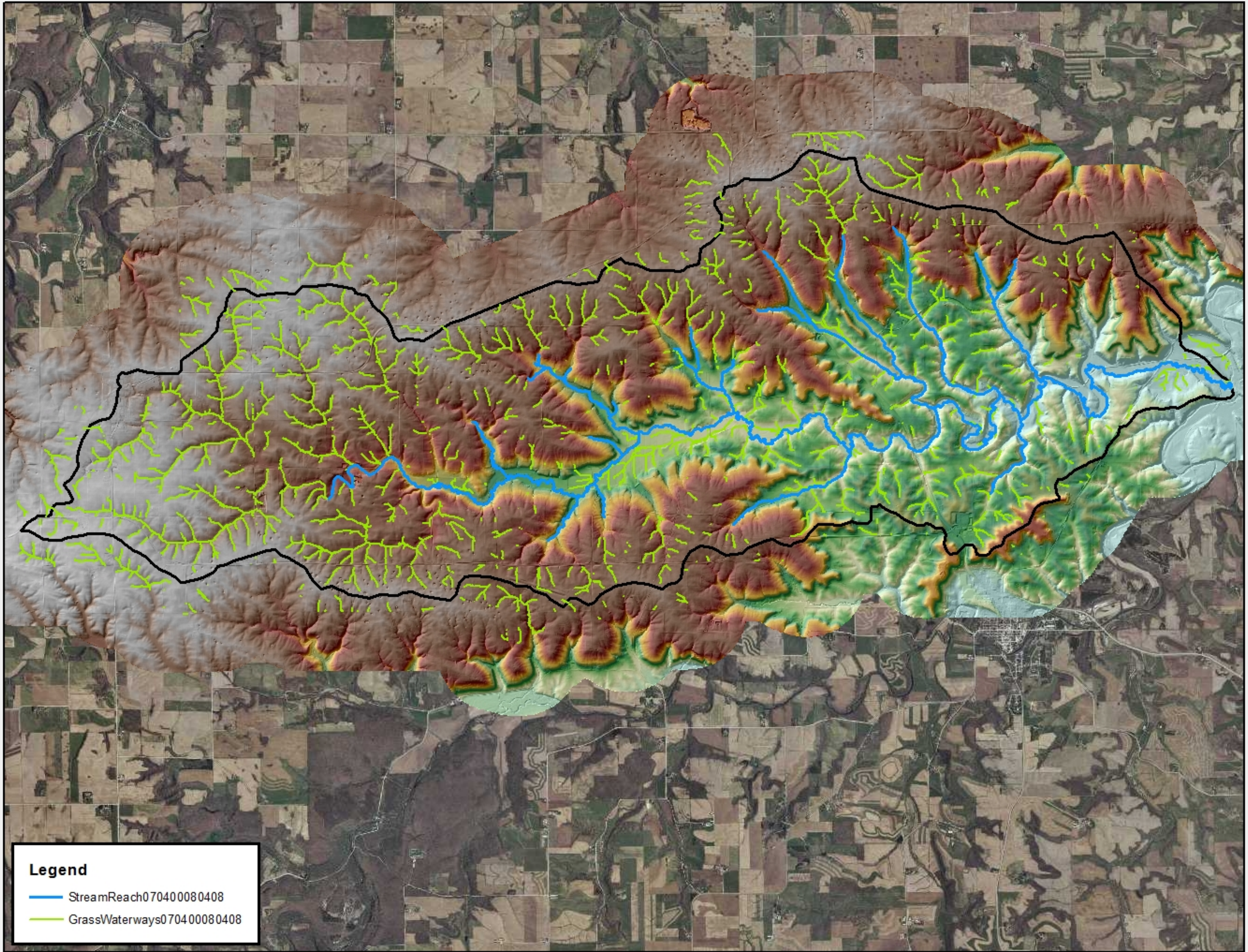
Field Characterization

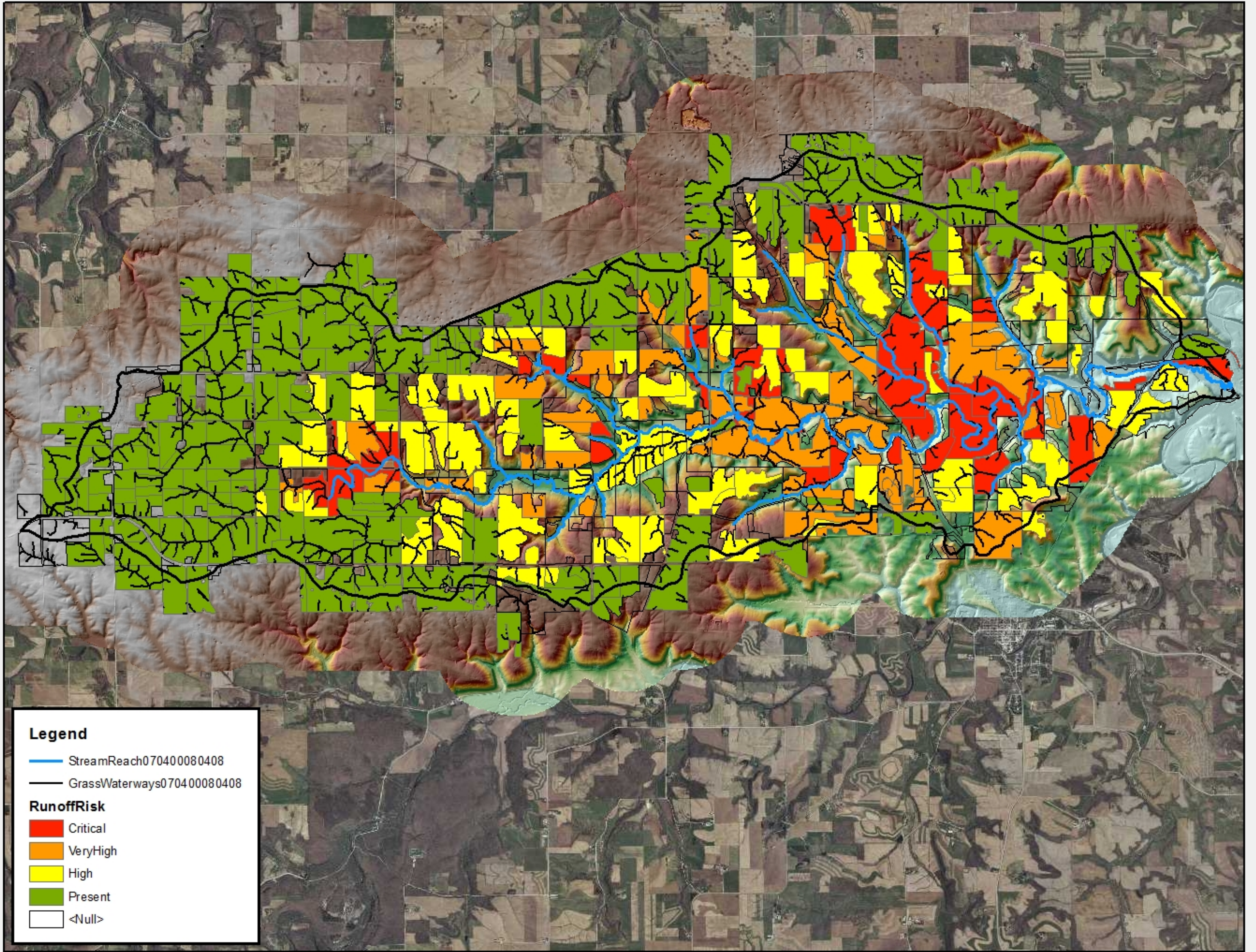

Legend
Drained
<Null>
NO
NonAg
Pasture
YES

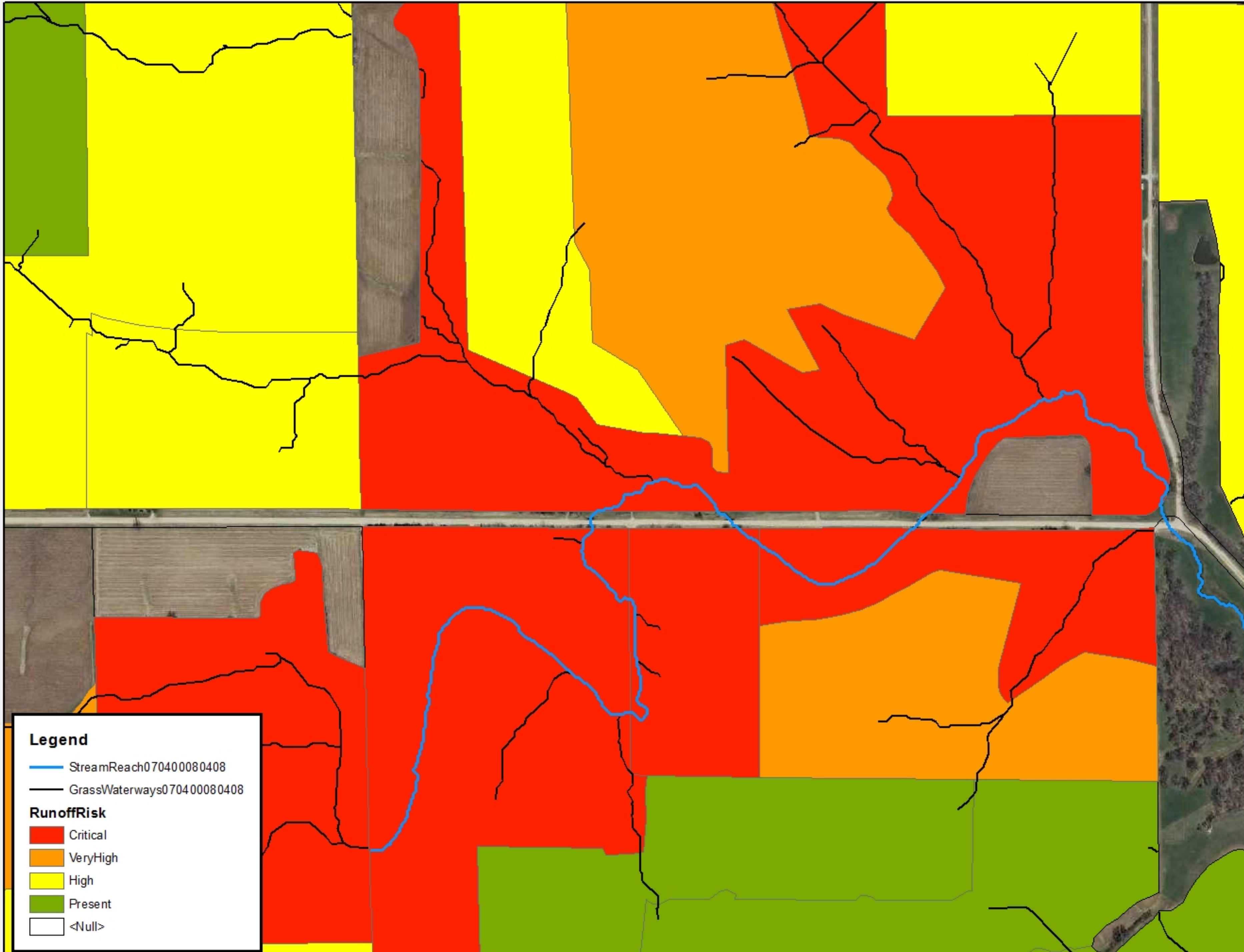
Runoff Risk Assessment & Grassed Waterways

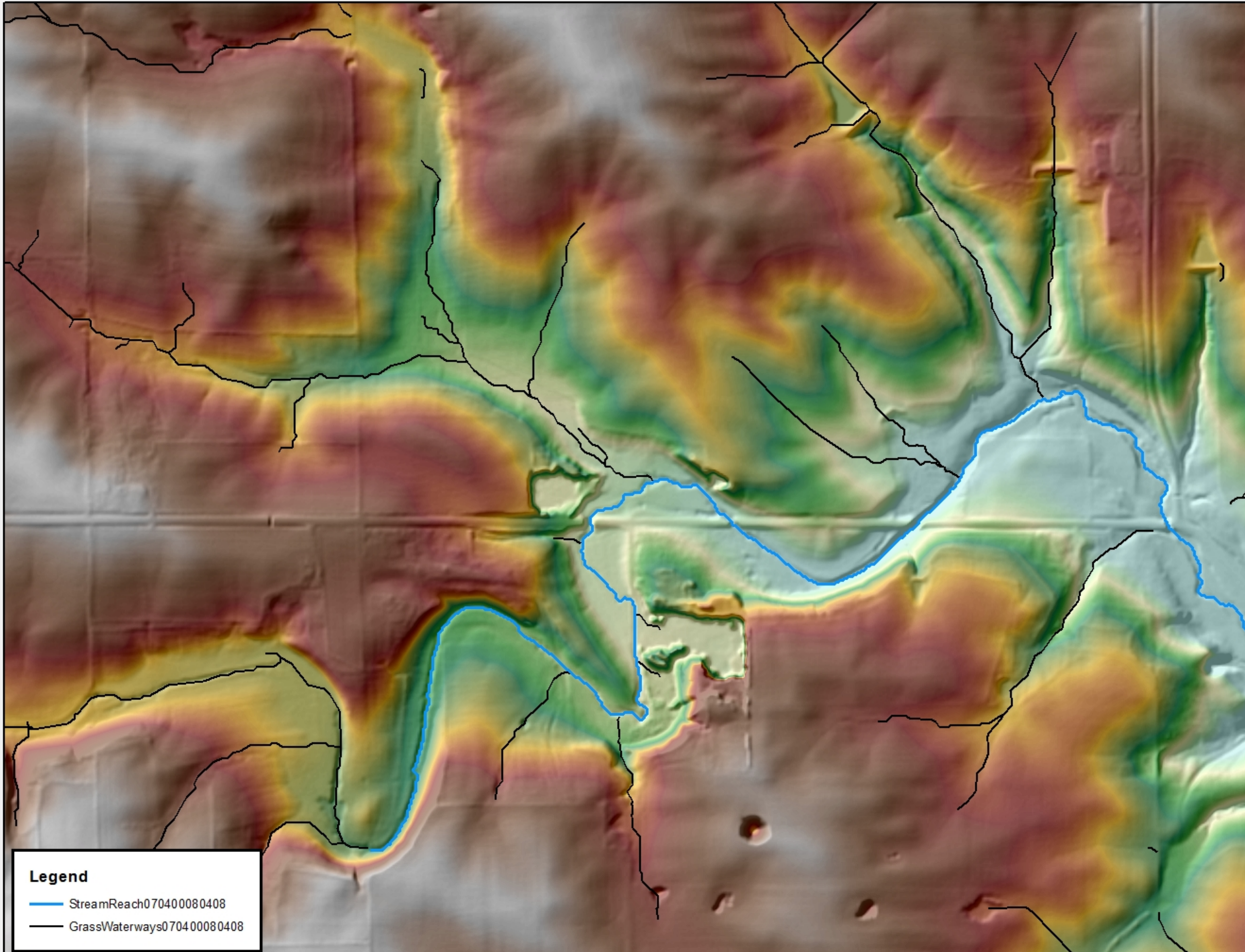
Field Characterization

The cross classification of the “Runoff Risk Assessment” matrix classifies each field according to its runoff risk. A more-detailed look at the within field topography and flow accumulation can then identify which conservation practices may be most suitable in a given field. This image shows possible locations for grassed waterways, located along areas where channelized flow may occur .

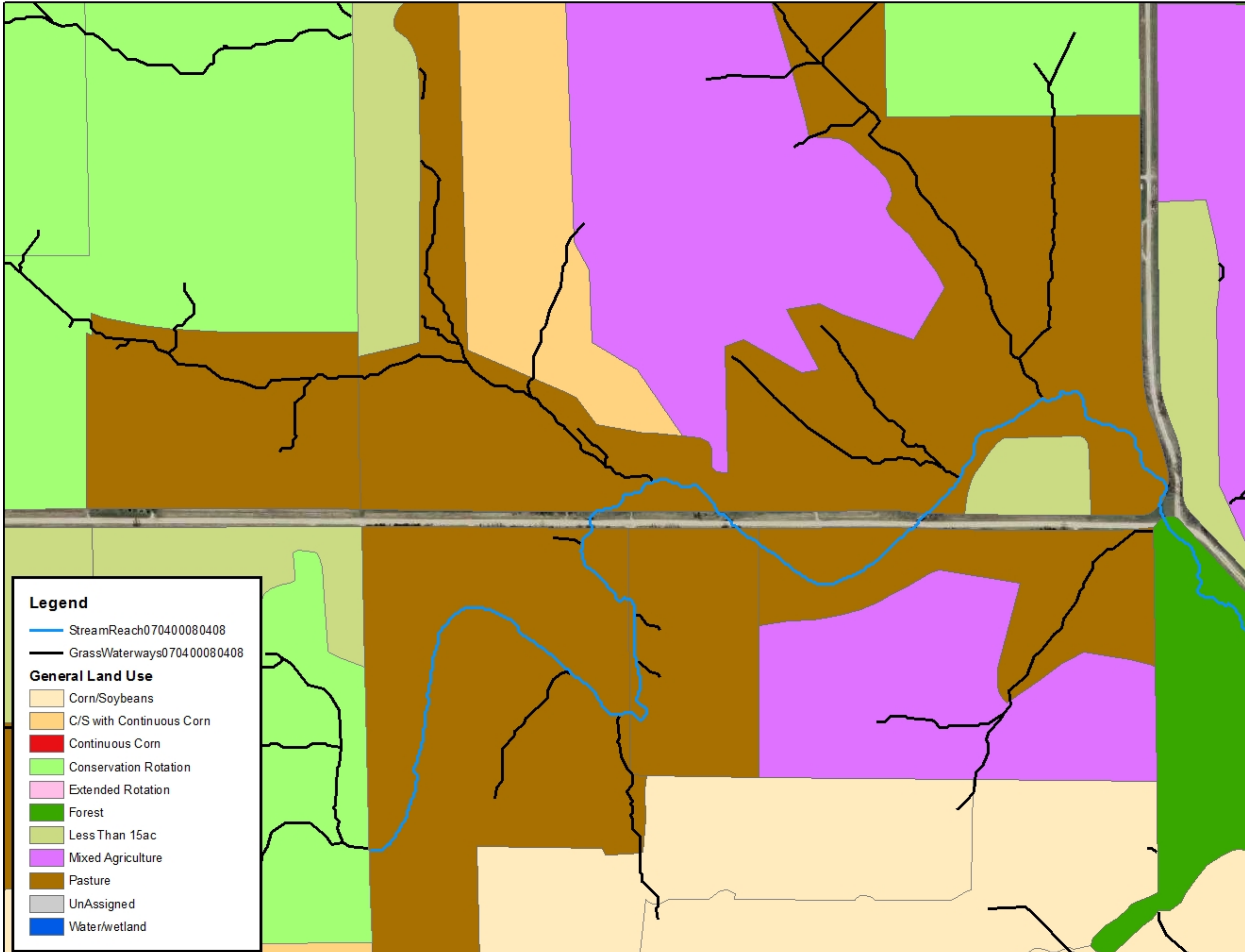

Legend
StreamReach070400080408
GrassWaterways070400080408

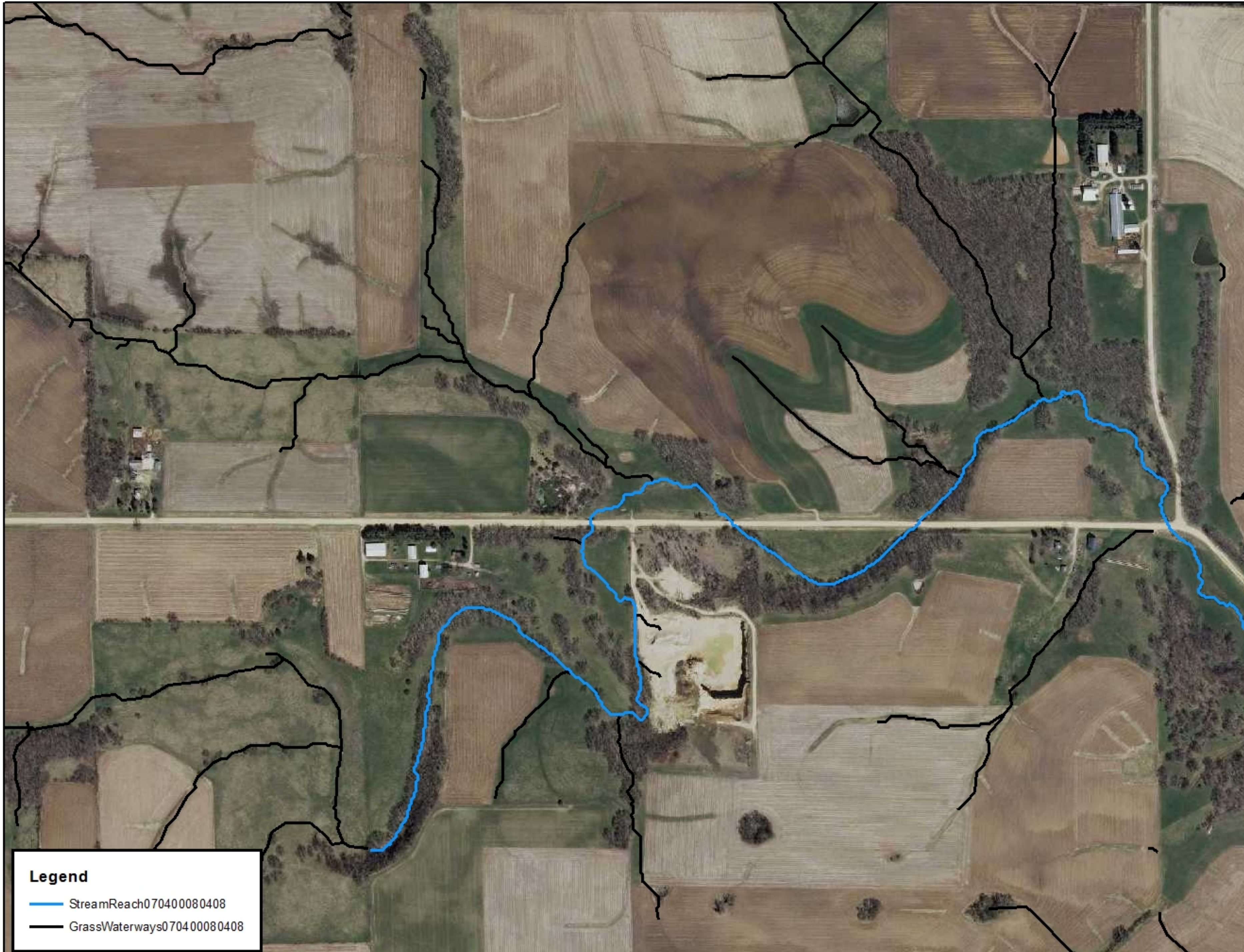

Legend
StreamReach070400080408
GrassWaterways070400080408
RunoffRisk
Critical
VeryHigh
High
Present
<Null>


Legend
StreamReach070400080408
GrassWaterways070400080408
RunoffRisk
Critical
VeryHigh
High
Present
<Null>



Legend
StreamReach070400080408
GrassWaterways070400080408

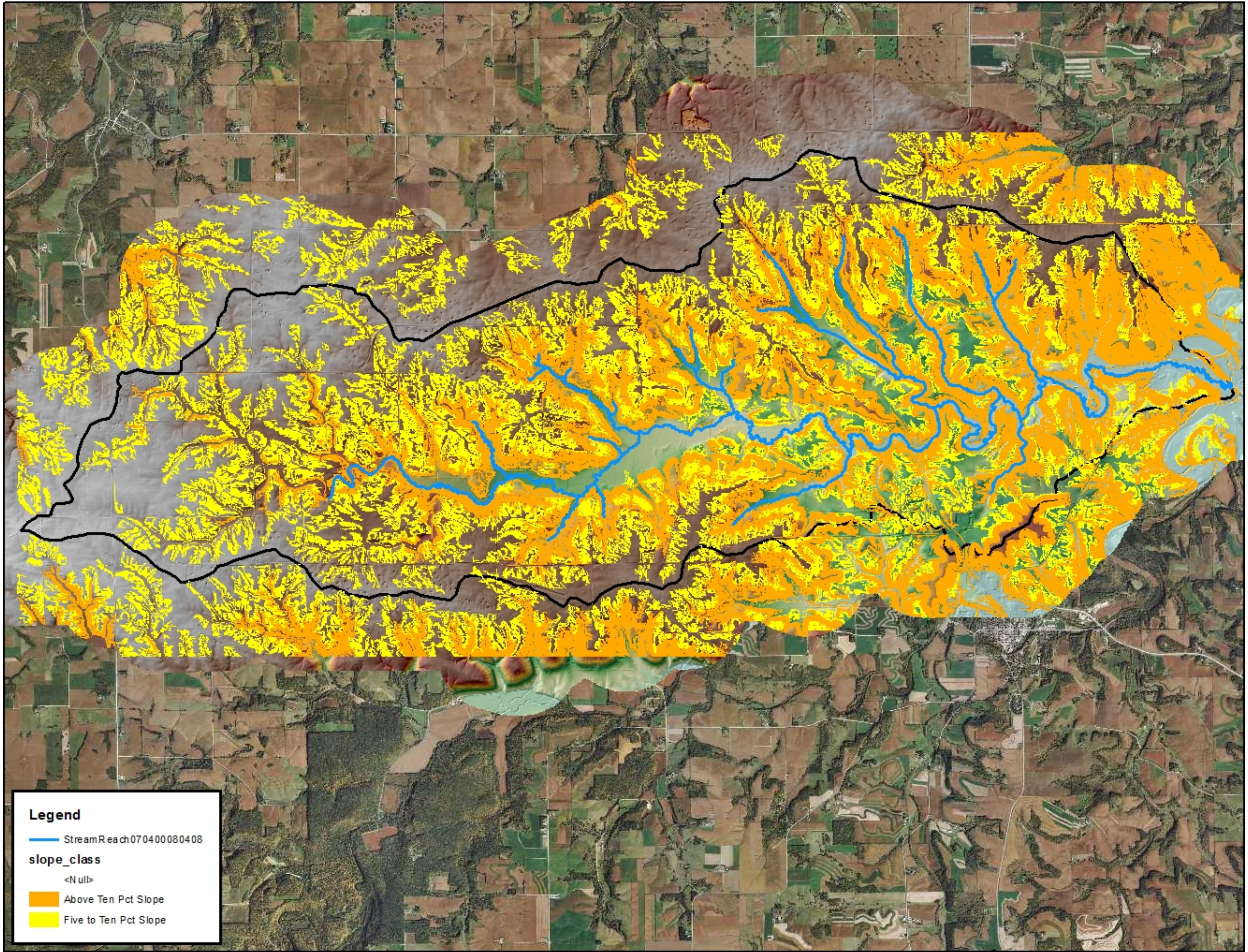

Legend
StreamReach070400080408
GrassWaterways070400080408
General Land Use
Corn/Soybeans
C/S with Continuous Corn
Continuous Corn
Conservation Rotation
Extended Rotation
Forest
Less Than 15ac
Mixed Agriculture
Pasture
UnAssigned
Water/wetland

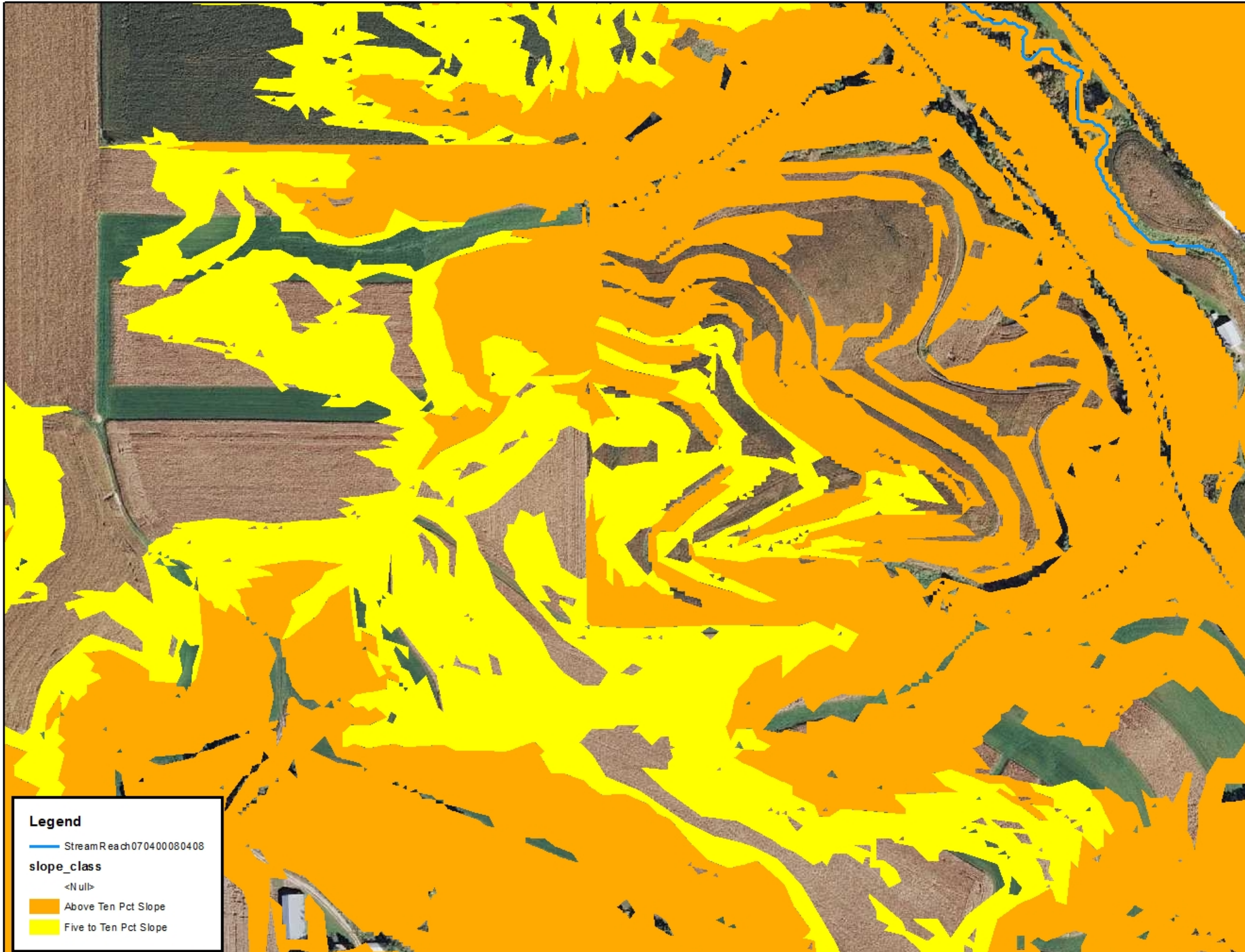

Legend
StreamReach070400080408
GrassWaterways070400080408

Contour Filter Strips

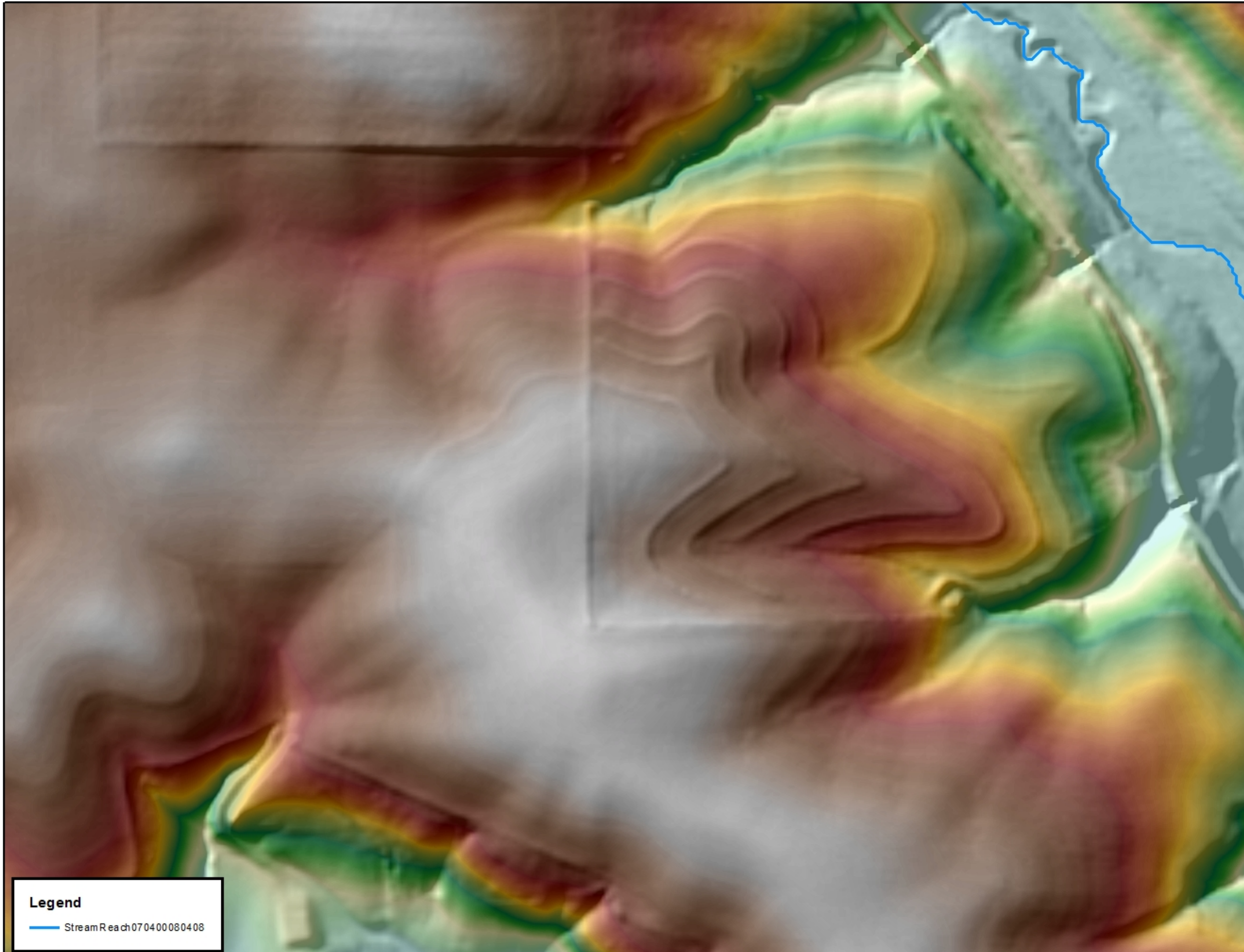
Precision Conservation Practice Siting

- Contour filter strips are strips of perennial vegetation alternated down a slope with wider cultivated strips that are farmed on the contour. Similar to grassed waterways, contour filter strips are in-field runoff control practices, designed to decrease the occurrence of concentrated flow and reduce sheet and rill erosion.
- The contour filter strip tool identifies contiguous areas of high slopes (> 5%) in agricultural fields. Contour buffer strips and/or terraces (more suited to steeper ground) placed within these areas are beneficial for reducing sheet and rill erosion.


Legend
StreamReach070400080408
slope_class
<Null>
Above Ten Pct Slope
Five to Ten Pct Slope


Legend
StreamReach070400080408
slope_class
<Null>
Above Ten Pct Slope
Five to Ten Pct Slope

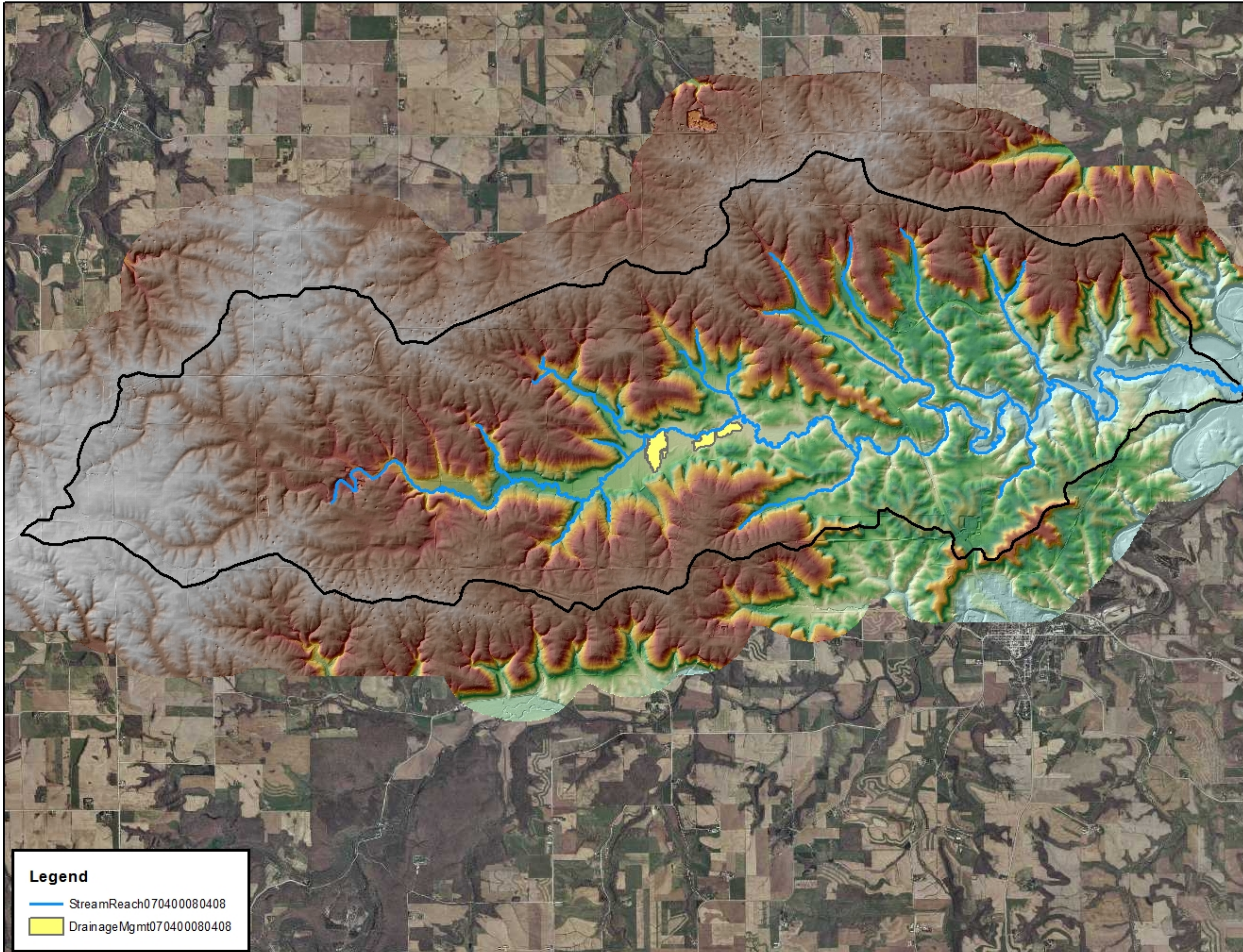

Legend
StreamReach070400080408


Legend
StreamReach070400080408

Drainage Water Management

Precision Conservation Practice Siting

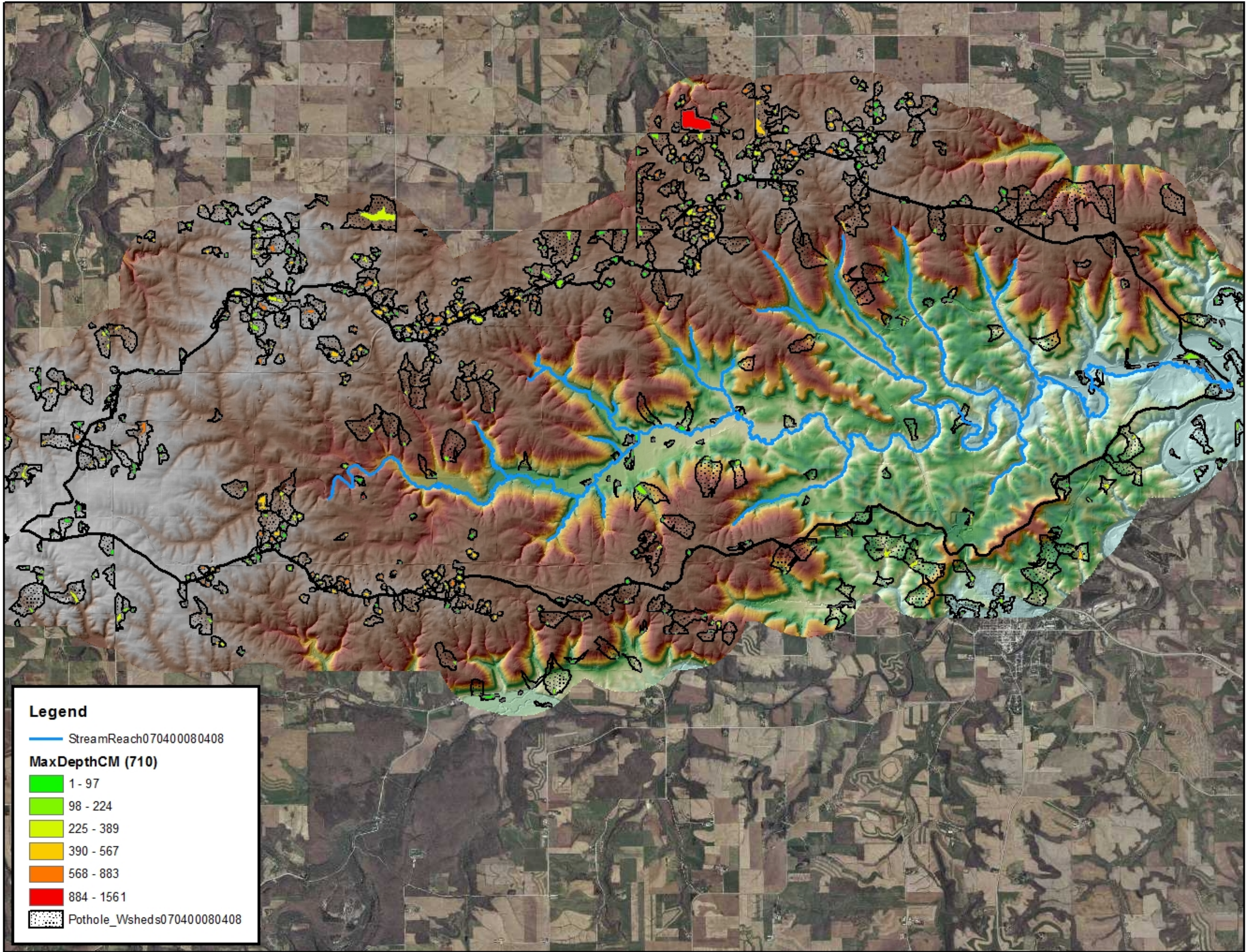
Controlled drainage may be used on fields with flat topography (typically one percent or less slope, such as in flood plains and on flat fields typical of the large areas of the glaciated Midwest. The practice can be expensive to design and install in areas with slopes steeper than about one percent because of the number of control structures required in a typical field. A single control gate (dependent on its size) can influence the water table within approximately .5 meter change in elevation. To identify fields potentially suited to this practice, the Drainage Water Management tool identifies the largest area within any 1-meter (3.3 ft) contour interval (representing the addition of 2 control-gate structures), within each tile-drained, agricultural field.

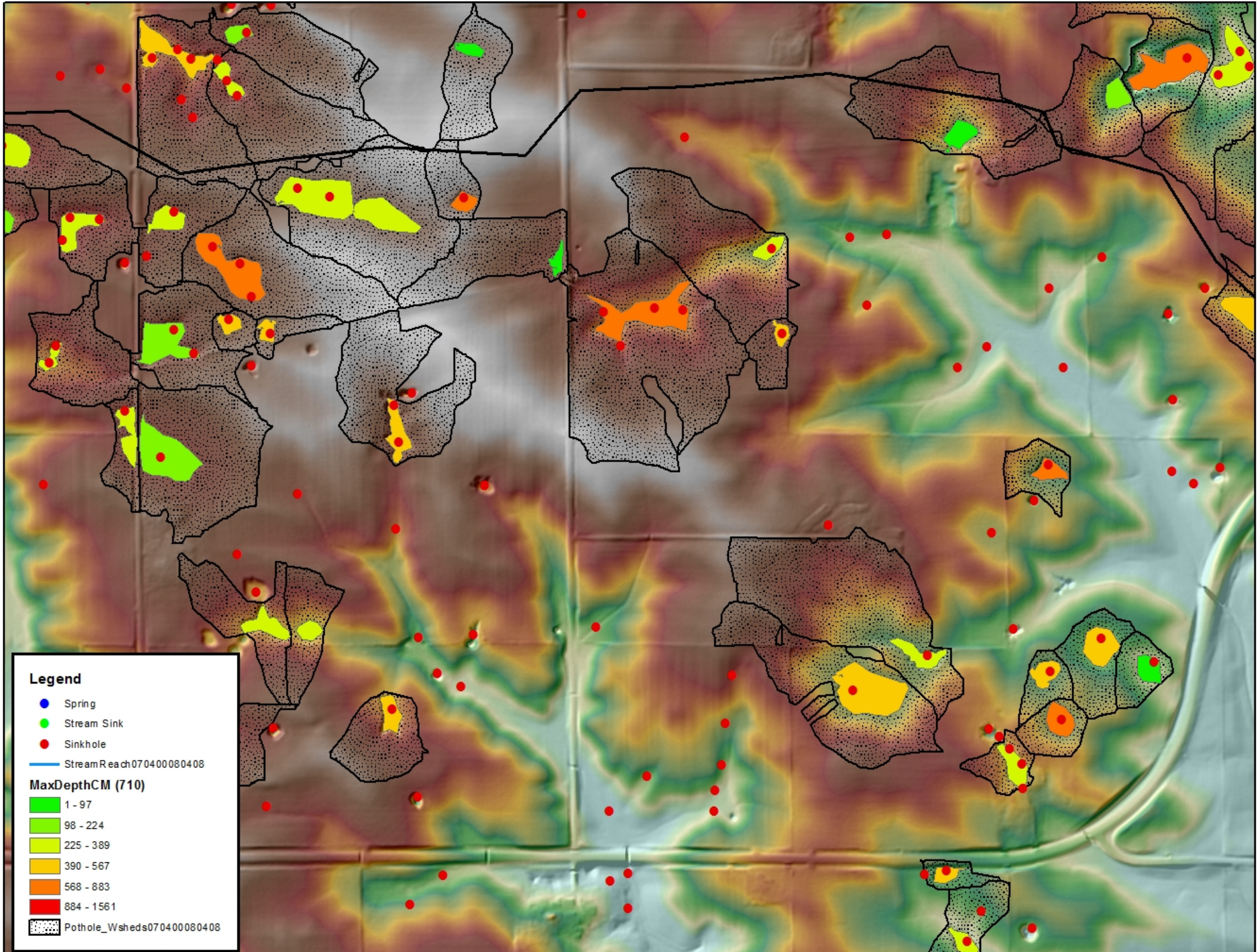

Legend
StreamReach070400080408
DrainageMgmt070400080408

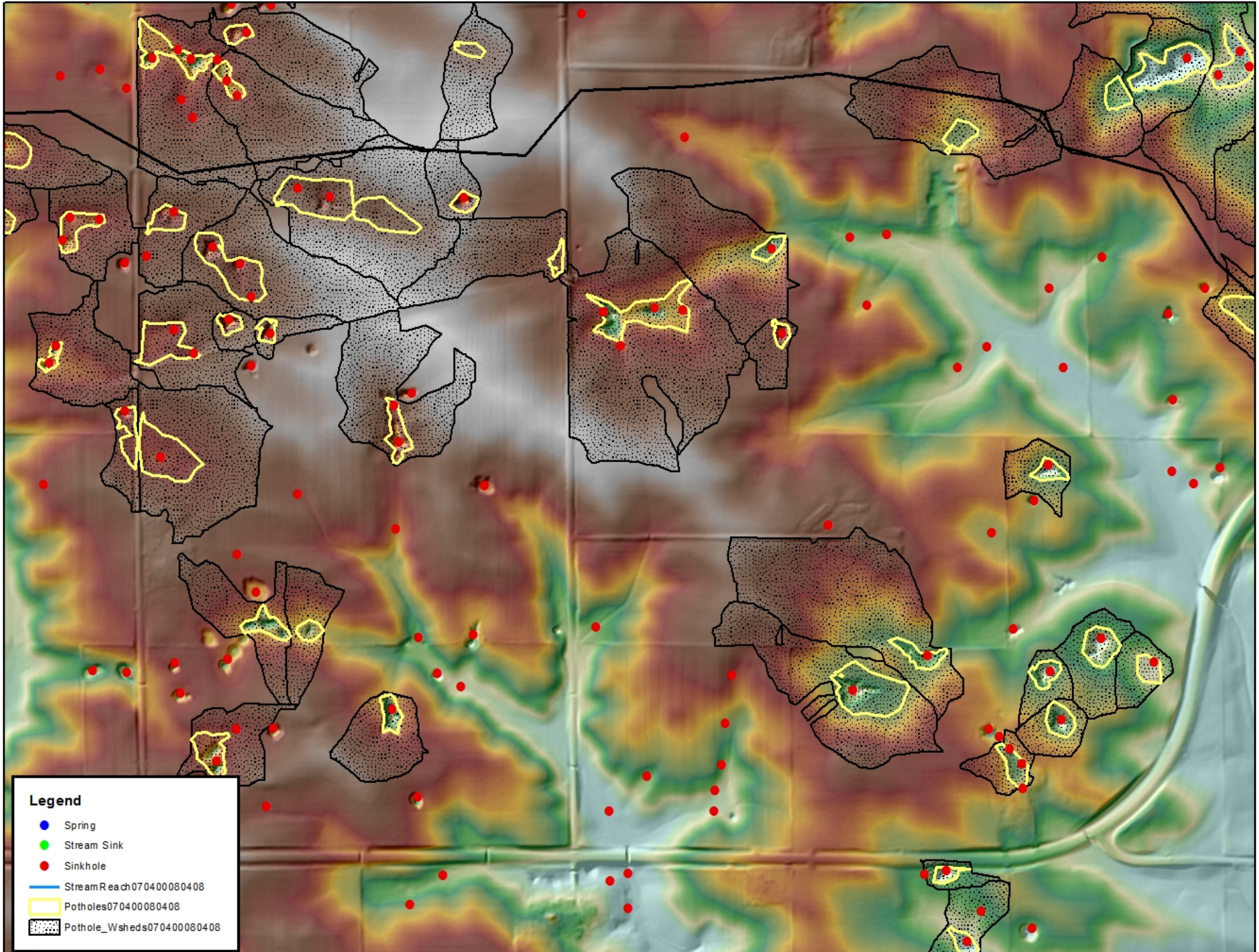
Pothole Identification

Precision Conservation Practice Siting

Depressions are common in the glacial landscapes of the Midwest and present challenges for managing water quality and wetness of fields. We have shaded depressions based on the depth of the depression observed using LiDAR imagery. Installation of filter strips could be prioritized for those depressions receiving runoff from the largest drainage areas.


Legend
StreamReach070400080408
MaxDepthCM (710)
1 - 97
98 - 224
225 - 389
390 - 567
568 - 883
884 - 1561
Pothole_Wsheds070400080408


Legend
Spring
Stream Sink
Sinkhole
StreamReach070400080408
MaxDepthCM (710)
1 - 97
98 - 224
225 - 389
390 - 567
568 - 883
884 - 1561
Pothole_Wsheds070400080408

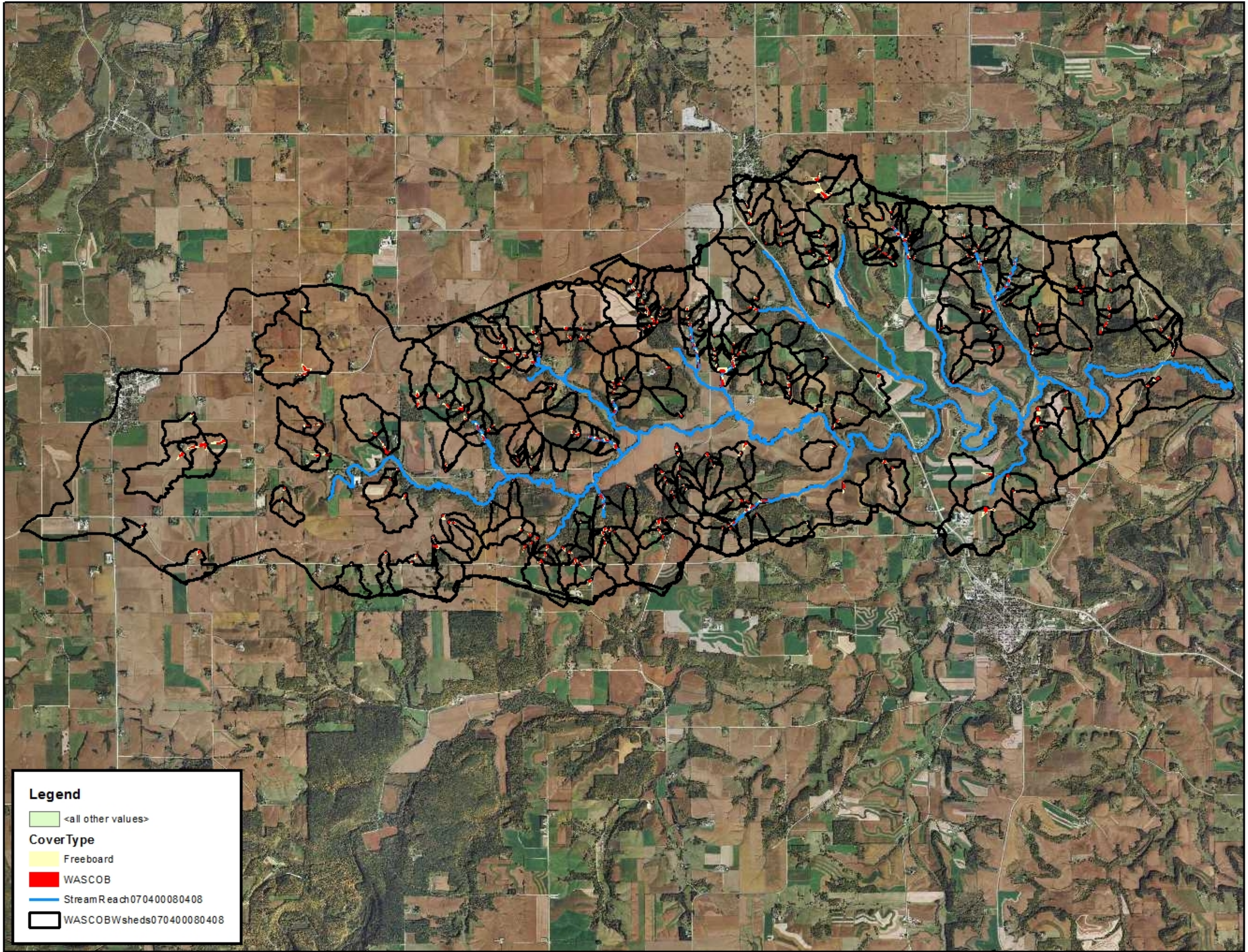

Legend
Spring
Stream Sink
Sinkhole
StreamReach070400080408
Potholes070400080408
Pothole_Wsheds070400080408


Legend
Spring
Stream Sink
Sinkhole
StreamReach070400080408
Potholes070400080408
Pothole_Wsheds070400080408

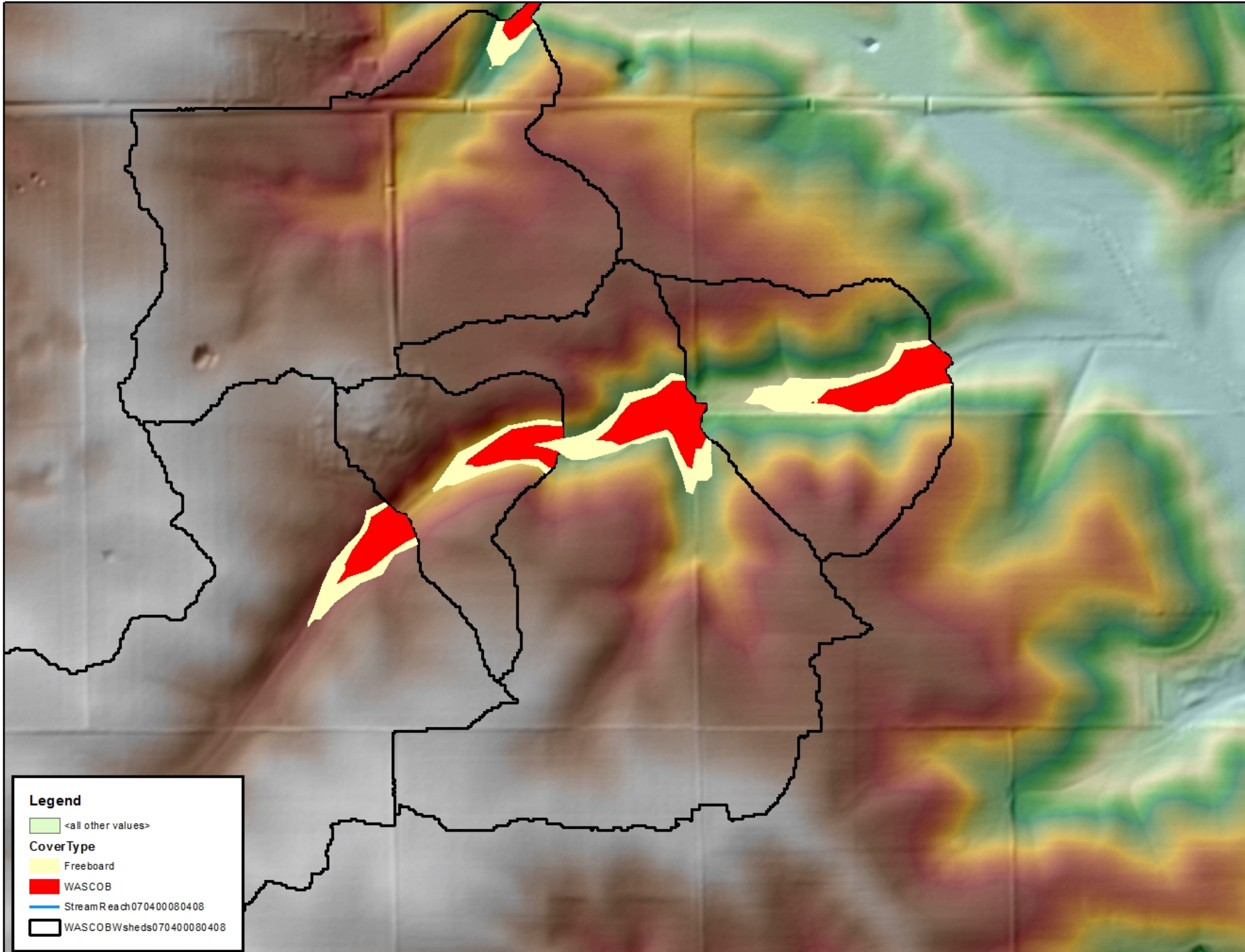
WASCOB's - Water and Sediment Control Basins

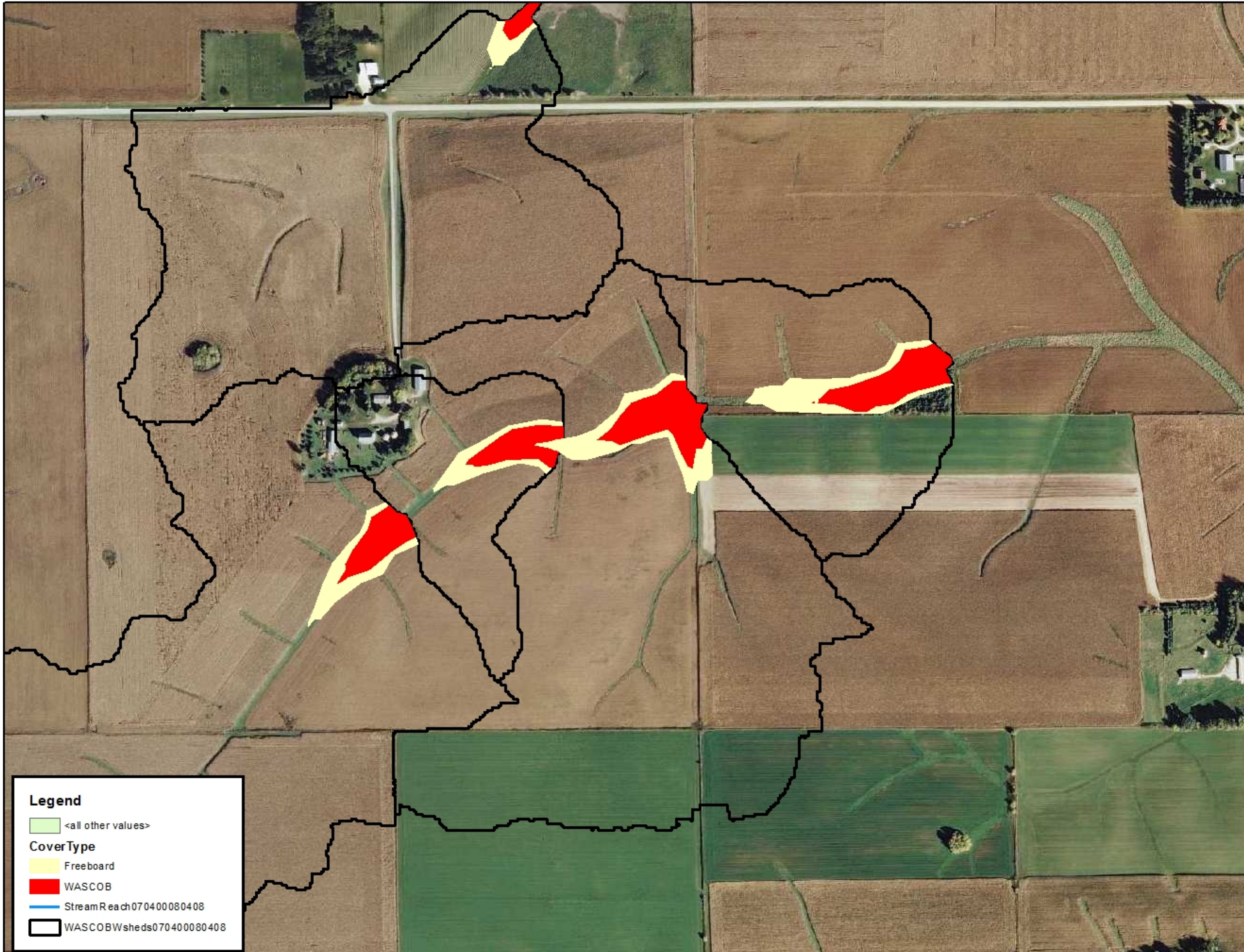
Impound Siting

Water and sediment control basins (WASCOBS, or 'sediment detention basins) are placed along waterways to detain runoff water the opportunity for sediment to settle out to avoid its delivery to the stream channel. The set of criteria used are similar to that used to locate wetlands, but the idea is to have somewhat deeper water (to provide a depth and storage volume for sediment to settle to the bottom) and a smaller surface area. These basins can (and should) be placed along ephemeral drainage ways that are somewhat more incised than those selected for wetlands.



Legend
<all other values>
CoverType
Freeboard
WASCOB
StreamReach070400080408
WASCOBWsheds070400080408


Legend
<all other values>
CoverType
Freeboard
WASCOB
StreamReach070400080408
WASCOBWsheds070400080408

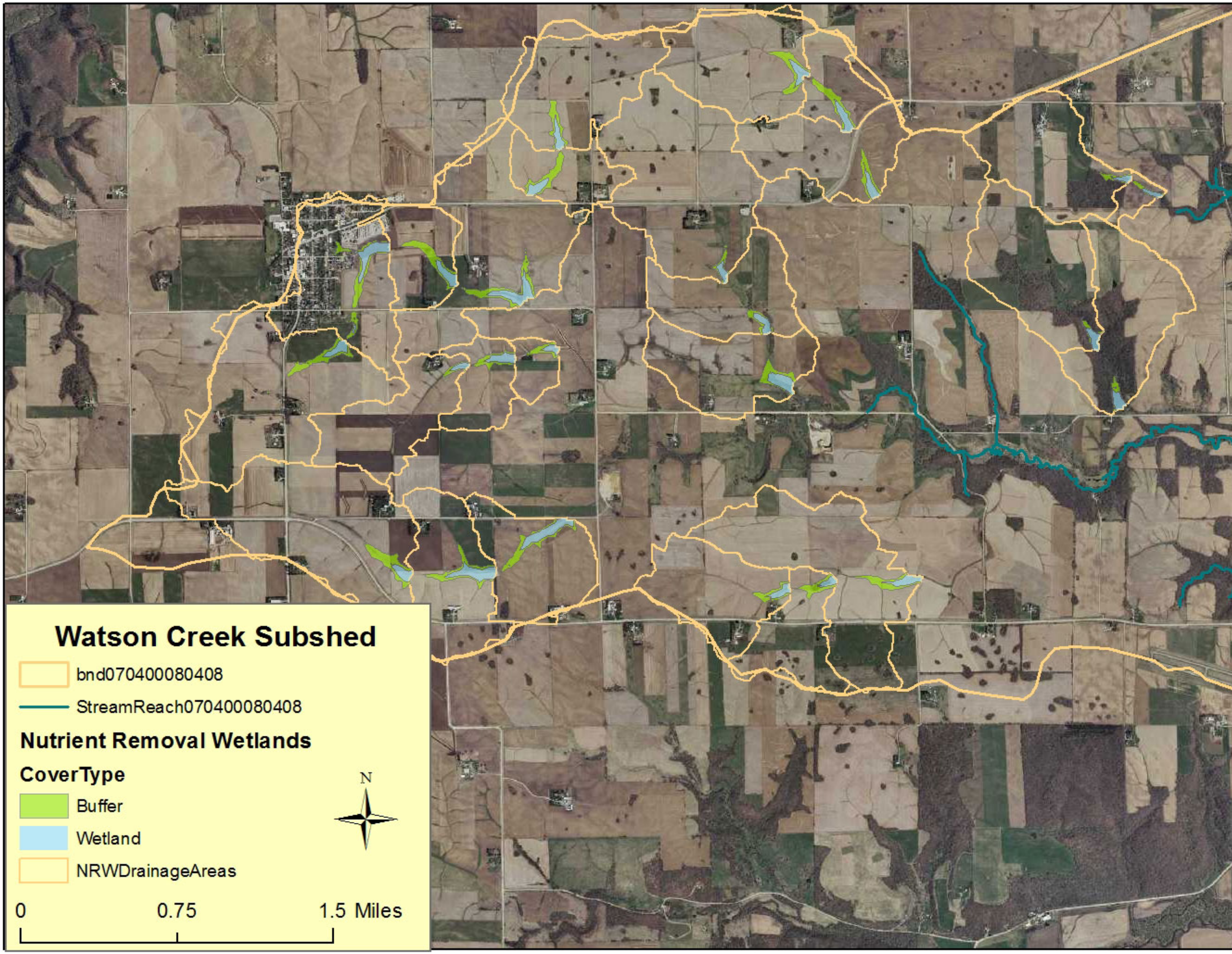

Legend
<all other values>
CoverType
Freeboard
WASCOB
StreamReach070400080408
WASCOBWsheds070400080408

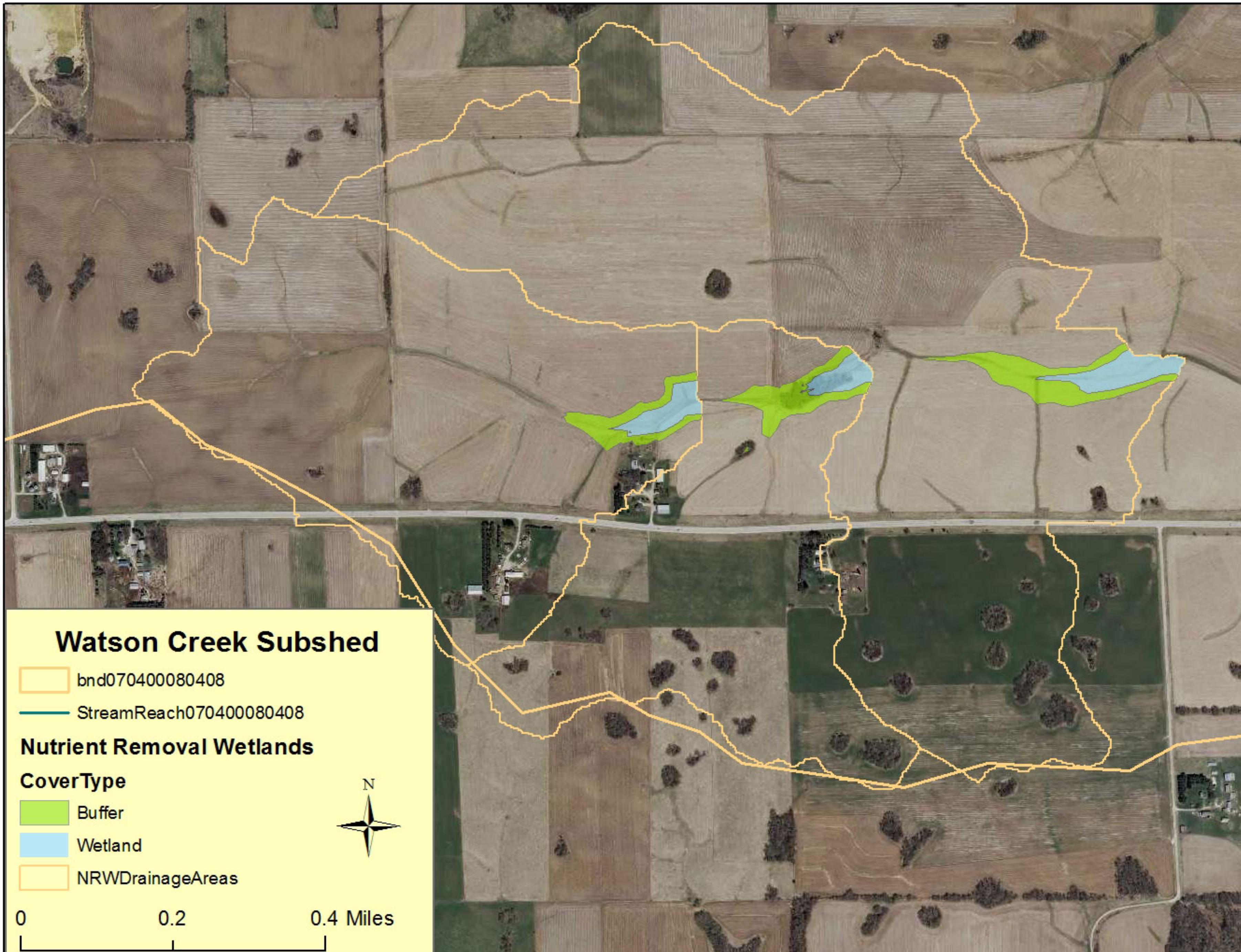

Legend
StreamReach070400080408
WASCOBWsheds070400080408

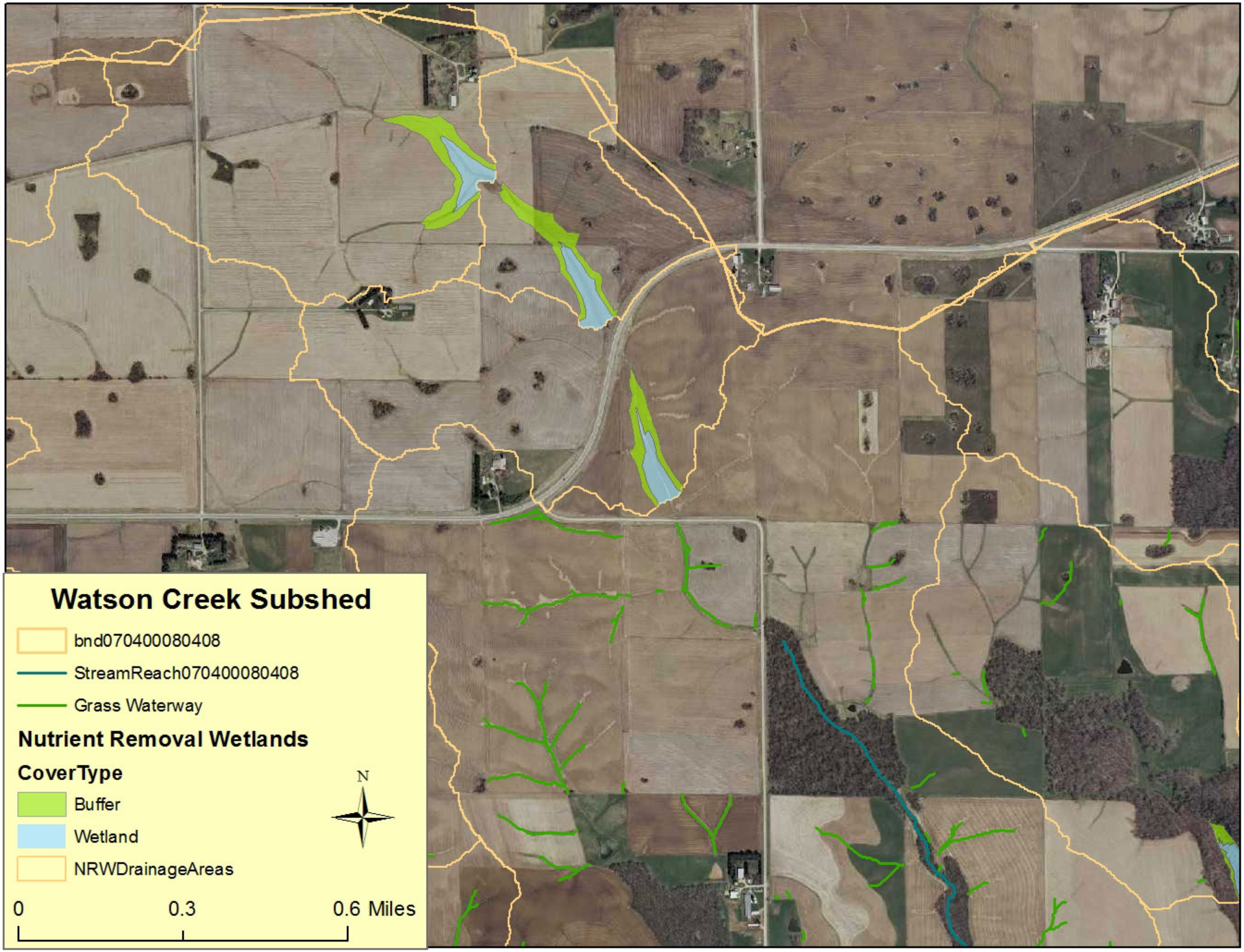
Nutrient Removal Wetlands

Impound Siting

- Wetlands can be strategically located below tile drained fields and designed to provide an off-site strategy for reducing nitrate from tile drainage water. It may also be possible to place sediment detention structures in these areas to reduce phosphorus loss from the watershed. This map shows nutrient removal wetlands that could be placed below fields in this watershed that are most likely to be tile drained. We recognize that this is a highly permeable landscape and that the feasibility of installing wetlands may be low in some of these locations.


Watson Creek Subshed
bnd070400080408
StreamReach070400080408
Nutrient Removal Wetlands
CoverType
Buffer
Wetland
NRWDrainageAreas
N
0
0.75
1.5 Miles

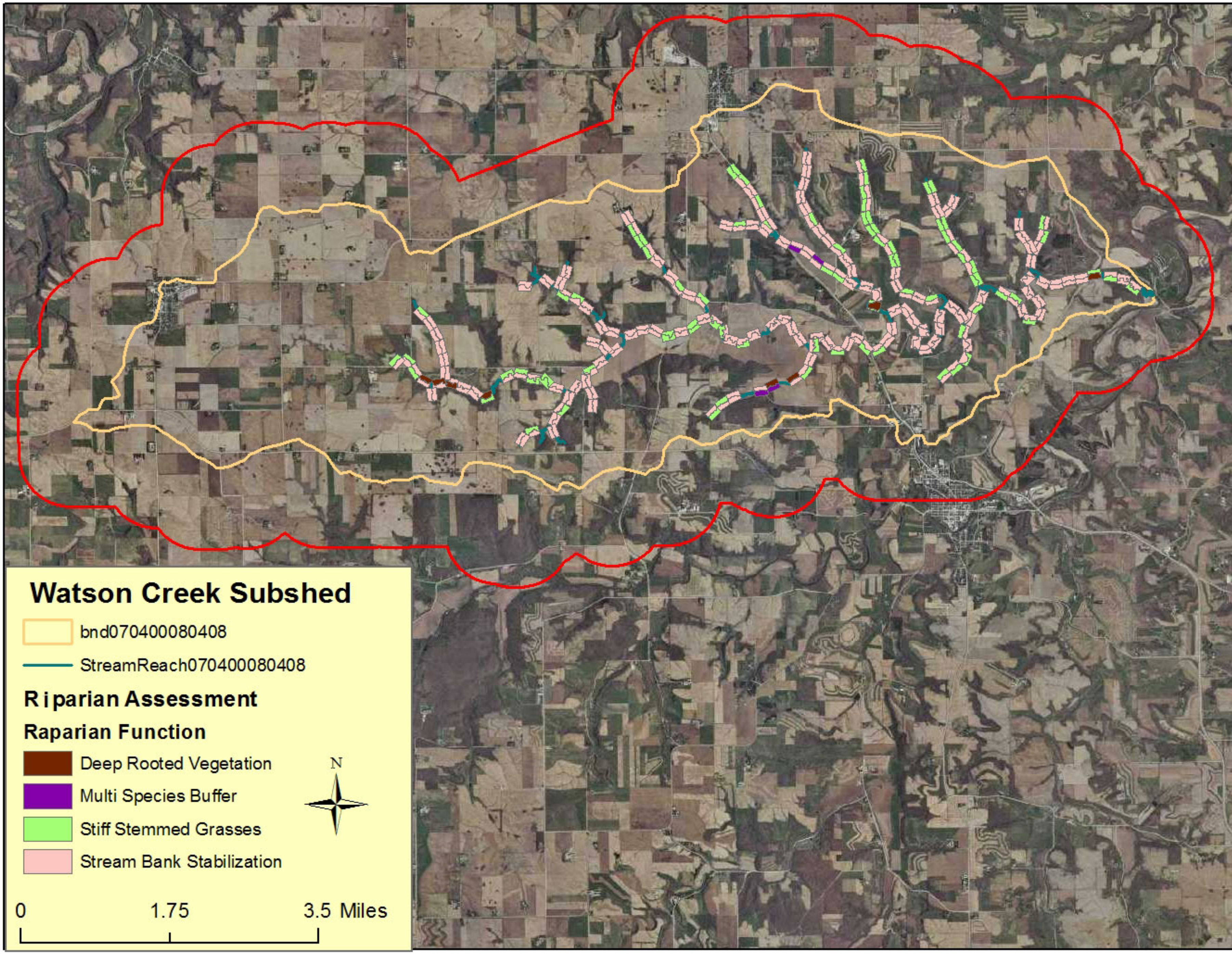

Watson Creek Subshed
bnd070400080408
StreamReach070400080408
Nutrient Removal Wetlands
CoverType
Buffer
Wetland
NRWDrainageAreas
0
0.2
0.4 Miles
N

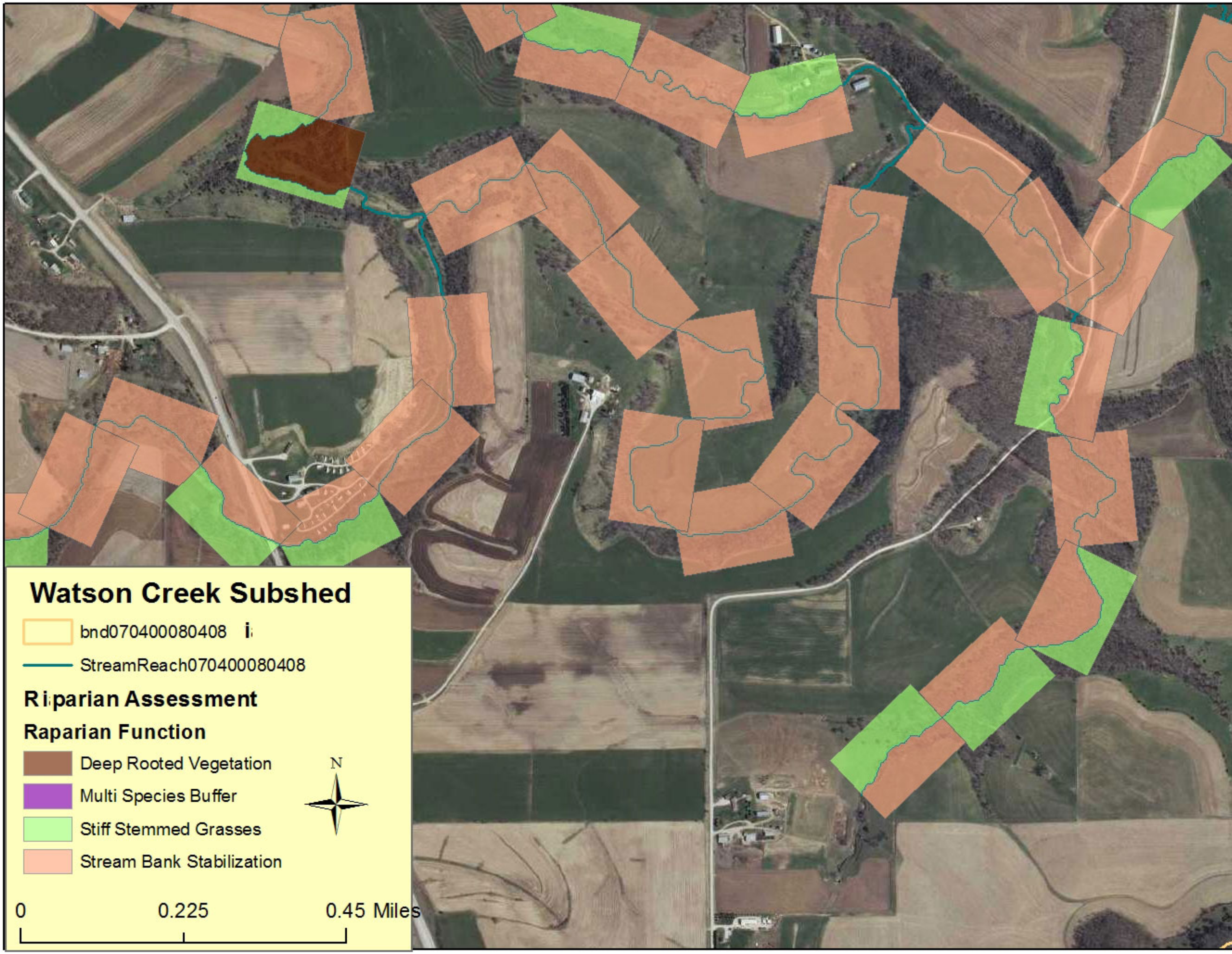

Watson Creek Subshed
bnd070400080408
StreamReach070400080408
Grass Waterway
Nutrient Removal Wetlands
CoverType
Buffer
Wetland
NRWDrainageAreas
N
0
0.3
0.6 Miles

Riparian Function Assessment

Riparian Characterization

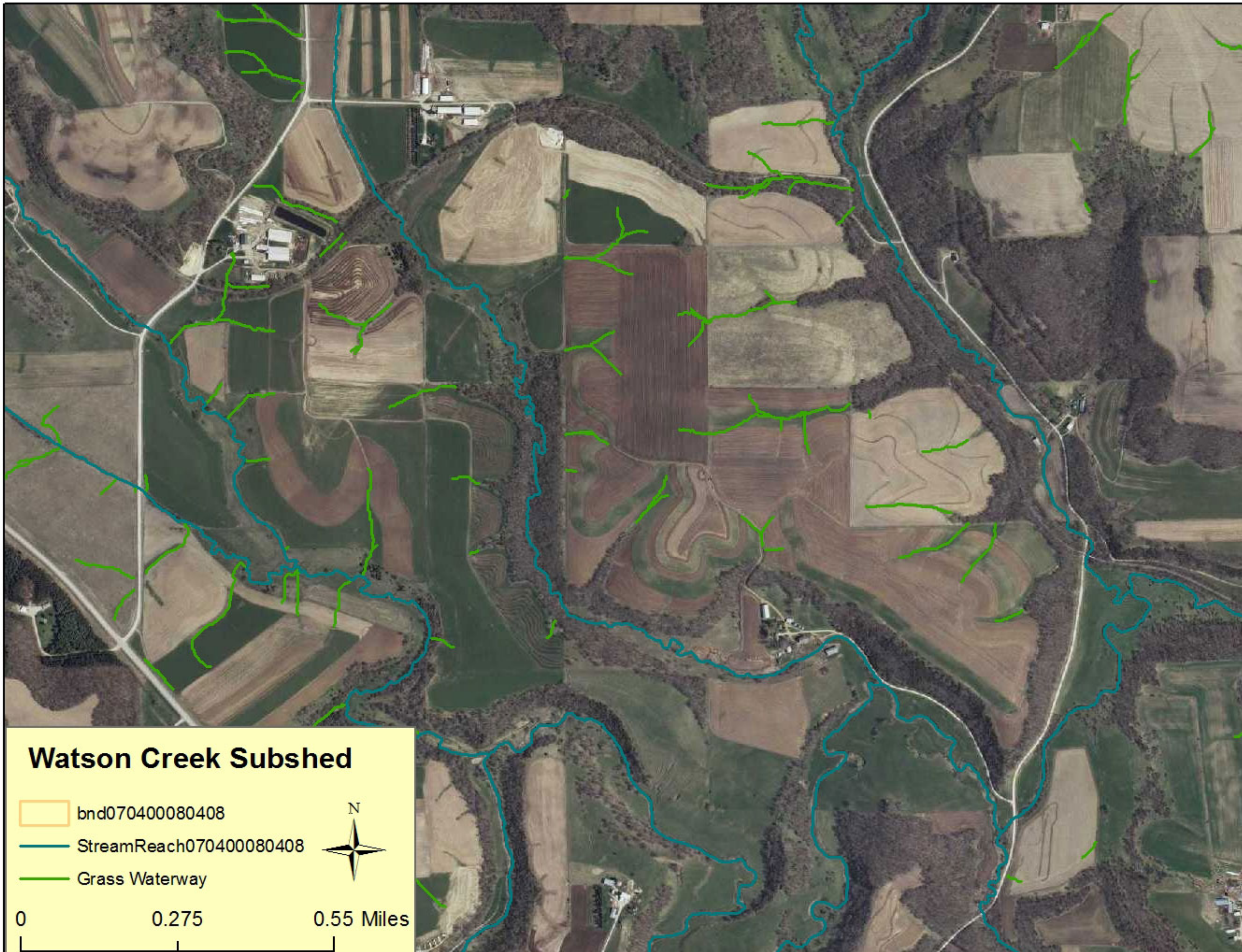
Along a watershed's network of riparian corridors, there are varying opportunities to stabilize streambanks, intercept surface runoff, and influence shallow groundwater. Our objective was to classify these riparian management opportunities and develop a mapping aid for watershed planning. This approach identifies the likely distributions of surface runoff contributions and shallow water tables in a watershed, delineates and tabulates results along both banks of the channels, and applies a cross classification that conveys recommendations for buffer vegetation and width.

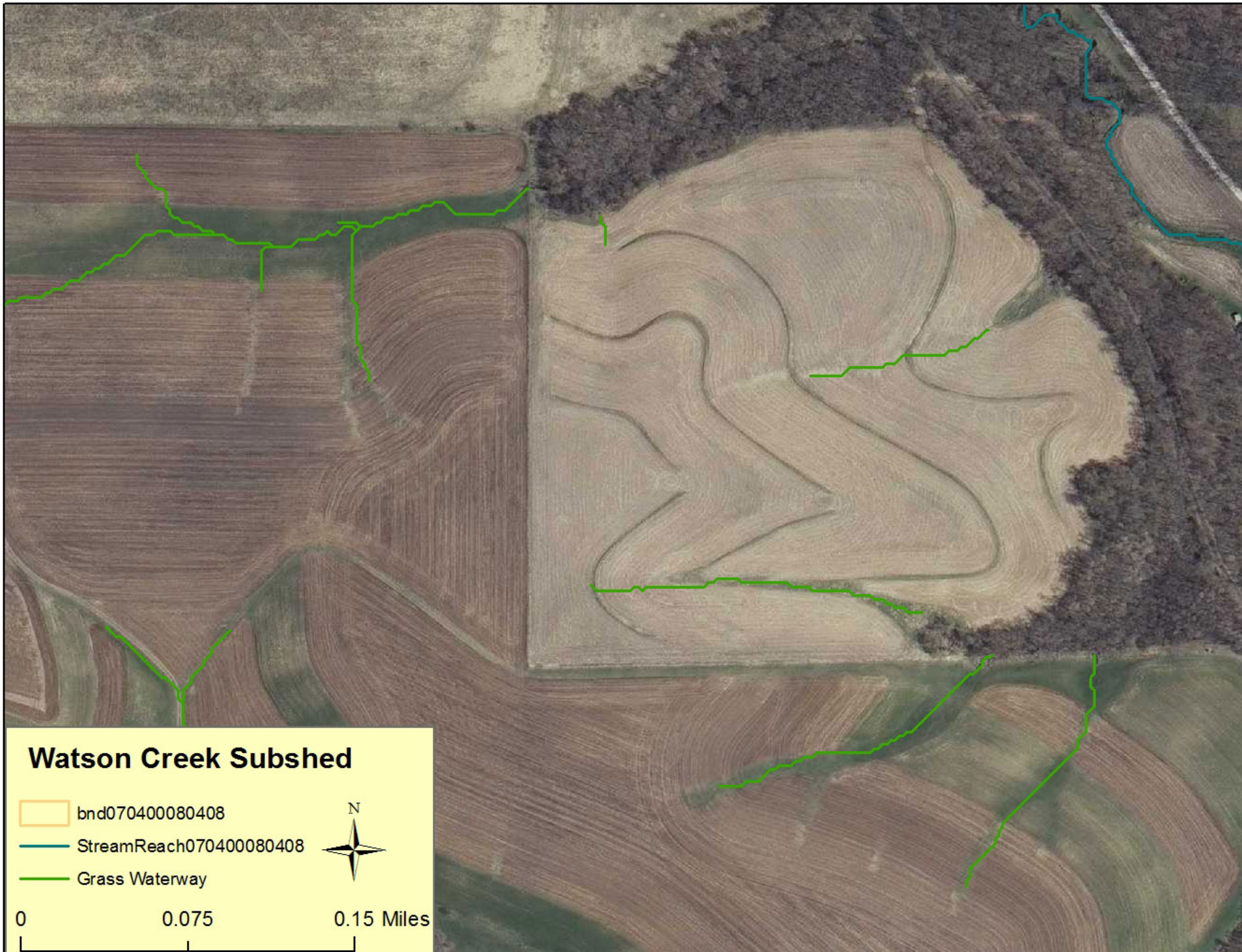

Watson Creek Subshed
bnd070400080408
StreamReach070400080408
Riparian Assessment
Raparian Function
Deep Rooted Vegetation
Multi Species Buffer
Stiff Stemmed Grasses
Stream Bank Stabilization
N
0
1.75
3.5 Miles



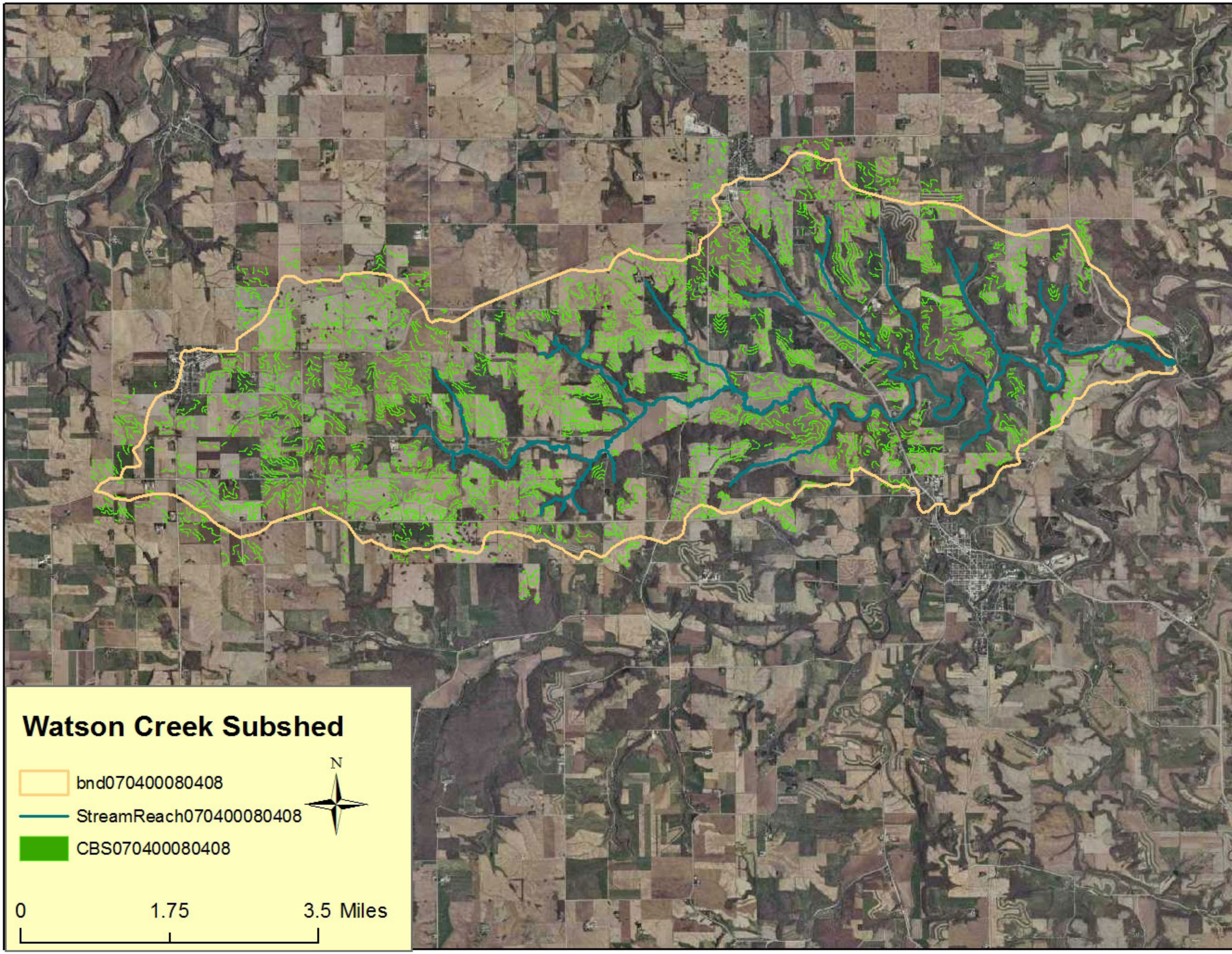
Watson Creek Subshed
bnd070400080408
StreamReach070400080408
Riparian Assessment
Raparian Function
Deep Rooted Vegetation
Multi Species Buffer
Stiff Stemmed Grasses
Stream Bank Stabilization
N
0
0.225
0.45 Miles

Grass Waterways


Watson Creek Subshed
bnd070400080408
StreamReach070400080408
Grass Waterway
N
0
0.275
0.55 Miles

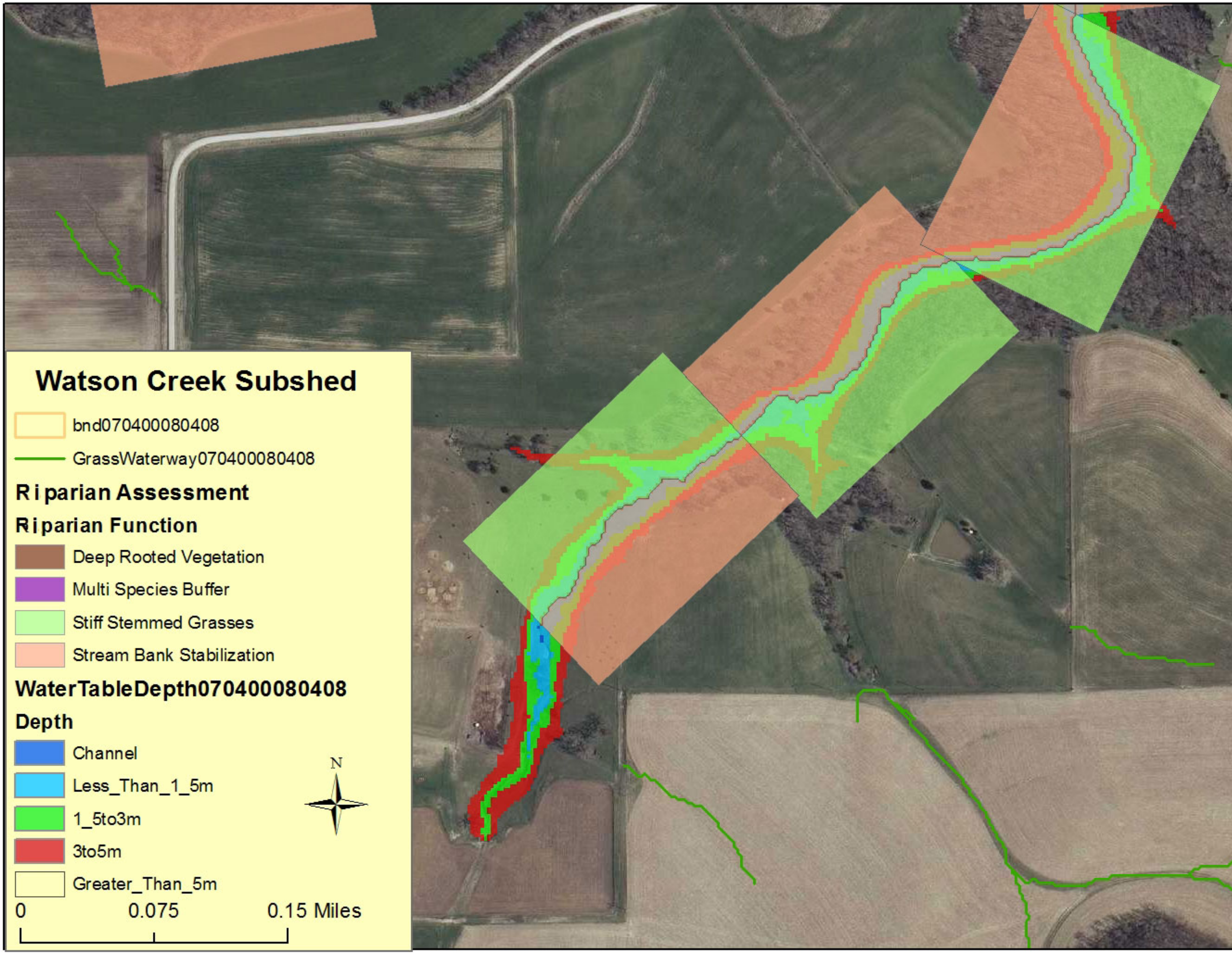


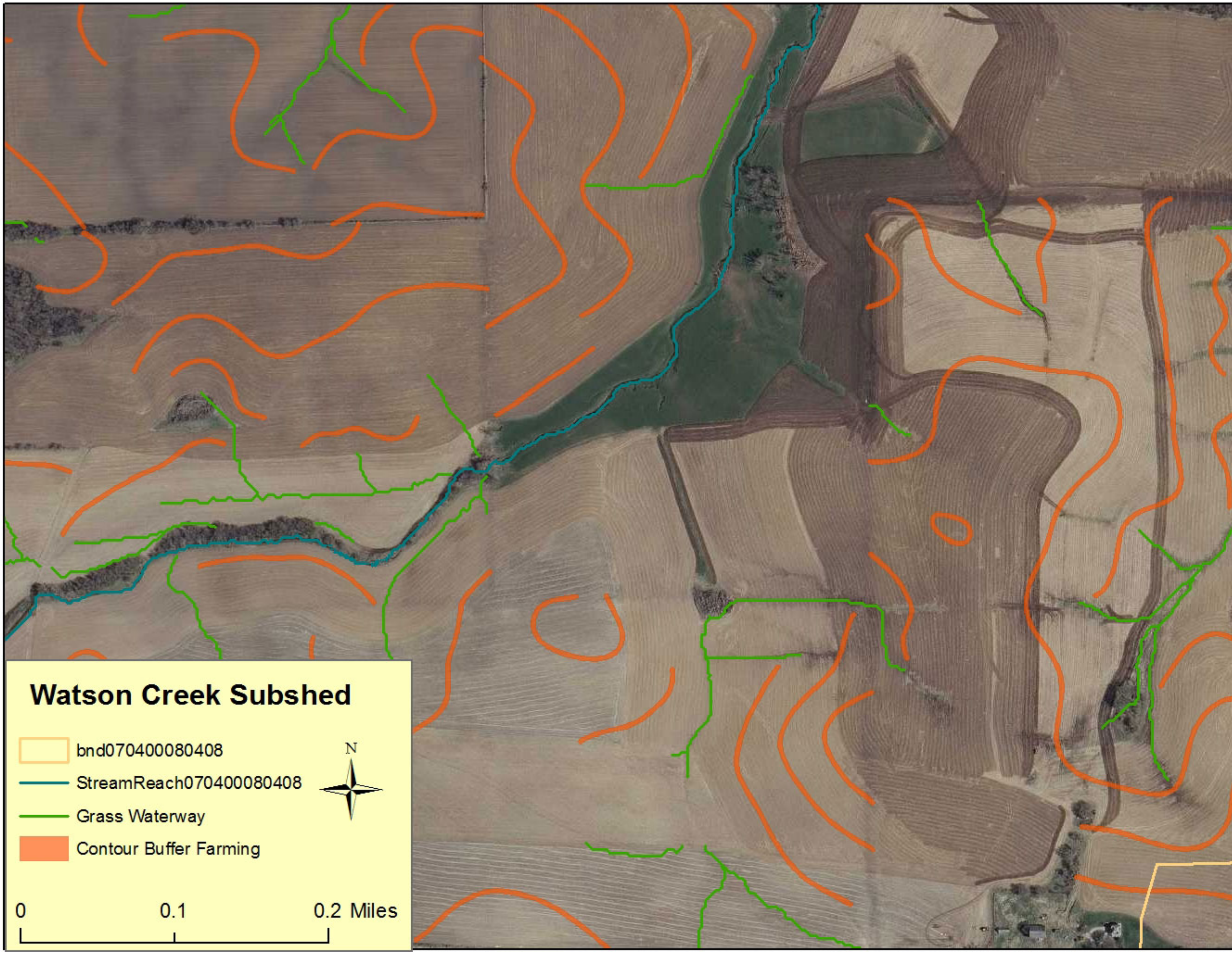
Watson Creek Subshed
bnd070400080408
StreamReach070400080408
Grass Waterway
N
0
0.075
0.15 Miles



Watson Creek Subshed
bnd070400080408
StreamReach070400080408
CBS070400080408
N
0
1.75
3.5 Miles

Multiple Parameters


Watson Creek Subshed
bnd070400080408
GrassWaterway070400080408
Riparian Assessment
Riparian Function
Deep Rooted Vegetation
Multi Species Buffer
Stiff Stemmed Grasses
Stream Bank Stabilization
WaterTableDepth070400080408
Depth
Channel
Less_Than_1_5m
1_5to3m
3to5m
Greater_Than_5m
0
0.075
0.15 Miles
N


Watson Creek Subshed
bnd070400080408
StreamReach070400080408
Grass Waterway
Contour Buffer Farming
N
0
0.1
0.2 Miles

Terrain Analysis Applications

Value-added LiDAR Analysis

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